# Linux From Scratch

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# Linux From Scratch


## Gerard Beekmans





This book describes the process of creating a Linux system from scratch from an already installed Linux distribution, using nothing but the sources of software that are needed.

# Dedication

This book is dedicated to my loving and supportive wife *Beverly Beekmans*.

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# Preface

# Foreword

Having used a number of different Linux distributions, I was never fully satisfied with any of those. I didn't like the way the bootscripts were arranged, I didn't like the way certain programs were configured by default, and more of those things. I came to realize that if I wanted to be fully satisfied with a Linux system, I would have to build my own system from scratch, ideally using only the source code. Not using pre−compiled packages of any kind. No help from some sort of CD−ROM or bootdisk that would install some basic utilities. I would use my current Linux system and use that one to build my own.

This, at one time, wild idea seemed very difficult and at times almost impossible. After sorting out all kinds of dependency problems, compile problems, etcetera, a custom−built Linux system was created and fully operational. I called this system an LFS system, which stands for Linux From Scratch.

I hope all of you will have a great time working on LFS!

−−
Gerard Beekmans
gerard@linuxfromscratch.org

# Who would want to read this book

This book is intended for Linux users who want to setup their own custom built Linux system. Reasons for wanting to build such a system are diverse. Perhaps you want to get into more detail as to what happens behind the scenes. Perhaps you are fed up with distributions which are often bloated or perhaps you don't want to rely on pre−compiled binaries due to security concerns. There are many reasons why someone may want a custom built system. If you are one of them, this book is meant for you.

The fruits of building your own system are plentiful, but the labor may be hard. There is a long way ahead, but in the end you will be able to call yourself the proud owner of your own Linux system, completely tailored after your needs. You will dictate the layout of bootscripts, the file system hierarchy, which programs are installed in which directory, which versions of software to use, and more. Perhaps the most important reason is that you will know exactly what is installed where, why, and how.

# Who would not want to read this book

People who don't want to build an entire Linux system from scratch probably don't want to read this book. If you, however, want to learn more about what happens behind the scenes, in particular what happens between turning on the computer and seeing the command prompt, you may want to read the "From Power Up To Bash Prompt" (P2B) HOWTO. This HOWTO builds a bare system, in way similar to the one this book uses, but it focuses more on just installing a bootable system instead of a complete system.

To decide whether to read this book or the P2B HOWTO, ask yourself this question: "Is my main objective to get a working Linux system that I'm going to build myself and, along the way, learn what every component of a system is for, or is just the learning part my main objective?" If you want to build and learn, read this book. If you just want to learn the basics, then the P2B HOWTO is probably better material to read.

The "From Power Up To Bash Prompt" HOWTO is located at
http://www.netspace.net.au/~gok/power2bash/

# Organization

This book is divided into the following parts. Although there is a lot of duplicate information in certain parts, it's the easiest way to read it.

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## Part I – Introduction

Part One gives general information about this book (versions, where to get it, changelog, mailing lists, and how to get in touch with us). It also explains a few important aspects you really want and need to read before starting to build an LFS system.

---

## Part II – Installation of the LFS system

Part Two guides through the installation of the LFS system which will be the foundation for the rest of the system. Whatever you choose to do with your brand new LFS system, it will be built on the foundation that's installed in this part.

---

## Part III – Appendixes

Part Three contains various Appendices.

# I. Part I – Introduction

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# Chapter 1. Introduction

# How things are going to be done

We are going to build the LFS system by using an already installed Linux distribution such as Debian, SuSe, Slackware, Mandrake, RedHat, etc. There is no need to have any kind of bootdisk. We will use an existing Linux system as the base (since we need a compiler, linker, text editor, and other tools).

After you have downloaded the necessary packages that make up an LFS system you will create a new Linux native partition where the LFS system will be installed onto.

The next step, chapter 5, will be the installation of a number of packages that are statically linked and installed on the LFS partition. These packages form a basic development suite which will be used to install the actual system.

Chapter 6 installs the actual base system. We use the chroot program to start a new shell who's root directory will be set to the LFS partition. This, in essence, is the same as rebooting and have the kernel mount the LFS partition as the root partition. The reason that we don't actually reboot, but instead chroot, is that this way you can still use your host system. While software is being installed you can simply switch to a different VC (Virtual Console) or X desktop and continue using your computer.

When all the software is installed, chapter 7 will setup the boot scripts. Chapter 8 will setup the Linux boot loader and you can finally reboot your system into LFS. The last step, after rebooting, is setting up the networking tools and boot scripts. When you finish that last step you will have finished the book and your LFS system is ready for use.

This is the process in a nutshell. Detailed information on the steps you are taking are provided in the chapters as you go through them. If something isn't completely clear yet, don't worry. It will become very clear shortly.

Please read chapter 2 carefully as it explains a few important things you need to be aware of before you work your way through chapters 5 and above.

# Book version

This is LFS−BOOK−INTEL version 3.0−pre3 dated May 12th, 2001. If this version is older than a month a newer version might be available for download at the LFS homepage.

Below is a list of our current HTTP and FTP mirror sites as of April 12th, 2001. This list might not be accurate anymore. The latest info can be found on our website at http://www.linuxfromscratch.org.

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## HTTP Mirrors

- Columbus, Ohio, United States − http://www.linuxfromscratch.org/intro/
- United States − http://lfs.sourceforge.net/intro/
- Canmore, Alberta, Canada − http://www.ca.linuxfromscratch.org/intro/
- Braunschweig, Germany − http://www.de.linuxfromscratch.org/intro/
- Vienna Univ. of Technology, Austria − http://www.at.linuxfromscratch.org/intro/
- Bistrita, Romania − http://www.ro.linuxfromscratch.org/intro/
- Oslo, Norway − http://www.no.linuxfromscratch.org/intro/
- Brisbane, Australia − http://lfs.planetmirror.com/intro/

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## FTP Mirrors

- Columbus, Ohio, USA [FTP]− ftp://packages.linuxfromscratch.org
- Columbus, Ohio, USA [HTTP]− http://packages.linuxfromscratch.org
- Canmore, Alberta, Canada [FTP] − ftp://ftp.ca.linuxfromscratch.org/pub/
-

Canmore, Alberta, Canada [HTTP] – http://ftp.ca.linuxfromscratch.org/pub/

- Vienna Univ. of Tech., Austria [FTP] – ftp://ftp.at.linuxfromscratch.org/lfs/packages
- Vienna Univ. of Tech., Austria [HTTP] – http://ftp.at.linuxfromscratch.org/lfs/packages
- Oslo, Norway [FTP] – ftp://ftp.no.linuxfromscratch.org/mirrors/lfs/
- Brisbane, Australia – ftp://ftp.planetmirror.com/pub/lfs/

# Acknowledgments

We would like to thank the following people and organizations for their contributions toward the Linux From Scratch project:

- Bryan Dumm for providing the hardware and bandwidth to run linuxfromscratch.org
- DREAMWVR.COM for their ongoing sponsorship by donating various resources to the LFS and related sub−projects .
- Jan Niemann for providing http://helga.lk.etc.tu−bs.de as the 134.169.139.209 mirror.
- Johan Lenglet for running the French translation project at http://www.fr.linuxfromscratch.org.
- Michael Peters for contributing the Apple PowerPC modifications.
- VA Linux Systems who, on behalf of Linux.com, donated a VA Linux 420 (formerly StartX SP2) workstation toward this project.
- Jesse Tie Ten Quee who donated a Yamaha CDRW 8824E CD−RW.
- Jesse Tie Ten Quee for providing quasar.highos.com as the www.ca.linuxfromscratch.org mirror.
- O'Reilly for donating books on SQL and PHP.
- Robert Briggs for donating the linuxfromscratch.org and linuxfromscratch.com domain names.
- Torsten Westermann for running the lfs.linux−provider.net HTTP and FTP mirror sites.
- Dag Stenstad for providing the hardware and bandwidth to run the Norwegian mirror and Ian Chilton for maintaining this mirror.
- Countless other people from the various LFS mailing lists who are making this book happen by making suggestions, testing, and submitting bug reports.

# Changelog

If, for example, a change is listed for chapter 5, it (usually) means the same change has been made in the corresponding chapter for the other architectures.

k.0−pre3 – May 12th, 2001

- Converted the SGML source to XML.
- Chapter 4: Tell the user to use cfdisk rather than fdisk. The fdisk man page recommends cfdisk over fdisk because it's more stable.
- Chapter 4: Changed the wording to make it more general as ext2 no longer is the only used file system. Reiserfs, for example, is often used too now.
- Chapter 4: Updated the directory list to be more FHS compliant. Mainly this meant adding the opt directories and removing /usr/tmp and /usr/local/tmp
- Chapter 5: Added static mawk, texinfo, and partially gettext to facilitate the move of Glibc from Chapter 5 to Chapter 6.
- Chapter 5: Added Makedev to chapter 5. We don't create the device files here, only copy the MAKEDEV script and make a temp copy which will be used to create device files. This second file (MAKEDEV−temp) doesn't contain user names and group names but only user id's and group id's. We need a few device files to get Glibc installed, but, before Glibc is installed, user and group names are not recognized yet, only the numeric id's. This requires a slightly modified MAKEDEV script which will be generated by patching the original one. This patching is done here in chapter 5. Also, fixed the explanations on both makedev installations.
- Chapter 5: Recommended to install all the software while logged in (or su'ed to) user root.
- Chapter 5: Simplified ln commands.
- Chapter 5: Removed prefix=$LFS/usr from tar's make install.
- Chapter 5: We now copy the kernel include directories instead of linking to them. This is theoretically safer if we plan on upgrading the kernel.
-

Chapter 5+6: Removed fileutils−patch. After upgrading to fileutils−4.1 the patch isn't needed anymore.

- Chapter 5+6: Added the fileutils−4.0 patch which is needed to compile the fileutils package on Glibc−2.2 based systems (such as the upcoming LFS−3.0 system).
- Chapter 5+6: Removed −−disable−nls from configuration of programs that don't need it (bash, diffutils, gzip, sed, m4).
- Chapter 5+6: Changed from "cd dir && make" to "make −C dir" (gettext−static, sysvinit).
- Chapter 5: Beautified the static link process for mawk.
- Chapter 5+6: Upgraded gcc−2.95.2 to gcc−2.95.2.1.
- Chapter 5: Changed the links we create during gcc−installation to $LFS/usr/bin/cpp.
- Chapter 5+6: Moved Glibc from chapter 5 to chapter 6.
- Chapter 5+6: Put back the instructions on how to copy/remove the old NSS library files, in case the original distribution uses glibc−2.0.x.
- Chapter 5: Added the notice about an old version of install−info.
- Chapter 5: Removed the installation of a static gettext.
- Chapter 6: Changed libexecdir=/usr/bin in fileutils to libexecdir=/bin.
- Chapter 6: Updated Glibc installation instructions. The 'configparms' file creation has been deleted. No need to pick a compiler (either distro's native or the /usr/local/gcc2952/bin/gcc one); we're in chroot now so we'll use the one we have.
- Chapter 6: Only copy the man pages from the ld.so package. We don't need the ldconfig and ldd programs anymore; Glibc−2.2.1 comes with good working versions.
- Chapter 6: Changed the procps installation from sed'ing to an easier way.
- 

Chapter 6: Added the creation of the lex symlink to the flex installation.

- Chapter 6: Changed $* into "$@" in the yacc script during bison's installation. "$@" allows usage of quoted arguments with blanks.
- Chapter 6: Fixed the man page installation during console−tools' installation.
- Chapter 6: When entering chroot, the $TERM variable inside chroot is set properly. This is accomplished by: chroot ... −i HOME=/root TERM=$TERM ...
- Chapter 6: Merged the different sulogin lines from the inittab file into one line.
- Chapter 6: Changed all "rm file && ln −s dest file" into "ln −sf file" (in glibc, bzip2 and gzip installations).
- Chapter 6: Added a sed to fix a problem during glibc−installation. pt_chown can not be installed setuid root, because "root" is not known by glibc yet (kind of hen and egg−problem).
- Chapter 6: Changed consoledata/tools to kbd, which is more actively developed, and less of a pain to install.
- Chapter 6: Changed bin86's installation from "make PREFIX=/usr install" to "make INSTALL_OPTS="−m 755" PREFIX=/usr install". This will prevent install from invoking strip −s on the files. This fails because a couple of the installed files are shell scripts rather than programs, so they can't be stripped.
- Chapter 6: Removed the ld.so section since we only used the man pages and replaced it with a patch to man−pages.
- Chapter 7: Fixed the delays in the killproc function in the functions script. Now, after kill, first check PIDs, then sleep 2 if needed. More details can be read in the comments in the script itself.
- Chapter 7: Added the explanation how the runlevels and boot process works when using the LFS scripts.
- Chapter 7+8: Moved the creation of /etc/fstab to chapter 8.
-

Chapter 10: Added this chapter. It contains "thanks and good luck" notes and suggest creating the /etc/lfs−3.0−pre3 file.

- Appendix A: Added the description of the Netkit−base and Net−tools packages.
- Appendix A: Added missing descriptions of frcode, code and bigram in the findutils−4.1 package.
- Everywhere: Added numerous FHS compliance notes. These instructions can be followed if one wishes to build a fully FHS−compliant system.

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# Mailing lists and archives

The linuxfromscratch.org server is hosting the following publicly accessible mailing lists:

- lfs−discuss
- lfs−apps
- lfs−announce
- lfs−security
- alfs−discuss
- alfs−docs
- alfs−ipc
- alfs−profile
- alfs−backend

## lfs−discuss

The lfs−discuss mailing list discusses matters strictly related to the LFS−BOOK. If problems with the book come up, a bug or two need to be reported, or suggestions to improve the book should be made, this mailing list is the right one.

Any other mail is to be posted on the lfs−apps list.

## lfs−apps

The lfs−apps list deals with everything that does not fit on the lfs−discuss list.

## lfs−announce

The lfs−announce list is a moderated list. It can be subscribed to, but you can't post any messages to this list. This list is used to announce new stable releases. The lfs−discuss list will carry information about development releases as well. If a user is already on the lfs−discuss list, there's little use subscribing to this list as well because everything that is posted to the lfs−announce list will be posted to the lfs−discuss list as well.

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## lfs−security

The lfs−security mailing list discusses security−related matters. Security concerns or security problems with a package used by LFS, should be addressed on this list.

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## alfs−discuss

The alfs−discuss list discusses the development of ALFS, which stands for Automated Linux From Scratch. The goal of this project is to develop an installation tool that can install an LFS system automatically. It's main goal is to speed up compilation by taking away the need to manually enter the commands to configure, compile, and install packages.

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## alfs−docs

ALFS−docs is the ALFS documentation project which creates and maintains all of the ALFS documentation.

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## alfs−ipc

The alfs−ipc list discusses the ALFS InterProcess Communication issues.

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## alfs−profile

The alfs−profile list discusses the development of the ALFS XML profile and DTD.

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## alfs−backend

The alfs−backend mailinglist discusses matters regarding the ALFS backend.

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## Mail archives

All these lists are archived and can be viewed online at http://archive.linuxfromscratch.org/mail−archives or downloaded from http://download.linuxfromscratch.org/mail−archives or ftp://download.linuxfromscratch.org/mail−archives.

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## How to subscribe?

Any of the above−mentioned mailinglists can be subscribed to by sending an email to listar@linuxfromscratch.org and writing *subscribe listname* as the subject header of the message.

Multiple lists at the same time can be subscribed to by using one email. This is done by leaving the subject blank and putting all the commands in the body of the email. The email will look like:

```
To: listar@linuxfromscratch.org
Subject:

subscribe lfs−discuss
subscribe lfs−apps
subscribe alfs−discuss
```

After the email is sent, the Listar program will reply with an email requesting a confirmation of the subscription request. After this confirmation email was sent back, Listar will send an email again with the message that the user has been subscribed to the list(s) along with an introduction message for that particular list.

---

## How to unsubscribe?

To unsubscribe from a list, send an email to listar@linuxfromscratch.org and write *unsubscribe listname* as the subject header of the message.

Multiple lists can be unsubscribed at the same time using one email. This is done by leaving the subject header blank and putting all the commands in the body of the email. The email will look like:

```
To: listar@linuxfromscratch.org
Subject:

unsubscribe lfs−discuss
unsubscribe lfs−apps
unsubscribe alfs−discuss
```

After the email was sent, the Listar program will reply with an email requesting a confirmation of the unsubscription request. After this confirmation email is sent back, Listar will send an email again with the message that the user has been unsubscribed from the list(s).

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## Other list modes

The modes that can be set by a user require to send an email to listar@linuxfromscratch.org. The modes themselves are set by writing the appropriate commands in the subject headers of the message.

As the name implies, the *Set command* tells what to write to set a mode. The *Unset command* tells what to write to unset a mode.

The listname in the example subject headers should be replaced with the listname to which the mode is going to be applied to. If more than one mode is to be set (to the same list or multiple lists) with one email, this can be done by leaving the subject header blank and write all the commands in the body of the message instead.

---

## Digests

Set command: *set listname digest*
Unset command: *unset listname digest*

All lists have the digest mode available which can be set after a user has subscribed to a list. Being in digest mode will cause to stop receiving individual messages as they are posted to the list and instead send one email daily containing all the messages posted to the list during that day.

There is a second digest mode called digest2. When a user is set to this mode he will receive the daily digests but will also continue to receive the individual messages to the lists as they are posted. To set this mode *digest2* has to be written instead of *digest* in the subject header.

---

## Vacation

Set command: *set listname vacation*
Unset command: *unset listname vacation*

If a user is going to be away for a while or wishes to stop receiving messages from the lists but doesn't want to unsubscribe, he can set to vacation mode. This has the same effect as unsubscribing, but without having to go through the unsubscribe process and then later through the subscribe process again.

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# Contact information

Direct all emails to the lfs−discuss mailing list preferably.

If you need to reach Gerard Beekmans personally, send an email to gerard@linuxfromscratch.org

# Chapter 2. Important information

# About $LFS

Please read the following carefully: throughout this book the variable $LFS will be used frequently. $LFS must at all times be replaced by the directory where the partition that contains the LFS system is mounted. How to create and where to mount the partition will be explained in full detail in chapter 4. In my case, the LFS partition is mounted on /mnt/lfs.

For example when you are told to run a command like **`./configure --prefix=$LFS`** you actually have to execute **`./configure --prefix=/mnt/lfs`**

It's important that this is done no matter where it is read; be it in commands entered in a shell, or in a file edited or created.

A possible solution is to set the environment variable LFS. This way $LFS can be entered literally instead of replacing it by /mnt/lfs. This is accomplished by running **`export LFS=/mnt/lfs`**.

Now, if you are told to run a command like **`./configure --prefix=$LFS`** you can type that literally. Your shell will replace $LFS with /mnt/lfs when it processes the command line (meaning when you hit enter after having typed the command).

If you plan to use $LFS, do not forget to set the $LFS variable at all times. If the variable is not set and is used in a command, $LFS will be ignored and whatever is left will be executed. A command like **`echo "root:x:0:0:root:/root:/bin/bash" > $LFS/etc/passwd`** without the $LFS variable set will re−create your host system's /etc/passwd file. Simply put: it will destroy your current password database file.

One way to make sure that $LFS is set at all times is adding it to the /root/.bash_profile and/or /root/.bashrc file(s) so that every time you login as user root, or you 'su' to user root, the $LFS variable is set.

# How to download the software

Throughout this document, I will assume that all the packages that were downloaded are placed somewhere in $LFS/usr/src.

I use the convention of having a $LFS/usr/src/sources directory. Under sources, I have the directory 0−9 and the directories a through z. A package like sysvinit−2.78.tar.gz is stored under $LFS/usr/src/sources/s/. A package like bash−2.04.tar.gz is stored under $LFS/usr/src/sources/b/, and so forth. This convention does not have to be followed, of course; I was just giving an example. It's better to keep the packages out of $LFS/usr/src and move them to a subdirectory, so we'll have a clean $LFS/usr/src directory in which we will unpack the packages and work with them.

The next chapter contains the list of all the packages that need to be downloaded, but the partition that is going to contain our LFS system isn't created yet. Therefore, the files are temporarily stored somewhere else (it's up to you to decide where this 'else' is) and later moved to $LFS/usr/src/ when the chapter in which the new partition is prepared has been finished.

# How to install the software

Before you can actually start doing something with a package, you need to unpack it first. Often the package files are tar'ed and gzip'ed or bzip2'ed. I'm not going to write down every time how to unpack an archive. I will explain how to do that once, in this section.

To start with, change to the $LFS/usr/src directory by running:

```
cd $LFS/usr/src
```

If a file is tar'ed and gzip'ed, it is unpacked by running either one of the following two commands, depending on the filename:

```
tar xvzf filename.tar.gz
tar xvzf filename.tgz
```

If a file is tar'ed and bzip2'ed, it is unpacked by running:

```
bzcat filename.tar.bz2 | tar xv
```

Some tar programs (most of them nowadays but not all of them) are slightly modified to be able to use bzip2 files directly using either the I or the y tar parameter, which works the same as the z tar parameter to handle gzip archives. The above construction works no matter how your host system decided to patch bzip2.

If a file is just tar'ed, it is unpacked by running:

```
tar xvf filename.tar
```

When an archive is unpacked, a new directory will be created under the current directory (and this book assumes that the archives are unpacked under the $LFS/usr/src directory). Please enter that new directory before continuing with the installation instructions. Again, every time this book is going to install a package, it's up to you to unpack the source archive and cd into the newly created directory.

From time to time you will be dealing with single files such as patch files. These files are generally gzip'ed or bzip2'ed. Before such files can be used they need to be uncompressed first.

If a file is gzip'ed, it is unpacked by running:

```
gunzip filename.gz
```

If a file is bzip2'ed, it is unpacked by running:

```
bunzip2 filename.bz2
```

After a package has been installed, two things can be done with it: either the directory that contains the sources can be deleted, or it can be kept. If it is kept, that's fine with me, but if the same package is needed again in a later chapter, the directory needs to be deleted first before using it again. If this is not done, you might end up in trouble because old settings will be used (settings that apply to the host system but which don't always apply to the LFS system). Doing a simple make clean or make distclean does not always guarantee a totally clean source tree.

So, save yourself a lot of hassle and just remove the source directory immediately after you have installed it.

There is one exception to that rule: don't remove the Linux kernel source tree. A lot of programs need the kernel headers, so that's the only directory that should not be removed, unless no package is to be compiled anymore.

# Download the bootscripts

Typing out all the bootscripts in chapters 7 and 9 can be a long, tedious process, not to mention very error−prone.

To save some time, the bootscripts can be downloaded from http://packages.linuxfromscratch.org/bootscripts/ or ftp://packages.linuxfromscratch.org/bootscripts/.

# Download the LFS Commands

LFS Commands is a tarball containing files which list the installation commands for the packages installed in this book.

These files can also be used to quickly find out which commands have been changed between the different LFS versions as well. Download the lfs−commands tarball for this book version and the previous book version and run a diff on the files. That way it is possible to see which packages have updated installation instructions, so any scripts you may have can be modified, or you can reinstall a package if you think that necessary.

A side effect is that these files can be used to dump to a shell and install the packages, though some files need to be modified (for example, when the kbd package is installed, you needed to select the keyboard layout file, becaue it can't reliably be guessed). Keep in mind, please, that these files are not checked for correctness, integrity and so forth. There may be bugs in the files (since they are manually created, typo's are often inevitable) so do check them and don't blindly trust them.

