Fedora 20
Installation Guide

Installing Fedora 20 on 32 and 64-bit Intel-compatible computers

Fedora Documentation Project
Fedora 20 Installation Guide
Installing Fedora 20 on 32 and 64-bit Intel-compatible computers
Edition 1

Author
Fedora Documentation Project

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Provides documentation for the installation process.
# Preface

1. Document Conventions .................................................................................. ix
   1.1. Typographic Conventions ........................................................................ ix
   1.2. Pull-quote Conventions ........................................................................... x
   1.3. Notes and Warnings ................................................................................ xi
2. We Need Feedback! ......................................................................................... xi
3. Acknowledgments ......................................................................................... xii

# Introduction

1. Background ........................................................................................................ xiii
   1.1. About Fedora ................................................................................................. xiii
   1.2. Getting Additional Help ................................................................................ xiii
2. About This Document ......................................................................................... xiii
   2.1. Goals ............................................................................................................... xiii
   2.2. Audience ........................................................................................................ xiii

# 1. Quick Start for Experts

1.1. Overview ......................................................................................................... 1
1.2. Download Files ............................................................................................... 1
1.3. Prepare for Installation .................................................................................. 2
1.4. Install Fedora .................................................................................................. 2

# 2. Obtaining Fedora

2.1. Downloading Fedora ...................................................................................... 3
   2.1.1. How Do I Download Installation Files? ..................................................... 3
   2.1.2. Which Architecture Is My Computer? ....................................................... 4
   2.1.3. Which Files Do I Download? .................................................................... 5
2.2. Obtaining Fedora on CD or DVD .................................................................. 6

# 3. Making Media

3.1. Making an installation DVD ........................................................................... 7
3.2. Preparing a USB flash drive as an installation source ................................. 8
   3.2.1. Making Fedora USB Media on a Windows Operating System ............... 9
   3.2.2. Making Fedora USB Media in UNIX, Linux, and Similar Operating Systems 9
3.3. Making Minimal Boot Media ....................................................................... 15

# I. Installation and Booting

4. Planning for Installation on the x86 Architecture .......................................... 19
   4.1. Upgrade or Install? ...................................................................................... 19
   4.2. Is Your Hardware Compatible? ................................................................... 19
   4.3. RAID and Other Disk Devices .................................................................. 19
   4.3.1. Hardware RAID .................................................................................... 19
   4.3.2. Software RAID ..................................................................................... 20
   4.3.3. FireWire and USB Disks ......................................................................... 20
   4.4. Do You Have Enough Disk Space? .............................................................. 20
   4.5. Selecting an Installation Method ................................................................. 20
   4.6. Choose a boot method ................................................................................ 21

# 5. Preparing for Installation

5.1. Preparing for a Network Installation ............................................................ 23
   5.1.1. Preparing for FTP and HTTP installation ............................................... 24
   5.1.2. Preparing for an NFS installation ............................................................ 24
5.2. Preparing for a Hard Drive Installation ....................................................... 25

# 6. System Specifications List

29
### 7. Booting the Installer

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1. Starting the Installation Program</td>
<td>32</td>
</tr>
<tr>
<td>7.1.1. Booting the Installation Program on x86, AMD64, and Intel 64 Systems</td>
<td>33</td>
</tr>
<tr>
<td>7.1.2. The Boot Menu</td>
<td>34</td>
</tr>
<tr>
<td>7.1.3. Additional Boot Options</td>
<td>35</td>
</tr>
<tr>
<td>7.2. Booting from the Network using PXE</td>
<td>36</td>
</tr>
</tbody>
</table>

### 8. Configuring Installation Source

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1. Installation Method</td>
<td>39</td>
</tr>
<tr>
<td>8.1.1. Installing from DVD</td>
<td>39</td>
</tr>
<tr>
<td>8.1.2. Installing from a Hard Drive</td>
<td>39</td>
</tr>
<tr>
<td>8.1.3. Installing via NFS</td>
<td>40</td>
</tr>
<tr>
<td>8.1.4. Installing via FTP or HTTP</td>
<td>41</td>
</tr>
</tbody>
</table>

### 9. Using the Fedora installer

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1. The Text Mode Installation Program User Interface</td>
<td>43</td>
</tr>
<tr>
<td>9.1.1. Using the Keyboard to Navigate</td>
<td>44</td>
</tr>
<tr>
<td>9.2. The Graphical Installation Program User Interface</td>
<td>44</td>
</tr>
<tr>
<td>9.2.1. Screenshots during installation</td>
<td>45</td>
</tr>
<tr>
<td>9.2.2. A Note about Virtual Consoles</td>
<td>45</td>
</tr>
<tr>
<td>9.3. Language Selection</td>
<td>46</td>
</tr>
<tr>
<td>9.4. The Installation Summary Menu</td>
<td>46</td>
</tr>
<tr>
<td>9.5. Date and time</td>
<td>48</td>
</tr>
<tr>
<td>9.6. Keyboard Configuration</td>
<td>49</td>
</tr>
<tr>
<td>9.7. Language Support</td>
<td>50</td>
</tr>
<tr>
<td>9.8. Installation Source</td>
<td>51</td>
</tr>
<tr>
<td>9.8.1. Installing from Additional Repositories</td>
<td>53</td>
</tr>
<tr>
<td>9.9. Network Configuration</td>
<td>54</td>
</tr>
<tr>
<td>9.9.1. Edit Network Connections</td>
<td>55</td>
</tr>
<tr>
<td>9.10. Software Selection</td>
<td>64</td>
</tr>
<tr>
<td>9.10.1. Core Network Services</td>
<td>66</td>
</tr>
<tr>
<td>9.11. Storage and partitioning</td>
<td>67</td>
</tr>
<tr>
<td>9.11.1. Specialized and Networked Disks</td>
<td>72</td>
</tr>
<tr>
<td>9.11.1.1. x86, AMD64, and Intel 64 Boot Loader Installation</td>
<td>79</td>
</tr>
<tr>
<td>9.12. Encrypt Partitions</td>
<td>81</td>
</tr>
<tr>
<td>9.13. Reclaim disk space</td>
<td>82</td>
</tr>
<tr>
<td>9.14.2. Create Software RAID</td>
<td>87</td>
</tr>
<tr>
<td>9.14.3. Create LVM Logical Volume</td>
<td>89</td>
</tr>
<tr>
<td>9.14.4. Create a Btrfs subvolume</td>
<td>91</td>
</tr>
<tr>
<td>9.14.5. Recommended Partitioning Scheme</td>
<td>93</td>
</tr>
<tr>
<td>9.15. Begin installation</td>
<td>98</td>
</tr>
<tr>
<td>9.16. The Configuration Menu and Progress Screen</td>
<td>100</td>
</tr>
<tr>
<td>9.16.1. Set the Root Password</td>
<td>101</td>
</tr>
<tr>
<td>9.16.2. User Creation</td>
<td>102</td>
</tr>
<tr>
<td>9.17. Installation Complete</td>
<td>104</td>
</tr>
<tr>
<td>9.17.1. GNOME Initial Setup</td>
<td>105</td>
</tr>
<tr>
<td>9.17.2. Initial Setup in Other Desktop Environments</td>
<td>106</td>
</tr>
</tbody>
</table>

### 10. Troubleshooting Installation on an Intel or AMD System

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1. You are unable to boot Fedora</td>
<td>109</td>
</tr>
<tr>
<td>10.1.1. Are You Unable to Boot With Your RAID Card?</td>
<td>109</td>
</tr>
<tr>
<td>10.1.2. Is Your System Displaying Signal 11 Errors?</td>
<td>110</td>
</tr>
</tbody>
</table>
19.2.1. Your computer dual-boots Fedora and a Microsoft Windows operating
system ............................................................................................................ 223
19.2.2. Your computer dual-boots Fedora and Mac OS X .................................. 227
19.2.3. Your computer dual-boots Fedora and a different Linux distribution ....... 227
19.3. Replacing Fedora with MS-DOS or legacy versions of Microsoft Windows .... 231

IV. Technical appendixes 233

A. An Introduction to Disk Partitions 235
   A.1. Hard Disk Basic Concepts ............................................................................ 235
   A.1.1. It is Not What You Write, it is How You Write It ....................................... 235
   A.1.2. Partitions: Turning One Drive Into Many .................................................. 237
   A.1.3. Partitions within Partitions — An Overview of Extended Partitions .......... 239
   A.1.4. Making Room For Fedora ....................................................................... 239
   A.1.5. Partition Naming Scheme ....................................................................... 244
   A.1.6. Disk Partitions and Other Operating Systems .......................................... 245
   A.1.7. Disk Partitions and Mount Points ............................................................ 245
   A.1.8. How Many Partitions? ........................................................................... 245

B. iSCSI disks 247
   B.1. iSCSI disks in anaconda ............................................................................. 247
   B.2. iSCSI disks during start up ........................................................................... 247

C. Disk Encryption 249
   C.1. What is block device encryption? ................................................................. 249
   C.2. Encrypting block devices using dm-crypt/LUKS .......................................... 249
   C.2.1. Overview of LUKS ................................................................................... 249
   C.2.2. How will I access the encrypted devices after installation? (System
         Startup) ......................................................................................................... 250
   C.2.3. Choosing a Good Passphrase .................................................................. 250
   C.3. Creating Encrypted Block Devices in Anaconda ........................................ 250
   C.3.1. What Kinds of Block Devices Can Be Encrypted? .................................... 251
   C.3.2. Saving Passphrases ............................................................................... 251
   C.3.3. Creating and Saving Backup Passphrases .............................................. 251
   C.4. Creating Encrypted Block Devices on the Installed System After Installation 251
   C.4.1. Create the block devices ....................................................................... 251
   C.4.2. Optional: Fill the device with random data .............................................. 251
   C.4.3. Format the device as a dm-crypt/LUKS encrypted device ....................... 252
   C.4.4. Create a mapping to allow access to the device's decrypted contents .......... 252
   C.4.5. Create filesystems on the mapped device, or continue to build complex
         storage structures using the mapped device .............................................. 253
   C.4.6. Add the mapping information to /etc/crypttab ....................................... 253
   C.4.7. Add an entry to /etc/fstab ................................................................. 254
   C.5. Common Post-Installation Tasks .............................................................. 254
   C.5.1. Set a randomly generated key as an additional way to access an
         encrypted block device .............................................................................. 254
   C.5.2. Add a new passphrase to an existing device ........................................... 254
   C.5.3. Remove a passphrase or key from a device ............................................ 255

D. Understanding LVM 257

E. Logging the Installation 259
   E.1. Log files and formats .................................................................................. 259
   E.1.1. Logging on the installed system ............................................................... 259
   E.2. Remote logging via virtio ........................................................................... 259
   E.2.1. virtio logging with virt-install ............................................................ 260
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\(^1\) 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:

books        Desktop   documentation  drafts  mss    photos   stuff  svn
books_tests  Desktop1  downloads      images  notes  scripts  svgs

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

package org.jboss.book.jca.ex1;
import javax.naming.InitialContext;
1.3. Notes and Warnings

Finally, we use three visual styles to draw attention to information that might otherwise be overlooked.

---

**Note**

Notes are tips, shortcuts or alternative approaches to the task at hand. Ignoring a note should have no negative consequences, but you might miss out on a trick that makes your life easier.

---

**Important**

Important boxes detail things that are easily missed: configuration changes that only apply to the current session, or services that need restarting before an update will apply. Ignoring a box labeled 'Important' will not cause data loss but may cause irritation and frustration.

---

**Warning**

Warnings should not be ignored. Ignoring warnings will most likely cause data loss.

---

2. We Need Feedback!

If you find a typographical error in this manual, or if you have thought of a way to make this manual better, we would love to hear from you! Please submit a report in Bugzilla: [http://bugzilla.redhat.com/bugzilla/](http://bugzilla.redhat.com/bugzilla/) against the product Fedora.

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

If you have a suggestion for improving the documentation, try to be as specific as possible when describing it. If you have found an error, please include the section number and some of the surrounding text so we can find it easily.
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 20 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 20 Installation Quick Start Guide is available from https://docs.fedoraproject.org/en-US/Fedora/html/Installation_Quick_Start_Guide/index.html.

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:

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 netinst.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 9.14, “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.
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?

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 20 distribution normally appears in the directory fedora/linux/releases/20/. 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 20 for x86_64 at fedora/linux/releases/20/Fedora/x86_64/iso/Fedora-20-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</td>
<td>1386 (32-bit)</td>
</tr>
<tr>
<td>Xeon; AMD Athlon, Duron, some Semprons; and older; VIA C3, C7</td>
<td></td>
</tr>
<tr>
<td>Intel Atom (See note below), Core 2 series, Core i series and Xeon; AMD:</td>
<td>x86_64 (64-bit)</td>
</tr>
<tr>
<td>Athlon 64, Athlon II, Sempron64, Phenom series, Fusion series, Bulldozer</td>
<td></td>
</tr>
<tr>
<td>series and Opteron; Apple MacBook, MacBook Pro, and MacBook Air</td>
<td></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 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 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 20 for x86_64 is named Fedora-20-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. If you decide you like what you see, and want to install it, select Install to Hard Drive on the desktop to copy Fedora to your hard disk (alternatively, in GNOME, a shortcut can be found in the Activities menu). You can download the Live image directly from a mirror, or using BitTorrent.
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.

<table>
<thead>
<tr>
<th>Media type</th>
<th>File locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full distribution on DVD</td>
<td>fedora/linux/releases/20/Fedora/arch/iso/Fedora-20-arch-DVD.iso</td>
</tr>
<tr>
<td>Live image</td>
<td>fedora/linux/releases/20/Live/arch/iso/Fedora-Live-Desktop-arch-20-1.iso, fedora/linux/releases/20/Live/arch/iso/Fedora-Live-KDE-arch-20-1.iso</td>
</tr>
<tr>
<td>Minimal CD boot media</td>
<td>fedora/linux/releases/20/Fedora/arch/iso/Fedora-20-arch-netinst.iso</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>
<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>
<th>Live image DVD or 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>x86 netinst ISO image file</td>
<td>x86 netinst ISO image file</td>
<td>x86 Live ISO image file</td>
</tr>
<tr>
<td>BIOS-based x86_64 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>x86_64 netinst ISO image file</td>
<td>x86_64 netinst ISO image file</td>
<td>x86_64 Live ISO image file</td>
</tr>
<tr>
<td>UEFI-based 32-bit x86</td>
<td>Not available</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UEFI-based x86_64 and Intel 64</td>
<td>x86_64 DVD ISO image file</td>
<td>x86_64 DVD ISO image file</td>
<td>x86_64 netinst ISO image file</td>
<td>x86_64 netinst ISO image file</td>
<td>x86_64 Live 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.