If you decide to use these files for scripting purposes, then don't place the files inside the directory of a package. For example, don't put the autoconf file from the lfs−commands package into the autoconf directory. The files may interfere with the actual package files, which may contain a file with the same name. Autoconf is one example of this: if an autoconf file is present in the autoconf directory, the configure script won't create a new autoconf file. You will end up with /usr/bin/autoconf containing autoconf's installation instructions, rather than the real autoconf perl script. There may be other packages that behave in similar ways, so just keep the lfs−commands files outside the package directory.

The lfscommands can be downloaded from http://packages.linuxfromscratch.org/lfs−commands/ or ftp://packages.linuxfromscratch.org/lfs−commands/.

# II. Part II – Installing the LFS system

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# Chapter 3. Packages that need to be downloaded

# Introduction

Below is a list of all the packages that are needed to download for building the basic system. The version numbers printed correspond to versions of the software that is known to work and which this book is based on. If you experience problems which you can't solve yourself, then please download the version that is assumed in this book (in case you downloaded a newer version).

If the packages.linuxfromscratch.org server isn't allowing connections anymore try one of our mirror sites. The addresses of the mirror sites can be found in Chapter 1 – Book Version

We have provided a list of official download sites of the packages below in Appendix C – Official download locations . The LFS FTP archive only contains the versions of packages that are recommended for use in this book. You can check the official sites in Appendix C to determin whether a newer package is available. If you do download a newer package, we would appreciate hearing whether you were able to install the package using this book's instructions or not.

Please note that all files downloaded from the LFS FTP archive are files compressed with bzip2 instead of gz. If you don't know how to handle bz2 files, check out Chapter 2 – How to install the software.

The following list is current as of April 2nd, 2001

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# Packages that need to be downloaded

Browse FTP:
 ftp://packages.linuxfromscratch.org/

Browse HTTP:
 http://packages.linuxfromscratch.org/

You can either download one tarball that contains all the packages used
to compile an LFS system:

All LFS Packages − 74,140 KB:
 ftp://packages.linuxfromscratch.org/3.0−pre3/lfs−packages−intel−cvs−2001−05−11−0104.tar
 http://packages.linuxfromscratch.org/3.0−pre3/lfs−packages−intel−cvs−2001−05−11−0104.tar

Or download the following packages individually:

Bash (2.05) − 1,360 KB:
 ftp://packages.linuxfromscratch.org/3.0−pre3/bash−2.05.tar.bz2
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Binutils (2.11) − 7586.95 KB:
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Bzip2 (1.0.1) − 410 KB:
 ftp://packages.linuxfromscratch.org/3.0−pre3/bzip2−1.0.1.tar.bz2
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Diff Utils (2.7) − 247 KB:
 ftp://packages.linuxfromscratch.org/3.0−pre3/diffutils−2.7.tar.bz2
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File Utils (4.1) 1217.29 KB:
 ftp://packages.linuxfromscratch.org/3.0−pre3/fileutils−4.1.tar.bz2
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GCC (2.95.2.1) 9,551 KB:
 ftp://packages.linuxfromscratch.org/3.0−pre3/gcc−2.95.2.1.tar.bz2
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Linux Kernel (2.4.4) 20,859.16 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/linux−2.4.4.tar.bz2
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Grep (2.4.2) 382 KB:
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Gzip (1.2.4a) 178 KB:
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Gzip Patch (1.2.4a) 0.49 KB:
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Make (3.79.1) 794 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/make−3.79.1.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/make−3.79.1.tar.bz2

Sed (3.02) 221 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/sed−3.02.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/sed−3.02.tar.bz2

Sh−utils (2.0) 824 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/sh−utils−2.0.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/sh−utils−2.0.tar.bz2

Shellutils Patch (2.0) 0.75 KB:
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Tar (1.13) 730 KB:
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Tar Patch (1.13) 1.06 KB:
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Text Utils (2.0) 1,040 KB:
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Mawk (1.3.3) 168 KB:
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Texinfo (4.0) 812 KB:
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Patch (2.5.4) 149 KB:
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MAKEDEV − 7 KB:
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Glibc (2.2.1) 10,137 KB:
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Glibc−linuxthreads (2.2.1) 149 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/glibc−linuxthreads−2.2.1.tar.bz2
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Man−pages (1.35) 478 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/man−pages−1.35.tar.bz2
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Man−pages Patch (1.35) 3.2 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/man−pages−1.35.patch.bz2
http://packages.linuxfromscratch.org/3.0−pre3/man−pages−1.35.patch.bz2

Ed (0.2) − 158 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/ed−0.2.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/ed−0.2.tar.bz2

Find Utils (4.1) 226 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/findutils−4.1.tar.bz2
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Find Utils Patch (4.1) 1.01 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/findutils−4.1.patch.bz2
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Ncurses (5.2) 1,308 KB:
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Vim−rt (5.7) 905 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/vim−5.7−rt.tar.bz2
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Vim−src (5.7) 963 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/vim−5.7−src.tar.bz2
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Bison (1.28) − 321 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/bison−1.28.tar.bz2
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Less (358) 178 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/less−358.tar.bz2
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Groff (1.17) 1,198.50 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/groff−1.17.tar.bz2
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Man (1.5i) 158 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/man−1.5i.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/man−1.5i.tar.bz2

Man Patch (1.5i) 3.24 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/man−1.5i.patch.bz2
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Perl (5.6.1) 4,750.30 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/perl−5.6.1.tar.bz2

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M4 (1.4) 249 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/m4−1.4.tar.bz2
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Autoconf (2.13) − 333 KB:
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Automake (1.4−p1) − 280.33 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/automake−1.4−p1.tar.bz2
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Flex (2.5.4a) 278 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/flex−2.5.4a.tar.bz2
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File (3.34) − 130 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/file−3.34.tar.bz2
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Libtool (1.4) 604.79 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/libtool−1.4.tar.bz2
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Bin86 (0.15.5) − 111.58 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/bin86−0.15.5.tar.bz2
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Gettext (0.10.37) 760.43 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/gettext−0.10.37.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/gettext−0.10.37.tar.bz2

Kbd (1.05) 585 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/kbd−1.05.tar.bz2
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E2fsprogs (1.19) − 808 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/e2fsprogs−1.19.tar.bz2

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Lilo (21.7.5) 174.53 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/lilo−21.7.5.tar.bz2
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Modutils (2.4.6) 199.20 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/modutils−2.4.6.tar.bz2
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Procinfo (18) 22 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/procinfo−18.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/procinfo−18.tar.bz2

Procps (2.0.7) 153 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/procps−2.0.7.tar.bz2
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Psmisc (20.1) 51 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/psmisc−20.1.tar.bz2
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Shadow Password Suite (20001016) 551 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/shadow−20001016.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/shadow−20001016.tar.bz2

Shadow Password Suite Patch (20001016) 0.40 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/shadow−20001016.patch.bz2
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Sysklogd (1.4.1) 67 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/sysklogd−1.4.1.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/sysklogd−1.4.1.tar.bz2

Sysvinit (2.78) 90 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/sysvinit−2.78.tar.bz2
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Sysvinit Patch (2.78) 0.39 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/sysvinit−2.78.patch.bz2
http://packages.linuxfromscratch.org/3.0−pre3/sysvinit−2.78.patch.bz2

Util Linux (2.11b) 919 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/util−linux−2.11b.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/util−linux−2.11b.tar.bz2

Netkit−base (0.17) 49 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/netkit−base−0.17.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/netkit−base−0.17.tar.bz2

Net−tools (1.60) 193.87 KB:
ftp://packages.linuxfromscratch.org/3.0−pre3/net−tools−1.60.tar.bz2
http://packages.linuxfromscratch.org/3.0−pre3/net−tools−1.60.tar.bz2

Total size of all intel−packages: 74,500.57 KB (72.75 MB)

# Chapter 4. Preparing a new partition

# Introduction

In this chapter, the partition that is going to host the LFS system is going to be prepared. We will be creating the partition itself, a file system and the directory structure. When this is done, we can move on to the next chapter and start the actual building process.

# Creating a new partition

First, let me tell you that it is possible to build LFS on only one partition, which is where your original distribution is installed. This is not recommended if it is the first time you try LFS, but may be useful if you are short on disk space. If you feel brave, take a look at the one partition hint.

Before we can build our new Linux system, we need to have an empty Linux partition on which we can build our new system. I recommend a partition size of at least 750 MB. This gives enough space to store all the tarballs and to compile all packages without worrying about running out of the necessary temporary disk space. But you probably want more space than that if you plan to use the LFS system as your primary Linux system. If that's the case you'd want more space so you can install additional software. If a Linux Native partition is already available, this subsection can be skipped.

The cfdisk program (or another fdisk like program you prefer)) is started with the appropriate hard disk as the option (like /dev/hda if a new partition is to be created on the primary master IDE disk). It is used to create a Linux Native partition, write the partition table and exit the cfdisk program. Please refer to the documentation that comes with your fdisk program of choice (the man pages are often a good place to start) and read the procedures about how to create a new Linux native partition and how to write the partition table.

The new partition's designation should be remembered. It could be something like hda11. This newly created partition will be referred to as the LFS partition in this book.

# Creating a file system on the new partition

Once the partition is created, we have to create a new file system on that partition. The standard file system used these days is the ext2 file system, but the socalled journaling file systems are becoming increasingly popular too. It's of course up to you to decide which file system you want to create, but because we have to assume and work with something, we will assume you chose the ext2 file system.

To create an ext2 file system, use the mke2fs command. The LFS partition is used as the only option to the command and the file system is created.

```
mke2fs /dev/xxx
```

Replace "xxx" by the partition's designation (like hda11).

# Mounting the new partition

Now that we have created a file system, it is ready for use. All we have to do to be able to access the partition (as in reading data from and writing data to) is mount it. If it is mounted under /mnt/lfs, this partition can be accessed by cd'ing to the /mnt/lfs directory. This book will assume that the partition was mounted under /mnt/lfs. It doesn't matter which directory is chosen, just make sure you remember what you chose.

Create the /mnt/lfs directory by running:

```
mkdir -p /mnt/lfs
```

Now mount the LFS partition by running:

```
mount /dev/xxx /mnt/lfs
```

Replace "xxx" by the partition's designation (like hda11).

This directory (/mnt/lfs) is the $LFS variable you have read about earlier. If you were planning to make use of the $LFS environment variable, **`export LFS=/mnt/lfs`** has to be executed now.

# Creating directories

Let's create the directory tree on the LFS partition based on the FHS standard, which can be found at http://www.pathname.com/fhs/. Issuing the following commands will create a default directory layout:

```
cd $LFS
mkdir -p bin boot dev/pts etc/opt home lib mnt proc  root sbin
tmp var opt
for dirname in $LFS/usr $LFS/usr/local
   do
   mkdir $dirname
   cd $dirname
   mkdir bin etc include lib sbin share  src var
   ln -s share/man man
   ln -s share/doc doc
   ln -s share/info info
   cd $dirname/share
   mkdir dict doc info locale man nls misc  terminfo zoneinfo
   cd $dirname/share/man
   mkdir man{1,2,3,4,5,6,7,8}
done
cd $LFS/var
mkdir -p lock log mail run spool tmp opt cache lib/misc  local
cd $LFS/opt
mkdir bin doc include info lib man
cd $LFS/usr
ln -s ../var/tmp tmp
```

Normally, directories are created with permission mode 755, which isn't desired for all directories. The first change is a mode 0750 for the $LFS/root directory. This is to make sure that not just everybody can enter the /root directory (the same a user would do with /home/username directories). The second change is a mode 1777 for the tmp directories. This way, any user can write data to the /tmp or /var/tmp directory but cannot remove another user's files (the latter is caused by the so–called "sticky bit" – bit 1 of the 1777 bit mask).

```
cd $LFS &&
chmod 0750 root &&
chmod 1777 tmp var/tmp
```

Now that the directories are created, copy the source files that were downloaded in chapter 3 to some subdirectory under $LFS/usr/src (you will need to create the desired directory yourself).

---

# FHS compliance notes

The FHS stipulates that the /usr/local directory should contain the bin, games, include, lib, man, sbin, and share subdirectories. You can alter your /usr/local directory yourself if you want your system to be FHS−compliant.

Also, the standard says that there should exist a /usr/share/games directory, which we don't much like for a base system. But feel free to make your system FHS−compliant if you wish. The FHS isn't precise as to the structure of the /usr/local/share subdirectories, so we took the liberty of creating the directories that we felt needed.

# Chapter 5. Preparing the LFS system

# Introduction

In the following chapters we will install all the software that belongs to a basic Linux system. After you're done with this and the next chapter, you'll have a fully working Linux system. The remaining chapters deal with creating the boot scripts, making the LFS system bootable and setting up basic networking.

The software in this chapter will be linked statically. These programs will be reinstalled in the next chapter and linked dynamically. The reason for the static version first is that there is a chance that our normal Linux system and the LFS system aren't using the same C Library versions. If the programs in the first part are linked against an older C library version, those programs might not work well on the LFS system.

The key to learn what makes Linux tick is to know exactly what packages are used for and why a user or the system needs them. Descriptions of the package content are provided after the Installation subsection of each package and in Appendix A as well.

During the installation of various packages, you will more than likely see all kinds of compiler warnings scrolling by on the screen. These are normal and can be safely ignored. They are just that, warnings (mostly about improper use of the C or C++ syntax, but not illegal use. It's just that, often, C standards changed and packages still use the old standard which is not a problem).

Before we start, make sure the LFS environment variable is setup properly if you decided to make use of it. Run the following:

```
echo $LFS
```

Check to make sure the output contains the correct directory to the LFS partition's mount point (/mnt/lfs for example).

# Install all software as user root

It's best to log in as root or su's to root when installing the packages. That way you are assured that all files are owned by user and group root (and not owned by the userid of the non−root user), and if a package wants to set special permissions, it can do so without problems due to non−root access.

The documentation that comes with Glibc, Gcc, and other packages recommend not to compile the packages as user root. We feel it's safe to ignore that recommendation and compile as user root anyway. Hundreds of people using LFS have done so without any problems whatsoever, and we haven't encountered any bugs in the compile processes that cause harm. So it's pretty safe (never can be 100% safe though, so it's up to you what you end up doing).

# Installing Bash

## Installation of Bash

Install Bash by running the following commands:

```
./configure --enable-static-link --prefix=$LFS/usr \
   --bindir=$LFS/bin  --with-curses &&
make &&
make install &&
cd $LFS/bin &&
ln -s bash sh
```

If the make install phase ends with something along the lines of

```
install-info: unknown option `--dir-file=/mnt/lfs/usr/info/dir'
usage: install-info [--version] [--help] [--debug] [--maxwidth=nnn]
        [--section regexp title] [--infodir=xxx] [--align=nnn]
        [--calign=nnn] [--quiet] [--menuentry=xxx]
        [--info-dir=xxx]
        [--keep-old] [--description=xxx] [--test]
        [--remove] [--] filename
make[1]: *** [install] Error 1
make[1]: Leaving directory `/mnt/lfs/usr/src/bash-2.04/doc'
make: [install] Error 2 (ignored)
```

then that means that you are probably using Debian, and that you have an old version of the texinfo package. This error is not severe by any means: the info pages will be installed when we recompile bash dynamically in chapter 6, so you can ignore it. You do, however, have to run the last two commands manually (the **cd $LFS/bin** and **ln -s bash sh** commands) because they won't be executed when the error occurs.

---

## Command explanations

**--enable-static-link:** This configure option causes Bash to be linked statically

**--prefix=$LFS/usr:** This configure option installs all of Bash's files under the $LFS/usr directory, which becomes the /usr directory after the user chroot'ed into $LFS or when he rebooted the system into LFS.

**--bindir=$LFS/bin:** This installs the executable files in $LFS/bin. We do this because we want bash to be in /bin, not in /usr/bin. One reason being: the /usr partition might be on a separate partition which has to be mounted at some point. Before that partition is mounted a user needs and will want to have bash available (it will be hard to execute the boot scripts without a shell for instance).

**--with-curses:** This causes Bash to be linked against the curses library instead of the default termcap library which is becoming obsolete.

**ln -s bash sh:** This command creates the sh symlink that points to bash. Most scripts run themselves via 'sh' (invoked by the #!/bin/sh as the first line in the scripts) which invokes a special bash mode. Bash will then behave (as closely as possible) as the original Bourne shell.

The **&&**'s at the end of every line cause the next command to be executed only if the previous command exists with a return value of 0 indicating success. In case all of these commands are copy&pasted on the shell, is is important to be ensured that if ./configure fails, make isn't being executed and, likewise, if make fails, that make install isn't being executed, and so forth.

## Contents

The Bash package contains the bash program

## Description

Bash is the Bourne−Again SHell, which is a widely used command interpreter on Unix systems. Bash is a program that reads from standard input, the keyboard. A user types something and the program will evaluate what he has typed and do something with it, like running a program.

# Installing Binutils

## Installation of Binutils

Install Binutils by running the following commands:

```
./configure --prefix=$LFS/usr --disable-nls  &&
make -e LDFLAGS=-all-static tooldir=$LFS/usr  &&
make -e tooldir=$LFS/usr install
```

## Command explanations

**`make -e:`** The -e parameter tells make that environment variables take precedence over variables defined in the Makefile file(s). This is needed in order to successfully link binutils statically.

**`LDFLAGS=-all-static:`** Setting the variable LDFLAGS to the value -all-static causes binutils to be linked statically.

**`tooldir=$LFS/usr:`** Normally, the tooldir (the directory where the executables from binutils end up in) is set to $(exec_prefix)/$(target_alias) which expands into, for example, /usr/i686-pc-linux-gnu. Since we only build for our own system, we don't need this target specific directory in $LFS/usr. That setup would be used if the system was used to cross-compile (for example compiling a package on the Intel machine that generates code that can be executed on Apple PowerPC machines).

## Description

The Binutils package contains the gasp, gprof, ld, as, ar, nm, objcopy, objdump, ranlib, readelf, size, strings, strip, c++filt and addr2line programs

## Description

### gasp

Gasp is the Assembler Macro Preprocessor.

### gprof

gprof displays call graph profile data.

## ld

ld combines a number of object and archive files, relocates their data and ties up symbol references. Often the last step in building a new compiled program to run is a call to ld.

---

## as

as is primarily intended to assemble the output of the GNU C compiler gcc for use by the linker ld.

---

## ar

The ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

---

## nm

nm lists the symbols from object files.

---

## objcopy

objcopy utility copies the contents of an object file to another. objcopy uses the GNU BFD Library to read and write the object files. It can write the destination object file in a format different from that of the source object file.

---

## objdump

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

---

## ranlib

ranlib generates an index to the contents of an archive, and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

---

## readelf

readelf displays information about elf type binaries.

---

## size

size lists the section sizes −−and the total size−− for each of the object files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

---

## strings

For each file given, strings prints the printable character sequences that are at least 4 characters long (or the number specified with an option to the program) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non−text files.

---

## strip

strip discards all or specific symbols from object files. The list of object files may include archives. At least one object file must be given. strip modifies the files named in its argument, rather than writing modified copies under different names.

---

## c++filt

The C++ language provides function overloading, which means that it is possible to write many functions with the same name (providing each takes parameters of different types). All C++ function names are encoded into a low−level assembly label (this process is known as mangling). The c++filt program does the inverse mapping: it decodes (demangles) low−level names into user−level names so that the linker can keep these overloaded functions from clashing.

---

## addr2line

addr2line translates program addresses into file names and line numbers. Given an address and an executable, it uses the debugging information in the executable to figure out which file name and line number are associated with a given address.

---

# Installing Bzip2

## Installation of Bzip2

Install Bzip2 by running the following commands:

```
sed \
   s/"\$(CC) \$(CFLAGS) -o"/"\$(CC) \$(CFLAGS)  \$(LDFLAGS)
-o"/ \
   Makefile | make -f -  LDFLAGS=-static &&
make PREFIX=$LFS/usr install &&
cd $LFS/usr/bin &&
mv bzcat bunzip2 bzip2 bzip2recover $LFS/bin
```

---

## Command explanations

**`sed:`** The sed command here searches for the string "$(CC) $(CFLAGS) −o" and replaces it by "$(CC) $(CFLAGS) $(LDFLAGS) −o" in the Makefile file. We make that modification so it will be easier to link bzip2 statically.

**`...Makefile | make -f -:`** Makefile is the last parameter of the sed command which indicates the file to search and replace in. Sed normally sends the modified file to stdout (standard output), which will be the console. With the construction we use, sed's output will be piped to the make program. Normally, when make is started, it tries to find a number of files like Makefile. But we have modified the Makefile file so we don't want make to use it. The "−f −" parameter tells make to read it's input from another file, or from stdin (standard input) which the dash (−) implies. This is one way to do it. Another way would be to have sed write the output to a different file and tell make with the −f parameter to read that alternate file.

**`LDFLAGS=-static:`** This is the second way we use to link a package statically. This is also the most common way. The −all−static value is only used with the binutils and the gettext packages and won't be used throughout the rest of this book.

---

## Contents

The Bzip2 packages contains the bzip2, bunzip2, bzcat and bzip2recover programs.

---

## Description

### Bzip2

bzip2 compresses files using the Burrows−Wheeler block sorting text compression algorithm, and Huffman coding. Compression is generally considerably better than that achieved by more conventional

LZ77/LZ78−based compressors, and approaches the performance of the PPM family of statistical compressors.

## Bunzip2

Bunzip2 decompresses files that are compressed with bzip2.

## bzcat

bzcat (or bzip2 −dc) decompresses all specified files to the standard output.

## bzip2recover

bzip2recover recovers data from damaged bzip2 files.

# Installing Diffutils

## Installation of Diffutils

Install Diffutils by running the following commands:

```
export CPPFLAGS=-Dre_max_failures=re_max_failures2  &&
./configure --prefix=$LFS/usr &&
unset CPPFLAGS &&
make LDFLAGS=-static &&
make install
```

## Command explanations

**CPPFLAGS=-Dre_max_failures=re_max_failures2:** The CPPFLAGS variable is a variable that's read by the cpp program (C PreProcessor). The value of this variable tells the preprocessor to replace every instance of re_max_failures it finds by re_max_failures2 before handing the source file to the compiler itself for compilation. This package has problems linking statically on certain platforms (depending on the Glibc version used on that system) and this construction fixes that problem.

## Contents

The Diffutils package contains the cmp, diff, diff3 and sdiff programs.

## Description

### cmp and diff

cmp and diff both compare two files and report their differences. Both programs have extra options which compare files in different situations.

### diff3

The difference between diff and diff3 is that diff compares 2 files, diff3 compares 3 files.

### sdiff

sdiff merges two files and interactively outputs the results.

# Installing Fileutils

## Installation of Fileutils

Install Fileutils by running the following commands:

```
./configure --disable-nls \
--prefix=$LFS/usr --libexecdir=$LFS/bin  --bindir=$LFS/bin &&
make LDFLAGS=-static &&
make install &&
cd $LFS/usr/bin &&
ln -s ../../bin/install
```

---

## Command explanations

**`--libexecdir=$LFS/bin:`** This configure option will set the program executable directory to $LFS/bin. This is normally set to /usr/libexec, but nothing is placed in it. Changing it just prevents that directory from being created.