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 20 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.
3.2.1. Making Fedora USB Media on a Windows Operating System

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.


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](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:

   ```
   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 flash drive.

3. Find the flash drive's device name. If the media has a volume name, use it to look up the device name in `/dev/disk/by-label`, or use the `findfs` command:

   ```bash
   findfs LABEL=MyLabel
   ```

   If the media does not have a volume name or you do not know it, you can also use the `dmesg` command shortly after connecting the media to your computer. After running the command, the device name (such as `sdb` or `sdc`) should appear in several lines towards the end of the output.

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. Find the flash drive's device name. If the media has a volume name, use it to look up the device name in /dev/disk/by-label, or use the findfs command:

   ```
   findfs LABEL=MyLabel
   ```

   If the media does not have a volume name or you do not know it, you can also use the dmesg command shortly after connecting the media to your computer. After running the command, the device name (such as sdb or sdc) should appear in several lines towards the end of the output.

3. Use the dd command to transfer the boot ISO image to the USB device:

   ```
   su -c 'dd if=path/image_name.iso of=/dev/device bs=block size'
   ```

   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 (such as sdc), not the partition name (such as sdc1). The bs option specifies the block size; it can be omitted, but specifying it will speed up the process. For example:

   ```
   su -c 'dd if=/Downloads/Fedora-Live-Desktop-x86_64-20-1.iso of=/dev/sdc bs=512k'
   ```

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

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 flash drive.

3. Find the flash drive’s device name. If the media has a volume name, use it to look up the device name in /dev/disk/by-label, or use the findfs command:

   ```bash
   findfs LABEL=MyLabel
   ```

   If the media does not have a volume name or you do not know it, you can also use the dmesg command shortly after connecting the media to your computer. After running the command, the device name (such as sdb or sdc) should appear in several lines towards the end of the output.

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:

   a. select File > Unmount if the operating system presents you with a window that displays the contents of the device.

   b. right-click on an icon of the device and click Unmount.

   c. 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.

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-Live-Desktop-x86_64-20-1.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-Live-Desktop-x86_64-20-1.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-Live-Desktop-x86_64-20-1.iso /dev/sdc1
```

3.2.2.2. 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. Find the flash drive’s device name. If the media has a volume name, use it to look up the device name in `/dev/disk/by-label`, or use the `findfs` command:

```
findfs LABEL=MyLabel
```

If the media does not have a volume name or you do not know it, you can also use the `dmesg` command shortly after connecting the media to your computer. After running the command, the device name (such as `sdb` or `sdc`) should appear in several lines towards the end of the output.

3. Use the `dd` command to transfer the boot ISO image to the USB device:

```
su -c 'dd if=path/image_name.iso of=/dev/device bs=block size'
```

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 (such as `sdc`), not the partition name (such as `sdc1`). The `bs` option specifies the block size; it can be omitted, but specifying it will speed up the process. For example:

```
su -c 'dd if=~/Downloads/Fedora-Live-Desktop-x86_64-20-1.iso of=/dev/sdc bs=512k'
```

### 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.

To make minimal boot media:

1. Download the ISO image file named `netinst.iso` that is available at the same location as the images of the Fedora 20 installation DVD — refer to Chapter 2, Obtaining Fedora.

2. Burn `netinst.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 `netinst.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 `netinst.iso` file is only around 300 MB in size, you do not need an especially large USB flash drive.
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 18, 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 20 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.

If you have issues with your hardware, consider one of the following:
Consult the release notes for minimum system requirements at http://docs.fedoraproject.org/release-notes.
Seek Support at http://fedoraproject.org/wiki/Communicating_and_getting_help
Check online compatibility lists, such as http://www.fsf.org/resources/hw and http://www.linux-drivers.org/

4.3. RAID and Other Disk Devices

Important — Systems with Intel BIOS RAID sets

Fedora 20 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 20. 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 9.14, “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 9.14.5, “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:/device` boot option, or by selecting Local CD/DVD on the Installation Method menu (refer to Section 8.1, "Installation Method").

Live
If you have a optical or USB drive and the Fedora Live image 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 installation instructions.

Hard Drive
If you have copied the Fedora ISO images to a local hard drive, you can use this method. Add the boot option `linux repo=hd:device:/path` or you select ISO file: from the Installation Source menu after starting the installation. (refer to Section 8.1, "Installation Method"). Refer to Section 8.1.2, "Installing from a Hard Drive", for hard drive installation instructions. If your system already has GRUB installed, you can set up a completely medialess installation with the instructions at Chapter 12, Installing Without Media.

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:options:/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 20 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 DVD or netinstall CD, you can also boot the Fedora installation program from a USB flash drive. Refer to Section 3.2, "Preparing a USB flash drive as an installation source" for instructions on making USB install media.
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/Fedora20` on the network server can be accessed as `http://network.server.com/inst/Fedora20`.

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/isos`. `/publicly_available_directory` might be `/var/www/html/Fedora20`, 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 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.

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 (use `systemctl start nfs`). If NFS is already running, reload the configuration file (use `systemctl reload nfs`).

5. Be sure to test the NFS share following the directions in the Fedora System Administrators 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:

   ```
   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:

   ```
   $ 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:

```
linux rd.live.check
```
Chapter 6.

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.
Chapter 7.

Booting the Installer

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

Fedora 20 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 20 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 20, 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 **Begin Installation** on the Installation Summary Menu. 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 20 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 20 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 20, 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”.
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 11.3.1, “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:

  \texttt{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:

  \texttt{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:

  \texttt{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 9.11.2, “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:
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.
Chapter 8.