---

## Contents

The Fileutils package contains the chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch and vdir programs.

---

## Description

### chgrp

chgrp changes the group ownership of each given file to the named group,  which can be either a group name or a numeric group ID.

---

### chmod

chmod changes the permissions of each given file according to mode, which  can be either a symbolic representation of changes to make, or an octal  number representing the bit pattern for the new permissions.

---

## chown

chown changes the user and/or group ownership of each given file.

---

## cp

cp copies files from one place to another.

---

## dd

dd copies a file (from the standard input to the standard output, by default) with a user−selectable blocksize, while optionally performing conversions on it.

---

## df

df displays the amount of disk space available on the filesystem containing each file name argument. If no file name is given, the space available on all currently mounted filesystems is shown.

---

## ls, dir and vdir

dir and vdir are versions of ls with different default output formats. These programs list each given file or directory name. Directory contents are sorted alphabetically. For ls, files are by default listed in columns, sorted vertically, if the standard output is a terminal; otherwise they are listed one per line. For dir, files are by default listed in columns, sorted vertically. For vdir, files are by default listed in long format.

---

## dircolors

dircolors outputs commands to set the LS_COLOR environment variable. The LS_COLOR variable is use to change the default color scheme used by ls and related utilities.

---

## du

du displays the amount of disk space used by each argument and for each subdirectory of directory arguments.

---

## install

install copies files and sets their permission modes and, if possible, their owner and group.

---

## ln

ln makes hard or soft (symbolic) links between files.

---

## mkdir

mkdir creates directories with a given name.

---

## mkfifo

mkfifo creates a FIFO with each given name.

---

## mknod

mknod creates a FIFO, character special file, or block special file with the given file name.

---

## mv

mv moves files from one directory to another or renames files, depending on the arguments given to mv.

---

## rm

rm removes files or directories.

---

## rmdir

rmdir removes directories, if they are empty.

---

## shred

shred deletes a file securely, overwriting it first so that its contents can't be recovered.

---

## sync

sync forces changed blocks to disk and updates the super block.

---

## touch

touch changes the access and modification times of each given file to the current time. Files that do not exist are created empty.

# Installing GCC

## Installation of GCC

Install GCC by running the following commands:

```
mkdir $LFS/usr/src/gcc-build &&
cd $LFS/usr/src/gcc-build &&
../gcc-2.95.2.1/configure --prefix=/usr \
   --with-gxx-include-dir=/usr/include/g++  \
   --enable-languages=c,c++ --disable-nls  &&
make -e LDFLAGS=-static bootstrap &&
make prefix=$LFS/usr local_prefix=$LFS/usr/local  \
   gxx_include_dir=$LFS/usr/include/g++  install &&
cd $LFS/lib &&
ln -s ../usr/bin/cpp  &&
cd $LFS/usr/lib &&
ln -s ../bin/cpp  &&
cd $LFS/usr/bin &&
ln -s gcc cc
```

---

## Command explanations

**--enable-languages=c,c++:** This only builds the C and C++ compilers and not the other available compilers as they are, on the average, not often used. If those other compilers are needed, the −−enable−languages parameter can be omitted.

**ln -s ../usr/bin/cpp:** This creates the $LFS/lib/cpp symlink. Some packages explicitly try to find cpp in /lib.

**ln -s ../bin/cpp:** This creates the $LFS/usr/lib/cpp symlink as there are packages that expect cpp to be in /usr/lib.

---

## Contents

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

## Description

## Compiler

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

## Preprocessor

A preprocessor pre−processes a source file, such as including the contents of header files into the source file. It's a good idea to not do this manually to save a lot of time. Someone just inserts a line like #include <filename>. The preprocessor inserts the contents of that file into the source file. That's one of the things a preprocessor does.

---

## C++ Library

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Installing Linux Kernel

## Installation of Linux Kernel

We won't be compiling a new kernel image yet. We'll do that after we have finished the installation of the basic system software in this chapter. But because certain software need the kernel header files, we're going to unpack the kernel archive now and set it up so that we can compile package that need the kernel.

The kernel configuration file is created by running the following command:

```
make mrproper &&
yes "" | make config &&
make dep &&
cd $LFS/usr/include &&
cp -R ../src/linux/include/linux . &&
mkdir asm &&
cp -a ../src/linux/include/asm/* asm
```

## Command explanations

**`make mrproper:`** This will ensure that the kernel tree is absolutely clean.

**`yes "" | make config:`** This runs make config and answers with the default answer to every question the config script asks the user (it does this by simply doing the equivalent of hitting the Enter key, thus accepting the default Y and N answers to the questions). We're not configuring the real kernel here, we just need to have some sort of configure file created so that we can run make dep next that will create a few files in $LFS/usr/src/linux/include/linux, like version.h, among others, that we will need to compile Glibc and other packages later in chroot.

**`make dep:`** make dep checks dependencies and sets up the dependencies file. We don't really care about the dependency checks, but what we do care about is that make dep creates those aforementioned files in $LFS/usr/src/linux/include/linux we will be needing later on.

**`cp -R ../src/linux/include/linux .`** and **`mkdir asm && cp -a ../src/linux/include/asm/* .`**: These commands copy the kernel headers in the `$LFS/usr/include` directory. For details on why we don't link to these directories (anymore), and instead copy them, please refer to the `README` file in the kernel source.

## Contents

The Linux kernel package contains the Linux kernel.

## Description

The Linux kernel is at the core of every Linux system. It's what makes Linux tick. When a computer is turned on and boots a Linux system, the very first piece of Linux software that gets loaded is the kernel. The kernel initializes the system's hardware components such as serial ports, parallel ports, sound cards, network cards, IDE controllers, SCSI controllers and a lot more. In a nutshell the kernel makes the hardware available so that the software can run.

# Installing Grep

## Installation of Grep

Install Grep by running the following commands:

```
export CPPFLAGS=-Dre_max_failures=re_max_failures2  &&
./configure --prefix=$LFS/usr --disable-nls  &&
unset CPPFLAGS &&
make LDFLAGS=-static &&
make install
```

## Contents

The grep package contains the egrep, fgrep and grep programs.

## Description

### egrep

egrep prints lines from files matching an extended regular expression pattern.

### fgrep

fgrep prints lines from files matching a list of fixed strings, separated by newlines, any of which is to be matched.

### grep

grep prints lines from files matching a basic regular expression pattern.

# Installing Gzip

## Installation of Gzip

Before Gzip is installed, the gzip patch file needs to be unpacked.

```
patch -Np1 -i ../gzip-1.2.4a.patch  &&
./configure --prefix=$LFS/usr &&
make LDFLAGS=-static &&
make install &&
cp $LFS/usr/bin/gunzip $LFS/usr/bin/gzip  $LFS/bin &&
rm $LFS/usr/bin/gunzip $LFS/usr/bin/gzip
```

## Contents

The Gzip package contains the compress, gunzip, gzexe, gzip, uncompress, zcat, zcmp, zdiff, zforece, zgrep, zmore and znew programs.

## Description

### gunzip

gunzip decompresses files that are compressed with gzip.

### gzexe

gzexe allows to compress executables in place and have them automatically uncompress and execute when they are run (at a penalty in performance).

### gzip

gzip reduces the size of the named files using Lempel–Ziv coding (LZ77).

### zcat

zcat uncompresses either a list of files on the command line or its standard input and writes the uncompressed data on standard output

## zcmp

zcmp invokes the cmp program on compressed files.

---

## zdiff

zdiff invokes the diff program on compressed files.

---

## zforce

zforce forces a .gz extension on all gzip files so that gzip will not compress them twice. This can be useful for files with names truncated after a file transfer.

---

## zgrep

zgrep invokes the grep program on compressed files.

---

## zmore

Zmore is a filter which allows examination of compressed or plain text files one screen at a time on a soft−copy terminal (similar to the more program).

---

## znew

Znew re−compresses files from .Z (compress) format to .gz (gzip) format.

---

# Installing Make

## Installation of Make

Install Make by running the following commands:

```
./configure --prefix=$LFS/usr  --disable-nls &&
make LDFLAGS=-static &&
make install
```

## Contents

The Make package contains the make program.

## Description

make determine automatically which pieces of a large program need to be recompiled, and issue the commands to recompile them.

# Installing Sed

## Installation of Sed

Install Sed by running the following commands:

```
export CPPFLAGS=-Dre_max_failures=re_max_failures2  &&
./configure --prefix=$LFS/usr  --bindir=$LFS/bin &&
unset CPPFLAGS &&
make LDFLAGS=-static &&
make install
```

## Contents

The Sed package contains the sed program.

## Description

sed is a stream editor. A stream editor is used to perform basic text transformations on an input stream (a file or input from a pipeline).

# Installing Shellutils

## Installation of Sh–utils

Before Sh–utils is installed, the sh–utils patch file needs to be unpacked.

```
patch -Np1 -i ../sh-utils-2.0.patch  &&
./configure --prefix=$LFS/usr  --disable-nls &&
make LDFLAGS=-static &&
make install &&
cd $LFS/usr/bin &&
mv date echo false pwd stty $LFS/bin &&
mv su true uname hostname $LFS/bin
```

## Contents

The Shellutils package contains the basename, chroot, date, dirname, echo, env, expr, factor, false, groups, hostid, hostname, id, logname, nice, nohup, pathchk, pinky, printenv, printf, pwd, seq, sleep, stty, su, tee, test, true, tty, uname, uptime, users, who, whoami and yes programs.

## Description

### basename

basename strips directory and suffixes from filenames.

### chroot

chroot runs a command or interactive shell with special root directory.

### date

date displays the current time in a specified format, or sets the system  date.

### dirname

dirname strips non–directory suffixes from file name.

## echo

echo displays a line of text.

## env

env runs a program in a modified environment.

## expr

expr evaluates expressions.

## factor

factor prints the prime factors of all specified integer numbers.

## false

false always exits with a status code indicating failure.

## groups

groups prints the groups a user is in.

## hostid

hostid prints the numeric identifier (in hexadecimal) for the current host.

## hostname

hostname sets or prints the name of the current host system

## id

id prints the real and effective UIDs and GIDs of a user or the current user.

## logname

logname prints the current user's login name.

## nice

nice runs a program with modified scheduling priority.

## nohup

nohup runs a command immune to hangups, with output to a non−tty

## pathchk

pathchk checks whether file names are valid or portable.

## pinky

pinky is a lightweight finger utility which retrieves information about a certain user

## printenv

printenv prints all or part of the environment.

## printf

printf formats and print data (the same as the printf C function).

## pwd

pwd prints the name of the current/working directory

## seq

seq prints numbers in a certain range with a certain increment.

## sleep

sleep delays for a specified amount of time.

---

## stty

stty changes and prints terminal line settings.

---

## su

su runs a shell with substitute user and group IDs

---

## tee

tee reads from standard input and write to standard output and files.

---

## test

test checks file types and compares values.

---

## true

True always exits with a status code indicating success.

---

## tty

tty prints the file name of the terminal connected to standard input.

---

## uname

uname prints system information.

---

## uptime

uptime tells how long the system has been running.

---

## users

users prints the user names of users currently logged in to the current host.

---

## who

who shows who is logged on.

---

## whoami

whoami prints the users effective userid.

---

## yes

yes outputs a string repeatedly until killed.

---

# Installing Tar

## Installation of Tar

To be able to directly use bzip2 files with tar, use the tar patch available from the LFS FTP site. This patch will add the −y option to tar which works the same as the −z option to tar (which can be used for gzip files).

Apply the patch by running the following command:

```
cd src &&
patch -i ../../gnutarpatch.txt &&
cd ..
```

Install Tar by running the following commands:

```
./configure --prefix=$LFS/usr  --disable-nls \
   --libexecdir=$LFS/usr/bin  --bindir=$LFS/bin &&
make LDFLAGS=-static &&
make install
```

---

## Contents

The tar package contains the tar and rmt programs.

---

## Description

### tar

tar is an archiving program designed to store and extract files from an archive file known as a tar file.

---

### rmt

rmt is a program used by the remote dump and restore programs in manipulating a magnetic tape drive through an interprocess communication connection.

---

# Installing Textutils

## Installation of Textutils

Install Textutils by running the following commands:

```
./configure --prefix=$LFS/usr  --disable-nls &&
make LDFLAGS=-static &&
make install &&
mv $LFS/usr/bin/cat $LFS/bin
```

## Contents

The Textutils package contains the cat, cksum, comm, split, cut, expand, fmt, fold, head, join, md5sum, nl, od, paste, pr, ptx, sort, split, sum, tac, tail, tr, tsort, unexpand, uniq and wc programs.

## Description

### cat

cat concatenates file(s) or standard input to standard output.

### cksum

cksum prints CRC checksum and byte counts of each specified file.

### comm

comm compares two sorted files line by line.

### csplit

cplit outputs pieces of a file separated  by (a) pattern(s) to files xx01, xx02, ..., and outputs byte counts of each piece to standard output.

## cut

cut prints selected parts of lines from specified files to standard output.

## expand

expand converts tabs in files to spaces, writing to standard output.

## fmt

fmt reformats each paragraph in the specified file(s), writing to standard output.

## fold

fold wraps input lines in each specified file (standard input by default), writing to standard output.

## head

Print first xx (10 by default) lines of each specified file to standard output.

## join

join joins lines of two files on a common field.

## md5sum

md5sum prints or checks MD5 checksums.

## nl

nl writes each specified file to standard output, with line numbers added.

## od

od writes an unambiguous representation, octal bytes by default, of a specified file to standard output.

## paste

paste writes lines consisting of the sequentially corresponding lines from each specified file, separated by TABs, to standard output.

---

## pr

pr paginates or columnates files for printing.

---

## ptx

ptx produces a permuted index of file contents.

---

## sort

sort writes sorted concatenation of files to standard output.

---

## split

split outputs fixed−size pieces of an input file to PREFIXaa, PREFIXab, ...

---

## sum

sum prints checksum and block counts for each specified file.

---

## tac

tac writes each specified file to standard output, last line first.

---

## tail

tail print the last xx (10 by default) lines of each specified file to  standard output.

---

## tr

tr translates, squeezes, and/or deletes characters from standard input, writing to standard output.

---

## tsort

tsort writes totally ordered lists consistent with the partial ordering in specified files.

## unexpand

unexpand converts spaces in each file to tabs, writing to standard output.

## uniq

uniq discards all but one of successive identical lines from files or standard input and writes to files or standard output.

## wc

wc prints line, word, and byte counts for each specified file, and a total line if more than one file is specified.

# Installing Mawk

## Installation of Mawk

Install Mawk by running the following commands:

```
./configure &&
sed \
   s/"\$(CC) \$(CFLAGS) -o"/"\$(CC) \$(CFLAGS) \$(LDFLAGS)
-o"/ \
   Makefile | make  -f - LDFLAGS=-static &&
make BINDIR=$LFS/usr/bin \
   MANDIR=$LFS/usr/share/man/man1  install
```

## Contents

The Mawk package contains the mawk program.

## Description

### mawk

Mawk is an interpreter for the AWK Programming Language. The AWK language is useful for manipulation of data files, text retrieval and processing, and for prototyping and experimenting with algorithms.

# Installing Texinfo

## Installation of Texinfo

Install Texinfo by running the following commands:

```
./configure --prefix=$LFS/usr  --disable-nls &&
make LDFLAGS=-static &&
make install
```

## Contents

The Texinfo package contains the info, install–info, makeinfo, texi2dvi and texindex programs

## Description

### info

The info program reads Info documents, usually contained in the /usr/doc/info directory. Info documents are like man(ual) pages, but they tend to be more in depth than just explaining the options to a program.

### install–info

The install–info program updates the info entries. When the info program is run a list with available topics (ie: available info documents) will be presented. The install–info program is used to maintain this list of available topics. If info files are removed manually, it is also necessary to delete the topic in the index file as well. This program is used for that. It also works the other way around when info documents are added.

### makeinfo

The makeinfo program translates Texinfo source documents into various formats. Available formats are: info files, plain text and HTML.

### texi2dvi

The texi2dvi program prints Texinfo documents

## texindex

The texindex program is used to sort Texinfo index files.

# Installing Patch

## Installation of Patch

Install Make by running the following commands:

```
./configure --prefix=$LFS/usr  &&
make LDFLAGS=-static &&
make install
```

## Contents

The Patch package contains the patch program.

## Description

The patch program modifies a file according to a patch file. A patch file usually is a list created by the diff program that contains instructions on how an original file needs to be modified. Patch is used a lot for source code patches since it saves time and space. Imagine a package that is 1MB in size. The next version of that package only has changes in two files of the first version. It can be shipped as an entirely new package of 1MB or just as a patch file of 1KB which will update the first version to make it identical to the second version. So if the first version was downloaded already, a patch file avoids a second large download.

# Creating passwd and group files

In order for the user and group root to be recognized and to be able to login, there needs to be an entry in the /etc/passwd and /etc/group file. Besides the group root a couple of other groups are recommended and needed by packages. The groups with their GID's below aren't part of any standard. The LSB only recommends besides a group root a group bin to be present with GID 1. Other group names and GID's can be chosen by the user. Well written packages don't depend on GID numbers but just use the group name, since it doesn't matter all that much what GID a group has. Since there aren't any standards for groups I won't follow any conventions used by Debian, RedHat and others. The groups added here are the groups the MAKEDEV script (the script that creates the device files in the /dev directory) mentions.

Create a new file `$LFS/etc/passwd` by running the following command:

```
echo "root:x:0:0:root:/root:/bin/bash" >  $LFS/etc/passwd
```

Create a new file `$LFS/etc/group` by running the following:

```
cat > $LFS/etc/group << "EOF"
root:x:0:
bin:x:1:
sys:x:2:
kmem:x:3:
tty:x:4:
tape:x:5:
daemon:x:6:
floppy:x:7:
disk:x:8:
lp:x:9:
dialout:x:10:
audio:x:11:
EOF
```

# Copying old NSS library files

If your normal Linux system runs glibc−2.0, you need to copy the NSS library files to the LFS partition. Certain statically linked programs still depend on the NSS library, especially programs that need to lookup usernames,userid's and groupid's. You can check which C library version your normal Linux system uses by simply executing the library, like this:

```
/lib/libc.so.6
```

The first line will give you the release version. Following lines contain interesting information. If you have Glibc−2.0.x installed on your starting distribution, copy the NSS library files by running:

```
cp −av /lib/libnss* $LFS/lib
```

# Mounting $LFS/proc file system

In order for certain programs to function properly the proc file system must be mounted and available from within the chroot'ed environment as well. It's not a problem to mount the proc file system twice or even more than that, since it's a virtual file system maintained by the kernel itself.

The proc file system is mounted under $LFS/proc by running the following command:

```
mount proc $LFS/proc -t proc
```

# Chapter 6. Installing basic system software

# Introduction

The installation of all the software is pretty straightforward and you will probably think it's so much easier and shorter to give the generic installation instructions for each package and only explain how to install something if a certain package requires an alternate installation method. Although I agree on that, I choose to give the full instructions for each and every package. This is simply to avoid any possible confusion and errors.

Now would be a good time to take a look at the optimization hint if you plan on using compiler optimization for the packages installed in the following chapter. Compiler optimization can make a program run faster, but may also cause some compilation problems. If you run into problems after having used optimization, always try it without optimizing to see if you can reproduce the problem.

# About debugging symbols

Most programs and libraries by default are compiled with debugging symbols (gcc option −g) Let me explain what these debugging symbols are and why you may not want them.

A program compiled with debugging symbols means a user can run a program or library through a debugger and the debugger's output will be user friendly. These debugging symbols also enlarge the program or library significantly.

Before you start wondering whether these debugging symbols really make a big difference, here are some statistics. Use them to draw your own conclusion.

- A dynamic Bash binary with debugging symbols: 1.2MB
- A dynamic Bash binary without debugging symbols: 478KB
- /lib and /usr/lib (glibc and gcc files) with debugging symbols: 87MB
- /lib and /usr/lib (glibc and gcc files) without debugging symbols: 16MB

Sizes vary depending on which compiler was used and which C library version was used to link dynamic programs against, but results will be similar if you compare programs with and without debugging symbols. After I was done with this chapter and stripped all debugging symbols from all LFS binaries I regained a little over 102 MB of disk space. Quite the difference.

To remove debugging symbols from a binary (must be an a.out or ELF binary) run **`strip --strip-debug filename`**. Wild cards can be used to strip debugging symbols from multiple files (use something like **`strip --strip-debug $LFS/usr/bin/*`**). Most people will probably never use a debugger on software, so by removing those symbols a lot of disk space can be regained.

You might find additional information in the optimization hint which can be found at http://cvs.linuxfromscratch.org/index.cgi/hints/.

# Creating $LFS/root/.bash_profile

When we have entered the chroot'ed environment in the next section we want to export a couple of environment variables in that shell such as PS1, PATH and others variables which are good to have set. For that purpose we'll create the $LFS/root/.bash_profile file which will be read by bash when we enter the chroot environment.

Create a new file `$LFS/root/.bash_profile` by running the following.

```
cat > $LFS/root/.bash_profile << "EOF"
# Begin /root/.bash_profile

PS1='\u:\w\$ '
PATH=/bin:/usr/bin:/sbin:/usr/sbin

export PS1 PATH

# End /root/.bash_profile
EOF
```

Additional environment variables, aliases and so forth that are needed and/or wanted can be added at your own discretion.

---

# Entering the chroot'ed environment

It's time to enter our chroot'ed environment in order to install the rest of the software we need.

Enter the following commands to enter the chroot'ed environment. From this point on there's no need to use the $LFS variable anymore, because everything a user does will be restricted to the LFS partition (since / is actually /mnt/lfs but the shell doesn't know that).

```
cd $LFS &&
chroot $LFS /usr/bin/env -i HOME=/root  \
   TERM=$TERM /bin/bash --login
```

The TERM=$TERM construction will set the $TERM value inside chroot to the same value as outside chroot which is needed for programs like vim and less to operate properly.

Now that we are inside a chroot'ed environment, we can continue to install all the basic system software. You have to make sure all the following commands in this and following chapters are run from within the chroot'ed environment. If you ever leave this environment for any reason (when rebooting for example) please remember to mount $LFS/proc again and re–enter chroot before continuing with the book.

Note that the bash prompt will contain "I have no name!" This is normal because Glibc hasn't been installed yet.

# Installing Glibc

## Installation of Glibc

Unpack the glibc−linuxthreads in the glibc−2.2.1 directory, not in /usr/src.

Install Glibc by running the following commands:

```
mknod -m 0666 /dev/null c 1 3 &&
touch /etc/ld.so.conf &&
mkdir /usr/src/glibc-build &&
cd /usr/src/glibc-build &&
sed s/"\$(PERL)"/"\/usr\/bin\/perl"/ \
   ../glibc-2.2.1/malloc/Makefile  > tmp~ &&
mv tmp~ ../glibc-2.2.1/malloc/Makefile &&
sed "s/root/0/" ../glibc-2.2.1/login/Makefile  > tmp~ &&
mv tmp~ ../glibc-2.2.1/login/Makefile &&
../glibc-2.2.1/configure \
   --prefix=/usr --enable-add-ons  \
   --libexecdir=/usr/bin &&
sed s/"cross-compiling = yes"/"cross-compiling = no"/  \
   config.make > config.make~  &&
mv config.make~ config.make &&
make &&
make install &&
make localedata/install-locales
```

During the configure stage you will see the following warning:

```
configure: warning:
*** An auxiliary program is missing or too old;
*** some features will be disabled.
*** Check the INSTALL file for required versions.
```

This warning refers to the missing msgfmt program from the gettext package. But there is nothing to worry about: Glib will still be installed the same way as when msgfmt is present. It can safely be ignored in our case.

By exiting the chroot'ed environment and re−entering it, you will be able to get rid of the "I have no name!" message in the command prompt, which is caused by bash's inability to resolve a userid to a username. You don't have to exit and re−enter chroot, but it's highly recommended to ensure a properly working bash.

Run the following commands to accomplish this:

```
logout
```

```
chroot $LFS /usr/bin/env -i HOME=/root  \
   TERM=$TERM /bin/bash --login
```

## Command explanations

**mknod -m 0666 /dev/null c 1 3:** Glibc needs a null device to compile properly. All other devices will be created in the next section.

**touch /etc/ld.so.conf** One of the final steps of the Glibc installation is running ldconfig to update the dynamic loader cache. If this file isn't present Glibc will abort with an error that it can't read the file. So we create an empty file for it (the empty file will have Glibc default to using /lib and /usr/lib which is fine right now).

**--enable-add-ons:** This enables the add–on that we install with Glibc: linuxthreads

## Contents

The Glibc package contains the GNU C Library.

## Description

The C Library is a collection of commonly used functions in programs. This way a programmer doesn't need to create his own functions for every single task. The most common things like writing a string to the screen are already present and at the disposal of the programmer.

The C library (actually almost every library) come in two flavors: dynamic ones and static ones. In short when a program uses a static C library, the code from the C library will be copied into the executable file. When a program uses a dynamic library, that executable will not contain the code from the C library, but instead a routine that loads the functions from the library at the time the program is run. This means a significant decrease in the file size of a program. The documentation that comes with the C Library describes this in more detail, as it is too complicated to explain here in one or two lines.

# Creating devices

## Creating devices

Note: the MAKEDEV.bz2 file you have unpacked is not an archive, so it won't create a directory for you to cd into.

Create the device files by running the following commands:

```
chmod 755 MAKEDEV &&
cp MAKEDEV /dev &&
cd /dev &&
./MAKEDEV -v generic
```

MAKEDEV will create hda[1−20] and hdb[1−20] and such but keep in mind that you may not be able to use all of those devices due to kernel limitations regarding the max. number of partitions.

---

## Command explanations

**`./MAKEDEV -v generic:`** This creates generic devices. Normally, these devices are all devices you need. It's possible that you are missing some special devices that are needed for your hardware configuration. Create them with ./MAKEDEV −v <device>.

---

## Contents

The MAKEDEV package contains the MAKEDEV script.

---

## Description

MAKEDEV is a script that can help in creating the necessary static device files that usually reside in the /dev directory.

---

# Installing Man−pages

## Installation of Man−pages

Install Man−pages by running the following command:

```
patch -Np1 -i ../man-pages-1.35.patch  &&
make install
```

## Contents

The Man−pages package contains various manual pages that don't come with the packages.

## Description

Examples of provided manual pages are the manual pages describing all the C and C++ functions, few important /dev/ files and more.

# Installing Ed

## Installation of Ed

Install Ed by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
mv /usr/bin/ed /usr/bin/red /bin
```

## Contents

The Ed package contains the ed program.

## Description

Ed is a line–oriented text editor. It is used to create, display, modify and otherwise manipulate text files.

# Installing Patch

## Installation of Patch

Install Patch by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

## Contents

The Patch package contains the patch program.

## Description

The patch program modifies a file according to a patch file. A patch file usually is a list created by the diff program that contains instructions on how an original file needs to be modified. Patch is used a lot for source code patches since it saves time and space. Imagine a package that is 1MB in size. The next version of that package only has changes in two files of the first version. It can be shipped as an entirely new package of 1MB or just as a patch file of 1KB which will update the first version to make it identical to the second version. So if the first version was downloaded already, a patch file avoids a second large download.

# Installing Findutils

## Installing Findutils

Before Findutils is installed the findutils patch file has to be unpacked.

Install Findutils by running the following commands:

```
patch -Np1 -i ../findutils-4.1.patch &&
./configure --prefix=/usr &&
make &&
make libexecdir=/usr/bin install
```

## Contents

The Findutils package contains the find, locate, updatedb, xargs, frcode, code and bigram programs.

## Description

### Find

The find program searches for files in a directory hierarchy which match a certain criteria. If no criteria is given, it lists all files in the current directory and it's subdirectories.

### Locate

Locate scans a database which contain all files and directories on a filesystem. This program lists the files and directories in this database matching a certain criteria. If a user is looking for a file this program will scan the database and tell him exactly where the files he requested are located. This only makes sense if the locate database is fairly up–to–date else it will provide out–of–date information.

### Updatedb

The updatedb program updates the locate database. It scans the entire file system (including other file system that are currently mounted unless it is told not to do so) and puts every directory and file it finds into the database that's used by the locate program which retrieves this information. It's a good practice to update this database once a day to have it up–to–date whenever it is needed.

## Xargs

The xargs command applies a command to a list of files. If there is a need to perform the same command on multiple files, a file can be created that contains all these files (one per line) and use xargs to perform that command on the list.

---

## frcode

updatedb runs a program called frcode to compress the list of file names using front−compression, which reduces the database size by a factor of 4 to 5.

---

## code

code is the ancestor of frcode. It was used in older−style locate databases.

---

## bigram

bigram is used together with code to produce older−style locate databases. To learn more about these last three programs, read the locatedb.5 manual page.

---

# Installing Mawk

## Installation of Mawk

Install Mawk by running the following commands:

```
./configure &&
make &&
make BINDIR=/usr/bin \
   MANDIR=/usr/share/man/man1 install  &&
cd /usr/bin &&
ln -s mawk awk
```

## Contents

The Mawk package contains the mawk program.

## Description

### mawk

Mawk is an interpreter for the AWK Programming Language. The AWK language is useful for manipulation of data files, text retrieval and processing, and for prototyping and experimenting with algorithms.

# Installing Ncurses

## Installation of Ncurses

Install Ncurses by running the following commands:

```
./configure --prefix=/usr --libdir=/lib \
   --with-shared  --disable-termcap &&
make &&
make install &&
cd /lib &&
ln -s libncurses.a libcurses.a
```

## Command explanations

**--with-shared:** This enables the build of the shared ncurses library files.

**--disable-termcap:** Disabled the compilation of termcap fall back support.

**ln -s libncurses.a libcurses.a:** This creates the /lib/libcurses.a symlink that for some reason isn't created during the libncurses installation.

## Contents

The Ncurses package contains the ncurses, panel, menu and form libraries. It also contains the tic, infocmp, clear, tput, toe and tset programs.

## Description

### The libraries

The libraries that make up the Ncurses library are used to display text (often in a fancy way) on the screen. An example where ncurses is used is in the kernel's "make menuconfig" process. The libraries contain routines to create panels, menu's, form and general text display routines.

### Tic

Tic is the terminfo entry–description compiler. The program translates a terminfo file from source format into the binary format for use with the ncurses library routines. Terminfo files contain information about the capabilities of a terminal.

## Infocmp

The infocmp program can be used to compare a binary terminfo entry with other terminfo entries, rewrite a terminfo description to take advantage of the use= terminfo field, or print out a terminfo description from the binary file (term) in a variety of formats (the opposite of what tic does).

## clear

The clear program clears the screen if this is possible. It looks in the environment for the terminal type and then in the terminfo database to figure out how to clear the screen.

## tput

The tput program uses the terminfo database to make the values of terminal−dependent capabilities and information available to the shell, to initialize or reset the terminal, or return the long name of the requested terminal type.

## toe

The toe program lists all available terminal types by primary name with descriptions.

## tset

The Tset program initializes terminals so they can be used, but it's not widely used anymore. It's provided for 4.4BSD compatibility.

# Installing Vim

## Installation of Vim

If you don't like vim to be installed as an editor on the LFS system, you may want to download an alternative and install an editor he prefers. There are a few hints how to install different editors available at http://archive.linuxfromscratch.org/lfs−hints/editors/

Both the vim−rt and vim−src packages need to be unpacked to install Vim. Both packages will unpack their files into the vim−5.7 directory. This won't overwrite any files from the other package. So it doesn't matter in which order it is done. Install Vim by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
cd /usr/bin &&
ln -s vim vi
```

If you plan on installing the X Window system on his LFS system, you might want to re−compile Vim after he has installed X. Vim comes with a nice GUI version of the editor which requires X and a few other libraries to be installed. For more information read the Vim documentation.

## FHS compliance notes

The FHS says that editors like vim should use /var/lib/<editor> for their temporary state files, like temporary save files for example. If you wish vim to conform to the FHS, you should use this command set instead of the one presented above:

```
./configure --prefix=/usr --localstatedir=/var/lib/vim &&
make &&
make install &&
cd /usr/bin &&
ln -s vim vi &&
mkdir /var/lib/vim
```

## Contents

The Vim package contains the ctags, etags, ex, gview, gvim, rgview, rgvim, rview, rvim, view, vim, vimtutor and xxd programs.

# Description

## ctags

ctags generate tag files for source code.

---

## etags

etags does the same as ctags but it can generate cross reference files which list information about the various source objects found in a set of language files.

---

## ex

ex starts vim in Ex mode.

---

## gview

gview is the GUI version of view.

---

## gvim

gvim is the GUI version of vim.

---

## rgview

rgview is the GUI version of rview.

---

## rgvim

rgvim is the GUI version of rvim.

---

## rview

rview is a restricted version of view. No shell commands can be started and Vim can't be suspended.

---

## rvim

rvim is the restricted version of vim. No shell commands can be started and Vim can't be suspended.

## view

view starts vim in read−only mode.

## vim

vim starts vim in the normal, default way.

## vimtutor

vimtutor starts the Vim tutor.

## xxd

xxd makes a hexdump or does the reverse.

# Installing GCC

## Installation of GCC

Install GCC by running the following commands:

```
mkdir /usr/src/gcc-build &&
cd /usr/src/gcc-build &&
../gcc-2.95.2.1/configure --prefix=/usr \
   --with-gxx-include-dir=/usr/include/g++  \
   --enable-shared  --enable-languages=c,c++ &&
make bootstrap &&
make install
```

---

## Contents

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

## Description

### Compiler

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

### Preprocessor

A preprocessor pre−processes a source file, such as including the contents of header files into the source file. It's a good idea to not do this manually to save a lot of time. Someone just inserts a line like #include <filename>. The preprocessor inserts the contents of that file into the source file. That's one of the things a preprocessor does.

---

### C++ Library

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Installing Bison

## Installation of Bison

Install Bison by running the following commands:

```
./configure --prefix=/usr \
   --datadir=/usr/share/bison  &&
make &&
make install
```

Some programs don't know about bison and try to find the yacc program (bison is a (better) alternative for yacc). So to please those few programs out there we'll create a yacc script that calls bison and have it emulate yacc's output file name conventions).

Create a new file `/usr/bin/yacc` by running the following:

```
cat > /usr/bin/yacc << "EOF"
#!/bin/sh
# Begin /usr/bin/yacc

/usr/bin/bison -y "$@"

# End /usr/bin/yacc
EOF
chmod 755 /usr/bin/yacc
```

---

## Command explanations

**--datadir=/usr/share/bison:** This installs the bison grammar files in /usr/share/bison rather than /usr/share.

---

## Contents

The Bison package contains the bison program.

---

## Description

Bison is a parser generator, a replacement for YACC. YACC stands for Yet Another Compiler Compiler. What is Bison then? It is a program that generates a program that analyzes the structure of a text file. Instead of writing the actual program a user specifies how things should be connected and with those rules a program is constructed that analyzes the text file.

There are a lot of examples where structure is needed and one of them is the calculator.

Given the string :

```
1 + 2 * 3
```

A human can easily come to the result 7. Why? Because of the structure. Our brain knows how to interpret the string. The computer doesn't know that and Bison is a tool to help it understand by presenting the string in the following way to the compiler:

```
    +
   / \
  *   1
 / \
2   3
```

Starting at the bottom of a tree and coming across the numbers 2 and 3 which are joined by the multiplication symbol, the computer multiplies 2 and 3. The result of that multiplication is remembered and the next thing that the computer sees is the result of 2*3 and the number 1 which are joined by the add symbol. Adding 1 to the previous result makes 7. In calculating the most complex calculations can be broken down in this tree format and the computer just starts at the bottom and works it's way up to the top and comes with the correct answer. Of course, Bison isn't only used for calculators alone.

# Installing Less

## Installation of Less

Install Less by running the following commands:

```
./configure --prefix=/usr --bindir=/bin &&
make &&
make install
```

---

## Contents

The Less package contains the less program

---

## Description

The less program is a file pager (or text viewer). It displays the contents of a file with the ability to scroll. Less is an improvement on the common pager called "more". Less has the ability to scroll backwards through files as well and it doesn't need to read the entire file when it starts, which makes it faster when reading large files.

---

# Installing Groff

## Installation of Groff

Install Groff by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

---

## Contents

The Groff packages contains the addftinfo, afmtodit, eqn, grodvi, groff, grog, grohtml, grolj4, grops, grotty, hpftodit, indxbib, lkbib, lookbib, neqn, nroff, pfbtops, pic, psbb, refer, soelim, tbl, tfmtodit and troff programs.

---

## Description

### addftinfo

addftinfo reads a troff font file and adds some additional font−metric information that is used by the groff system.

---

### afmtodit

afmtodit creates a font file for use with groff and grops.

---

### eqn

eqn compiles descriptions of equations embedded within troff input files into commands that are understood by troff.

---

### grodvi

grodvi is a driver for groff that produces TeX dvi format.

---

## groff

groff is a front−end to the groff document formatting system. Normally it runs the troff program and a post−processor appropriate for the selected device.

---

## grog

grog reads files and guesses which of the groff options −e, −man, −me, −mm, −ms, −p, −s, and −t are required for printing files, and prints the groff command including those options on the standard output.

---

## grohtml

grohtml translates the output of GNU troff to html

---

## grolj4

grolj4 is a driver for groff that produces output in PCL5 format suitable for an HP Laserjet 4 printer.

---

## grops

grops translates the output of GNU troff to Postscript.

---

## grotty

grotty translates the output of GNU troff into a form suitable for typewriter−like devices.

---

## hpftodit

hpftodit creates a font file for use with groff −Tlj4 from an HP tagged font metric file.

---

## indxbib

indxbib makes an inverted index for the bibliographic databases a specified file for use with refer, lookbib, and lkbib.

---

## lkbib

lkbib searches bibliographic databases for references that contain specified keys and prints any references found on the standard output.

## lookbib

lookbib prints a prompt on the standard error (unless the standard input is not a terminal), reads from the standard input a line containing a set of keywords, searches the bibliographic databases in a specified file for references containing those keywords, prints any references found on the standard output, and repeats this process until the end of input.

## neqn

It is currently not known what neqn is and what it does.

## nroff

The nroff script emulates the nroff command using groff.

## pfbtops

pfbtops translates a Postscript font in .pfb format to ASCII.

## pic

pic compiles descriptions of pictures embedded within troff or TeX input files into commands that are understood by TeX or troff.

## psbb

psbb reads a file which should be a Postscript document conforming to the Document Structuring conventions and looks for a %%BoundingBox comment.

## refer

refer copies the contents of a file to the standard output, except that lines between .[ and .] are interpreted as citations, and lines between .R1 and .R2 are interpreted as commands about how citations are to be processed.

## soelim

soelim reads files and replaces lines of the form *.so file* by the contents of *file*.

## tbl

tbl compiles descriptions of tables embedded within troff input files into commands that are understood by troff.

---

## tfmtodit

tfmtodit creates a font file for use with **`groff -Tdvi`**

---

## troff

troff is highly compatible with Unix troff. Usually it should be invoked using the groff command, which will also run preprocessors and post−processors in the appropriate order and with the appropriate options.

---

# Installing Man

## Installation of Man

Before Man is installed, the man patch file needs to be unpacked.

```
patch −Np1 −i ../man−1.5i.patch  &&
./configure −default &&
make &&
make install
```

You may want to take a look at the man hint which deals with formatting and compression issues for man pages.

---

## Contents

The Man package contains the man, apropos whatis and makewhatis programs.

---

## Description

### man

man formats and displays the on−line manual pages.

---

### apropos

apropos searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output.

---

### whatis

whatis searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output. Only complete word matches are displayed.

---

### makewhatis

makewhatis reads all the manual pages contained in given sections of manpath or the pre−formatted pages contained in the given sections of catpath. For each page, it writes a line in the whatis database; each line consists of the name of the page and a short description, separated by a dash. The description is extracted using the content of the NAME section of the manual page.

# Installing Perl

## Installation of Perl

Install Perl by running the following commands:

```
./Configure -Dprefix=/usr &&
make &&
make install
```

If you don't want to answer all those questions Perl asks, you can add the −d option to the configure script and Perl will use all the default settings. To avoid the Configure script asking questions after the config.sh file has been created you can pass the −e parameter to perl as well. The commands with these parameters included will be:

```
./Configure -Dprefix=/usr -d -e &&
make &&
make install
```

---

## Contents

The Perl package contains Perl − Practical Extraction and Report Language

---

## Description

Perl combines the features and capabilities of C, awk, sed and sh into one powerful programming language.

---

# Installing M4

## Installation of M4

Install M4 by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

If the base system is running a 2.0 kernel and the Glibc version is 2.1 then a user will most likely get problems executing M4 in the chroot'ed environment due to incompatibilities between the M4 program, Glibc−2.1 and the running 2.0 kernel. If he has problems executing the m4 program in the chroot'ed environment (for example when he installs the autoconf and automake packages) he'll have to exit the chroot'ed environment and compile M4 statically. This way the binary is linked against Glibc 2.0 (if he runs kernel 2.0, Glibc version is 2.0 as well on a decent system. Kernel 2.0 and Glibc−2.1 don't mix very well) and won't give any problems.

To create a statically linked version of M4, execute the following commands:

```
logout
cd $LFS/usr/src/m4-1.4
./configure --prefix=/usr
make LDFLAGS=-static
make prefix=$LFS/usr install
```

Now the chroot'ed environment can be re−entered and the next package an be installed. If M4 should be re−compiled dynamically, this can be done after having rebooted into the LFS system rather than chrooting into it.

```
chroot $LFS /usr/bin/env -i HOME=/root \
   TERM=$TERM /bin/bash --login
```

## Contents

The M4 package contains the M4 processor

## Description

M4 is a macro processor. It copies input to output expanding macros as it goes. Macros are either built−in or user−defined and can take any number of arguments. Besides just doing macro expansion m4 has built−in functions for including named files, running UNIX commands, doing integer arithmetic, manipulating text in various ways, recursion, etc. M4 can be used either as a front−end to a compiler or as a macro processor in its own right.

# Installing Texinfo

## Installation of Texinfo

Install Texinfo by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
make TEXMF=/usr/share/texmf install-tex
```

## Contents

The Texinfo package contains the info, install–info, makeinfo, texi2dvi and texindex programs

## Description

### info

The info program reads Info documents, usually contained in the /usr/doc/info directory. Info documents are like man(ual) pages, but they tend to be more in depth than just explaining the options to a program.

### install–info

The install–info program updates the info entries. When the info program is run a list with available topics (ie: available info documents) will be presented. The install–info program is used to maintain this list of available topics. If info files are removed manually, it is also necessary to delete the topic in the index file as well. This program is used for that. It also works the other way around when info documents are added.

### makeinfo

The makeinfo program translates Texinfo source documents into various formats. Available formats are: info files, plain text and HTML.

### texi2dvi

The texi2dvi program prints Texinfo documents

## texindex

The texindex program is used to sort Texinfo index files.

# Installing Autoconf

## Installation of Autoconf

Install Autoconf by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

---

## Contents

The Autoconf package contains the autoconf, autoheader, autoreconf, autoscan, autoupdate and ifnames programs

---

## Description

### autoconf

Autoconf is a tool for producing shell scripts that automatically configure software source code packages to adapt to many kinds of UNIX−like systems. The configuration scripts produced by Autoconf are independent of Autoconf when they are run, so their users do not need to have Autoconf.

---

### autoheader

The autoheader program can create a template file of C #define statements for configure to use

---

### autoreconf

If there are a lot of Autoconf−generated configure scripts, the autoreconf program can save some work. It runs autoconf (and autoheader, where appropriate) repeatedly to remake the Autoconf configure scripts and configuration header templates in the directory tree rooted at the current directory.

---

### autoscan

The autoscan program can help to create a configure.in file for a software package. autoscan examines source files in the directory tree rooted at a directory given as a command line argument, or the current directory if none is given. It searches the source files for common portability problems and creates a file configure.scan which is a preliminary configure.in for that package.

## autoupdate

The autoupdate program updates a configure.in file that calls Autoconf macros by their old names to use the current macro names.

## ifnames

ifnames can help when writing a configure.in for a software package. It prints the identifiers that the package already uses in C preprocessor conditionals. If a package has already been set up to have some portability, this program can help to figure out what its configure needs to check for. It may help fill in some gaps in a configure.in generated by autoscan.

# Installing Automake

## Installation of Automake

Install Automake by running the following commands:

```
./configure --prefix=/usr &&
make install
```

## Contents

The Automake package contains the aclocal and automake programs

## Description

### aclocal

Automake includes a number of Autoconf macros which can be used in packages; some of them are actually required by Automake in certain situations. These macros must be defined in the aclocal.m4−file; otherwise they will not be seen by autoconf.

The aclocal program will automatically generate aclocal.m4 files based on the contents of configure.in. This provides a convenient way to get Automake−provided macros, without having to search around. Also, the aclocal mechanism is extensible for use by other packages.

### automake

To create all the Makefile.in's for a package, run the automake program in the top level directory, with no arguments. automake will automatically find each appropriate Makefile.am (by scanning configure.in) and generate the corresponding Makefile.in.

# Installing Bash

## Installation of Bash

Install Bash by running the following commands:

```
./configure --prefix=/usr --with-curses  &&
make &&
make install &&
logout
```

The static bash is replaced with the dynamic bash and the chroot'ed environment is re−entered by running:

```
mv $LFS/usr/bin/bash $LFS/usr/bin/bashbug  $LFS/bin &&
chroot $LFS /usr/bin/env -i HOME=/root  \
   TERM=$TERM /bin/bash  --login
```

---

## Contents

The Bash package contains the bash program

---

## Description

Bash is the Bourne−Again SHell, which is a widely used command interpreter on Unix systems. Bash is a program that reads from standard input, the keyboard. A user types something and the program will evaluate what he has typed and do something with it, like running a program.

---

# Installing Flex

## Installation of Flex

Install Flex by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
cd /usr/bin &&
ln -s flex lex
```

## Contents

The Flex package contains the flex program

## Description

Flex is a tool for generating programs which recognizes patterns in text. Pattern recognition is very useful in many applications. A user sets up rules what to look for and flex will make a program that looks for those patterns. The reason people use flex is that it is much easier to set up rules for what to look for than to write the actual program that finds the text.