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 you select Begin Installation on the Installation Summary Menu. Refer to Section 9.15, “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
```
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/sdal.

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/Fedora20</td>
</tr>
<tr>
<td>ext2, ext3, ext4</td>
<td>/home</td>
<td>/home/user1/Fedora20</td>
<td>/user1/Fedora20</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.
Installing via FTP or HTTP

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/20/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:fedora20pw@name.example.com/fedora/linux/releases/20/Fedora/x86_64/iso/

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

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 17.2, “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>localhost login</td>
</tr>
<tr>
<td>7</td>
<td>Ctrl+alt+f6</td>
<td>graphical display</td>
</tr>
</tbody>
</table>

9.3. Language Selection

At the **Welcome to Fedora 20** screen, use your mouse to select the language (for example, English) you prefer to use for the installation and as the system default on the left side. On the right side, select your keyboard layout (for example, English (United Kingdom)). Again, this layout will be used during the installation and it will be the default on the installed system. You can also change the keyboard layout at any time during the installation using the layout switching tool in the upper right hand corner.

Alternatively, type your preferred language into the search box and select from the list of results.

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

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.

The keyboard icon at the top of the menu allows you to switch between your selected keyboard layouts (refer to Section 9.6, “Keyboard Configuration”).

Once all required sections are complete, click **Begin Installation** (refer to Section 9.15, “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.

![Figure 9.3. Configuring the Time Zone](image)

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))**.

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, select the keyboard icon at the top of the Installation Summary Menu to switch between your selected layouts. Alternatively, you can 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.

**Important**

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.

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

**Note**

To change your keyboard configuration after you have completed the installation, visit the **Keyboard** (in GNOME) or **Input Devices** (in KDE) section of the **System Settings** menu.

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-6r**) while you press the E key. Other keyboards might have a dedicated key for this character.

### 9.7. Language Support

To install languages in addition to the one you selected in **Section 9.3, “Language Selection”**, select **Language Support** from the Installation Summary Menu.
Use your mouse to check the box next to each additional language you want to install.

Alternatively, type your preferred language into the search box and select from the list of results.

When you have made your selections, click **Done** to return to the Installation Summary Menu.

**9.8. 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.
Chapter 9. Using the Fedora installer

Figure 9.6. Installation source

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**.

Any Fedora updates available on the network will be automatically installed unless you check the **Updates** option in this section. This ensures that only the software versions available on the installation media are installed.

---

**Important**

Choosing not to install available updates may pose a security risk to your system.

---

Once you have selected your installation source, click **Done** to return to the Installation Summary Menu.

### 9.8.1. Installing from Additional Repositories

You can define additional repositories to increase the software available to your system during installation. A repository is a network location that stores software packages along with metadata that describes them. Many of the software packages used in Fedora require other software to be installed. The installer uses the metadata to ensure that these requirements are met for every piece of software you select for installation.

To include software from extra repositories, click the + button in the **Additional repositories** area to add a repository and provide a name and URL for its location.

---

**Fedora Software Mirrors**

To find a Fedora software mirror near you, refer to [http://mirrors.fedoraproject.org/publiclist/](http://mirrors.fedoraproject.org/publiclist/).

To determine the URL to use, find the directory on the mirror you are using that contains a directory named **repodata**.

Optionally, provide a URL, username, and password to connect to a proxy server.

Once you provide information for an additional repository, the installer reads the package metadata over the network. Software that is specially marked is then included in the package listings in the
Software Selection section of the Installation Summary Menu (refer to Section 9.10, “Software Selection”).

**Network Access Required**

If you add repositories during a non-network installation, such as from a Fedora DVD, you will need to configure a network connection via the Installation Summary Menu before the installation can proceed (refer to Section 9.9, “Network Configuration”).

### 9.9. 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 9.8. 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 Host Names

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).

9.9.1. 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.
9.9.1. 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.

![Figure 9.9. The General tab](image.png)

The following options are available in the General tab:

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.
Automatically connect to this network when it is available
Check this box to start the connection automatically when the system boots.

All users may connect to this network
Check this box to control whether a network configuration is available system-wide or not. During installation, ensure that it remains checked for any network interface that you configure.

Note
The VPN and Firewall Zone options in the General tab are not available during installation.

9.9.1.2. The Ethernet tab
Use the Ethernet tab to specify or change the media access control (MAC) address for the network adapter. The Device MAC address drop-down menu allows you to choose from a list of actual MAC addresses of devices available on the system, while the Cloned MAC Address field allows you to set an arbitrary address for this connection if necessary. Leave this field blank to use the device address.

The MTU (maximum transmission unit) field sets the maximum unit size (in bytes) that can pass through the interface either manually or automatically.
9.9.1.3. 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 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.

---

**Figure 9.11. The 802.1x Security tab**
Chapter 9. Using the Fedora installer

9.9.1.4. 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.
9.9.1.4.1. 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.
Chapter 9. Using the Fedora installer

Figure 9.13. The Editing IPv4 Routes dialog

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.

9.9.1.5. 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 9.14. The IPv6 Settings tab](image)
Chapter 9. Using the Fedora installer

9.9.1.5.1. 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 eth0](image)

Figure 9.15. 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.

9.10. 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 yum utility to make desired changes.
Figure 9.16. Software Selection

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
Chapter 9. Using the Fedora installer

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 Desktop
   This option provides the X Window System without a full graphical desktop environment. Optionally, you can select a window manager.

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, with packages specific to the environment at the top. Add-ons range from common utilities such as Administrative Tools and LibreOffice to specialist tools such as RPM Development Tools and Design Suite.

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.

9.10.1. Core Network Services

All Fedora installations include the following network services:

- centralized logging through the systemd journal
- network file sharing through NFS (Network File System)
- remote access through SSH (Secure SHell)
- 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.

### 9.11. 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 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 9.14, “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 9.17. 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, size, and available space. Hold down Ctrl or Shift while clicking on the disks to select or unselect multiple disks. A tick icon will appear on the disk once it is selected.

To install Fedora on specialized storage devices or to configure iSCSI and FCoE connections, click Add a disk under Specialized and Network Disks and refer to Section 9.11.1, “Specialized and Networked Disks”.

Click Done once you have made your selections.

---

**Note**

Selecting a partitioning layout will not immediately affect your disks. The installer will make no changes to them until you return to the Installation Summary Menu and click Begin Installation.

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
- select **Automatically configure my Fedora installation to the disk(s) I selected...** and press **Continue** to return to the Installation Summary Menu
- select **I want more space...** and press **Continue** to reassign space to this installation by manually shrinking or removing partitions (refer to **Section 9.13, "Reclaim disk space"**)
- select **I want to review/modify my disks before continuing** to create and edit the partitions yourself, then click **Continue** to reach the **Manual Partitioning** section (refer to **Section 9.14, "Creating a Custom Partition Layout"**)
INSTALLATION OPTIONS

Your current Fedora software selection requires 5.62 GB of available space: 4.5 GB for software and 2.08 GB for swap space. The disks you've selected have the following amounts of free space:

- **3.07 GB** Free space available for use.
- **407 MB** Free space unavailable but reclaimable from existing partitions.

You don't have enough space available to install Fedora. You can shrink or remove existing filesystems, reorganize existing partitions via our guided reclaim space tool, or you can adjust your partitions on the custom partitioning interface.

**Partition scheme:** LVM

- Encrypted my data. I'll set a passphrase later.

**Figure 9.19. Installation Options dialog - insufficient 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 two categories:

- **Free space available for use**
- **Free space unavailable but reclaimable from 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 the Fedora software selection link to transfer to the Software Selection section to choose a package configuration suitable for the available space** (refer to Section 9.10, “Software Selection”)
- **click Custom partitioning to reach the Manual Partitioning section** (refer to Section 9.14, “Creating a Custom Partition Layout”)
- **click Reclaim space to choose how to reassign space from other filesystems to this installation** (refer to Section 9.13, “Reclaim disk space”)

71
Chapter 9. Using the Fedora installer

To encrypt all partitions except the /boot partition, check the box labeled Encrypt my data. I'll set a passphrase later in the Installation Options dialog (refer to Appendix C, Disk Encryption for information on encryption). You will be prompted to create a passphrase when you click Continue or Reclaim space (refer to Section 9.12, "Encrypt Partitions").

Optionally, use the Partition Scheme dropdown menu 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)
- **BTRFS** (B-Tree File System, as described in Section 9.14.1.1, "File System Types")
- **LVM** (Logical Volume Management, as described in Appendix D, Understanding LVM. This is the default scheme.)

**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 9.14, "Creating a Custom Partition Layout").

### 9.11.1. Specialized and Networked Disks

The Specialized and Networked Disks selection screen displays all specialized storage devices to which anaconda has access.

Devices are grouped under the following tabs:

**Multipath Devices**

- Storage devices accessible through more than one path, such as through multiple SCSI controllers or Fiber Channel ports on the same system.

**Important — device serial numbers must be 16 or 32 characters**

The installer only detects multipath storage devices with serial numbers that are 16 or 32 characters in length.

**Other SAN Devices**

- Any other devices available on a storage area network (SAN).

**Firmware RAID**

- Storage devices attached to a firmware RAID controller.
If you do need to configure iSCSI or FCoE storage, click **Add iSCSI Target** and refer to Section 9.11.1, “Add an iSCSI target”, or click **Add FCoE SAN** and refer to Section 9.11.1.2, “Add an FCoE SAN”.

To assign non-friendly multipath device names, click **Device Options** and uncheck **Use friendly names for multipath devices**.

The **Specialized and Networked Disks** selection screen also contains a **Search** tab that allows you to filter storage devices either by their **World Wide Identifier** (WWID) or by the port, target, or **logical unit number** (LUN) at which they are accessed.

![Figure 9.20. The Storage Devices Search Tab](image)

The tab contains a drop-down menu to select searching by port, target, WWID, or LUN (with corresponding text boxes for these values). Searching by WWID or LUN requires additional values in the corresponding text box.

Each tab presents a list of devices detected by **anaconda** with columns of information about the device to help you to identify it, such as **WWID**, **Capacity**, **Interconnect**, and **Vendor**.

Each device is presented on a separate row, with a checkbox to its left. Click the checkbox to make a device available during the installation process, or click the **radio button** at the left of the column headings to select or deselect all the devices listed in a particular screen. Later in the installation process, you can choose to install Fedora onto any of the devices selected here, and can choose to automatically mount any of the other devices selected here as part of the installed system.

Note that the devices that you select here are not automatically erased by the installation process. Selecting a device on this screen does not, in itself, place data stored on the device at risk. Note also that any devices that you do not select here to form part of the installed system can be added to the system after installation by modifying the `/etc/fstab` file.

When you have selected the storage devices to make available during installation, click **Done** to return to the **Installation Destination** screen.

### 9.11.1.1. Add an iSCSI target

To use iSCSI storage devices for the installation, **anaconda** must be able to **discover** them as iSCSI targets and be able to create an iSCSI **session** to access them. Each of these steps might require a username and password for **CHAP** (Challenge Handshake Authentication Protocol) authentication.

Additionally, you can configure an iSCSI target to authenticate the iSCSI initiator on the system to which the target is attached (**reverse CHAP**), both for discovery and for the session. Used together, CHAP and reverse CHAP are called **mutual CHAP** or **two-way CHAP**. Mutual CHAP provides the greatest level of security for iSCSI connections, particularly if the username and password are different for CHAP authentication and reverse CHAP authentication.

Repeat the iSCSI discovery and iSCSI login steps as many times as necessary to add all required iSCSI storage. However, you cannot change the name of the iSCSI initiator after you attempt discovery for the first time. To change the iSCSI initiator name, you must restart the installation.

**Procedure 9.1. iSCSI discovery**

Use the **Add iSCSI Storage Target** dialog to provide **anaconda** with the information that it needs to discover the iSCSI target.
Chapter 9. Using the Fedora installer

Figure 9.21. The iSCSI Discovery Details dialog

1. Enter the IP address of the iSCSI target in the **Target IP Address** field.

2. The **iSCSI Initiator Name** will be automatically filled by the installer with a generated initiator name. You may change this field to a different name, provided it follows the *iSCSI qualified name* (IQN) format.

   A valid IQN contains:

   - the string *iqn.* (note the period)

   - a date code that specifies the year and month in which your organization’s Internet domain or subdomain name was registered, represented as four digits for the year, a dash, and two digits for the month, followed by a period. For example, represent September 2010 as **2010-09**.
• your organization's Internet domain or subdomain name, presented in reverse order with the top-level domain first. For example, represent the subdomain storage.example.com as com.example.storage

• a colon followed by a string that uniquely identifies this particular iSCSI initiator within your domain or subdomain. For example, :diskarrays-sn-a8675309.

A complete IQN therefore resembles: iqn.2010-09.storage.example.com:diskarrays-sn-a8675309, and anaconda pre-populates the iSCSI Initiator Name field with a name in this format to help you with the structure.


3. Use the drop-down menu to specify the type of authentication to use for iSCSI discovery:

![Figure 9.22. iSCSI discovery authentication](image)

- No credentials
- CHAP pair
- CHAP pair and a reverse pair
Chapter 9. Using the Fedora installer

4. If you selected **CHAP pair** as the authentication type, provide the username and password for the iSCSI target in the **CHAP Username** and **CHAP Password** fields.

![Figure 9.23. CHAP pair](image)

If you selected **CHAP pair and a reverse pair** as the authentication type, provide the username and password for the iSCSI target in the **CHAP Username** and **CHAP Password** fields.
field and the username and password for the iSCSI initiator in the Reverse CHAP Username and Reverse CHAP Password fields.

**Figure 9.24. CHAP pair and a reverse pair**

5. Click **Start Discovery**. Anaconda will attempt to discover an iSCSI target based on the information that you provided. If the discovery succeeds, a new dialog will present you with a list of all the iSCSI nodes discovered on the target. If the discovery fails, an error message will appear describing the nature of the problem.

6. In the list of discovered nodes, select the one you want to access using the radio buttons in the left hand side column. Then select an authentication method from the **Node login authentication type** drop-down menu. If you selected CHAP pair or CHAP pair and a reverse
pair, fill out the appropriate fields with valid credentials. To use the same credentials used in the discovery process, select the **Use the credentials from discovery** option.

![Figure 9.25. The iSCSI Discovered Nodes dialog](image)

7. Click **Log In** to initiate an iSCSI session.

8. If **anaconda** discovered multiple nodes, you will be returned to the **Add iSCSI Storage Target** window, which will contain a list of discovered nodes you have not logged in to yet. Nodes you have already logged in to will not be displayed in the list. If you want to configure additional nodes, repeat step 6 in this procedure.

9. After you log in to all the nodes you want to configure, click **OK**. You will then be returned to the **Specialized and Network Disks** screen.

### 9.11.1.2. Add an FCoE SAN

To configure an FCoE SAN, select **Add FCoE SAN** and click **Add Drive**.

On the menu that appears in the next dialog box, select the network interface that is connected to your FCoE switch and click **Add FCoE Disk(s)**.
Data Center Bridging (DCB) is a set of enhancements to the Ethernet protocols designed to increase the efficiency of Ethernet connections in storage networks and clusters. Enable or disable the installer’s awareness of DCB with the checkbox in this dialog.

9.11.2. 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 20 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.

Chapter 9. Using the Fedora installer

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.

![Figure 9.27. Summary of selected disks](image)

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 9.14, “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.
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

9.11.2.1. 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.

9.12. 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.
Chapter 9. Using the Fedora installer

**DISK ENCRYPTION PASSPHRASE**

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

![Passphrase dialog box](image)

*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.*

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”*.

9.13. **Reclaim disk space**

If you chose to shrink or remove existing partitions at the *Installation Options* dialog (refer to *Section 9.11, “Storage and partitioning”*) in the *Installation Destination* section, you will be directed to the *Reclaim Disk Space* tool.
Reclaim disk space

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.

There is also free space available in pre-existing filesystems. While it’s risky and we recommend you back up your data first, you can recover that free disk space and make it available for this installation below.

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 three buttons:

- **Preserve**: leaves the filesystem intact and no data is deleted (this is the default action).
- **Shrink to**: recovers free space from the filesystem and makes it available for this installation.
- **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 one of the three buttons, or click **Delete All** to clear all reclaimable filesystems (the disks will not be touched at this point). 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 9.10, “Software Selection”**).
If you click the **Shrink to** button, a slider will appear next to it representing the size of the selected filesystem. Use your mouse to shrink the filesystem by dragging the indicator to your chosen size. The lowest possible size is displayed at the left-hand end of the slider.

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.


If you chose to partition your disks manually in Section 9.11, “Storage and partitioning”, you will directed to 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 9.14.5, “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 9.11, “Storage and partitioning” are displayed beneath this pane.


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.

**Important**

If you configured your disks in the shell prompt, click the arrow button at the bottom of the left-hand pane before you begin partitioning. In the resulting dialog, click **Rescan disks**. This enables the installer to take advantage of your changes.

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 9.14.5, “Recommended Partitioning Scheme”), but you can add additional partitions if you need to.
Adding and Configuring Partitions

Alternatively, create individual partitions using the + button at the bottom of the pane. The Add a New Mount Point dialog will open. Type a path for the mount point or select one from the drop-down menu (for example, enter / for the root partition, /boot for the boot partition, and so on). Enter 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 9.11, “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 9.11.2, “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.
Chapter 9. Using the Fedora installer

- **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 9.14.1.1, “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 9.14.1.1, “File System Types”. Check the adjacent Reformat box to format an existing partition, or leave it unchecked to retain your data.

Click Update Settings to save your changes and select another partition to customize. To undo the changes you have made to the partitions and start again, click Reset All.

When all partitions have been created and customized, click Done to return to the Installation Summary Menu. The Summary of Changes dialog will appear first, prompting you to either review and accept your partitions or to return and modify them.

Once you have accepted the partitions, you will be prompted to create a passphrase if you chose to encrypt any of them (refer to Section 9.12, “Encrypt Partitions”).

### 9.14.1.1. 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 9.14.3, “Create LVM Logical Volume”. For more information regarding LVM, refer to the Fedora System Administrators 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 9.14.2, “Create Software RAID”. For more information regarding RAID, refer to the chapter RAID (Redundant Array of Independent Disks) in the Fedora System Administrators Guide.

- **LVM thin provisioning** – Using thin provisioning, you can manage a storage pool of free space, known as a thin pool, which can be allocated to an arbitrary number of devices when needed by applications. The thin pool can be expanded dynamically when needed for cost-effective allocation of storage space.

- **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 9.14.4, “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.
Create Software RAID

- **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`\(^2\) 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 System Administrators Guide* for additional information.

- **BIOS Boot** — A small partition required for booting a device with a GPT/GUID partition table on BIOS systems. Not required for UEFI systems.

- **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.

### 9.14.2. 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.

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.

---

\(^2\) The `fsck` application is used to check the file system for metadata consistency and optionally repair one or more Linux file systems.
RAID configuration options will only be visible if you have selected two or more disks in Section 9.11, “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 9.14.1, “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 9.14.1.1, “File System Types”.

4. Click the RAID Level dropdown menu and select your preferred RAID level:

   **RAID0 (Performance)**
   
   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.
Create LVM Logical Volume

RAID1 (Redundancy)
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.

RAID4 (Error Checking)
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.

RAID5 (Distributed Error Checking)
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.

RAID6 (Redundant Error Checking)
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.

RAID10 (Performance, Redundancy)
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.

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 Update Settings to save your changes, and either continue with another partition or click Done to return to the Installation Summary Menu.

9.14.3. Create LVM Logical Volume

Important - LVM in Text-Mode is Automatic Partitioning Only

Text-mode installation only provides automatic partitioning for LVM volumes. If customization is required, use a kickstart, graphical, or vnc installation.

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 System Administrators Guide*. Note, LVM is only available in the graphical installation program.

![Test](image)

**Figure 9.32. Configure a logical volume**

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

1. Create a partition as described in *Section 9.14.1, “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, such as *fedora*. If this group and its default settings (no RAID level, automatic sizing) are acceptable, skip to step 5.

4. To edit the group, click **Modify** to open the **Configure Volume Group** dialog. Choose a name and select which disks will be included. Optionally, select a RAID level and a Sizing Policy (choose between **Automatic**, **As large as possible**, and **Fixed**, to set the size manually). For information on RAID levels, refer to *Section 9.14.2, “Create Software RAID”*.

   Alternatively, click the dropdown menu and select **Create a new volume group** to add an additional group using the same dialog.

   Click **Save** once the group is configured.
5. Click **Update Settings** to save your changes, and either continue with another partition or click **Done** to return to the Installation Summary Menu.

### 9.14.4. Create a Btrfs subvolume

#### Btrfs is still experimental

Fedora 20 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.
To create a Btrfs subvolume:

1. Create a partition as described in Section 9.14.1, “Adding and Configuring Partitions”. Configuring this partition will configure the Btrfs subvolume.

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

3. Beneath the File System dropdown menu (which is grayed out for Btrfs), an additional menu will appear: Volume Group. This menu will display a newly-created volume group name, such as fedora00. If this group and its default settings (no RAID level, automatic sizing) are acceptable, skip to step 5.

4. To edit the group, click Modify to open the Configure Volume dialog. Choose a name and select which disks will be included. Optionally, select a RAID level and a Sizing Policy (choose between Automatic, As large as possible, and Fixed, to set the size manually). For information on RAID levels, refer to Section 9.14.2, “Create Software RAID”.

   Alternatively, click the dropdown menu and select Create a new volume to add an additional group using the same dialog.
Click **Save** once the volume is configured.

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only RAID 0 and RAID 1 are available for btrfs subvolumes.</td>
</tr>
</tbody>
</table>

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 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.

6. Click **Update Settings** to save your changes, and either continue with another partition or click **Done** to return to the Installation Summary Menu.

<table>
<thead>
<tr>
<th>Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placing <code>/boot</code> on a Btrfs subvolume may lead to instability and is not recommended.</td>
</tr>
</tbody>
</table>

### 9.14.5. Recommended Partitioning Scheme

#### 9.14.5.1. 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.
Chapter 9. Using the Fedora installer

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 if allowing for hibernation</th>
</tr>
</thead>
<tbody>
<tr>
<td># 2GB</td>
<td>2 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 2GB – 8GB</td>
<td>3 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 8GB – 64GB</td>
<td>Equal to the amount of RAM</td>
</tr>
<tr>
<td>&gt; 64GB</td>
<td>2 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 8GB – 64GB</td>
<td>1.5 times the amount of RAM</td>
</tr>
<tr>
<td>&gt; 64GB</td>
<td>4GB of swap space</td>
</tr>
<tr>
<td>&gt; 64GB</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 (500 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 500 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 GB partition allows you to install a minimal installation. For a full desktop installation, a minimum of 20GB for the root partition is recommended.
**Root and /root**

The / (or root) partition is the top of the directory structure. The /root directory.getRoot() (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 9.14.5.1.1, “Advice on Partitions” for more information.

  If you create many partitions instead of one large / partition, upgrades become easier.

  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 2 GB, and you do not make a separate /foo partition, then the / (root) partition must be at least 2 GB.

<table>
<thead>
<tr>
<th>Directory</th>
<th>Minimum size</th>
</tr>
</thead>
<tbody>
<tr>
<td>/</td>
<td>2 GB</td>
</tr>
<tr>
<td>/usr</td>
<td>/usr on a separate partition is not supported.</td>
</tr>
<tr>
<td>/tmp</td>
<td>tempfs by default, 50 MB otherwise.</td>
</tr>
<tr>
<td>/var</td>
<td>500 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.

**9.14.5.1.1. 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.
Chapter 9. Using the Fedora installer

• 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 220 MB on the /boot partition. The boot partition can also be used during upgrades, so leaving extra room is recommended. Unless you plan to install a great many kernels, the default partition size of 500 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. Because crucial applications and utilities are located in /usr, Fedora does not support placing it on a separate partition.

![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>
<thead>
<tr>
<th>Partition</th>
<th>Size and type</th>
</tr>
</thead>
<tbody>
<tr>
<td>/boot</td>
<td>500 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>
<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>
9.14.6. Review and Confirm Custom Partition Layout
After manually configuring a partition layout, you are given a summary of changes to be made to the disk. Review the summary to ensure that the installation will proceed as expected, and that no filesystems with important data will be lost.

![Summary of Changes](image)

**Figure 9.34. Summary of Changes**

9.15. Begin installation
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.
If you have finished customizing your installation and are certain that you want to proceed, click **Beginning** 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.

9.16. 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.

![Figure 9.36. Installing packages](image)
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, select the menu items above the progress bar to create user profiles and a root password. These items must be configured in order to complete the installation.

### 9.16.1. 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.

![ROOT PASSWORD](image)

Figure 9.37. Root Password

Use the root account only for system administration. Create a non-root account for your general use and use the `su` command to change to root only when you need to perform tasks that require superuser authorization. These basic rules minimize the chances of a typo or an incorrect command doing damage to your system.

#### 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`.

The installation program requires you to set a root password\(^3\) for your system. You cannot proceed to the installation itself without entering a root password.

---

\(^3\) 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

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.

Note

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

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.

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.

9.16.2. User Creation

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.
User Creation

Figure 9.38. The Create User screen

Note — Network Login Not Available During Installation

It is not possible to configure network-based authentication during installation using the graphical interface in the current version of Fedora. This option now becomes available after the installation finishes and the system is started for the first time. Alternatively, you can use kickstart to configure network authentication during the installation process. See Chapter 15, Kickstart Installations for more details on kickstart installations, and the Fedora 19 Release Notes\(^4\) for information about this limitation.

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 Make this user administrator box if you would like administrative privileges. This will place you in the whee1 group, which gives you access to all administrative functions, including installing and updating software, creating and altering configuration files, and administering other users.

To create additional users or customise your first user account, click Advanced to open the Advanced User Configuration dialog.

---

Figure 9.39. Advanced User Configuration

In **Advanced User Configuration** 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 selected GNOME as your desktop environment during the package selection process, you will be able to create a user account after the installation finishes. Other desktop environments, such as KDE or Xfce, do not offer this functionality. It is therefore important to create at least one user account during this step; otherwise 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**.

---

### 9.17. Installation Complete

Congratulations! Now that you have configured the remaining settings, your Fedora installation is 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. Once you have logged in, you can begin using Fedora.

### 9.17.1. GNOME Initial Setup

If you selected **GNOME** as your default desktop environment, you will be presented with a **Welcome** screen when the newly installed system starts for the first time. Here you can configure your system settings, such as the time zone, keyboard layout and language. If you have not created a user account during the installation, you will be prompted to create one. All of the options available here can be changed using built-in tools accessible from the **Activities** menu after the initial setup is complete.

After you have finished configuring the available options, click the **Start using GNOME 3** button on the application's final screen. You will then be able to log in to your user account.

When you log in for the first time, a **Desktop Help** window will automatically open, allowing you to view tutorials and watch several videos showcasing some of the desktop environment's features.
9.17.2. Initial Setup in Other Desktop Environments

In desktop environments other than GNOME, such as XFCE or KDE, you will only be presented with a screen allowing you to customize system settings and create a user account if you have not done so during the installation. If you have configured your language, keyboard layout, time zone and created a user previously (for example during the graphical installation), you will be able to log in and start using your system immediately. If only some of the available options are configured, the Initial Setup menu will prompt you the remaining ones.

The Initial Setup application works the same way as the Anaconda graphical installer. For instructions on how to configure the available settings, see Section 9.2, “The Graphical Installation Program User Interface”.
Figure 9.42. The Initial Setup Menu
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.
Chapter 10. Troubleshooting Installation on an Intel or AMD System

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.
Trouble During the Installation

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]

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

[Report Bug]  [Quit]

[More info...]

Figure 10.1. The Crash Reporting Dialog Box

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. In a non-Live installation, 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

An unknown error has occurred

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

☐ More info...

The output below may help determine the cause of the error:

```
anaconda 18.29 exception report
Traceback (most recent call first):
  File "str_eval", line 3, in f1353463738
  File "str_eval", line 5, in <module>
  File "/usr/lib64/python2.7/site-packages/pyanaconda/exception.py", line 191, in raise_except eval(compile(code, "str_eval", "exec"))
```

'Debug' will take you to tty1. Press Ctrl + Alt + F6 to return.

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.

Wrong settings detected for Bugzilla, reporting will probably fail if you continue with the current configuration.

Read more about the configuration

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.

![Figure 10.4. Configure Bugzilla](image)

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.
Figure 10.5. Describe the problem

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.

Figure 10.6. Review the data 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 9.11, “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, such as the boot menu being corrupt and unusable, you may need to disable the graphical boot screen. To do this, become the root user and add the following line to the /etc/default/grub file:

```
GRUB_TERMINAL=console
```

Refresh the grub.cfg file by running the following command with root privileges so the changes will take effect:

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

To re-enable the graphical boot screen, remove the newly added line or comment it out by inserting the # character at the beginning of the line.

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. See the GRUB documentation at [http://www.gnu.org/software/grub/grub-documentation.html](http://www.gnu.org/software/grub/grub-documentation.html) 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 set the graphical **systemd** boot target as the default target. The system boots to the target described in the **default.target** file, which is a symbolic link (or symlink) to a specific target file.

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

Now, type the following command to create a new symlink to the graphical target, which we will call `default2`:

```
ln -s /lib/systemd/system/graphical.target /etc/systemd/system/default2.target
```

Then, overwrite the current **default.target** symlink with the new symlink:
Chapter 10. Troubleshooting Installation on an Intel or AMD System

mv /etc/systemd/system/default2.target /etc/systemd/system/default.target

You will be prompted to confirm whether the file should be overwritten. Press y followed by Enter.

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 17.2, “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:

df -h

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

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

10.4.6. Problems When You Try to Log In

If you did not create a user account in the Configuration Menu and Progress Screen, 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:
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

   \[
   \text{mem}=\text{xxM}
   \]

   where \text{xx} equals the amount of RAM in your system, then press \textbf{Enter} to exit edit mode.

5. Once the boot loader screen has returned, type \textbf{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:

   \[
   \text{mem}=\text{xxM}
   \]

   Replace \text{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.

   \[
   \text{grub2-mkconfig \textendash output=}/boot/grub/grub.cfg
   \]

   In `10_linux`, the above example would look similar to the following:
Chapter 10. Troubleshooting Installation on an Intel or AMD System

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, append them to the boot command line. To access the command line on a system that displays a graphical boot screen, press the Tab key while one of the boot options on the screen is highlighted, or press the Esc key at any point in the boot menu. Multiple options added to the boot line need to be separated by a single space.

Throughout this chapter, some options are presented ending an "equals" sign ('='). These options require a value to be specified. For example, the inst.vncpassword= option must also contain a password — for example, inst.vncpassword=testpasswd. Other options are presented without the = sign; these options are booleans. This means that you either use them without specifying a value, or you can append either =1 or =0 to enable or disable them, respectively. For example, the rd.live.check option is the same as rd.live.check=1, and using rd.live.check=0 is exactly the same as not using the option at all.

Note
The Fedora installation can either boot with rescue mode, or load the installation system. For more information on rescue mode, see Section 11.3.3, "Booting Your Computer in Rescue Mode".

11.1. Configuring the Installation System at the Boot Menu
The boot: prompt always expects the first option to specify the image file to be loaded. When using custom boot options with the Anaconda installer, the linux option will come first in most cases. A valid command in the boot prompt will therefore almost always look like the following:

```
boot:linux options
```

This only applies to the actual boot prompt, which is accessed by pressing the Esc key in the boot menu. If you are only modifying an existing set of options (accessed by highlighting a choice in the boot menu and pressing the Tab key), the linux option is not displayed, but it is implied. A valid set of boot options will then be:

```
>options
```

In addition to the options described in this chapter, the boot prompt also accepts valid dracut kernel options. A list of these options is available as the dracut.cmdline(7) man page.

Note
Boot options specific to the installer always start with inst. in this guide. Currently, this prefix is optional, for example, inst.resolution= will work exactly the same as resolution=. However, it is expected that Anaconda will require the inst. prefix in future releases.

Specifying the Installation Source
### inst.repo=

Specifies the installation source — that is, a location where the installer can find the images and packages it needs. For example:

```
inst.repo=cdrom
```

The target must be either:

- an installable tree, which is a directory structure containing the installer's images, packages and repodata as well as a valid `.treeinfo` file
- a mounted DVD (either a physical DVD in a DVD drive or a loopback-mounted image)

This option allows for the configuration of different installation methods using different formats. The syntax is described in the table below.

<table>
<thead>
<tr>
<th>Installation source</th>
<th>Option format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any CD/DVD drive</td>
<td><code>inst.repo=cdrom</code></td>
</tr>
<tr>
<td>Specific CD/DVD drive</td>
<td><code>inst.repo=cdrom:device</code></td>
</tr>
<tr>
<td>Hard Drive</td>
<td><code>inst.repo=hd:device/path</code></td>
</tr>
<tr>
<td>HTTP Server</td>
<td><code>inst.repo=http://host/path</code></td>
</tr>
<tr>
<td>HTTPS Server</td>
<td><code>inst.repo=https://host/path</code></td>
</tr>
<tr>
<td>FTP Server</td>
<td><code>inst.repo=ftp://username:password@host/path</code></td>
</tr>
<tr>
<td>NFS Server</td>
<td><code>inst.repo=nfs:options:server:/path</code>¹</td>
</tr>
</tbody>
</table>

¹ This option uses NFS protocol version 3 by default. To use a different version, add `+nfsvers=X` to `options`.

Disk device names may be specified using the following formats:

- Kernel device name, for example `/dev/sda1` or `sdb2`
- File system label, for example `LABEL=Flash` or `LABEL=RHEL7`
- File system UUID, for example `UUID=8176c7bf-04ff-403a-a832-9557f94e61db`

Non-alphanumeric characters must be represented as \xNN, where NN is the hexadecimal representation of the character. For example, \x20 is a white space (" ").

### inst.stage2=

Specifies the location of the installer runtime image to be loaded. The syntax is the same as in Specifying the Installation Source. This option will ignore everything except for the image itself, it is not possible to use it to specify the location of packages.

### inst.dd=

If you need to perform a driver update during the installation, use the `inst.dd=` option. It can be used multiple times. The location of a driver rpm package can be specified using any of the formats detailed in Specifying the Installation Source. For example:

```
inst.dd=cdrom
```
**Kickstart Boot Options**

**inst.ks=**

Gives the location of a Kickstart file to be used to automate the installation. Locations can be specified using any of the formats valid for `inst.repo`. See *Specifying the Installation Source* for details.

If you only specify a device and not a path, Anaconda will look for the Kickstart file in `/ks.cfg` on the specified device. If you use this option without specifying a device, the installer will use the following:

```
instd.ks=nfs:next-server:/filename
```

In the above example, `next-server` is the DHCP `next-server` option or the IP address of the DHCP server itself, and `filename` is the DHCP `filename` option, or `/kickstart/`. If the given file name ends with the `/` character, `ip-kickstart` is appended. For example:

<table>
<thead>
<tr>
<th>DHCP server address</th>
<th>Client address</th>
<th>Kickstart file location</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.122.1</td>
<td>192.168.122.100</td>
<td>192.168.122.1:/kickstart/192.168.122.100-kickstart</td>
</tr>
</tbody>
</table>

**inst.ks.sendmac**

Adds headers to outgoing HTTP requests with the MAC addresses of all network interfaces. For example:

```
X-RHN-Provisioning-MAC-0: eth0 01:23:45:67:89:ab
```

This can be useful when using `inst.ks=http` to provision systems.

**inst.ks.sendsn**

Adds a header to outgoing HTTP requests. This header will contain the system's serial number, read from `/sys/class/dmi/id/product_serial`. The header has the following syntax:

```
X-System-Serial-Number: R8VA23D
```

Console, Environment and Display Options

**console=**

This kernel option specifies a device to be used as the primary console. For example, if you want to use a console on the first serial port, use `console=ttyS0`. Implies the `inst.text` option.

You can use this option multiple times. In that case, the boot message will be displayed on all specified consoles, but only the last one will be used by the installer afterwards. For example, if you specify `console=ttyS0 console=ttyS1`, the installer will use `ttyS1`.

**inst.lang=**

Sets the language to be used during the installation. Language codes are the same as the ones used in the `lang` Kickstart command as described in *Section 15.4, “Kickstart Options”*. On systems where the `system-config-language` package is installed, a list of valid values can also be found in `/usr/share/system-config-language/locale-list`.
Chapter 11. Boot Options

**inst.geoloc=**

Configures geolocation usage in the installer. Geolocation is used to pre-set the language and time zone. This option takes the following format:

```
inst.geoloc=value
```

The `value` parameter can be any of the following:

<table>
<thead>
<tr>
<th>Table 11.3. Valid Values for the inst.geoloc Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disable geolocation</td>
</tr>
<tr>
<td>Use the Fedora GeoIP API</td>
</tr>
<tr>
<td>Use the Hostip.info GeoIP API</td>
</tr>
</tbody>
</table>

If this option is not specified, Anaconda will use `provider_fedora_geoip`.

**inst.keymap=**

Specifies the keyboard layout to be used by the installer. Layout codes are the same as the ones used in the `keyboard` Kickstart command as described in Section 15.4, “Kickstart Options”.

**inst.text**

Forces the installer to run in text mode instead of graphical mode. The text user interface is limited, for example, it does not allow you to modify the partition layout or set up LVM. When installing a system on a machine with a limited graphical capabilities, it is recommended to use VNC as described in Enabling Remote Access.

**inst.cmdline**

Forces the installer to run in command line mode. This mode does not allow any interaction, all options must be specified in a Kickstart file or on the command line.

**inst.graphical**

Forces the installer to run in graphical mode. This mode is the default.

**inst.resolution=**

Specifies the screen resolution in graphical mode. The format is `N x M`, where `N` is the screen width and `M` is the screen height (in pixels). The lowest supported resolution is `640x480`.

**inst.headless**

Specifies that the machine being installed onto does not have any display hardware. In other words, this option prevents the installer from trying to detect a screen.

**inst.xdriver=**

Specifies the name of the X driver to be used both during the installation and on the installed system.

**inst.usefbx**

Tells the installer to use the frame buffer X driver instead of a hardware-specific driver. This option is equivalent to `inst.xdriver=fbdev`.

**inst.sshd**

Starts the sshd service during the installation, which allows you to connect to the system during the installation using SSH and monitor its progress. For more information on SSH, see the `ssh(1)` man page and the corresponding chapter in the *Fedora System Administrator’s Guide*.  

---

126
Network Boot Options

Initial network initialization is handled by `dracut`. This section only lists some of the more commonly used options; for a complete list, see the `dracut.cmdline(7)` man page.

`ip=`

Configures one or more network interfaces. To configure multiple interfaces, use the `ip` option multiple times — once for each interface. If multiple interfaces are configured, you must specify a primary boot interface using the `bootdev` option described below.

This option accepts several different formats. The most common are described in `Table 11.4, "Network Interface Configuration Formats"`.

### Table 11.4. Network Interface Configuration Formats

<table>
<thead>
<tr>
<th>Configuration Method</th>
<th>Option format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic configuration of any interface</td>
<td><code>ip=method</code></td>
</tr>
<tr>
<td>Automatic configuration of a specific interface</td>
<td><code>ip=interface:method</code></td>
</tr>
<tr>
<td>Static configuration</td>
<td><code>ip=ip::gateway:netmask:hostname:interface:none</code></td>
</tr>
<tr>
<td>Automatic configuration of a specific interface</td>
<td><code>ip=ip::gateway:netmask:hostname:method:mtu</code></td>
</tr>
</tbody>
</table>

1. Brings up the specified interface using the specified method of automatic configuration, such as `dhcp`, but overrides the automatically obtained IP address, gateway, netmask, hostname or other specified parameter. All parameters are optional; only specify the ones you wish to override and automatically obtained values will be used for the others.

The `method` parameter can be any the following:

### Table 11.5. Automatic Interface Configuration Methods

<table>
<thead>
<tr>
<th>Automatic configuration method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHCP</td>
<td><code>dhcp</code></td>
</tr>
<tr>
<td>IPv6 DHCP</td>
<td><code>dhcp6</code></td>
</tr>
<tr>
<td>IPv6 automatic configuration</td>
<td><code>auto6</code></td>
</tr>
<tr>
<td>iBFT (iSCSI Boot Firmware Table)</td>
<td><code>ibft</code></td>
</tr>
</tbody>
</table>
Chapter 11. Boot Options

Note

If you used a boot option which requires network access, such as
\texttt{inst.ks=http\://host\:/path} and you did not specify the \texttt{ip} option, the installer will use
\texttt{ip=dhcp}.

In the above tables, the \texttt{ip} parameter specifies the client's IP address. IPv6 addresses can be
specified by putting them in square brackets, for example, \texttt{[2001:DB8::1]}.

The \texttt{gateway} parameter is the default gateway. IPv6 addresses are accepted here as well.

The \texttt{netmask} parameter is the netmask to be used. This can either be a full netmask (for example \texttt{255.255.255.0}) or a prefix (for example \texttt{64}).

The \texttt{hostname} parameter is the host name of the client system. This parameter is optional.

\texttt{nameserver=}

Specifies the address of the nameserver you want to use. This option can be used multiple times.

\texttt{bootdev=}

Specifies the boot interface. This option is mandatory if you used more than one \texttt{ip} option.

\texttt{ifname=}

Assigns a given interface name to a network device with a given MAC address. Can be used
multiple times. The syntax \texttt{ifname=interface:MAC}. For example:

\begin{verbatim}
ifname=eth0:01:23:45:67:89:ab
\end{verbatim}

\texttt{inst.dhcpclass=}

Specifies the DHCP class vendor identifier. The dhcpd service will see this value as \texttt{vendor-class-identifier}. The default value is \texttt{anaconda-$(uname -srm)}.

Advanced Installation Options

\texttt{inst.multilib}

Configure the system for multilib packages (that is, to allow installing 32-bit packages on a 64-bit
x86 system) and install packages specified in this section as such.

Normally, on an AMD64/Intel 64 system, only packages for this architecture (marked as \texttt{x86_64})
and packages for all architectures (marked as \texttt{noarch}) would be installed. When you use this
option, packages for 32-bit AMD/Intel systems (marked as \texttt{i586}, \texttt{i686}, etc.) will be automatically
installed as well if available.

This only applies to packages directly specified in the \texttt{packages} section. If a package is only
installed as a dependency, only the exact specified dependency will be installed. For example,
if you are installing package \texttt{foo} which depends on package \texttt{bar}, the former will be installed in
multiple variants, while the latter will only be installed in variants specifically required.

\texttt{gpt}

Install partition information into a GPT (GUID Partition Table) instead of MBR (Master Boot
Record).
Enabling Remote Access

`inst.vnc`  
Specifies that the installer's graphical interface should be run in a VNC session. If you specify this option, you will need to connect to the system using a VNC client application to be able to interact with the installer. VNC sharing is enabled, so multiple clients can connect to the system at the same time.

**Note**  
A system installed using VNC will start in text mode by default.

`inst.vncpassword=`  
Sets a password on the VNC server used by the installer. Any VNC client attempting to connecting to the system will have to provide the correct password to gain access. For example, `inst.vncpassword=testpasswd` will set the password to `testpasswd`.

`inst.vncconnect=`  
Connect to a listening VNC client at a specified host and port once the installation starts. The correct syntax is `inst.vncconnect=host:port`, where `host` is the address to the VNC client's host, and `port` specifies which port to use. The `port` parameter is optional, if you do not specify one, the installer will use 5900.

Debugging and Troubleshooting

`inst.update=`  
Specifies the location of the `updates.img` file to be applied to the installer runtime. The syntax is the same as in the `inst.repo` option — see Table 11.1, “Installation Sources” for details. In all formats, if you do not specify a file name but only a directory, the installer will look for a file named `updates.img`.

`inst.loglevel=`  
Specifies the minimum level for messages to be logged on a terminal. This only concerns terminal logging; log files will always contain messages of all levels.

Possible values for this option from the lowest to highest level are: `debug`, `info`, `warning`, `error` and `critical`. The default value is `info`, which means that by default, the logging terminal will display messages ranging from `info` to `critical`.

`inst.syslog=`  
Once the installation starts, this options sends log messages to the syslog process on the specified host. The remote syslog process must be configured to accept incoming connections. For information on how to configure a syslog service to accept incoming connections, see the Fedora System Administrator's Guide.

`inst.virtiolog=`  
Specifies a `virtio` port (a character device at `/dev/virtio-ports/name`) to be used for forwarding logs. The default value is `org.fedoraproject.anaconda.log.0`; if this port is present, it will be used.
11.2. 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.

11.2.1. 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

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 11.6. 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>
<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 value in megabytes</td>
<td>mem=xxxm</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>
11.3. Using the Maintenance Boot Modes

11.3.1. 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 **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.

**Note**

**Memtest86+** only works on BIOS installations and is not available on UEFI systems.

11.3.2. 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.

To test the checksum integrity of an ISO image, append the `rd.live.check` to the boot loader command line. Note that this option is used automatically if you select the default installation option from the boot menu (Test this media & install Fedora).

### 11.3.3. Booting Your Computer in Rescue Mode

You may boot a command-line Linux system from an installation disc without actually 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 the system.

To load the rescue system with the installation disc, choose Rescue a Fedora system from the Troubleshooting submenu in the boot menu, or use the `inst.rescue` boot option.

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/`. 
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:

```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:

```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 *Enabling Remote Access* for assistance in connecting to the remote system.
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 configures 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`:
Chapter 13. Setting Up an Installation Server

```
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/syslinux.doc` and `/usr/share/doc/syslinux/pxelinux.doc`.

### 13.2. Setting Up the Distribution

To set up a distribution from a full Fedora DVD or ISO image, use this procedure.

**Network Locations**

To create a local mirror from an existing network source, skip this section and refer instead to Section 13.3, “Mirroring a Network Location”.

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:

```
systemctl start rpcbind
systemctl start nfs
```

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.
Chapter 13. Setting Up an Installation Server

```
cobbler import --path=/mnt/dvd --name=distro_name --available-as=network_URI
cobbler import --path=network_URI --name=distro_name --available-as=network_URI
```

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. Start the xinetd service, and enable it to persist across reboots:

   ```
   systemctl start xinetd
   systemctl enable xinetd
   ```

4. 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 System Administrators Guide.)

A sample configuration in /etc/dhcp/dhcpd.conf might look like:

```
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 "pxelinux" {
        match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
        next-server 10.0.0.1;
        if option arch = 00:06 {
            filename "pxelinux/boottia32.efi";
        } else if option arch = 00:07 {
            filename "pxelinux/boottia64.efi";
        } else {
            filename "pxelinux/pxelinux.0";
        }
    }

    class "pxeeclients" {
        match if substring (option vendor-class-identifier, 0, 9) = "PXEClient";
        next-server 10.0.0.1;
        if option arch = 00:06 {
            filename "pxelinux/boottia32.efi";
        } else if option arch = 00:07 {
            filename "pxelinux/boottia64.efi";
        } else {
            filename "pxelinux/pxelinux.0";
        }
    }
}
```
Chapter 13. Setting Up an Installation Server

```plaintext
host example-ia32 {
    hardware ethernet XX:YY:ZZ:11:22:33;
    fixed-address 10.0.0.2;
}
```

5. You now need the `pxelinux.0` file from the SYSLINUX package installed with Fedora. Create a `pxelinux` directory within `tftpboot` and copy `pxelinux.0` and `vesamenu.c32` into it:

   ```bash
   mkdir /var/lib/tftpboot/pxelinux
cp /usr/share/syslinux/{pxelinux.0, vesamenu.c32} /var/lib/tftpboot/pxelinux
   ```

6. Create a `pxelinux.cfg` directory within `pxelinux`:

   ```bash
   mkdir /var/lib/tftpboot/pxelinux/pxelinux.cfg
   ```

7. 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 `A0000001`

   A sample config file at `/var/lib/tftpboot/pxelinux/pxelinux.cfg/default` might look like:

   ```plaintext
   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
   /20/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/20/Fedora/x86_64/os/

   label rescue
   menu label ^Rescue installed system
   kernel vmlinuz
   append initrd=initrd.img root=live:http://dl.fedoraproject.org/pub/fedora/linux/
   releases/20/Fedora/x86_64/os/LiveOS/squashfs.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

140
8. Copy the boot images into your `tftp` root directory:

   ```bash
cp /path/to/x86_64/os/images/pxeboot/{vmlinuz,initrd.img} /var/lib/tftpboot/pxelinux/
   
   
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 installation media:

   ```bash
   mkdir /var/lib/tftpboot/pxelinux
   mkdir /var/lib/tftpboot/pxelinux/bootx64.efi
   cp /path/to/image/os/EFI/BOOT/grubx64.efi /var/lib/tftpboot/pxelinux/
   
   
4. Start the xinetd service, and enable it to persist across reboots

   ```bash
   systemctl start xinetd
   systemctl enable xinetd
   systemctl status xinetd
   
   
5. 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 System Administrators Guide*.)

   A sample configuration in `/etc/dhcp/dhcpd.conf` might look like:

   ```conf
   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";
       }
   }
   ```
Chapter 13. Setting Up an Installation Server

```plaintext
host example-ia32 {
    hardware ethernet XX:YY:ZZ:11:22:33;
    fixed-address 10.0.0.2;
}
```

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/dhcpd6.conf` might look like:

```plaintext
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::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.efi` 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](https://fedoraproject.org/wiki/SecureBoot/UEFI).

6. Create a `pxelinux.cfg` directory within `pxelinux`:

   ```bash
   mkdir /var/lib/tftpboot/pxelinux/pxelinux.cfg
   ```

7. 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:

   ```plaintext
default=0
```
For instructions on how to specify the installation source, refer to *Chapter 8, Configuring Installation Source*

8. Copy the boot images into your **tftp** root directory:

```
cp /path/to/image/os/images/pxeboot/{vmlinuz,initrd.img} /var/lib/tftpboot/pxelinux/
```

9. Reboot the system, and select the network device as your boot device when prompted.

### 13.5.3. Starting the **tftp** Server

On the DHCP server, verify that the **tftp-server** package is installed with the command `rpm -q tftp-server`.

**tftp** is an xinetd-based service. Configure xinetd to process tftp requests by editing `/etc/xinetd.d/tftp` so that `disable = no`.

Start the **tftp** service with the following commands:

```
systemctl start xinetd.service
systemctl enable xinetd.service
```

These commands configure the **tftp** and **xinetd** services to immediately turn on and also configure them to start at boot.

### 13.5.4. Adding a Custom Boot Message

Optionally, modify `/tftpboot/linux-install/mgs/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 **iPXE** bootloader. The Fedora Project does not distribute **iPXE** — refer to the project website at [http://ipxe.org/](http://ipxe.org/) for more information.

After the system boots the installation program, refer to the *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:

  ```bash
  # yum install tigervnc
  ```


- 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 vncconnect 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)
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.

<table>
<thead>
<tr>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

**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=**.

• **--enableldapauth** — 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 **--enableldapauth**, 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 **--enableldapauth**, 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/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.
• **--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 creates partitions — a root (/) partition (1 GB or bigger), a **/swap** partition, and an appropriate **/boot** partition for the architecture. On large enough drives, this also creates a **/home** partition.

**Note**

Note that the **autopart** option cannot be used together with the **part/partition, raid, logvol, or volgroup** options in the same kickstart file.

• **--encrypted** — Should all devices with support be encrypted by default? This is equivalent to checking the **Encrypt** checkbox on the initial partitioning screen.

• **--cipher=** — Specifies which type of encryption will be used if the **anaconda** default aes-xts-plain64 is not satisfactory. You must use this option together with the **--encrypted** option; by itself it has no effect. Available types of encryption are listed in the **Red Hat Enterprise Linux Security Guide**, but Red Hat strongly recommends using either aes-xts-plain64 or aes-cbc-essiv:sha256.

• **--passphrase=** — Provide a default system-wide passphrase for all encrypted devices.
Kickstart Options

- **--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.

- **--type=** — Select one of the predefined automatic partitioning scheme you want to use. Accepts the following values:
  - **lvm**: The LVM partitioning scheme.
  - **btrfs**: The BTRFS partitioning scheme.
  - **thinp**: The LVM Thin Provisioning partitioning scheme.
  - **plain**: Regular partitions with no LVM or BTRFS.

  For a description of the available partition schemes, see Section 9.14.1.1, “File System Types”.

- **--nolvm** — Do not use LVM or BTRFS for automatic partitioning. This option is equal to **--type=plain**.

**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:

  ```
  bootloader --location=mbr --append="hdd=ide-scsi ide=nodma"
  ```

- **--driveorder** — Specify which drive is first in the BIOS boot order. For example:

  ```
  bootloader --driveorder=sda,hda
  ```
Chapter 15. Kickstart Installations

- **--boot-drive=** — Specifies which drive the bootloader is installed to.
- **--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.
- **--extlinux** — install and use the extlinux bootloader.

**btrfs (optional)**

Create a BTRFS volume or subvolume. For a volume, the syntax is:

```
  btrfs <mntpoint> --data=<level> --metadata=<level> --label=<label> <partitions>
```

*<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.
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:

  ```bash
  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:

```bash
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:

```bash
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.