# Installing File

## Installation of File

Install File by running the following commands:

```
./configure --prefix=/usr  --datadir=/usr/share/misc &&
make &&
make install
```

File uses magic numbers to determine a file type. These magic numbers come with File in a plain text file. File internally compiles this database each time it is run. This is not the normal type of operation for File since compiling a plain text file each time is not the fastest way to do it. File offers an option "−C" to compile this magic number file. The reason this isn't done automatically is that some people like to work on the magic numbers. On the other hand many people didn't get it that they should compile the magic numbers, so the author of File added a warning when the plain text magic file is used. As we usually won't work on the plain text magic file, we compile this file, because it's faster, fixes that annoying warning and is how it was meant to be:

```
file −C
```

## Contents

The File package contains the file program.

## Description

File tests each specified file in an attempt to classify it. There are three sets of tests, performed in this order: filesystem tests, magic number tests, and language tests. The first test that succeeds causes the file type to be printed.

# Installing Libtool

## Installation of Libtool

Install Libtool by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

---

## Contents

The Libtool package contains the libtool and libtoolize programs. It also contains the ltdl library.

---

## Description

### libtool

Libtool provides generalized library−building support services.

---

### libtoolize

libtoolize provides a standard way to add libtool support to a package.

---

### ltdl library

Libtool provides a small library, called `libltdl', that aims at hiding the various difficulties of dlopening libraries from programmers.

---

# Installing Bin86

## Installation of Bin86

Install Bin86 by running the following commands:

```
make &&
make INSTALL_OPTS="-m 755"  PREFIX=/usr install
```

## Command explanations

**make INSTALL_OPTS="-m 755"...**: The Makefile declares INSTALL_OPTS="−m 755 −s". The −s parameter causes the install program to invoke the strip program to strip debug symbols from the program. This doesn't work properly because a few files aren't programs, but shell scripts. The strip program errors on those.

## Contents

The Bin86 contains the as86, as86_encap, ld86, objdump86, nm86 and size86 programs.

## Description

### as86

as86 is an assembler for the 8086...80386 processors.

### as86_encap

as86_encap is a shell script to call as86 and convert the created binary into a C file prog.v to be included in or linked with programs like boot block installers.

### ld86

ld86 understands only the object files produced by the as86 assembler, it can link them into either an impure or a separate I&D executable.

## objdump86

No description available.

## nm86

No description available.

## size86

No description available.

# Installing Binutils

## Installation of Binutils

Install Binutils by running the following commands:

```
./configure --prefix=/usr --enable-shared &&
make -e tooldir=/usr &&
make -e tooldir=/usr install &&
make -e tooldir=/usr install-info
```

## Description

The Binutils package contains the gasp, gprof, ld, as, ar, nm, objcopy, objdump, ranlib, readelf, size, strings, strip, c++filt and addr2line programs

## Description

### gasp

Gasp is the Assembler Macro Preprocessor.

### gprof

gprof displays call graph profile data.

### ld

ld combines a number of object and archive files, relocates their data and ties up symbol references. Often the last step in building a new compiled program to run is a call to ld.

### as

as is primarily intended to assemble the output of the GNU C compiler gcc for use by the linker ld.

## ar

The ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

---

## nm

nm lists the symbols from object files.

---

## objcopy

objcopy utility copies the contents of an object file to another. objcopy uses the GNU BFD Library to read and write the object files. It can write the destination object file in a format different from that of the source object file.

---

## objdump

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

---

## ranlib

ranlib generates an index to the contents of an archive, and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

---

## readelf

readelf displays information about elf type binaries.

---

## size

size lists the section sizes ––and the total size–– for each of the object files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

---

## strings

For each file given, strings prints the printable character sequences that are at least 4 characters long (or the number specified with an option to the program) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non−text files.

---

## strip

strip discards all or specific symbols from object files. The list of object files may include archives. At least one object file must be given. strip modifies the files named in its argument, rather than writing modified copies under different names.

---

## c++filt

The C++ language provides function overloading, which means that it is possible to write many functions with the same name (providing each takes parameters of different types). All C++ function names are encoded into a low−level assembly label (this process is known as mangling). The c++filt program does the inverse mapping: it decodes (demangles) low−level names into user−level names so that the linker can keep these overloaded functions from clashing.

---

## addr2line

addr2line translates program addresses into file names and line numbers. Given an address and an executable, it uses the debugging information in the executable to figure out which file name and line number are associated with a given address.

---

# Installing Bzip2

## Installation of Bzip2

Install Bzip2 by running the following commands:

```
make −f Makefile−libbz2_so &&
make bzip2recover libbz2.a &&
cp bzip2−shared /bin/bzip2 &&
cp bzip2recover /bin &&
cp bzip2.1 /usr/share/man/man1 &&
cp bzlib.h /usr/include &&
cp −a libbz2.so* libbz2.a /lib &&
rm /usr/lib/libbz2.a &&
cd /bin &&
ln −sf bzip2 bunzip2 &&
ln −sf bzip2 bzcat &&
cd /usr/share/man/man1 &&
ln −s bzip2.1 bunzip2.1 &&
ln −s bzip2.1 bzcat.1 &&
ln −s bzip2.1 bzip2recover.1
```

Although it's not strictly a part of a basic LFS system it's worth mentioning that a patch for Tar can be downloaded which enables the tar program to compress and uncompress using bzip2/bunzip2 easily. With a plain tar a user has to use constructions like bzcat file.tar.bz|tar xv or tar −−use−compress−prog=bunzip2 −xvf file.tar.bz2 to use bzip2 and bunzip2 with tar. This patch gives the −y option so a user can unpack a Bzip2 archive with tar xvfy file.tar.bz2. Applying this patch will be mentioned later on when the Tar package is re−installed.

---

## Command explanations

**`make −f Makefile−libbz2_so:`** This will cause bzip2 to be build using a different Makefile file, in this case the Makefile−libbz2_so file which creates a dynamic libbz2.so library and links the bzip2 utilities against it.

---

## Contents

The Bzip2 packages contains the bzip2, bunzip2, bzcat and bzip2recover programs.

---

## Description

## Bzip2

bzip2 compresses files using the Burrows−Wheeler block sorting text compression algorithm, and Huffman coding. Compression is generally considerably better than that achieved by more conventional LZ77/LZ78−based compressors, and approaches the performance of the PPM family of statistical compressors.

---

## Bunzip2

Bunzip2 decompresses files that are compressed with bzip2.

---

## bzcat

bzcat (or bzip2 −dc) decompresses all specified files to the standard output.

---

## bzip2recover

bzip2recover recovers data from damaged bzip2 files.

---

# Installing Gettext

## Installation of Gettext

Install Gettext by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

## Contents

The gettext package contains the gettext, gettextize, msgcmp, msgcomm, msgfmt, msgmerge, msgunfmt and xgettext programs.

## Description

### gettext

The gettext package is used for internationalization (also known as i18n) and for localization (also known as l10n). Programs can be compiled with Native Language Support (NLS) which enable them to output messages in the users native language rather than in the default English language.

# Installing Kbd

## Installation of Kbd

Install Kbd by running the following commands:

```
./configure --datadir=/usr/share/kbd &&
make &&
make install &&
rm  /usr/share/kbd/keymaps/i386/qwerty/defkeymap.map.gz
```

Now we have to choose a default keymap. Explore the /usr/share/kbd/keymaps directory, and find the keymap that you would like to use as a default. Then execute this command:

```
cd /usr/share/kbd/keymaps &&
ln -s <path-to-keymap> defkeymap.map.gz
```

Replace **<path-to-keymap>** with the path to the keymap you have selected, relative to the /usr/share/kbd/keymaps/ directory. For example, if you have chosen the US keymap, you would replace it with i386/qwerty/us.map.gz.

---

## Command explanations

**--datadir=/usr/share/kbd:** This puts the kbd data files (fonts, keymaps, and such) in the /usr/share/kbd directory, as the FHS suggests.

**rm /usr/share/kbd/keymaps/i386/qwerty/defkeymap.map.gz:** We remove this file because we don't know which keymap you need to use.

**ln -s <path-to-keymap> defkeymap.map.gz** With this command you set the default keymap that can be loaded using the **loadkeys -d** command.

---

## Contents

The Kbd package contains the chvt, deallocvt, dumpkeys, fgconsole, getkeycodes, kbd_mode, kbdrate, loadkeys, loadunimap, mapscrn, psfxtable, resizecons, screendump, setfont, setkeycodes, setleds, setmetamode, setvesablank, showfont, showkey, unicode_start, and unicode_stop programs. There are some other programs that don't get installed by default, as they are very optional. Take a look at the Kbd package contents if you have trouble with your console.

---

# Description

## chvt

chvt changes foreground virtual terminal.

---

## deallocvt

deallocvt deallocates unused virtual terminals.

---

## dumpkeys

dumpkeys dumps keyboard translation tables.

---

## fgconsole

fgconsole prints the number of the active virtual terminal.

---

## getkeycodes

getkeycodes prints the kernel scancode−to−keycode mapping table.

---

## kbd_mode

kbd_mode reports or sets the keyboard mode.

---

## kbdrate

kbdrate sets the keyboard repeat and delay rates.

---

## loadkeys

loadkeys loads keyboard translation tables.

---

## loadunimap

loadunimap loads the kernel unicode−to−font mapping table.

---

## mapscrn

mapscrn loads a user defined output character mapping table into the console driver. Note that it is obsolete and that its features are built into setfont.

---

## psfxtable

psfxtable is a tool for handling Unicode character tables for console fonts.

---

## resizecons

resizecons changes the kernel idea of the console size.

---

## screendump

A screen shot utility for the console.

---

## setfont

This lets you change the EGA/VGA fonts in console.

---

## setkeycodes

setkeycodes loads kernel scancode−to−keycode mapping table entries.

---

## setleds

setleds sets the keyboard LEDs. Many people find it useful to have numlock enabled by default, and it is by using this program that you can achieve this.

---

## setmetamode

setmetamode defines the keyboard meta key handling.

---

## setvesablank

This lets you fiddle with the built−in hardware screensaver (not toasters, only a blank screen).

---

## showfont

showfont displays data about a font. The information shown includes font information, font properties, character metrics, and character bitmaps.

## showkey

showkey examines the scancodes and keycodes sent by the keyboard.

## unicode_start

unicode_start puts the console in Unicode mode.

## unicode_stop

unicode_stop reverts keyboard and console from unicode mode.

# Installing Diffutils

## Installation of Diffutils

Install Diffutils by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

---

## Contents

The Diffutils package contains the cmp, diff, diff3 and sdiff programs.

---

## Description

### cmp and diff

cmp and diff both compare two files and report their differences. Both programs have extra options which compare files in different situations.

---

### diff3

The difference between diff and diff3 is that diff compares 2 files, diff3 compares 3 files.

---

### sdiff

sdiff merges two files and interactively outputs the results.

---

# Installing E2fsprogs

## Installation of E2fsprogs

Install E2fsprogs by running the following commands:

Please note that the empty −−with−root−prefix= option below is supposed to be like this. We did not forget to supply a value there.

```
./configure --prefix=/usr --with-root-prefix= \
   --enable-elf-shlibs &&
make &&
make install &&
make install-libs &&
mv /usr/sbin/mklost+found /sbin
```

---

## Contents

The e2fsprogs package contains the chattr, lsattr, uuidgen, badblocks, debugfs, dumpe2fs, e2fsck, e2label, fsck, fsck.ext2, mke2fs, mkfs.ext2, mklost+found and tune2fs programs.

---

## Description

### chattr

chattr changes the file attributes on a Linux second extended file system.

---

### lsattr

lsattr lists the file attributes on a second extended file system.

---

### uuidgen

The uuidgen program creates a new universally unique identifier (UUID) using the libuuid library. The new UUID can reasonably be considered unique among all UUIDs created on the local system, and among UUIDs created on other systems in the past and in the future.

---

## badblocks

badblocks is used to search for bad blocks on a device (usually a disk partition).

---

## debugfs

The debugfs program is a file system debugger. It can be used to examine and change the state of an ext2 file system.

---

## dumpe2fs

dumpe2fs prints the super block and blocks group information for the filesystem present on a specified device.

---

## e2fsck and fsck.ext2

e2fsck is used to check a Linux second extended file system. fsck.ext2 does the same as e2fsck.

---

## e2label

e2label will display or change the filesystem label on the ext2 filesystem located on the specified device.

---

## fsck

fsck is used to check and optionally repair a Linux file system.

---

## mke2fs and mkfs.ext2

mke2fs is used to create a Linux second extended file system on a device (usually a disk partition). mkfs.ext2 does the same as mke2fs.

---

## mklost+found

mklost+found is used to create a lost+found directory in the current working directory on a Linux second extended file system. mklost+found pre−allocates disk blocks to the directory to make it usable by e2fsck.

---

## tune2fs

tune2fs adjusts tunable filesystem parameters on a Linux second extended filesystem.

# Installing Fileutils

## Installation of Fileutils

Install Fileutils by running the following commands:

```
./configure --prefix=/usr --bindir=/bin \
   --libexecdir=/bin  &&
make &&
make install
```

## Contents

The Fileutils package contains the chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch and vdir programs.

## Description

### chgrp

chgrp changes the group ownership of each given file to the named group, which can be either a group name or a numeric group ID.

### chmod

chmod changes the permissions of each given file according to mode, which can be either a symbolic representation of changes to make, or an octal number representing the bit pattern for the new permissions.

### chown

chown changes the user and/or group ownership of each given file.

### cp

cp copies files from one place to another.

## dd

dd copies a file (from the standard input to the standard output, by default) with a user−selectable blocksize, while optionally performing conversions on it.

---

## df

df displays the amount of disk space available on the filesystem containing each file name argument. If no file name is given, the space available on all currently mounted filesystems is shown.

---

## ls, dir and vdir

dir and vdir are versions of ls with different default output formats. These programs list each given file or directory name. Directory contents are sorted alphabetically. For ls, files are by default listed in columns, sorted vertically, if the standard output is a terminal; otherwise they are listed one per line. For dir, files are by default listed in columns, sorted vertically. For vdir, files are by default listed in long format.

---

## dircolors

dircolors outputs commands to set the LS_COLOR environment variable. The LS_COLOR variable is use to change the default color scheme used by ls and related utilities.

---

## du

du displays the amount of disk space used by each argument and for each subdirectory of directory arguments.

---

## install

install copies files and sets their permission modes and, if possible, their owner and group.

---

## ln

ln makes hard or soft (symbolic) links between files.

---

## mkdir

mkdir creates directories with a given name.

---

## mkfifo

mkfifo creates a FIFO with each given name.

---

## mknod

mknod creates a FIFO, character special file, or block special file with the given file name.

---

## mv

mv moves files from one directory to another or renames files, depending on the arguments given to mv.

---

## rm

rm removes files or directories.

---

## rmdir

rmdir removes directories, if they are empty.

---

## shred

shred deletes a file securely, overwriting it first so that its contents can't be recovered.

---

## sync

sync forces changed blocks to disk and updates the super block.

---

## touch

touch changes the access and modification times of each given file to the current time. Files that do not exist are created empty.

---

# Installing Grep

## Installation of Grep

Install Grep by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

## Contents

The grep package contains the egrep, fgrep and grep programs.

## Description

### egrep

egrep prints lines from files matching an extended regular expression pattern.

### fgrep

fgrep prints lines from files matching a list of fixed strings, separated by newlines, any of which is to be matched.

### grep

grep prints lines from files matching a basic regular expression pattern.

# Installing Gzip

## Installation of Gzip

Install Gzip by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
cd /usr/bin &&
mv gzip /bin &&
rm gunzip zcat &&
cd /bin &&
ln -sf gzip gunzip &&
ln -s gzip zcat &&
ln -s gzip compress &&
ln -s gunzip uncompress
```

## Contents

The Gzip package contains the compress, gunzip, gzexe, gzip, uncompress, zcat, zcmp, zdiff, zforece, zgrep, zmore and znew programs.

## Description

### gunzip

gunzip decompresses files that are compressed with gzip.

### gzexe

gzexe allows to compress executables in place and have them automatically uncompress and execute when they are run (at a penalty in performance).

### gzip

gzip reduces the size of the named files using Lempel−Ziv coding (LZ77).

## zcat

zcat uncompresses either a list of files on the command line or its standard input and writes the uncompressed data on standard output

## zcmp

zcmp invokes the cmp program on compressed files.

## zdiff

zdiff invokes the diff program on compressed files.

## zforce

zforce forces a .gz extension on all gzip files so that gzip will not compress them twice. This can be useful for files with names truncated after a file transfer.

## zgrep

zgrep invokes the grep program on compressed files.

## zmore

Zmore is a filter which allows examination of compressed or plain text files one screen at a time on a soft−copy terminal (similar to the more program).

## znew

Znew re−compresses files from .Z (compress) format to .gz (gzip) format.

# Installing Lilo

## Installation of Lilo

We have chosen Lilo because we feel confortable with it, but you may wish to take a look elsewhere. Someone has written a hint on GRUB, an alternative boot loader.

Install Lilo by running the following commands:

```
make &&
make install
```

It appears that compilation of this package fails on certain machines when the −g compiler flag is being used. If a user can't compile Lilo at all, he should try to remove the −g value from the CFLAGS variable in the `Makefile` file.

At the end of the installation the make install process will print a message stating that /sbin/lilo has to be executed to complete the update. Don't do this as it has no use. The /etc/lilo.conf isn't present yet. We will complete the installation of lilo in chapter 8.

Maybe you'll be interested to know that someone wrote a hint on how to get a logo instead the the standard LILO prompt or menu. Take a look at it here.

## Contents

The Lilo package contains the lilo program.

## Description

lilo installs the Linux boot loader which is used to start a Linux system.

# Installing Make

## Installation of Make

Install Make by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

## Contents

The Make package contains the make program.

## Description

make determine automatically which pieces of a large program need to be recompiled, and issue the commands to recompile them.

# Installing Modutils

## Installation of Modutils

Install Modutils by running the following commands:

```
./configure &&
make &&
make install
```

---

## Contents

The Modutils package contains the depmod, genksyms, insmod, insmod_ksymoops_clean, kerneld, kernelversion, ksyms, lsmod, modinfo, modprobe and rmmod programs.

---

## Description

### depmod

depmod handles dependency descriptions for loadable kernel modules.

---

### genksyms

genksyms reads (on standard input) the output from gcc −E source.c and generates a file containing version information.

---

### insmod

insmod installs a loadable module in the running kernel.

---

### insmod_ksymoops_clean

insmod_ksymoops_clean deletes saved ksyms and modules not accessed in 2 days.

---

### kerneld

kerneld performs kernel action in user space (such as on−demand loading of modules)

---

## kernelversion

kernelversion reports the major version of the running kernel.

---

## ksyms

ksyms displays exported kernel symbols.

---

## lsmod

lsmod shows information about all loaded modules.

---

## modinfo

modinfo examines an object file associated with a kernel module and displays any information that it can glean.

---

## modprobe

Modprobe uses a Makefile−like dependency file, created by depmod, to automatically load the relevant module(s) from the set of modules available in predefined directory trees.

---

## rmmod

rmmod unloads loadable modules from the running kernel.

---

# Installing Procinfo

## Installation of Procinfo

Install Procinfo by running the following commands:

```
sed "s/-ltermcap/-lncurses/" Makefile | make -f -  &&
make install
```

## Command explanations

**sed "s/-ltermcap/-lncurses/" Makefile | make -f -:** This will replace –ltermcap with –lncurses in the Makefile and pipe the output of sed (the modified Makefile) directly to the make program. This is an alternate and more efficient way to direct the output to a file and tell make to use that alternate file. We do this because libtermcap is declared obsolete in favor of libncurses.

## Contents

The Procinfo package contains the procinfo program.

## Description

procinfo gathers some system data from the /proc directory and prints it nicely formatted on the standard output device.

# Installing Procps

## Installation of Procps

Install Procps by running the following commands:

```
make &&
make XSCPT='' install  &&
mv /usr/bin/kill /bin
```

## Command explanations

**`make XSCPT='' install:`** This will set the Makefile variable XSCPT to an empty value so that the XConsole installation is disabled. Otherwise "Make install" tries to copy the file XConsole to /usr/X11R6/bin. And that directory does not exist, because X is not installed yet.

## Contents

The Procps package contains the free, kill, oldps, ps, skill, snice, sysctl, tload, top, uptime, vmstat, w and watch programs.

## Description

### free

free displays the total amount of free and used physical and swap memory in the system, as well as the shared memory and buffers used by the kernel.

### kill

kills sends signals to processes.

### oldps and ps

ps gives a snapshot of the current processes.

## skill

skill sends signals to process matching a criteria.

---

## snice

snice changes the scheduling priority for process matching a criteria.

---

## sysctl

sysctl modifies kernel parameters at runtime.

---

## tload

tload prints a graph of the current system load average to the specified tty (or the tty of the tload process if none is specified).

---

## top

top provides an ongoing look at processor activity in real time.

---

## uptime

uptime gives a one line display of the following information: the current time, how long the system has been running, how many users are currently logged on, and the system load averages for the past 1, 5, and 15 minutes.

---

## vmstat

vmstat reports information about processes, memory, paging, block IO, traps, and cpu activity.

---

## w

w displays information about the users currently on the machine, and their processes.

---

## watch

watch runs command repeatedly, displaying its output (the first screen full).

---

# Installing Psmisc

## Installation of Psmisc

Install Psmisc by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install
```

## Contents

The Psmisc package contains the fuser, killall and pstree programs.

## Description

### fuser

fuser displays the PIDs of processes using the specified files or file systems.

### killall

killall sends a signal to all processes running any of the specified commands.

### pstree

pstree shows running processes as a tree.

# Installing Sed

## Installation of Sed

Install Sed by running the following commands:

```
./configure --prefix=/usr --bindir=/bin &&
make &&
make install
```

## Contents

The Sed package contains the sed program.

## Description

sed is a stream editor. A stream editor is used to perform basic text transformations on an input stream (a file or input from a pipeline).

# Installing Shellutils

## Installation of Sh−utils

Install Shellutils by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
cd /usr/bin &&
mv date echo false pwd stty /bin &&
mv su true uname hostname /bin
```

## FHS compliance notes

There is a command installed in this package which is named test. It is often used in shell scripts to evaluate conditions, but if more often encountered under the form **[ condition ]**. These brackets are built into the bash interpreter, but the FHS dictates that there should exist a `[` binary. We create that in this way, while still in the `/usr/bin` directory:

```
ln -s test [
```

## Contents

The Shellutils package contains the basename, chroot, date, dirname, echo, env, expr, factor, false, groups, hostid, hostname, id, logname, nice, nohup, pathchk, pinky, printenv, printf, pwd, seq, sleep, stty, su, tee, test, true, tty, uname, uptime, users, who, whoami and yes programs.

## Description

### basename

basename strips directory and suffixes from filenames.

### chroot

chroot runs a command or interactive shell with special root directory.

## date

date displays the current time in a specified format, or sets the system date.

---

## dirname

dirname strips non–directory suffixes from file name.

---

## echo

echo displays a line of text.

---

## env

env runs a program in a modified environment.

---

## expr

expr evaluates expressions.

---

## factor

factor prints the prime factors of all specified integer numbers.

---

## false

false always exits with a status code indicating failure.

---

## groups

groups prints the groups a user is in.

---

## hostid

hostid prints the numeric identifier (in hexadecimal) for the current host.

---

## hostname

hostname sets or prints the name of the current host system

## id

id prints the real and effective UIDs and GIDs of a user or the current user.

## logname

logname prints the current user's login name.

## nice

nice runs a program with modified scheduling priority.

## nohup

nohup runs a command immune to hangups, with output to a non−tty

## pathchk

pathchk checks whether file names are valid or portable.

## pinky

pinky is a lightweight finger utility which retrieves information about a certain user

## printenv

printenv prints all or part of the environment.

## printf

printf formats and print data (the same as the printf C function).

## pwd

pwd prints the name of the current/working directory

## seq

seq prints numbers in a certain range with a certain increment.

## sleep

sleep delays for a specified amount of time.

## stty

stty changes and prints terminal line settings.

## su

su runs a shell with substitute user and group IDs

## tee

tee reads from standard input and write to standard output and files.

## test

test checks file types and compares values.

## true

True always exits with a status code indicating success.

## tty

tty prints the file name of the terminal connected to standard input.

## uname

uname prints system information.

## uptime

uptime tells how long the system has been running.

## users

users prints the user names of users currently logged in to the current host.

## who

who shows who is logged on.

## whoami

whoami prints the users effective userid.

## yes

yes outputs a string repeatedly until killed.

# Installing Shadowpwd

## Installation of Shadow Password Suite

Install the Shadow Password Suite by running the following commands:

```
patch -Np1 -i ../shadow-20001016.patch &&
./configure --prefix=/usr &&
make &&
make install &&
cd etc &&
cp limits login.access /etc &&
sed "s|/var/spool/mail|/var/mail|" login.defs.linux >
/etc/login.defs
```

## Command explanations

**`cp limits login.access and others:`** These files were not installed during the installation of the package so we copy them manually as those files are used to configure authentication details on the system.

**`sed "s|/var/spool/mail|/var/mail|" login.defs.linux > /etc/login.defs`**: /var/spool/mail is the old location of the user mailboxes. The location that is used nowadays is /var/mail.

## Contents

The Shadow Password Suite contains the chage, chfn, chsh, expiry, faillog, gpasswd, lastlog, login, newgrp, passwd, sg, su, chpasswd, dpasswd, groupadd, groupdel, groupmod, grpck, grpconv, grpunconv, logoutd, mkpasswd, newusers, pwck, pwconv, pwunconv, useradd, userdel, usermod and vipw programs.

## Description

### chage

chage changes the number of days between password changes and the date of the last password change.

### chfn

chfn changes user full name, office number, office extension, and home phone number information for a user's account.

## chsh

chsh changes the user login shell.

## expiry

Checks and enforces password expiration policy.

## faillog

faillog formats the contents of the failure log,/var/log/faillog, and maintains failure counts and limits.

## gpasswd

gpasswd is used to administer the /etc/group file

## lastlog

lastlog formats and prints the contents of the last login log, /var/log/lastlog. The login−name, port, and last login time will be printed.

## login

login is used to establish a new session with the system.

## newgrp

newgrp is used to change the current group ID during a login session.

## passwd

passwd changes passwords for user and group accounts.

## sg

sg executes command as a different group ID.

## su

Change the effective user id and group id to that of a user. This replaces the su programs that's installed from the Shellutils package.

---

## chpasswd

chpasswd reads a file of user name and password pairs from standard input and uses this information to update a group of existing users.

---

## dpasswd

dpasswd adds, deletes, and updates dial−up passwords for user login shells.

---

## groupadd

The groupadd command creates a new group account using the values specified on the command line and the default values from the system.

---

## groupdel

The groupdel command modifies the system account files, deleting all entries that refer to group.

---

## groupmod

The groupmod command modifies the system account files to reflect the changes that are specified on the command line.

---

## grpck

grpck verifies the integrity of the system authentication information.

---

## grpconv

grpunconv converts to shadow group files from normal group files.

---

## grpunconv

grpunconv converts from shadow group files to normal group files.

## logoutd

logoutd enforces the login time and port restrictions specified in /etc/porttime.

## mkpasswd

mkpasswd reads a file in the format given by the flags and converts it to the corresponding database file format.

## newusers

newusers reads a file of user name and clear text password pairs and uses this information to update a group of existing users or to create new users.

## pwck

pwck verifies the integrity of the system authentication information.

## pwconv

pwconv converts to shadow passwd files from normal passwd files.

## pwunconv

pwunconv converts from shadow passwd files to normal files.

## useradd

useradd creates a new user or update default new user information.

## userdel

userdel modifies the system account files, deleting all entries that refer to a specified login name.

## usermod

usermod modifies the system account files to reflect the changes that are specified on the command line.

---

## vipw and vigr

vipw and vigr will edit the files /etc/passwd and /etc/group, respectively. With the −s flag, they will edit the shadow versions of those files, /etc/shadow and /etc/gshadow, respectively.

---

# Installing Sysklogd

## Installation of Sysklogd

Install Sysklogd by running the following commands:

```
make &&
make install
```

---

## Contents

The Sysklogd package contains the klogd and syslogd programs.

---

## Description

### klogd

klogd is a system daemon which intercepts and logs Linux kernel messages.

---

### syslogd

Syslogd provides a kind of logging that many modern programs use. Every logged message contains at least a time and a hostname field, normally a program name field, too, but that depends on how trusty the logging program is.

---

# Installing Sysvinit

## Installation of Sysvinit

When run levels are changed (for example when going to shutdown the system) the init program is going to send the TERM and KILL signals to all the processes that init started. But init prints a message to the screen saying "sending all processes the TERM signal" and the same for the KILL signal. This implies that init sends this signal to all the currently running processes, which isn't the case. To avoid this confusion a user can apply the sysvinit patch found on the LFS FTP site to sysvinit that changes the sentence in the shutdown.c file and have it print "sending all processes started by init the TERM signal".

Apply the patch by running the following command:

```
patch -Np1 -i ../sysvinit-2.78.patch
```

Install Sysvinit by running the following commands:

```
make -C src &&
make -C src install
```

## Contents

The Sysvinit package contains the pidof, last, lastb, mesg, utmpdump, wall, halt, init, killall5, poweroff, reboot, runlevel, shutdown, sulogin and telinit programs.

## Description

### pidof

Pidof finds the process id's (pids) of the named programs and prints those id's on standard output.

### last

last searches back through the file /var/log/wtmp (or the file designated by the -f flag) and displays a list of all users logged in (and out) since that file was created.

## lastb

lastb is the same as last, except that by default it shows a log of the file /var/log/btmp, which contains all the bad login attempts.

---

## mesg

Mesg controls the access to the users terminal by others. It's typically used to allow or disallow other users to write to his terminal.

---

## utmpdump

utmpdumps prints the content of a file (usually /var/run/utmp) on standard output in a user friendly format.

---

## wall

Wall sends a message to everybody logged in with their mesg permission set to yes.

---

## halt

Halt notes that the system is being brought down in the file /var/log/wtmp, and then either tells the kernel to halt, reboot or poweroff the system. If halt or reboot is called when the system is not in runlevel 0 or 6, shutdown will be invoked instead (with the flag −h or −r).

---

## init

Init is the parent of all processes. Its primary role is to create processes from a script stored in the file /etc/inittab. This file usually has entries which cause init to spawn gettys on each line that users can log in. It also controls autonomous processes required by any particular system.

---

## killall5

killall5 is the SystemV killall command. It sends a signal to all processes except the processes in its own session, so it won't kill the shell that is running the script it was called from.

---

## poweroff

poweroff is equivalent to shutdown −h −p now. It halts the computer and switches off the computer (when using an APM compliant BIOS and APM is enabled in the kernel).

---

## reboot

reboot is equivalent to shutdown −r now. It reboots the computer.

---

## runlevel

Runlevel reads the system utmp file (typically /var/run/utmp) to locate the runlevel record, and then prints the previous and current system runlevel on its standard output, separated by a single space.

---

## shutdown

shutdown brings the system down in a secure way. All logged−in users are notified that the system is going down, and login is blocked.

---

## sulogin

sulogin is invoked by init when the system goes into single user mode (this is done through an entry in /etc/inittab). Init also tries to execute sulogin when it is passed the −b flag from the boot loader (eg, LILO).

---

## telinit

telinit sends appropriate signals to init, telling it which runlevel to change to.

---

# Installing Tar

## Installation of Tar

If a user wants to be able to directly use bzip2 files with tar, he can use the tar patch available from the LFS FTP site. This patch will add the −y option to tar which works the same as the −z option to tar (which can be used for gzip files).

Apply the patch by running the following command:

```
cd src &&
patch −i ../../gnutarpatch.txt &&
cd ..
```

Install Tar by running the following commands from the toplevel directory:

```
./configure --prefix=/usr --libexecdir=/usr/bin  \
   --bindir=/bin &&
make &&
make install
```

---

## Contents

The tar package contains the tar and rmt programs.

---

## Description

### tar

tar is an archiving program designed to store and extract files from an archive file known as a tar file.

---

### rmt

rmt is a program used by the remote dump and restore programs in manipulating a magnetic tape drive through an interprocess communication connection.

---

# Installing Textutils

## Installation of Textutils

Install Textutils by running the following commands:

```
./configure --prefix=/usr &&
make &&
make install &&
mv /usr/bin/cat /bin
```

## Contents

The Textutils package contains the cat, cksum, comm, split, cut, expand, fmt, fold, head, join, md5sum, nl, od, paste, pr, ptx, sort, split, sum, tac, tail, tr, tsort, unexpand, uniq and wc programs.

## Description

### cat

cat concatenates file(s) or standard input to standard output.

### cksum

cksum prints CRC checksum and byte counts of each specified file.

### comm

comm compares two sorted files line by line.

### csplit

cplit outputs pieces of a file separated by (a) pattern(s) to files xx01, xx02, ..., and outputs byte counts of each piece to standard output.

## cut

cut prints selected parts of lines from specified files to standard output.

## expand

expand converts tabs in files to spaces, writing to standard output.

## fmt

fmt reformats each paragraph in the specified file(s), writing to standard output.

## fold

fold wraps input lines in each specified file (standard input by default), writing to standard output.

## head

Print first xx (10 by default) lines of each specified file to standard output.

## join

join joins lines of two files on a common field.

## md5sum

md5sum prints or checks MD5 checksums.

## nl

nl writes each specified file to standard output, with line numbers added.

## od

od writes an unambiguous representation, octal bytes by default, of a specified file to standard output.

## paste

paste writes lines consisting of the sequentially corresponding lines from each specified file, separated by TABs, to standard output.

---

## pr

pr paginates or columnates files for printing.

---

## ptx

ptx produces a permuted index of file contents.

---

## sort

sort writes sorted concatenation of files to standard output.

---

## split

split outputs fixed−size pieces of an input file to PREFIXaa, PREFIXab, ...

---

## sum

sum prints checksum and block counts for each specified file.

---

## tac

tac writes each specified file to standard output, last line first.

---

## tail

tail print the last xx (10 by default) lines of each specified file to standard output.

---

## tr

tr translates, squeezes, and/or deletes characters from standard input, writing to standard output.

---

## tsort

tsort writes totally ordered lists consistent with the partial ordering in specified files.

---

## unexpand

unexpand converts spaces in each file to tabs, writing to standard output.

---

## uniq

uniq discards all but one of successive identical lines from files or standard input and writes to files or standard output.

---

## wc

wc prints line, word, and byte counts for each specified file, and a total line if more than one file is specified.

---

# Installing Utillinux

## FHS compliance notes

The FHS recommends that we use /var/lib/hwclock as the location of the adjtime file, instead of the usual /etc. To make hwclock, which is part of the util−linux package, FHS−compliant, run the following.

```
sed "s|etc/adjtime\"\$|var/lib/hwclock/adjtime\"|" \
   hwclock/hwclock.c > hwclock~  &&
mv hwclock~ hwclock/hwclock.c &&
mkdir /var/lib/hwclock
```

## Installation of Util−Linux

Install Util−Linux by running the following commands:

```
sed s/HAVE_SLN=no/HAVE_SLN=yes/ \
   MCONFIG > MCONFIG~  &&
mv MCONFIG~ MCONFIG &&
./configure &&
make &&
make install
```

## Command explanations

**HAVE_SLN=yes**: We don't build this program because it already was installed by Glibc.

## Contents

The Util−linux package contains the arch, dmesg, kill, more, mount, umount, agetty, blockdev, cfdisk, ctrlaltdel, elvtune, fdisk, fsck.minix, hwclock, kbdrate, losetup, mkfs, mkfs.bfs, mkfs.minix, mkswap, sfdisk, swapoff, swapon, cal, chkdupexe, col, colcrt, colrm, column, cytune, ddate, fdformat, getopt, hexdump, ipcrm, ipcs, logger, look, mcookie, namei, rename, renice, rev, script, setfdprm, setsid, setterm, ul, whereis, write, ramsize, rdev, readprofile, rootflags, swapdev, tunelp and vidmode programs.

## Description

## arch

arch prints the machine architecture.

## dmesg

dmesg is used to examine or control the kernel ring buffer (boot messages from the kernel).

## kill

kill sends a specified signal to the specified process.

## more

more is a filter for paging through text one screen full at a time.

## mount

mount mounts a filesystem from a device to a directory (mount point).

## umount

umount unmounts a mounted filesystem.

## agetty

agetty opens a tty port, prompts for a login name and invokes the /bin/login command.

## blockdev

blockdev allows to call block device ioctls from the command line

## cfdisk

cfdisk is an libncurses based disk partition table manipulator.

## ctrlaltdel

ctrlaltdel sets the function of the CTRL+ALT+DEL key combination (hard or soft reset).

## elvtune

elvtune allows to tune the I/O elevator per block device queue basis.

## fdisk

fdisk is a disk partition table manipulator.

## fsck.minix

fsck.minix performs a consistency check for the Linux MINIX filesystem.

## hwclock

hwclock queries and sets the hardware clock (Also called the RTC or BIOS clock).

## kbdrate

kbdrate resets the keyboard repeat rate and delay time.

## losetup

losetup sets up and controls loop devices.

## mkfs

mkfs builds a Linux filesystem on a device, usually a harddisk partition.

## mkfs.bfs

mkfs.bfs creates a SCO bfs file system on a device, usually a harddisk partition.

### mkfs.minix

mkfs.minix creates a Linux MINIX filesystem on a device, usually a harddisk partition.

---

### mkswap

mkswap sets up a Linux swap area on a device or in a file.

---

### sfdisk

sfdisk is a disk partition table manipulator.

---

### swapoff

swapoff disables devices and files for paging an swapping.

---

### swapon

swapon enables devices and files for paging and swapping.

---

### cal

cal displays a simple calender.

---

### chkdupexe

chkdupexe finds duplicate executables.

---

### col

col filters reverse line feeds from input.

---

### colcrt

colcrt filters nroff output for CRT previewing.

---

## colrm

colrm removes columns from a file.

---

## column

column columnates lists.

---

## cytune

cytune queries and modifies the interruption threshold for the Cyclades driver.

---

## ddate

ddate converts Gregorian dates to Discordian dates.

---

## fdformat

fdformat low−level formats a floppy disk.

---

## getopt

getops parses command options the same way as the getopt C command.

---

## hexdump

hexdump displays specified files, or standard input, in a user specified format (ascii, decimal, hexadecimal, octal).

---

## ipcrm

ipcrm removes a specified resource.

---

## ipcs

ipcs provides information on IPC facilities.

---

## logger

logger makes entries in the system log.

## look

look displays lines beginning with a given string.

## mcookie

mcookie generates magic cookies for xauth.

## namei

namei follows a pathname until a terminal point is found.

## rename

rename renames files.

## renice

renice alters priority of running processes.

## rev

rev reverses lines of a file.

## script

script makes typescript of terminal session.

## setfdprm

setfdprm sets user−provides floppy disk parameters.

## setsid

setsid runs programs in a new session.

## setterm

setterm sets terminal attributes.

## ul

ul reads a file and translates occurrences of underscores to the sequence which indicates underlining for the terminal in use.

## whereis

whereis locates a binary, source and manual page for a command.

## write

write sends a message to another user.

## ramsize

ramsize queries and sets RAM disk size.

## rdev

rdev queries and sets image root device, swap device, RAM disk size, or video mode.

## readprofile

readprofile reads kernel profiling information.

## rootflags

rootflags queries and sets extra information used when mounting root.

## swapdev

swapdev queries and sets swap device.

## tunelp

tunelp sets various parameters for the LP device.

## vidmode

vidmode queries and sets the video mode.

# Removing old NSS library files

If you have copied the NSS Library files from the normal Linux system to the LFS system (because the normal system runs glibc–2.0) it's time to remove them now by running:

```
rm /lib/libnss*.so.1 /lib/libnss*2.0*
```

# Configuring essential software

Now that all software is installed, all that we need to do to get a few programs running properly is to create their configuration files.

---

## Configuring Vim

By default Vim runs in vi compatible mode. Some people might like this, but we have a high preference to run vim in vim mode (else we wouldn't have included Vim in this book but the original Vi). Create the `/root/.vimrc` by running the following:

```
cat > /root/.vimrc << "EOF"
" Begin /root/.vimrc

set nocompatible
set bs=2

" End /root/.vimrc
EOF
```

---

## Configuring Glibc

We need to create the /etc/nsswitch.conf file. Although glibc should provide defaults when this file is missing or corrupt, it's defaults don't work well with networking which will be dealt with in a later chapter. Also, our timezone needs to be setup.

Create a new file `/etc/nsswitch.conf` by running the following:

```
cat > /etc/nsswitch.conf << "EOF"
# Begin /etc/nsswitch.conf

passwd: files
group: files
shadow: files

publickey: files

hosts: files dns
networks: files

protocols: db files
services: db files
ethers: db files
rpc: db files
```

netgroup: db files

# End /etc/nsswitch.conf
**EOF**

The **tzselect** script has to be run and the questions regarding your timezone have to be answered. When you're done, the script will give the location of the needed timezone file.

Create the `/etc/localtime` symlink by running:

```
cd /etc &&
ln -sf ../usr/share/zoneinfo/<tzselect's output>  localtime
```

tzselect's output can be something like *EST5EDT* or *Canada/Eastern*.

The symlink you'd create with that information would be:

```
ln -sf ../usr/share/zoneinfo/EST5EDT localtime
```

Or:

```
ln -sf ../usr/share/zoneinfo/Canada/Eastern localtime
```

# Configuring Dynamic Loader

By default the dynamic loader searches a few default paths for dynamic libraries, so there normally isn't a need for the `/etc/ld.so.conf` file unless the system has extra directories in which a user wants the system to search for paths. The `/usr/local/lib` directory isn't searched through for dynamic libraries by default, so we want to add this path so when you install software you won't be surprised by them not running for some reason.

Create a new file `/etc/ld.so.conf` by running the following:

**cat > /etc/ld.so.conf << "EOF"**
# Begin /etc/ld.so.conf

/lib
/usr/lib
/usr/local/lib

# End /etc/ld.so.conf

```
EOF
```

Although it's not necessary to add the `/lib` and `/usr/lib` directories it doesn't hurt. This way it can be seen right away what's being searched and a you don't have to remember the default search paths if you don't want to.

# Configuring Sysklogd

Create a new file `/etc/syslog.conf` by running the following:

```
cat > /etc/syslog.conf << "EOF"
# Begin /etc/syslog.conf

auth,authpriv.* –/var/log/auth.log
*.*;auth,authpriv.none –/var/log/sys.log
daemon.* –/var/log/daemon.log
kern.* –/var/log/kern.log
mail.* –/var/log/mail.log
user.* –/var/log/user.log
*.emerg *

# End /etc/syslog.conf
EOF
```

# Configuring Shadow Password Suite

This package contains the utilities to modify user's passwords, add new users/groups, delete users/groups and more. We're not going to explain what 'password shadowing' means. All about that can be read in the doc/HOWTO file within the unpacked shadow password suite's source tree. There's one thing you should keep in mind, if you decide to use shadow support, that programs that need to verify passwords (examples are xdm, ftp daemons, pop3 daemons, etc) need to be 'shadow–compliant', eg. they need to be able to work with shadow'ed passwords.

Shadow'ed passwords are not enabled by default. Simply installing the shadow password suite does not enable shadow'ed passwords.

Now is a very good moment to read chapter 5 of the doc/HOWTO file. It describes how to enable shadow'ed passwords, how to test whether shadowing works and if not, how to disable it again.

The documentation mentions something about the creation of npasswd and nshadow after pwconv is run. This is an error in the documentation. Those two files will not be created. After pwconv is run, /etc/passwd will no longer contain the passwords and /etc/shadow will. You don't need to rename the npasswd and nshadow files yourself.

## Configuring Sysvinit

Create a new file `/etc/inittab` by running the following:

```
cat > /etc/inittab << "EOF"
# Begin /etc/inittab

id:3:initdefault:

si::sysinit:/etc/init.d/rcS

l0:0:wait:/etc/init.d/rc 0
l1:S1:wait:/etc/init.d/rc 1
l2:2:wait:/etc/init.d/rc 2
l3:3:wait:/etc/init.d/rc 3
l4:4:wait:/etc/init.d/rc 4
l5:5:wait:/etc/init.d/rc 5
l6:6:wait:/etc/init.d/rc 6

ca:12345:ctrlaltdel:/sbin/shutdown -t1 -a -r now

su:S016:respawn:/sbin/sulogin

1:2345:respawn:/sbin/agetty tty1 9600
2:2345:respawn:/sbin/agetty tty2 9600
3:2345:respawn:/sbin/agetty tty3 9600
4:2345:respawn:/sbin/agetty tty4 9600
5:2345:respawn:/sbin/agetty tty5 9600
6:2345:respawn:/sbin/agetty tty6 9600

# End /etc/inittab
EOF
```

---

## Creating the /var/run/utmp, /var/log/wtmp and /var/log/btmp files

Programs like login, shutdown, uptime and others want to read from and write to the /var/run/utmp /var/log/btmp and /var/log/wtmp. These files contain information about who is currently logged in. It also contains information on when the computer was last booted and shutdown and a record of the bad login attempts.

Create these files with their proper permissions by running the following commands:

```
touch /var/run/utmp /var/log/wtmp \
    /var/log/btmp  /var/log/lastlog &&
```

```
chmod 644 /var/run/utmp /var/log/wtmp \
   /var/log/btmp /var/log/lastlog
```

## Creating root password

Choose a password for user root and create it by running the following command:

```
passwd root
```

# Chapter 7. Creating system boot scripts

# Introduction

This chapter will create the necessary scripts that are run at boot time. These scripts perform tasks such as remounting the root file system mounted read−only by the kernel into read−write mode, activating the swap partition(s), running a check on the root file system to make sure it's intact and starting the daemons that the system uses.

We will be using SysV style init scripts. We have chosen this style because it is widely used and we feel confortable with it. If you want to try something else, someone has written an LFS−Hint on BSD style init scripts.

# How does the booting process with these scripts work?

Linux uses a special booting facility named SysVinit. It's based on a concept of *runlevels*. It can be widely different from one system to another, so it can not be assumed that because things worked in <insert distro name> they should work like that in LFS too. LFS has it's own way of doing things, but it respects generally accepted standards.

SysVinit (which we'll call *init* from now on) works using a runlevels scheme. There are 7 (from 0 to 6) runlevels (actually, there are more runlevels but they are for special cases and generally not used. The init man page describes those details), and each one of those corresponds to the things the computer is supposed to do when it starts up. The default runlevel is 3. Here are the descriptions of the different runlevels as they are often implemented:

0: halt the computer
1: single−user mode
2: multi−user mode without networking
3: multi−user mode with networking
4: reserved for customization, otherwise does the same as 3
5: same as 4, it is usually used for GUI login (like X's xdm or KDE's kdm)
6: reboot the computer

The command used to change runlevels is **`init <runlevel>`** where <runlevel> is the target runlevel. For example, to reboot the computer, a user would issue the init 6 command. The reboot command is just an alias, as is the halt command an alias to init 0.

The /etc/init.d/rcS script is run at every startup of the computer, before any runlevel is executed and runs the scripts listed in /etc/rcS.d

There are a number of directories under /etc that look like like rc?.d where ? is the number of the runlevel and rcS.d. A user might take a look at one of them (after this chapter is finished, right now there's nothing there yet). There are a number of symbolic links. Some begin with an K, the others begin with an S, and all of them have three numbers following the initial letter. The K means to stop (kill) a service, and the S means to start a service. The numbers determine the order in which the scripts are run, from 000 to 999; the lower the number the sooner it gets executed. When init switches to another runlevel, the appropriate services get killed and others get started.

The real scripts are in /etc/init.d. They do all the work, and the symlinks all point to them. Killing links and starting links point to the same script in /etc/init.d. That's because the scripts can be called with different parameters like start, stop, restart, reload, status. When a K link is encountered, the appropriate script is run with the stop argument. When a S link is encountered, the appropriate script is run with the start argument.

These are descriptions of what the arguments make the scripts do:

- *start*: The service is started.
-

*stop*: The service is stopped.

- *restart*: The service is stopped and then started again.
- *reload*: The configuration of the service is updated. This is used after the configuration file of a service was modified, when the service doesn't need to be restarted.
- *status*: Tells if the service is running and with which PID's.

Feel free to modify the way the boot process works (after all it's your LFS system, not ours). The files here are just an example of how it can be done in a nice way (well what we consider nice anyway. You may hate it).

# Creating directories

We need to start by creating a few extra directories that are used by the boot scripts. These directories are created by running:

```
cd /etc &&
mkdir sysconfig rc0.d rc1.d rc2.d rc3.d &&
mkdir rc4.d rc5.d rc6.d init.d rcS.d &&
cd init.d
```

# Creating the rc script

The first main boot script is the `/etc/init.d/rc` script. A new file `/etc/init.d/rc` is created containing the following:

```
cat > rc << "EOF"
#!/bin/sh
# Begin /etc/init.d/rc
#
# By Jason Pearce  – jason.pearce@linux.org
# Modified by Gerard Beekmans – gerard@linuxfromscratch.org
# print_error_msg based on ideas by Simon Perreault –
# nomis80@videotron.ca

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

#
# The print_error_msg function prints an error message when an unforeseen
# error occurred that wasn't trapped for some reason by a evaluate_retval
# call or error checking in different ways.

print_error_msg()
{

        echo
        $FAILURE
        echo –n "You should not read this error message. It means "
        echo "that an unforeseen error "
        echo –n "took place and subscript $i exited with "
        echo "a return value "
        echo –n "of $error_value for an unknown reason. If you're able "
        echo "to trace this error down "
        echo –n "to a bug in one of the files provided by this book, "
        echo "please be so kind to "
        echo –n "inform us at lfs–discuss@linuxfromscratch.org"
        $NORMAL
        echo
        echo
        echo "Press a key to continue..."
        read
}

#
# If you uncomment the debug variable below none of the scripts will be
# executed, just the script name and parameters will be echo'ed to the
```

```
# screen so you can see how the scripts are called by rc.
#

# Un−comment the following for debugging.
# debug=echo

#
# Start script or program.
#
startup() {

        $debug $*

}

#
# Ignore CTRL−C only in this shell, so we can interrupt subprocesses.
#

trap ":" INT QUIT TSTP

#
# Now find out what the current and what the previous runlevel are. The
# $RUNLEVEL variable is set by init for all it's children. This script
# runs as a child of init.
#

runlevel=$RUNLEVEL

#
# Get first argument. Set new runlevel to this argument. If no runlevel
# was passed to this script we won't change runlevels.
#

[ "$1" != "" ] && runlevel=$1
if [ "$runlevel" = "" ]
then
        echo "Usage: $0 <runlevel>" >&2
        exit 1
fi

#
# The same goes for $PREVLEVEL (see above for $RUNLEVEL). previous will
# be set to the previous run level. If $PREVLEVEL is not set it means
# that there is no previous runlevel and we'll set previous to N.
#

previous=$PREVLEVEL
[ "$previous" = "" ] && previous=N

export runlevel previous
```

```
#
# Is there an rc directory for the new runlevel?
#

if [ –d /etc/rc$runlevel.d ]

then

#
# If so, first collect all the K* scripts in the new run level.
#

    if [ $previous != N ]
    then
        for i in /etc/rc$runlevel.d/K*
        do
        [ ! –f $i ] && continue

#
# the suffix variable will contain the script name without the leading
# Kxxx
#

            suffix=${i#/etc/rc$runlevel.d/K[0–9][0–9][0–9]}
#
# If there is a start script for this K script in the previous runlevel
# determine what it's full path is
#
      previous_start=/etc/rc$previous.d/S[0–9][0–9][0–9]$suffix
#
# If there was no previous run level it could be that something was
# started in rcS.d (sysinit level) so we'll determine the path for that
# possibility as well.
#

            sysinit_start=/etc/rcS.d/S[0–9][0–9][0–9]$suffix

#
# Stop the service if there is a start script in the previous run level
# or in the sysinit level. If previous_start or sysinit_start do not
# exist the 'continue' command is run which causes the script to abort
# this iteration of the for loop and continue with the next iteration.
# This boils down to that it won't run the commands after the next two
# lines and start over from the top of this for loop. See man bash for
# more info on this.
#

            [ ! –f $previous_start ] &&
            [ ! –f $sysinit_start ] && continue
```

```
#
# If we found previous_start or sysinit_start, run the K script
#

                        startup $i stop
                        error_value=$?
#
# If the return value of the script is not 0, something went wrong with
# error checking inside the script. the print_error_msg function will be
# called and the message plus the return value of the K script will be
# printed to the screen
#

                        if [ $error_value != 0 ]
                        then
                                print_error_msg
                        fi

                done
        fi

#
# Now run the START scripts for this runlevel.
#

        for i in /etc/rc$runlevel.d/S*
        do
                [ ! −f $i ] && continue

                if [ $previous != N ]
        then
#
# Find start script in previous runlevel and stop script in this
# runlevel.
#

                        suffix=${i#/etc/rc$runlevel.d/S[0−9][0−9][0−9]}
                        stop=/etc/rc$runlevel.d/K[0−9][0−9][0−9]$suffix
                previous_start=/etc/rc$previous.d/S[0−9][0−9][0−9]$suffix
#
# If there is a start script in the previous level and no stop script in
# this level, we don't have to re−start the service; abort this
# iteration and start the next one.
#

                        [ −f $previous_start ] && [ ! −f $stop ] &&
                        continue
                fi

                case "$runlevel" in
                        0|6)
```

```
#
# levels 0 and 6 are halt and reboot levels. We don't really start
# anything here so we call with the 'stop' parameter
#

                        startup $i stop
                        error_value=$?
#
# If the return value of the script is not 0, something went wrong with
# error checking inside the script. the print_error_msg function will be
# called and the message plus the return value of the K script will be
# printed to the screen
#

                        if [ $error_value != 0 ]
                        then
                              print_error_msg
                        fi
                        ;;
                  *)
                        startup $i start
                        error_value=$?
#
# If the return value of the script is not 0, something went wrong with
# error checking inside the script. the print_error_msg function will be
# called and the message plus the return value of the K script will be
# printed to the screen
#

                        if [ $error_value != 0 ]
                        then
                              print_error_msg
                        fi
                        ;;
            esac
      done
fi

# End /etc/init.d/rc
EOF
```

# Creating the rcS script

The second main boot script is the `rcS` script. Create a new file `/etc/init.d/rcS` containing the following:

```
cat > rcS << "EOF"
#!/bin/sh
# Begin /etc/init.d/rcS

#
# See the rc script for the extensive comments on the constructions
# used here
#

runlevel=S
prevlevel=N
umask 022
export runlevel prevlevel

trap ":" INT QUIT TSTP

#
# Collect all the S scripts in /etc/rcS.d and execute them
#

for i in /etc/rcS.d/S*
do
        [ ! –f  "$i" ] && continue;
                $i start
done

# End /etc/init.d/rcS
EOF
```

# Creating the functions script

A new file `/etc/init.d/functions` is created containing the following:

```
cat > functions << "EOF"
#!/bin/sh
# Begin /etc/init.d/functions

#
# Set a few variables that influence the text that's printed on the
# screen. The SET_COL variable starts the text in column number 70 (as
# defined by the COL variable). NORMAL prints text in normal mode.
# SUCCESS prints text in a green colour and FAILURE prints text in a red
# colour
#

COL=70
SET_COL="echo –en \\033[${COL}G"
NORMAL="echo –en \\033[0;39m"
SUCCESS="echo –en \\033[1;32m"
FAILURE="echo –en \\033[1;31m"

#
# The evaluate_retval function evaluates the return value of the process
# that was run just before this function was called. If the return value
# was 0, indicating success, the print_status function is called with
# the 'success' parameter. Otherwise the print_status function is called
# with the failure parameter.
#

evaluate_retval()
{
	if [ $? = 0 ]
	then
		print_status success
	else
		print_status failure
	fi
}

#
# The print_status prints [  OK  ] or [FAILED] to the screen. OK appears
# in the colour defined by the SUCCESS variable and FAILED appears in
# the colour defined by the FAILURE variable. Both are printed starting
# in the column defined by the COL variable.
#

print_status()
{
```

```
#
# If no parameters are given to the print_status function, print usage
# information.
#

        if [ $# = 0 ]
        then
                echo "Usage: print_status {success|failure}"
                return 1
        fi

        case "$1" in
                success)
                        $SET_COL
                        echo -n "[  "
                        $SUCCESS
                        echo -n "OK"
                        $NORMAL
                        echo "  ]"
                        ;;
                failure)
                        $SET_COL
                        echo -n "["
                        $FAILURE
                        echo -n "FAILED"
                        $NORMAL
                        echo "]"
                        ;;
        esac

}

#
# The loadproc function starts a process (often a daemon) with
# proper error checking
#

loadproc()
{

#
# If no parameters are given to the print_status function, print usage
# information.
#

        if [ $# = 0 ]
        then
                echo "Usage: loadproc {program}"
                exit 1
        fi
```

```
#
# Find the basename of the first parameter (the daemon's name without
# the path
# that was provided so /usr/sbin/syslogd becomes plain 'syslogd' after
# basename ran)
#

        base=$(/usr/bin/basename $1)
#
# the pidlist variable will contains the output of the pidof command.
# pidof will try to find the PID's that belong to a certain string;
# $base in this case
#

        pidlist=$(/bin/pidof -o $$ -o $PPID -o %PPID -x $base)

        pid=""

        for apid in $pidlist
        do
                if [ -d /proc/$apid ]
                then
                        pid="$pid $apid"
                fi
        done
#
# If the $pid variable contains anything (from the previous for loop) it
# means the daemon is already running
#

        if [ ! -n "$pid" ]
        then
#
# Empty $pid variable means it's not running, so we run $* (all
# parameters giving to this function from the script) and then check the
# return value
#
                $*
                evaluate_retval
        else
#
# The variable $pid was not empty, meaning it was already running. We
# print [FAILED] now
#
                print_status failure
        fi

}

#
# The killproc function kills a process with proper error checking
```

```
#

killproc()
{

#
# If no parameters are given to the print_status function, print usage
# information.
#

        if [ $# = 0 ]
        then
                echo "Usage: killproc {program} [signal]"
                exit 1
        fi

#
# Find the basename of the first parameter (the daemon's name without
# the path
# that was provided so /usr/sbin/syslogd becomes plain 'syslogd' after
# basename ran)
#

        base=$(/usr/bin/basename $1)

#
# Check if we gave a signal to kill the process with (like −HUP, −TERM,
# −KILL, etc) to this function (the second parameter). If no second
# parameter was provided set the nolevel variable. Else set the
# killlevel variable to the value of $2 (the second parameter)
#

        if [ "$2" != "" ]
        then
                killlevel=−$2
        else
                nolevel=1
        fi

#
# the pidlist variable will contains the output of the pidof command.
# pidof will try to find the PID's that belong to a certain string;
# $base in this case
#

        pidlist=$(/bin/pidof −o $$ −o $PPID −o %PPID −x $base)

        pid=""

        for apid in $pidlist
        do
```

```
        if [ -d /proc/$apid ]
        then
            pid="$pid $apid"
        fi
    done

#
# If $pid contains something from the previous for loop it means one or
# more PID's were found that belongs to the processes to be killed
#
    if [ -n "$pid" ]
    then
#
# If no kill level was specified we'll try -TERM first and then sleep
# for 2 seconds to allow the kill to be completed
#
        if [ "$nolevel" = 1 ]
        then
            /bin/kill -TERM $pid
#
# If after -TERM the PID still exists we'll wait 2 seconds before
# trying to kill it with -KILL. If the PID still exist after that, wait
# two more seconds. If the PIDs still exist by then it's safe to assume
# that we cannot kill these PIDs.
#

            if /bin/ps h $pid >/dev/null 2>&1
            then
                /usr/bin/sleep 2
                if /bin/ps h $pid > /dev/null 2>&1
                then
                    /bin/kill -KILL $pid
                    if /bin/ps h $pid > /dev/null 2>&1
                    then
                        /usr/bin/sleep 2
                    fi
                fi
            fi
            /bin/ps h $pid >/dev/null 2>&1
            if [ $? = 0 ]
            then
#
# If after the -KILL it still exists it can't be killed for some reason
# and we'll print [FAILED]
#
                print_status failure
            else
#
# It was killed, remove possible stale PID file in /var/run and
# print [  OK  ]
#
```

```
                        /bin/rm -f /var/run/$base.pid
                        print_status success
                fi
        else
#
# A kill level was provided. Kill with the provided kill level and wait
# for 2 seconds to allow the kill to be completed
#
                /bin/kill $killlevel $pid
                if /bin/ps h $pid > /dev/null 2>&1
                then
                        /usr/bin/sleep 2
                fi
                /bin/ps h $pid >/dev/null 2>&1
                if [ $? = 0 ]
                then
#
# If ps' return value is 0 it means it ran ok which indicates that the
# PID still exists. This means the process wasn't killed properly with
# the signal provided. Print [FAILED]
#
                        print_status failure
                else
#
# If the return value was 1 or higher it means the PID didn't exist
# anymore which means it was killed successfully. Remove possible stale
# PID file and print [  OK  ]
#
                        /bin/rm -f /var/run/$base.pid
                        print_status success
                fi
        fi
    else
#
# The PID didn't exist so we can't attempt to kill it. Print [FAILED]
#
        print_status failure
    fi
}

#
# The reloadproc functions sends a signal to a daemon telling it to
# reload it's configuration file. This is almost identical to the
# killproc function with the exception that it won't try to kill it with
# a -KILL signal (aka -9)
#

reloadproc()
{

#
```

```
# If no parameters are given to the print_status function, print usage
# information.
#

        if [ $# = 0 ]
        then
                echo "Usage: reloadproc {program} [signal]"
                exit 1
        fi

#
# Find the basename of the first parameter (the daemon's name without
# the path that was provided so /usr/sbin/syslogd becomes plain 'syslogd'
# after basename ran)
#

        base=$(/usr/bin/basename $1)

#
# Check if we gave a signal to send to the process (like -HUP)
# to this function (the second parameter). If no second
# parameter was provided set the nolevel variable. Else set the
# killlevel variable to the value of $2 (the second parameter)
#


        if [ -n "$2" ]
        then
                killlevel=-$2
        else
                nolevel=1
        fi

#
# the pidlist variable will contains the output of the pidof command.
# pidof will try to find the PID's that belong to a certain string;
# $base in this case
#

        pidlist=$(/bin/pidof -o $$ -o $PPID -o %PPID -x $base)

        pid=""

        for apid in $pidlist
        do
                if [ -d /proc/$apid ]
                then
                        pid="$pid $apid"
                fi
        done
```

```
#
# If $pid contains something from the previous for loop it means one or
# more PID's were found that belongs to the processes to be reloaded
#

        if [ -n "$pid" ]
        then

#
# If nolevel was set we will use the default reload signal SIGHUP.
#

                if [ "$nolevel" = 1 ]
                then
                        /bin/kill -SIGHUP $pid
                        evaluate_retval
                else
#
# Else we will use the provided signal
#

                        /bin/kill $killlevel $pid
                        evaluate_retval
                fi
        else
#
# If $pid is empty no PID's have been found that belong to the process
# and print [FAILED]
#

                print_status failure
        fi
}

#
# The statusproc function will try to find out if a process is running
# or not
#

statusproc()
{

#
# If no parameters are given to the print_status function, print usage
# information.
#

        if [ $# = 0 ]
        then
                echo "Usage: status {program}"
                return 1
```

```
        fi

#
# $pid will contain a list of PID's that belong to a process
#

        pid=$(/bin/pidof -o $$ -o $PPID -o %PPID -x $1)
        if [ -n "$pid" ]
        then
#
# If $pid contains something, the process is running, print the contents
# of the $pid variable
#
                echo "$1 running with Process ID $pid"
                return 0
        fi

#
# If $pid doesn't contain it check if a PID file exists and inform the
# user about this stale file.
#

        if [ -f /var/run/$1.pid ]
        then
                pid=$(/usr/bin/head -1 /var/run/$1.pid)
                if [ -n "$pid" ]
                then
                        echo "$1 not running but /var/run/$1.pid exists"
                        return 1
                fi
        else
                echo "$1 is not running"
        fi

}

# End /etc/init.d/functions
EOF
```

# Creating the checkfs script

A new file `/etc/init.d/checkfs` is created containing the following:

```
cat > checkfs << "EOF"
#!/bin/sh
# Begin /etc/init.d/checkfs

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

#
# Activate all the swap partitions declared in the /etc/fstab file
#

echo -n "Activating swap..."
/sbin/swapon -a
evaluate_retval

#
# If the /fastboot file exists we don't want to run the partition checks
#

if [ -f /fastboot ]
then
        echo "Fast boot, no file system check"
else

#
# Mount the root partition read-only (just in case the kernel mounts it
# read-write and we don't want to run fsck on a read-write mounted
# partition).
#

        /bin/mount -n -o remount,ro /
        if [ $? = 0 ]
        then

#
# If the /forcefsck file exists we want to force a partition check even
# if the partition was unmounted cleanly the last time
#

                if [ -f /forcefsck ]
                then
                        echo -n "/forcefsck exists, forcing "
```

```
                echo "file system check"
                force="-f"
        else
                force=""
        fi

#
# Check all the file systems mentioned in /etc/fstab that have the
# fs_passno value set to 1 or 2 (the 6th field. See man fstab for more
# info)
#

        echo "Checking file systems..."
        /sbin/fsck $force -a -A -C -T

#
# If something went wrong during the checks of one of the partitions,
# fsck will exit with a return value greater than 1. If this is
# the case we start sulogin so you can repair the damage manually
#

        if [ $? -gt 1 ]
        then
                $FAILURE
                echo
                echo -n "fsck failed. Please repair your file "
                echo "systems manually by running /sbin/fsck"
                echo "without the -a option"
                echo
                echo -n "Please note that the root file system "
                echo "is currently mounted in read-only mode."
                echo
                echo -n "I will start sulogin now. When you  "
                echo "logout I will reboot your system."
                echo
                $NORMAL
                /sbin/sulogin
                /sbin/reboot -f
        else
                print_status success
        fi

    else

#
# If the remount to read-only mode didn't work abort the fsck and print
# an error
#

        echo -n "Cannot check root file system because it "
        echo "could not be mounted in read-only mode."
```

```
    fi
fi

# End /etc/init.d/checkfs
EOF
```

# Creating the halt script

A new file `/etc/init.d/halt` is created containing the following:

```
cat > halt << "EOF"
#!/bin/sh
# Begin /etc/init.d/halt

#
# Call halt. See man halt for the meaning of the parameters
#

/sbin/halt –d –f –i –p

# End /etc/init.d/halt
EOF
```

# Creating the loadkeys script

A user only needs to create this script if he don't have a default 101 keys US keyboard layout. A new file `/etc/init.d/loadkeys` containing the following has to be created:

```
cat > loadkeys << "EOF"
#!/bin/sh
# Begin /etc/init.d/loadkeys

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

#
# Load the default keymap file
#

echo -n "Loading keymap..."
/bin/loadkeys -d 2>/dev/null
evaluate_retval

# End /etc/init.d/loadkeys
EOF
```

# Creating the mountfs script

A new file `/etc/init.d/mountfs` is created containing the following:

```
cat > mountfs << "EOF"
#!/bin/sh
# Begin /etc/init.d/mountfs

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

case "$1" in
  start)

    #
    # Remount the root partition in read−write mode. −n tells mount
    # not to
    # write to the /etc/mtab file (because it can't do this. The
    # root
    # partition is most likely still mounted in read−only mode
    #

    echo −n "Remounting root file system in read−write mode..."
    /bin/mount −n −o remount,rw /
    evaluate_retval

    #
    # First empty the /etc/mtab file. Then remount root partition
    # in read−write
    # mode again but pass −f to mount. This way mount does
    # everything
    # except the mount itself. This is needed for it to write to the
    # mtab
    # file which contains a list of currently mounted file systems.
    #

    echo > /etc/mtab
    /bin/mount −f −o remount,rw /

    #
    # Remove the possible /fastboot and /forcefsck files. they are
    # only
    # supposed to be used during the next reboot's checkfs which just
    # happened. If you want to fastboot or forcefsck again you'll
    # have to
    # recreate the files
```

```
        #

        /bin/rm −f /fastboot /forcefsck

        #
        # Walk through /etc/fstab and mount all file systems that don't
        # have the noauto option set in the fs_mntops field (the 4th
        # field.
        # See man fstab for more info)
        #

        echo −n "Mounting other file systems..."
        /bin/mount −a
        evaluate_retval
        ;;

    stop)

        #
        # Deactivate all the swap partitions
        #

        echo −n "Deactivating swap..."
        /sbin/swapoff −a
        evaluate_retval

        #
        # And unmount all the file systems, mounting the root file
        # system
        # read−only (all are unmounted but because root can't be
        # unmounted
        # at this point mount will automatically mount it read−only
        # which
        # is what supposed to happen. This way no data can be written
        # anymore from disk)
        #

        echo −n "Unmounting file systems..."
        /bin/umount −a −r
        evaluate_retval
        ;;

    *)
        echo "Usage: $0 {start|stop}"
        exit 1
    ;;
esac

# End /etc/init.d/mountfs
EOF
```

# Creating the reboot script

Create a new file `/etc/init.d/reboot` containing the following:

```
cat > reboot << "EOF"
#!/bin/sh
# Begin /etc/init.d/reboot

#
# Call reboot. See man halt for the meaning of the parameters
#


echo "System reboot in progress..."