- **--list=** — Specifies individual partitions to be removed. For example, the following removes the first partition on the `hda` drive and the second partition on the `hdb` drive:

  ```bash
  clearpart --list=hda1,hdb2
  ```

- **--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.
Chapter 15. Kickstart Installations

- **--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 disks can be used during kickstart installations. You must copy the driver disks’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 disk:

```
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`.
- **<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`.  

156
• `<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.

**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.

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
  ```

`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:

  ```
  harddrive --partition=hdb2 --dir=/tmp/install-tree
  ```

- `liveimg` — Install a disk image instead of packages. The image can be the `squashfs.img` file from a live image or a bare image from any existing filesystem mountable by the installation
media, such as ext4. The image will be downloaded to the target drive after it has been partitioned.

- **--url=<url>** — specify where the live image should be downloaded from. HTTP, HTTPS, FTP, and local file access are all supported.

- **--proxy=[protocol://][username[:password]@]host[:port]** — specify a HTTP, HTTPS, or FTP proxy, if desired.

- **--checksum=** — pass the optional sha256 image checksum before files are copied to the target system.

- **--noverifyssl** — skip checking the SSL certificate if downloading via HTTPS.

For example:

```
liveimg --url=https://<server>/<dir> [--checksum=sha256] [--noverifyssl]
```

### Important

The disk image must have the necessary utilities that anaconda needs to complete the installation, so livemedia-creator is recommended for creating the disk image.

- **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:

```
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:

```
url --url http://<server>/<dir>
```

or:

```
url --url ftp://<username>:<password>@<server>/<dir>
```
Chapter 15. Kickstart Installations

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.
• **--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.

• **--addsupport** — Set additional languages to be supported on the installed system.

**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.
• **--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.

• **--thinpool** — Create a thin pool logical volume. (Use a mountpoint of “none”)

• **--metadatasize=size** — Specify the metadata area size (in MiB) for a new thin pool device.

• **--chunksize=size** — Specify the chunk size (in KiB) for a new thin pool device.

• **--thin** — Create a thin logical volume. (Requires use of **--poolname**)

• **--poolname=name** — Specify the name of the thin pool in which to create a thin logical volume. (Requires **--thin**)

• **--resize** — Resize an existing partition. This option must be used in conjunction with the **--size** to specify the new size and **--useexisting**.

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.

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.
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 `--nodefroute` 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:

  ```
  network --bootproto=dhcp
  ```

  To direct a machine to use BOOTP to obtain its networking configuration, use the following line in the kickstart file:

  ```
  network --bootproto=bootp
  ```

  To direct a machine to use the configuration specified in iBFT, use:

  ```
  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.

```
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.

```
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

```
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 address.
- **--ipv6gateway** — Default gateway as a single 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.
Chapter 15. Kickstart Installations

- **--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.
- **--vlanid** — Specifies virtual LAN ID number (802.1q tag).

**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".

- `<mntpoint multipath --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.
    - To determine the size of the swap partition automatically but also allow extra space for your system to hibernate, use the `--hibernation` option:
      
      ```
      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 9.14.5, "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).
Chapter 15. Kickstart Installations

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 9.14.5, “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).

- --resize — Resize an existing partition. This option must be used in conjunction with the --size= to specify the new size and --onpart= to specify the partition.

- --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:

  partition /home --onpart=hda1

puts /home on /dev/hda1.

The device must already exist on the system; the --onpart option will not create it.

- --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:

```bash
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`.
- **--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.
• \texttt{--grow=} — Only supported for RAID0. Tells the RAID device to grow to fill available space (if any), or up to the maximum size setting.

• \texttt{--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 \texttt{/etc/mke2fs.conf}.

• \texttt{--fstype=} — Sets the file system type for the RAID array. Valid values are \texttt{xfs}, \texttt{ext2}, \texttt{ext3}, \texttt{ext4}, \texttt{swap}, \texttt{vfat}, and \texttt{hfs}.

• \texttt{--fsoptions=} — Specifies a free form string of options to be used when mounting the filesystem. This string will be copied into the \texttt{/etc/fstab} file of the installed system and should be enclosed in quotes.

• \texttt{--noformat} — Use an existing RAID device and do not format the RAID array.

• \texttt{--useexisting} — Use an existing RAID device and reformat it.

• \texttt{--encrypted} — Specifies that this RAID device should be encrypted, using the passphrase provided in the \texttt{--passphrase} option. If you do not specify a passphrase, \texttt{anaconda} uses the default, system-wide passphrase set with the \texttt{autopart --passphrase} command, or stops the installation and prompts you to provide a passphrase if no default is set.

• \texttt{--passphrase=} — Specifies the passphrase to use when encrypting this RAID device. You must use this option together with the \texttt{--encrypted} option; by itself it has no effect.

• \texttt{--escrowcert=URL_of_X.509_certificate} — Store the data encryption key for this device in a file in \texttt{/root}, encrypted using the X.509 certificate from the URL specified with \texttt{URL_of_X.509_certificate}. This option is only meaningful if \texttt{--encrypted} is specified.

• \texttt{--backuppassphrase=} — Add a randomly-generated passphrase to this device. Store the passphrase in a file in \texttt{/root}, encrypted using the X.509 certificate specified with \texttt{--escrowcert}. This option is only meaningful if \texttt{--escrowcert} is specified.

The following example shows how to create a RAID level 1 partition for \texttt{/}, and a RAID level 5 for \texttt{/usr}, assuming there are three SCSI disks on the system. It also creates three swap partitions, one on each drive.

\begin{verbatim}
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
\end{verbatim}
Chapter 15. Kickstart Installations

For a detailed example of raid in action, refer to Section 15.4.1, “Advanced Partitioning Example”.

realm (optional)
Join Active Directory or IPA domains, with the syntax:

```
realm join <options> <domain>
```

The options are as follows:

- `--client-software=` — Only join realms that can run this client software. Valid values include sssd or winbind. Not all realms support all values. By default, the client software is chosen automatically.

- `--server-software=` — Only join realms that can run this server software. Possible values include active-directory or freeipa.

- `--membership-software=` — Use this software when joining the realm. Valid values include samba and adcli. Not all realms support all values. By default, the membership software is chosen automatically.

- `--one-time-password=` — Join using a one-time password. This is not possible with all types of realm.

- `--no-password` — Join automatically without a password.

- `--computer-ou OU=` — provide the distinguished name of an organizational unit in order to create the computer account. The exact format of the distinguished name depends on the client software and membership software. The root DSE portion of the distinguished name can typically be left out.

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>]
```
Kickstart Options

- **--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.

- **--cost=** — An integer value to assign a cost to this repository. If multiple repositories provide the same packages, this number will be used to prioritize which repository will be used before another. Repositories with a lower cost take priority over repositories with higher cost.

- **--excludepkgs=** — A comma-separated list of package names and globs that must not be pulled from this repository. This is useful if multiple repositories provide the same package and you want to make sure it comes from a particular repository.

- **--include=** — A comma-separated list of package names and globs that must be pulled from this repository. This is useful if multiple repositories provide the same package and you want to make sure it comes from this repository.

- **--proxy=[protocol://][username[:password]@]host[:port]** — Specify an HTTP/HTTPS/FTP proxy to use just for this repository. This setting does not affect any other repositories, nor how the install.img is fetched on HTTP installs. The various parts of the argument act like you would expect.

- **--ignoregroups=true** — This option is used when composing installation trees and has no effect on the installation process itself. It tells the compose tools to not look at the package group information when mirroring trees so as to avoid mirroring large amounts of unnecessary data.

- **--noverifyssl** — For a https repo do not check the server's certificate with what well-known CA validate and do not check the server's hostname matches the certificate's domain name.

---

**Important**

Repositories used for installation must be stable. The installation may fail if a repository is modified before the installation concludes.

---

**rootpw** *(required)*

Sets the system's root password to the `<password>` argument.

```
rootpw [-iscrypted|--allow-changes|--frozen] <password>
```

- **--iscrypted** — If this is present, the password argument is assumed to already be encrypted.

- **--allow-changes** — If this is present, the password argument can be changed with no additional actions required.

- **--frozen** — If this is present, the password argument cannot be changed.

**selinux** *(optional)*

Sets the state of SELinux on the installed system. SELinux defaults to enforcing in anaconda.
Chapter 15. Kickstart Installations

```
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 Security 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
  ```

**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 Console, Environment and Display Options 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.

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.

timezone (required)

Sets the system time zone to `<timezone>`. Refer to https://fedoraproject.org/wiki/Anaconda/Kickstart for a list of supported timezones.
Chapter 15. Kickstart Installations

```
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, 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/repodata/comps-*\.xml` file on the Fedora DVD for a list of groups; alternatively, you can use the `yum grouplist hidden -v` command to obtain a list of package groups if you have a working installation available already. Each group has an id, user visibility value, name, description, and package list. If the group is selected for installation, the packages marked `mandatory` 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 or in the yum grouplist hidden -v command's output. 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
-ipa*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:

```%
-%Conflicts (Server)
```

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.
Chapter 15. Kickstart Installations

--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:

```bash
#!/bin/sh
hds=""
mymedia=""
for file in /proc/ide/* 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
```
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.

**Note**

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 cannot resolve IP addresses. Thus, if you are using DHCP, you must specify IP addresses in the `%post` section.

**Note**

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.
Chapter 15. Kickstart Installations

--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 \texttt{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 \texttt{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 \texttt{ks.cfg} and must be located in the flash memory's top-level directory. Create the boot image first, and then copy the \texttt{ks.cfg} file.

Refer to Section 3.3, “Making Minimal Boot Media” for instructions on creating live USB media using the \texttt{Fedora-version-architecture-format.iso} image file that you can download from the Fedora Project site at \url{http://download.fedoraproject.org/}.

\begin{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.
\end{note}

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 \texttt{ks} kernel boot option in the \texttt{append} line of a target in your \texttt{pxelinux.cfg/default} file to specify the location of a kickstart file on your network. The syntax of the \texttt{ks} option in a \texttt{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 \texttt{ks} option in the \texttt{pxelinux.cfg/default} file” for an example of an \texttt{append} line.

If the \texttt{dhcpd.conf} file on the DHCP server is configured to point to \texttt{/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.

\begin{example}
\textbf{Example 15.2. Using the \texttt{ks} option in the \texttt{pxelinux.cfg/default} file}

For example, if \texttt{foo.ks} is a kickstart file available on an NFS share at \texttt{192.168.0.200:/export/kickstart/}, part of your \texttt{pxelinux.cfg/default} file might include:
\end{example}
Chapter 15. Kickstart Installations

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

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.

debug
Start up pdb immediately.
dd
Use a driver disk.

dhcpclass=<class>
Sends a custom DHCP vendor class identifier. ISC’s dhcpd 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'.

expert
Turns on special features:
• allows partitioning of removable media
• prompts for a driver disk

gateway=<gw>
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=<ip>
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=<keymap>
Keyboard layout to use. Valid layouts include:
• be-latin1 — Belgian
• bg_bds-utf8 — Bulgarian
• bg_photutf8 — Bulgarian (Phonetic)
• br абнт2 — Brazilian (ABNT2)
• cf — French Canadian
• croat — Croatian
• cz-us-qwertz — 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
Starting a Kickstart Installation

- **ru** — Russian
- **sr-cy** — Serbian
- **sr-latin** — Serbian (latin)
- **sv-latin1** — Swedish
- **sg** — Swiss German
- **sg-latin1** — Swiss German (latin1)
- **sk-qwerty** — Slovak (qwerty)
- **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.
Chapter 15. Kickstart Installations

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.
- 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.
Starting a Kickstart 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.
Chapter 15. Kickstart Installations

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 20. 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

![Figure 16.1. 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

![Figure 16.2. Installation Method](image)
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 11.3.2, “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

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 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, msdos for x86), select Initialize the disk label if you are installing on a brand new hard drive.

**Note**

Although anaconda and kickstart support Logical Volume Management (LVM), at present there is no mechanism for configuring this using the Kickstart Configurator.

16.4.1. Creating Partitions

To create a partition, click the Add button. The 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 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 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. Refer to the Fedora System Administrators 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 System Administrators 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.
SELinux Configuration

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, mkmkdir, mkswap, mktemp, modprobe, more, mount, mt, mv, nslookup, openvt, pidof, ping, ps, pwd, readlink, rm, rmdir, rmmount, 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.
Important

Do not include the \%pre command. It is added for you.

Note

The pre-installation script is run after the source media is mounted and stage 2 of the bootloader has been loaded. For this reason it is not possible to change the source media in the pre-installation script.

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.
Your Next Steps

17.1. 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 17.3, “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 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 the Fedora System Administrator's Guide for more information on `yum`.

**Network Connection Required**

Ensure that your system has an active network connection before you update with a graphical package manager, or the `yum` utility. The update process downloads information and packages from a network of servers.

17.2. 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 the Fedora System Administrator's Guide for information on configuring your network, or Section 17.2.1, “Using a Fedora Installation DVD as a Software Repository” to learn how to use the DVD if the network is not available.

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 -
   ```
Chapter 17. Your Next Steps

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.

If you encounter any problems with the graphical login, refer to Chapter 10, Troubleshooting Installation on an Intel or AMD System.

17.2.1. 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`
Subscribing to Fedora Announcements and News

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/Fedora20-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-20-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:

```
[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.

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.

17.3. Subscribing to Fedora Announcements and News

To receive information about package updates, subscribe to either the announcements mailing list, or the RSS feeds.
Chapter 17. Your Next Steps

Fedora Project announcements mailing list
https://admin.fedoraproject.org/mailman/listinfo/announce

Fedora Project RSS feeds
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.

#### 17.4. 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

- The documents available from the Fedora Documentation Project Web site
  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
  https://access.redhat.com/site/documentation/Red_Hat_Enterprise_Linux/

Many other organizations and individuals also provide tutorials and HOWTOs for Fedora on their Web sites. http://planet.fedoraproject.org aggregates posts from many members of the Fedora community, and you can find helpful content there often.

You can also visit https://ask.fedoraproject.org to participate in Question and Answer style support with the Fedora community.

#### 17.5. 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/
Chapter 18.

Upgrading Your Current System

This chapter explains how to upgrade your Fedora system.

18.1. 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 /var/log/fedup.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.

Fedora releases are supported through two releases, plus one month. For example, Fedora 19 will receive updates until one month after the release of Fedora 21. If you are moving from an older, unsupported Fedora release, you should re-install rather than upgrade.

⚠️ 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.

ℹ️ 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.
18.2. 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.

**Make sure you have the latest version of fedup**

Always make sure to update your system before attempting to upgrade to the next version of Fedora. In particular, it is important to have the most recent version of `fedup`. Using the latest `fedup` available in the stable updates repository ensures you have the version that has been tested for the release you are upgrading to.

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. Before beginning the upgrade, it is recommended that all updates are applied. Install any available updates via your graphical package manager, or with the command `yum update`.

2. Install `fedup` with your graphical package manager, or type `yum install fedup` at the command line and press `Enter`.

3. 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:
     ```bash
     sudo fedup --network 20
     ```

   - To upgrade using a Fedora 20 ISO file you have downloaded:
     ```bash
     sudo fedup --iso /path/to/isofile.iso
     ```

   - To upgrade using a mounted storage device such as optical or USB media:
     ```bash
     sudo fedup --device /path/to/mountpoint
     ```

   If the system you are updating has network access, the latest updates will also be installed regardless of which package source you specify.

4. If `fedup` runs successfully without errors, reboot your system.

5. In the GRUB menu at startup, select the new entry: **System Upgrade**.
6. **fedup** will now upgrade your system. It will again reboot the system on completion, and an option to boot Fedora 20 will then be present in the GRUB menu.

**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 20.

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.

---

### 18.3. Troubleshooting and Cleanup

In the event of an unsuccessful upgrade, try the following:

- Third party repositories can prevent an upgrade. They might not yet be available for the version of Fedora you are upgrading to, and some might not automatically change to reflect the update. You can list the enabled repositories with this command:

  ```
yum repolist
  ```

  To disable a repository, use this command:

  ```
yum-config-manager --disable <repo-name>
  ```

  To enable the repository again after the upgrade, use this command:

  ```
yum-config-manager --enable <repo-name>
  ```

  After the upgrade, you may have to reconfigure some third party repositories or reinstall the software they provide to get the correct version for Fedora 20.

- Check the upgrade log at `/var/log/fedup.log`. You can open this file in your favorite editor, or by executing the command `less /var/log/fedup.log` from a terminal. The file is large, but any problems will usually be towards the end.


- Upgrades can sometimes affect GRUB packages. Unlike other software, GRUB is installed only during installation or when manually reinstalled. It is suggested that after the upgrade is complete, the GRUB binary should be manually updated. The configuration can be regenerated if needed.
To upgrade GRUB on BIOS systems, first identify your boot drive. On a system with a single drive, this will be /dev/sda. Install the GRUB binary to the drive’s Master Boot Record with the following command:

```
grub2-install /dev/sda
```

To update the GRUB configuration on BIOS systems, use following command:

```
grub2-mkconfig -o /boot/grub2/grub.cfg
```

Updating GRUB on UEFI systems should not be necessary, but if required, the configuration can be updated with this command:

```
grub2-mkconfig -o /boot/efi/EFI/fedora/grub.cfg
```

- Differences in package versions can lead to conflicts between the system's installed package set and the updates to be installed. These issues can interfere with upgrading to the next Fedora release, or interfere with normal package updates, especially if a testing repository is used (such as with a pre-release) then disabled.

To sync packages to the versions available for your Fedora release, before or after the upgrade, use this command:

```
yum distro-sync
```

- New versions of packages or package groups can have different dependencies from those they replace. Packages on the system that were installed to fulfill dependencies that are no longer required are known as *leaves*.

To identify *leaves*, use this command:

```
package-cleanup --leaves
```

Some packages may have been available in previous releases, but not in the release you have upgraded to. These are known as *orphans*.

To identify *orphans*, use this command:

```
package-cleanup --orphans
```

`package-cleanup` can also be used for duplicate packages and old kernels, and offers more options. Refer to `man package-cleanup` for more information.
Be careful when cleaning packages!

Some packages may be listed by `package-cleanup` that you might use. For example, you might use a Python library in scripts you have written, but it may not have any packaged software that depends on it. Be sure that you do not need a package before you remove it. In most cases, it will do no harm to leave the package installed.

Duplicates or conflicts that prevent updates can be identified with `package-cleanup`, but `yum distro-sync` should be used first.

- Although SELinux policy changes are applied during package updates, the filesystem can be relabeled if required. If you experience more SELinux denials after an upgrade, or otherwise need to relabel the system, use the following command, then reboot the system. The relabel will take some time, so be patient.

  ```
  touch /.autorelabel
  ```

  Relabeling can also be done selectively with the `restorecon` utility. For example, this command can correct labels some files used by the `squid` caching proxy:

  ```
  restorecon -R /var/cache/squid/
  ```

- Once you have rebooted your system after performing an upgrade, you should also perform a manual system update. Consult Section 17.1, “Updating Your System” for more information.
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 the GRUB documentation at http://www.gnu.org/software/grub/grub-documentation.html and the relevant Fedora Wiki page at http://fedoraproject.org/wiki/GRUB_2 for more information.

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 19.3, "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.

19.1. 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.

### 19.2. 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 19.1, “Fedora is the only operating system on the computer”*
19.2.1. 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)
Chapter 19. Removing Fedora

**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 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**

**Note**

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.

19.2.1.2. 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 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**.
Your computer dual-boots Fedora and Mac OS X

19.2.2. 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.

19.2.3. 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 19.1. 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)
```
Chapter 19. Removing Fedora

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 19.1. 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`. 

c. At the (parted) prompt, enter \texttt{print}. The \texttt{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 \texttt{resize number start end}, where \textit{number} is the partition number, \textit{start} is the location on the disk at which the partition begins, and \textit{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 \texttt{print} command, and refer to the \texttt{parted} documentation for different ways to specify the end parameter.

e. When \texttt{parted} finishes resizing the partition, enter \texttt{quit} at the (parted) prompt.

f. Run \texttt{e2fsck partition}, where \textit{partition} is the partition that you just resized. For example, if you just resized \texttt{/dev/sda3}, enter \texttt{e2fsck /dev/sda3}.

Linux now checks the file system of the newly-resized partition.

g. When the file system check finishes, type \texttt{resize2fs partition} at a command line and press \texttt{Enter}, where \textit{partition} is the partition that you just resized. For example, if you just resized \texttt{/dev/sda3}, type \texttt{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 \texttt{fdisk} and \texttt{lvm2} if they are not already present.

  b. Create a new partition in the free space on the disk
     i. As root or with \texttt{sudo}, run \texttt{fdisk disk}, where \textit{disk} is the device name of the disk where you want to create new space, for example, \texttt{/dev/sda}.

     ii. At the prompt \texttt{Command (m for help):}, enter \texttt{n} to create a new partition. Refer to the \texttt{fdisk} documentation for options.

  c. Change the partition type identifier
     i. At the prompt \texttt{Command (m for help):}, enter \texttt{t} to change a partition type.

     ii. At the prompt \texttt{Partition number (1-4):}, type the number of the partition that you just created. For example, if you just created partition \texttt{/dev/sda3}, type the number \texttt{3} and press \texttt{Enter}. This identifies the partition whose type \texttt{fdisk} will change.

     iii. At the prompt \texttt{Hex code (type L to list codes):}, enter \texttt{8e} to create a Linux LVM partition.

     iv. At the prompt \texttt{Command (m for help):}, enter \texttt{w} to write the changes to disk and exit \texttt{fdisk}.

  d. Expand the volume group
     i. At the command prompt, type \texttt{lvm} and press \texttt{Enter} to start the \texttt{lvm2} tool.

     ii. At the \texttt{lvm>} prompt, type \texttt{pvcreate partition} and press \texttt{Enter}, where \textit{partition} is the partition that you recently created. For example, \texttt{pvcreate /dev/sda3}. This creates \texttt{/dev/sda3} as a physical volume in LVM.
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.

19.3. 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

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

Figure A.2. Disk Drive with a File System

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.

Figure A.3. Disk Drive with a Different File System

Of course, writing a file system to disk is only the beginning. The goal of this process is to actually store and retrieve data. Let us take a look at our drive after some files have been written to it.

Figure A.4. Disk Drive with Data 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.

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.

![Figure A.6. 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
Appendix A. An Introduction to Disk Partitions

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

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.

![Figure A.12. Disk Drive with Partition Resized](image)

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.

![Figure A.13. Disk Drive with Final Partition Configuration](image)

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 9.14.5, “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).
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.

**Tip**

You can use kickstart to set a separate passphrase for each new encrypted block device.
C.3.1. 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.

⚠️ Warning
The commands below will destroy any existing data on the device.
Appendix C. Disk Encryption

- The best way, which provides high quality random data but takes a long time (several minutes per gigabyte on most systems):

  \[ \text{dd if=/dev/urandom of=<device>} \]

- Fastest way, which provides lower quality random data:

  \[ \text{badblocks -c 10240 -s -w -t random -v <device>} \]

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.

\[ \text{cryptsetup luksFormat <device>} \]

**Note**

For more information, read the \texttt{cryptsetup(8)} man page.

After supplying the passphrase twice the device will be formatted for use. To verify, use the following command:

\[ \text{cryptsetup isLuks <device>} \&\& \text{echo Success} \]

To see a summary of the encryption information for the device, use the following command:

\[ \text{cryptsetup luksDump <device>} \]

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 \texttt{device-mapper}.

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:

\[ \text{cryptsetup luksUUID <device>} \]
Create filesystems on the mapped device, or continue to build complex storage structures using the mapped device

An example of a reliable, informative and unique mapping name would be \texttt{luks-<uuid>}, where \texttt{<uuid>} is replaced with the device's LUKS UUID (eg: \texttt{luks-50ec957a-5b5a-47ee-85e6-f8085bcc97a8}). This naming convention might seem unwieldy but is it not necessary to type it often.

```
cryptsetup luksOpen <device> <name>
```

There should now be a device node, \texttt{/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:

```
dmsetup info <name>
```

**Tip**

For more information, read the \texttt{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 (\texttt{/dev/mapper/<name>}) as any other block device. To create an \texttt{ext2} filesystem on the mapped device, use the following command:

```
mke2fs /dev/mapper/<name>
```

To mount this filesystem on \texttt{/mnt/test}, use the following command:

**Important**

The directory \texttt{/mnt/test} must exist before executing this command.

```
mount /dev/mapper/<name> /mnt/test
```

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 \texttt{/etc/crypttab} file. If the file doesn't exist, create it and change the owner and group to root (\texttt{root:root}) and change the mode to \texttt{0744}. Add a line to the file with the following format:

```
<name>  <device>  none
```

The \texttt{<device>} field should be given in the form "UUID=<luks_uuid>", where \texttt{<luks_uuid>} is the LUKS uuid as given by the command \texttt{cryptsetup luksUUID <device>}. This ensures the correct device will be identified and used even if the device node (eg: \texttt{/dev/sda5}) changes.
Appendix C. Disk Encryption

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`.

Title
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 `~/.keyfile`.

```
dd if=/dev/urandom of=~/.keyfile bs=32 count=1
chmod 600 ~/.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**

```bash
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. 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.

E.1. Log files and formats

E.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 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 E.1. anaconda log files

<table>
<thead>
<tr>
<th>Filename</th>
<th>Logs in /tmp, /var/log/anaconda</th>
</tr>
</thead>
<tbody>
<tr>
<td>anaconda.log</td>
<td>/dev/tty3 General installation information, including the step changes.</td>
</tr>
<tr>
<td>storage.log</td>
<td>/dev/tty3 Detection and manipulation of storage devices, including RAID, LVM, and partitioning actions.</td>
</tr>
<tr>
<td>program.log</td>
<td>/dev/tty3 Calls to external programs, and their output.</td>
</tr>
<tr>
<td>syslog</td>
<td>/dev/tty4 Messages from the kernel and external programs, such as NetworkManager.</td>
</tr>
<tr>
<td>yum.log</td>
<td>/dev/tty4 Yum's internal log.</td>
</tr>
</tbody>
</table>

Logs in /root, /mnt/sysimage/root

<table>
<thead>
<tr>
<th>Filename</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>install.log</td>
<td>The log of the package installation process</td>
</tr>
<tr>
<td>install.log.syslog</td>
<td>Messages from installation chroot logged through the system's syslog. Mostly information about users and groups created during yum's package installation.</td>
</tr>
</tbody>
</table>

E.2. Remote logging via virtio

The Anaconda installer can communicate with a KVM host when Fedora is installed as a virtual machine. By configuring the guest to use a virtio char device, logs are forwarded early in the
Appendix E. Logging the Installation

installation and in real time. Anaconda will automatically use the port /dev/virtio-ports/org.fedoraproject.anaconda.log.0 if available.

E.2.1. virtio logging with virt-install
To create a log channel when creating a virtual machine with virtio, use the --channel option:

```
--channel
tcp,host=127.0.0.1:6080,mode=connect,target_type=virtio,name=org.fedoraproject.anaconda.log.0
```

E.2.2. Adding a virtio log channel with virsh edit
A log channel can be added to an existing virtual machine, such as one created using virt-manager, using the following process:

Procedure E.1. Adding a log channel with virsh
1. Identify the virtual machine name:

```
virsh list --all
```

2. Open the guest configuration for editing:

```
virsh edit new-fedora-guest
```

3. Add the following information to the <devices> section:

```
<channel type='tcp'>
  <source mode='connect' host='127.0.0.1' service='6080'/>
  <target type='virtio' name='org.fedoraproject.anaconda.log.0'/>
</channel>
```

E.2.3. Listening for virtio logs
Start the listening rsyslogd on the host:

```
eval `analog -p 6080 -o rsyslogd.conf -s /path/to/logdir`
```

Or, view the raw logs using nc

```
nc -l 0.0.0.0 6080
```

rsyslog is also used in this way for tcp logging, but separate rsyslog instances must be used if logging by both methods.
Appendix F. 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.
Appendix F. Other Technical Documentation

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 G. Contributors and production methods

G.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)
• Michał 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 G. Contributors and production methods

- **Hans De Goede**⁹ (writer - iSCSI)
- Claudio Rodrigo Pereyra Diaz (translator - Spanish)
- **Piotr Drąg**¹⁰ (translator - Polish)
- **Damien Durand**¹¹ (translator - French)
- **Stuart Ellis**¹² (writer, editor)
- **Ali Fakoor**¹³ (translator - Persian)
- Felix I (translator - Tamil)
- Tony Fu (translator - Chinese (Simplified))
- **Paul W. FIELDS**¹⁴ (writer, editor)
- Paul Gampe (translator - Japanese)
- Sree Ganesh (translator - Telugu)
- **Dimitris Glezos**¹⁵ (translator - Greek)
- **Guillermo Gómez**¹⁶ (translator - Spanish)
- **Igor Gorbounov**¹⁷ (translator - Russian)
- **Rui Gouveia**¹⁸ (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**¹⁹ (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 https://fedoraproject.org/wiki/IgorGorbounov
¹⁸ http://fedoraproject.org/wiki/RuiGouveia
¹⁹ http://translate.fedoraproject.org/people/kmilos
Contributors

- Alexey Kostyuk (translator - Russian)
- Daniela Kugelmann (translator - German)
- Rüdiger Landmann\(^{20}\) (writer, editor)
- Magnus Larsson\(^{21}\) (translator - Swedish)
- Christopherus Laurentius\(^{22}\) (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 Maucher\(^{23}\) (translator - German)
- Igor Miletić\(^{24}\) (translator - Serbian)
- Noriko Mizumoto (translator - Japanese)
- Jeremy W. Mooney (writer)
- Enikő Nagy (translator - Hungarian)
- Igor Nestorović (translator - Serbian)
- David Nalley\(^{25}\) (writer, editor)
- John Nguyen (writer)
- Manuel Ospina (translator - Spanish)
- Janis Ozolins (translator - Latvian)
- Ankit Patel (translator - Gujarati)
- Davidson Paulo\(^{26}\) (translator - Brazilian Portuguese)
- Ani Peter (translator - Malayalam)
- Amitakhya Phukan\(^{27}\) (translator - Assamese)

\(^{20}\) https://fedoraproject.org/wiki/User:Rlandmann
\(^{21}\) http://translate.fedoraproject.org/people/raada
\(^{22}\) https://fedoraproject.org/wiki/ChristopherusLaurentius
\(^{23}\) http://fedoraproject.org/wiki/User:Jensm
\(^{24}\) http://fedoraproject.org/wiki/IgorMiletic
\(^{25}\) https://fedoraproject.org/wiki/User:ke4qqq
\(^{26}\) http://fedoraproject.org/wiki/User:Dpaulo
\(^{27}\) https://translate.fedoraproject.org/people/aphukan
Appendix G. Contributors and production methods

- **Silvio Pierro**<sup>28</sup> (translator - Italian)
- **Micha Pietsch**<sup>29</sup> (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**<sup>30</sup> (writer, editor)
- **Tommy Reynolds**<sup>31</sup> (writer)
- Tim Richert (translator - German)
- **Dominik Sandjaja**<sup>32</sup> (translator - German)
- **Sharuzzaman Ahmat Raslan**<sup>33</sup> (translator - Malay)
- **Mohsen Saeedi**<sup>34</sup> (translator - Persian)
- **Tian Shixiong**<sup>35</sup> (translator - Chinese (Simplified))
- Audrey Simons (translator - French)
- Keld Simonsen (translator - Danish)
- **Jared K. Smith**<sup>36</sup> (writer, editor)
- Espen Stefansen (translator - Norwegian Bokmål)
- **Sulyok Péter**<sup>37</sup> (translator - Hungarian)
- **Sümegi Zoltán**<sup>38</sup> (translator - Hungarian)
- **Francesco Tombolini**<sup>39</sup> (translator - Italian)
- Timo Trinks (translator - German)
- **Dimitris Typaldos**<sup>40</sup> (translator - Greek)

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G.2. 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.

http://docs.fedoraproject.org/install-guide/

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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 H. Revision History

Note that revision numbers relate to the edition of this manual, not to version numbers of Fedora.

Revision 1.0-0  Sun Jan 12 2014  Petr Bokoč pbokoc@redhat.com
Publishing for Fedora 20
Index

Symbols

/boot/ partition
recommended partitioning, 93

/root/install.log
install log file location, 101

/var/ partition
recommended partitioning, 93

A
adding partitions, 84
file system type, 86
anacdump.txt, 109
Anaconda, 261
anaconda.log, 109
architecture, 4
determining, 4
array (see RAID)
automatic partitioning, 67, 67

B
BIOS (Basic Input/Output System), 31
BitTorrent, 4
seeding, 4
boot loader, 79
GRUB, 79
installation, 79
boot menu
options, 123
boot options, 35, 123
console, 125
debugging, 129
disk device names, 124
driver updates, 124
gpt, 128
GUID Partition Table, 128
installation source, 123
installer runtime image, 124
logging, 129
media verification, 131
mediacheck, 35
memory testing mode, 131
multilib, 128
network, 127
remote access, 129
rescue mode, 132
serial mode, 35
UTF-8, 35
text mode, 35, 125
troubleshooting, 129
VNC, 129
booting

C
installing program
x86, AMD64 and Intel 64, 33
canceling the installation, 39
CD/DVD media
booting, 31
downloading, 3
(see also ISO images)
making, 7
(see also ISO images)
clock, 48
configuration
clock, 48, 48
hardware, 29
time, 48
time zone, 48
consoles, virtual, 45

D
DHCP (Dynamic Host Configuration Protocol), 54
Disk Partitioner
adding partitions, 84
disk partitioning, 67
disk space, 20
DVD
ATAPI, 39
IDE, 39
installation from, 39
SCSI, 39

E
Encryption
Backup passphrases
Creating backup passphrases, 251
Saving backup passphrases, 251
Passphrases
Saving passphrases, 251
ext2 (see file systems)
ext3 (see file systems)
ext4 (see file systems)
extended partitions, 239

F
fedup
usage, 217
feedback
contact information for this manual, xi
file system
formats, overview of, 235
file system types, 86
file systems
ext2, 39
Index

ext3, 39
ext4, 39
vfat, 39
firewall
documentation, 262
FTP
installation, 23, 41

G
GRUB, 79
alternatives to, 81
documentation, 261
installation, 79
GUID Partition Table
specifying as a boot option, 128

H
hard disk
basic concepts, 235
extended partitions, 239
file system formats, 235
partition introduction, 237
partition types, 238
partitioning of, 235
hard drive installation, 39
preparing for, 25
hardware
compatibility, 19
configuration, 29
hostname, 54, 54
HTTP
installation, 23, 41

I
install log file
/root/install.log, 101
installation
aborting, 39
disk space, 20
DVD, 39
FTP, 23, 41
GRUB, 79
GUI, 43
hard drive, 25, 39
HTTP, 23, 41
keyboard navigation, 44
kickstart (see kickstart installations)
mediacheck, 35
method
DVD, 20
hard drive, 21
NFS image, 21
selecting, 20
URL, 21
network, 23
NFS, 23, 40
server information, 40
partitioning, 84
program
graphical user interface, 44
starting, 32
virtual consoles, 45
serial mode, 35
UTF-8, 35
starting, 39
text mode, 35, 125
installation method
selecting, 39
installation program
x86, AMD64 and Intel 64
booting, 33
installing packages, 64
IPv4, 54
ISO images
downloading, 1, 3

K
kernel options, 36
keyboard
configuration, 49
navigating the installation program using, 44
keymap
selecting language, 45, 50
selecting type of keyboard, 49
kickstart
how the file is found, 184
Kickstart Configurator, 193
%post script, 206
%pre script, 205
authentication options, 201
basic options, 193
boot loader, 196
boot loader options, 196
Display configuration, 203
firewall configuration, 202
installation method selection, 194
interactive, 194
keyboard, 193
language, 193
network configuration, 200
package selection, 204
partitioning, 197
software RAID, 198
preview, 193
reboot, 194
root password, 193
encrypt, 193
saving, 207
SELinux configuration, 203
text mode installation, 194
time zone, 193
kickstart file
%include, 177
%post, 181
%pre, 180
auth, 150
authconfig, 150
autopart, 152
autostep, 153
bootloader, 153
btrfs, 154
CD-ROM-based, 183
clearpart, 154
cmdline, 156
creating, 150
device, 156
diskette-based, 183
driverdisk, 156
firewall, 156
flash-based, 183
format of, 149
graphical, 157
halt, 157
ignoredisk, 157
include contents of another file, 177
install, 158
installation methods, 158
iscsi, 160
iscsiname, 160
keyboard, 160
lang, 161
langsupport, 161
logging, 162
logvol, 161
mediacheck, 163, 163, 172
mouse, 163
network, 163
network-based, 183, 184
options, 150
    partitioning examples, 177
package selection specification, 178
part, 166
partition, 166
post-installation configuration, 181
poweroff, 170
pre-installation configuration, 180
raid, 170
realm, 172
reboot, 172
rootpw, 173
selinux, 173
services, 174
shutdown, 174
sshpw, 175
text, 175
timezone, 175
upgrade, 176
user, 176
vnc, 176
volgroup, 177
what it looks like, 149
xconfig, 177
zerombr, 177
kickstart installations, 149
    CD-ROM-based, 183
diskette-based, 183
    file format, 149
    file locations, 182
flash-based, 183
    installation tree, 184
LVM, 161
    network-based, 183, 184
realm, 172
    starting, 184, 184
        from a boot CD-ROM, 184
language
    configuration, 45
    support, 50
log files, 109
    kickstart installations, 149
LVM
    documentation, 261
    logical volume, 257
    physical volume, 257
    understanding, 257
    volume group, 257
    with kickstart, 161
master boot record, 79
memory testing mode, 131
mirror, 3
modem, 54
mount points
    partitions and, 245
multilib
    enabling during installation, 128
Multipath devices
    Mixing with non-multipath devices, 72
Index

N
network
  installations
    FTP, 41
    HTTP, 41
    NFS, 40
network installation
  preparing for, 23
NFS
  installation, 23, 40
NTFS partitions
  resizing, 2
NTP (Network Time Protocol), 48

O
OpenSSH, 261
  (see also SSH)

P
packages
  groups, 64
    selecting, 64
  installing, 64
  selecting, 64
parted partitioning utility, 244
partition
  extended, 239
partitioning, 84
  automatic, 67
  basic concepts, 235
  creating new, 84
    file system type, 86
  destructive, 241
  extended partitions, 239
  how many partitions, 237, 245
  introduction to, 237
  making room for partitions, 239
  mount points and, 245
  naming partitions, 244
  non-destructive, 242
  numbering partitions, 244
  other operating systems, 245
  primary partitions, 237
  recommended, 93
  types of partitions, 238
  using free space, 240
  using in-use partition, 241
  using unused partition, 240
Partitioning, 84
  adding partitions
    file system type, 86
Passphrases
  Block device encryption passphrases
  Creating backup block device encryption passphrases, 251
  Saving backup block device encryption passphrases, 251
  Saving block device encryption passphrases, 251
password
  setting root, 101
program.log, 109
PulseAudio, 261
PXE (Pre-boot eXecution Environment), 36
PXE installations
  boot message, custom, 143
  configuration, 139
  overview, 138
  performing, 143
  setting up the network server, 139

R
RAID
  hardware, 19
  kickstart installations, 170
    Kickstart Configurator, 198
  software, 19
  trouble booting from drive attached to RAID card, 109
re-installation, 215
realm
  with kickstart, 172
removing
  Fedora
    from x86-based systems, 221
rescue mode, 132
root / partition
  recommended partitioning, 93
  root password, 101

S
scp, 261
  (see also SSH)
screenshots
  during installation, 45
selecting
  packages, 64
SELinux
  documentation, 261
SSH (Secure SHell)
  documentation, 261
starting
  installation, 32, 39
steps
  booting with CD-ROM or DVD, 21
disk space, 20
hardware compatibility, 19
storage.log, 109
swap partition
  recommended partitioning, 93
syslog, 109
system-config-kickstart (see Kickstart Configurator)

T
text mode
  installation, 125
tftp, 143
time zone
  configuration, 48
traceback messages
  reporting traceback messages, 111, 111
troubleshooting, 109
after the installation, 116
  Apache HTTP Server stops responding during startup, 120
  booting into a graphical environment, 117
  booting into GNOME or KDE, 117
  booting into the X Window System, 117
  graphical GRUB screen, 116
  GRUB command line, 116
  logging in, 118
  printers, 120
  RAM not recognized, 119
  Sendmail stops responding during startup, 120
  X (X Window System), 118
  X server crashes, 118
beginning the installation, 110
  frame buffer, disabling, 110
  GUI installation method unavailable, 110
booting, 109
  RAID cards, 109
  signal 11 error, 110
during the installation, 111
  completing partitions, 116
  No devices found to install Fedora error message, 111
  partition tables, 115, 115
  reporting traceback messages, 111
  using remaining hard drive space, 116
DVD failure
  DVD verification, 35

U
UEFI (Unified Extensible Firmware Interface), 31
uninstalling
  from x86-based systems, 221
upgrade, 215
upgrading earlier versions of Fedora to 20 using fedup, 217
USB flash media
  downloading, 3
  making, 7
USB media
  booting, 31
user interface, graphical
  installation program, 44

V
vfat (see file systems)
virtual consoles, 45
Virtualization
  documentation, 262
VNC (Virtual Network Computing)
  documentation, 261

X
  Xorg, 261

Y
yum, 211
  documentation, 262
yum.log, 109