/sbin/reboot –d –f –i

# End /etc/init.d/reboot
EOF
```

# Creating the sendsignals script

Create a new file `/etc/init.d/sendsignals` containing the following:

```
cat > sendsignals << "EOF"
#!/bin/sh
# Begin /etc/init.d/sendsignals

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

#
# Send all the remaining processes the TERM signal
#

echo -n "Sending all processes the TERM signal..."
/sbin/killall5 -15
evaluate_retval

#
# Send all the remaining process (after sending them the TERM signal
# before) the KILL signal.
#

echo -n "Sending all processes the KILL signal..."
/sbin/killall5 -9
evaluate_retval

# End /etc/init.d/sendsignals
EOF
```

# Creating the setclock script

The following script is only for real use when the hardware clock (also known as BIOS or CMOS clock) isn't set to GMT time. The recommended setup is setting the hardware clock to GMT and having the time converted to localtime using the /etc/localtime symbolic link. But if an OS is run that doesn't understand a clock set to GMT (most notable are Microsoft OS'es) a user might want to set the clock to localtime so that the time is properly displayed on those OS'es. This script will reset the kernel time to the hardware clock without converting the time using the /etc/localtime symlink.

If you want to use this script on your system even if the hardware clock is set to GMT, then the UTC variable below has to be changed to the value of *1*.

```
cat > setclock << "EOF"
#!/bin/sh
# Begin /etc/init.d/setclock

#
# Include the functions declared in the /etc/init.d/functions file
# and include the variables from the /etc/sysconfig/clock file
#

source /etc/init.d/functions
source /etc/sysconfig/clock

#
# Right now we want to set the kernel clock according to the hardware
# clock, so we use the −hctosys parameter.
#

CLOCKPARAMS="−−hctosys"

#
# If the UTC variable is set in the /etc/sysconfig/clock file, add the
# −u parameter as well which tells hwclock that the hardware clock is
# set to UTC time instead of local time.
#

case "$UTC" in
        yes|true|1)
                CLOCKPARAMS="$CLOCKPARAMS −−utc"
                ;;
        no|false|0)
                CLOCKPARAMS="$CLOCKPARAMS −−localtime"
                ;;
esac

echo −n "Setting clock..."
/sbin/hwclock $CLOCKPARAMS
evaluate_retval
```

```
# End /etc/init.d/setclock
EOF
```

## Creating the /etc/sysconfig/clock file

Create a new file `/etc/sysconfig/clock` by running the following:

```
cat > /etc/sysconfig/clock << "EOF"
# Begin /etc/sysconfig/clock

UTC=1

# End /etc/sysconfig/clock
EOF
```

If the hardware clock (also known as BIOS or CMOS clock) is not set to GMT time, then the UTC variable in the /etc/sysconfig/clock file needs to be set to the value *0* (zero).

Now, you may want to take a look at a very good hint explaining how we deal with time on LFS. It explains issues such as timezones, UTC, and the TZ environment variable.

# Creating the sysklogd script

A new file `/etc/init.d/sysklogd` is created containing the following:

```
cat > sysklogd << "EOF"
#!/bin/sh
# Begin /etc/init.d/sysklogd

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

case "$1" in
        start)
                echo −n "Starting system log daemon..."
                loadproc /usr/sbin/syslogd −m 0

                echo −n "Starting kernel log daemon..."
                loadproc /usr/sbin/klogd
                ;;

        stop)
                echo −n "Stopping kernel log daemon..."
                killproc klogd

                echo −n "Stopping system log daemon..."
                killproc syslogd
                ;;

        reload)
        echo −n "Reloading system log daemon configuration file..."
                reloadproc syslogd 1
                ;;

        restart)
                $0 stop
                /usr/bin/sleep 1
                $0 start
                ;;

        status)
                statusproc /usr/sbin/syslogd
                statusproc /usr/sbin/klogd
                ;;

        *)
                echo "Usage: $0 {start|stop|reload|restart|status}"
```

```
                exit 1
        ;;

esac

# End /etc/init.d/sysklogd
EOF
```

# Creating the template script

A new file `/etc/init.d/template` is created containing the following:

```
cat > template << "EOF"
#!/bin/sh
# Begin /etc/init.d/

#
# Include the functions declared in the /etc/init.d/functions file
#

source /etc/init.d/functions

case "$1" in
	start)
		echo -n "Starting ..."
		loadproc
		;;

	stop)
		echo -n "Stopping ..."
		killproc
		;;

	reload)
		echo -n "Reloading ..."
		reloadproc
		;;

	restart)
		$0 stop
		/usr/bin/sleep 1
		$0 start
		;;

	status)
		statusproc
		;;

	*)
		echo "Usage: $0 {start|stop|reload|restart|status}"
		exit 1
	;;

esac

# End /etc/init.d/
EOF
```

# Setting up symlinks and permissions

These files get the proper permissions and the necessary symlinks are created by running the following commands. If you didn't create the loadkeys and setclock scripts, make sure not to type them in the commands below.

A note of caution: all the symlinks (that start with an S or K) have to be of the form Sxxxname where xxx are three digits donating the order in which the script is executed (the lower the number the sooner it's executed). If you feel a need to use less than three digits, make sure you pad with extra zero's at the beginning. This means, don't use S20mydaemon, but S020mydaemon. And don't use K2otherdaemon, but K002otherdaemon.

Revised rc and rcS scripts are on their way, but we had no time to properly test them for this release. They will appear in CVS shortly after this version of the book has been released.

```
cd /etc/init.d &&
chmod 754 rc rcS functions checkfs halt loadkeys mountfs
reboot &&
chmod 754 sendsignals setclock sysklogd template  &&
cd ../rc0.d &&
ln -s ../init.d/sysklogd K900sysklogd &&
ln -s ../init.d/sendsignals S800sendsignals &&
ln -s ../init.d/mountfs S900mountfs &&
ln -s ../init.d/halt S999halt &&
cd ../rc6.d &&
ln -s ../init.d/sysklogd K900sysklogd &&
ln -s ../init.d/sendsignals S800sendsignals &&
ln -s ../init.d/mountfs S900mountfs &&
ln -s ../init.d/reboot S999reboot &&
cd ../rcS.d &&
ln -s ../init.d/checkfs S200checkfs &&
ln -s ../init.d/mountfs S300mountfs &&
ln -s ../init.d/setclock S400setclock &&
ln -s ../init.d/loadkeys S500loadkeys &&
cd ../rc1.d &&
ln -s ../init.d/sysklogd K900sysklogd &&
cd ../rc2.d &&
ln -s ../init.d/sysklogd S100sysklogd &&
cd ../rc3.d &&
ln -s ../init.d/sysklogd S100sysklogd &&
cd ../rc4.d &&
ln -s ../init.d/sysklogd S100sysklogd &&
cd ../rc5.d &&
ln -s ../init.d/sysklogd S100sysklogd
```

# Chapter 8. Making the LFS system bootable

# Introduction

This chapter will make LFS bootable. This chapter deals with creating a new fstab file, building a new kernel for the new LFS system and adding the proper entries to LILO so that the LFS system can be selected for booting at the LILO: prompt.

# Creating the /etc/fstab file

In order for certain programs to be able to determine where certain partitions are supposed to be mounted by default, the /etc/fstab file is used. A new file `/etc/fstab` is created containing the following:

```
cat > /etc/fstab << "EOF"
# Begin /etc/fstab

/dev/<LFS−partition designation> / <fs−type> defaults 1 1
/dev/<swap−partition designation> swap swap defaults 0 0
proc /proc proc defaults 0 0

# End /etc/fstab
EOF
```

<LFS−partition designation>, <swap−partition designation> and <fs−type> have to be replaced with the appropriate values (/dev/hda2, /dev/hda5 and reiserfs for example).

# Installing a kernel

Building the kernel involves a few steps: configuring it and compiling it. There are a few ways to configure the kernel. If you don't like the way this book does it, read the `README` that comes with the kernel source tree, and find out what the options are. The following commands are run to build the kernel:

```
cd /usr/src/linux &&
make mrproper &&
make menuconfig &&
make dep &&
make bzImage &&
make modules &&
make modules_install &&
cp arch/i386/boot/bzImage /boot/lfskernel &&
cp System.map /boot
```

Note: the arch/i386/boot/bzImage path may vary on different platforms.

# Making the LFS system bootable

In order to being able to boot the LFS system, we need to update our bootloader. We're assuming that your host system is using Lilo (since that's the most commonly used boot loader at the moment).

We will not be running the lilo program inside chroot. Running lilo inside chroot can have fatal side–effects which render your MBR useles and you'd need a boot disk to be able to start any Linux system (either the host system or the LFS system).

First we'll exit chroot and copy the lfskernel file to the host system:

```
logout
cp $LFS/boot/lfskernel /boot
```

The next step is adding an entry to /etc/lilo.conf so that we can choose LFS when booting the computer:

```
cat >> /etc/lilo.conf << "EOF"
image=/boot/lfskernel
      label=lfs
      root=<partition>
      read–only
EOF
```

<partition> must be replaced by the LFS partition's designation.

Now the boot loader gets updated by running:

```
/sbin/lilo
```

The last step is syncing the host system lilo config. files with the LFS system:

```
cp /etc/lilo.conf $LFS/etc &&
cp <kernel images> $LFS/boot
```

To find out which kernel images files are being used, look at the /etc/lilo.conf file and find the lines starting with *image=*. If your host system has kernel files in other places than the /boot directory, make sure you update the paths in the $LFS/etc/lilo.conf file so that it does look for them in the /boot directory.

As soon as we have booted into LFS we can run **/sbin/lilo** from the LFS system in order to have the latest Lilo version in the MBR.

# Rebooting the system

Now that all software has been installed, bootscripts have been created, it's time to reboot the computer. Before we reboot let's exit the chroot'ed environment first and unmount the LFS partition by running:

```
umount $LFS/proc &&
umount $LFS
```

And you can reboot your system by running something like:

```
/sbin/shutdown -r now
```

At the LILO: prompt make sure that you tell it to boot *lfs* and not the default entry which will boot your host system again.

During the first boot you will get a few errors from syslogd and klogd. These errors occur because we haven't setup networking yet. That will be taken care of in the next chapter. So don't worry about those errors for now.

As just stated, one thing remains to be done and that's setting up networking. After having rebooted and finished the next chapter of this book the LFS system is completely ready for use, and you can start adding your own software.

# Chapter 9. Setting up basic networking

# Introduction

This chapter will setup basic networking. Although the system might not be connected to a network, Linux software uses network functions anyway. We'll be installing at least the local loopback device and a network card as well if applicable. Also the proper boot scripts will be created so that networking will be enabled during boot time.

# Installing Netkit−base

## Installation of Netkit−base

Install Netkit−base by running the following commands:

```
./configure &&
make &&
make install &&
cd etc.sample &&
cp services protocols /etc
```

There are other files in the `etc.sample` directory which might be of interest to the user.

---

## Contents

The Netkit−base package contains the inetd and ping programs.

---

## Description

### inetd

inetd is the mother of all daemons. It listens for connections, and transfers the call to the appropriate daemon.

---

### ping

ping sends ICMP ECHO_REQUEST packets to a host and determines its response time.

---

# Installing Net–tools

## Installation of Net–tools

Install Net–tools by running the following commands:

```
make &&
make install
```

## Contents

The Net–tools package contains the arp, hostname, ifconfig, netstat, plipconfig rarp, route, and slattach programs.

## Description

### arp

arp is used to manipulate the kernel's ARP cache, usually to add or delete an entry, or to dump the ARP cache.

### hostname

hostname, with its symlinks domainname, dnsdomainname, nisdomainname, ypdomainname, and nodename, is used to set or show the system's hostname (or other, depending on the symlink used).

### ifconfig

The ifconfig command is the general command used to configure network interfaces.

### netstat

netstat is a multi–purpose tool used to print the network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.

## plipconfig

plipconfig is used to fine−tune the PLIP device parameters, hopefully making it faster.

---

## rarp

Akin to the arp program, the rarp program manipulates the system's RARP table.

---

## route

route is the general utility which is used to manipulate the IP routing table.

---

## slattach

slattach attaches a network interface to a serial line, i.e.. puts a normal terminal line into one of several "network" modes.

---

# Creating the /etc/init.d/localnet boot script

A new file `/etc/init.d/localnet` is created containing the following:

```
cat > /etc/init.d/localnet << "EOF"
#!/bin/sh
# Begin /etc/init.d/localnet

#
# Include the functions declared in the /etc/init.d/functions file
# and include the variables from the /etc/sysconfig/network file.
#

source /etc/init.d/functions
source /etc/sysconfig/network

case "$1" in
        start)
                echo -n "Bringing up the loopback interface..."
                /sbin/ifconfig lo 127.0.0.1
                evaluate_retval

                echo -n "Setting up hostname..."
                /bin/hostname $HOSTNAME
                evaluate_retval
                ;;

        stop)
                echo -n "Bringing down the loopback interface..."
                /sbin/ifconfig lo down
                evaluate_retval
                ;;

        restart)
                $0 stop
                sleep 1
                $0 start
                ;;
        *)
                echo "Usage: $0: {start|stop|restart}"
                exit 1
                ;;
esac

# End /etc/init.d/localnet
EOF
```

# Setting up permissions and symlink

The proper file permissions and the necessary symlink are set or created by running the following commands:

```
cd /etc/init.d &&
chmod 754 localnet &&
cd ../rcS.d &&
ln -s ../init.d/localnet S100localnet
```

# Creating the /etc/sysconfig/network file

A new file `/etc/sysconfig/network` is created and the hostname is put in it by running:

```
echo "HOSTNAME=lfs" > /etc/sysconfig/network
```

"lfs" needs to be replaced by the name the computer is to be called. A user should not enter the FQDN (Fully Qualified Domain Name) here. That information will be put in the `/etc/hosts` file later.

# Creating the /etc/hosts file

If a network card is to be configured, a user has to decide on the IP−address, FQDN and possible aliases for use in the /etc/hosts file. An example is:

```
<my−IP> myhost.mydomain.org aliases
```

It should made sure that the IP−address is in the private network IP−address range. Valid ranges are:

```
Class Networks
A     10.0.0.0
B     172.16.0.0 through 172.31.0.0
C     192.168.0.0 through 192.168.255.0
```

A valid IP address could be 192.168.1.1. A valid FQDN for this IP could be www.linuxfromscratch.org

If a user is not going to use a network card, he still needs to come up with a FQDN. This is necessary for programs like Sendmail to operate correctly (in fact; Sendmail won't run when it can't determine the FQDN).

If a network card is not going to be configured, a new file `/etc/hosts` is created by running:

```
cat > /etc/hosts << "EOF"
# Begin /etc/hosts (no network card version)

127.0.0.1 www.mydomain.com <value of HOSTNAME> localhost

# End /etc/hosts (no network card version)
EOF
```

If a network card is to be configured, a new file `/etc/hosts` is created containing:

```
cat > /etc/hosts << "EOF"
# Begin /etc/hosts (network card version)

127.0.0.1 localhost.localdomain localhost
192.168.1.1 www.mydomain.org <value of HOSTNAME>

# End /etc/hosts (network card version)
EOF
```

Of course, the 192.168.1.1 and www.mydomain.org have to be changed to the users liking (or requirements if assigned an IP−address by a network/system administrator and this machine is planned to be connected to that network).

# Creating the /etc/init.d/ethnet script

This section only applies if a user is going to configure a network card. If not, this section can be skipped.

A new file `/etc/init.d/ethnet` is created containing the following:

```
cat > /etc/init.d/ethnet << "EOF"
#!/bin/sh
# Begin /etc/init.d/ethnet
#
# Main script by Gerard Beekmans − gerard@linuxfromscratch.org
# GATEWAY check by Jean−François Le Ray − jfleray@club−internet.fr
# "Specify which IF to use to reach default GATEWAY" by
#    Graham Cantin − gcantin@pacbell.net
#

#
# Include the functions declared in the /etc/init.d/functions file
# and the variables from the /etc/sysconfig/network file.
#

source /etc/init.d/functions
source /etc/sysconfig/network

case "$1" in
        start)

#
# Obtain all the network card configuration files
#

        for interface in $(ls /etc/sysconfig/network−scripts/ifcfg* | \
            grep −v ifcfg−lo)
        do
#
# Load the variables from that file
#

            source $interface
#
# If the ONBOOT variable is set to yes, process this file and bring the
# interface up.
#

            if [ "$ONBOOT" == yes ]
            then
                echo −n "Bringing up the $DEVICE interface..."
                /sbin/ifconfig $DEVICE $IP broadcast $BROADCAST \
                    netmask $NETMASK
```

```
            evaluate_retval
        fi
    done

#
# If the /etc/sysconfig/network file contains a GATEWAY variable, set
# the default gateway and the interface through which the default
# gateway can be reached.
#

        if [ "$GATEWAY" != "" ]; then
            echo −n "Setting up routing for eth0 interface..."
            /sbin/route add default gateway $GATEWAY \
                    metric 1 dev $GATEWAY_IF
            evaluate_retval
        fi
            ;;

    stop)

#
# Obtain all the network card configuration files
#

    for interface in $(ls /etc/sysconfig/network−scripts/ifcfg* | \
        grep −v ifcfg−lo)
    do
#
# Load the variables from that file
#

        source $interface
#
# If the ONBOOT variable is set, process the file and bring the
# interface down
#

        if [ $ONBOOT == yes ]
        then
            echo −n "Bringing down the $DEVICE interface..."
            /sbin/ifconfig $DEVICE down
            evaluate_retval
        fi
    done
            ;;

    restart)
            $0 stop
            sleep 1
            $0 start
            ;;
```

```
    *)
        echo "Usage: $0 {start|stop|restart}"
        exit 1
        ;;
esac

# End /etc/init.d/ethnet
EOF
```

## Adding default gateway to /etc/sysconfig/network

If a default gateway is required to be setup, the following command does that:

```
cat >> /etc/sysconfig/network << "EOF"
GATEWAY=192.168.1.2
GATEWAY_IF=eth0
EOF
```

GATEWAY and GATEWAY_IF need to be changed to match the network setup. GATEWAY contains the address of the default gateway, and GATEWAY_IF contains the network interface through which that default gateway can be reached.

## Creating NIC configuration files

Which interfaces are brought up and down by the ethnet script depends on the files in the /etc/sysconfig/network−scripts directory. This directory should contain files in the form of ifcfg−x where x is an identification number (or whatever a user named it).

First the network−scripts directory is created by running:

```
mkdir /etc/sysconfig/network-scripts
```

Now, new files are created in that directory containing the following. This creates a sample file ifcfg−eth0:

```
cat > /etc/sysconfig/network-scripts/ifcfg-eth0  << EOF
ONBOOT=yes
DEVICE=eth0
IP=192.168.1.1
NETMASK=255.255.255.0
BROADCAST=192.168.1.255
EOF
```

Of course, the values of those four variables have to be changed in every file to match the proper setup.

Usually NETMASK and BROADCAST will remain the same, just the DEVICE IP variables will change per network interface. If the ONBOOT variable is set to yes, the ethnet script will bring it up during boot up of the system. If set to anything else but yes it will be ignored by the ethnet script and thus not brought up.

# Setting up permissions and symlink

The proper file permissions and the necessary symlinks are set or created by running the following commands:

```
cd /etc/init.d &&
chmod 754 ethnet &&
cd ../rc0.d &&
ln -s ../init.d/ethnet K800ethnet &&
cd ../rc1.d &&
        ln -s ../init.d/ethnet K800ethnet &&
cd ../rc2.d &&
        ln -s ../init.d/ethnet K800ethnet &&
cd ../rc3.d &&
ln -s ../init.d/ethnet S200ethnet &&
cd ../rc4.d &&
ln -s ../init.d/ethnet S200ethnet &&
cd ../rc5.d &&
ln -s ../init.d/ethnet S200ethnet &&
cd ../rc6.d &&
        ln -s ../init.d/ethnet K800ethnet &&
```

# Final reboot

Reboot your system once more. You could run the network scripts by hand and then restart sysklogd, but rebooting is a nice way to test if everything works as it should. The errors from syslogd and klogd won't show up anymore.

Before you reboot you want to run lilo now. This will install the LFS version of Lilo in the MBR instead of your host system's version. Update Lilo by running:

```
/sbin/lilo
```

Now, let's reboot:

```
/sbin/reboot
```

# Chapter 10. The End

# The End

Well done! You have finished installing your LFS system. It may have been a long process but it was well worth it. We wish you a lot of fun with your new shiny custom built Linux system.

Now would be a good time to strip all debug and compiler symbols from the binaries on your LFS system. If you are not a programmer and don't plan on debugging your software, then you will be happy to know that you can reclaim a few tens of megs by removing debug symbols. This process causes no inconvenience other than not being able to debug the software fully anymore, which is not an issue if you don't know how to debug. You can remove the symbols by executing the following command:

```
find / -type f -exec strip --strip-unneeded '{}' ';'
```

If you plan to ever upgrade to a newer LFS version in the future it will be a good idea to create the /etc/lfs−3.0−pre3 file. By having this file it is very easy for you (and for us if you are going to ask for help with something at some point) to find out which LFS version you have installed on your system. This can just be a null−byte file by running:

```
touch /etc/lfs-3.0-pre3
```

If you are wondering: "Well, where to go now?" you'll be glad to hear that someone has written an LFS−Hint on that subject. On a same note, if you are not only newbie to LFS, but also newbie to Linux in general, you may find the newbie hint very interesting.

Don't forget there are several LFS mailinglists you can subscribe to if you are in need of help, advice, etc. See Chapter 1 − Mailinglists for more information.

Again, we thank you for using the LFS Book and hope you found this book useful and worth your time.

# III. Part III – Appendixes

***Table of Contents***

# Appendix A. Package descriptions

# Introduction

This appendix describes the following aspect of each and every package that is installed in this book:

- What every package contains
- What every program from a package does

The packages are listed in the same order as they are installed in chapter 5 (Intel system) or chapter 11 (PPC systems).

Most information about these packages (especially the descriptions of it) come from the man pages from those packages. I'm not going to print the entire man page, just the core elements to make it possible to understand what a program does. To get knowledge of all details on a program, I suggest to start by reading the complete man page in addition to this appendix.

Certain packages are documented more in depth than others, because I just happen to know more about certain packages than I know about others. If anything should be added on the following descriptions, please don't hesitate to email me. This list is going to contain an in depth description of every package installed, but I can't do this on my own. I have had help from various people but more help is needed.

Please note that currently only what a package does is described and not why it needs to be installed. That will be added later.

# Glibc

## Contents

The Glibc package contains the GNU C Library.

---

## Description

The C Library is a collection of commonly used functions in programs. This way a programmer doesn't need to create his own functions for every single task. The most common things like writing a string to the screen are already present and at the disposal of the programmer.

The C library (actually almost every library) come in two flavors: dynamic ones and static ones. In short when a program uses a static C library, the code from the C library will be copied into the executable file. When a program uses a dynamic library, that executable will not contain the code from the C library, but instead a routine that loads the functions from the library at the time the program is run. This means a significant decrease in the file size of a program. The documentation that comes with the C Library describes this in more detail, as it is too complicated to explain here in one or two lines.

---

# Linux kernel

## Contents

The Linux kernel package contains the Linux kernel.

---

## Description

The Linux kernel is at the core of every Linux system. It's what makes Linux tick. When a computer is turned on and boots a Linux system, the very first piece of Linux software that gets loaded is the kernel. The kernel initializes the system's hardware components such as serial ports, parallel ports, sound cards, network cards, IDE controllers, SCSI controllers and a lot more. In a nutshell the kernel makes the hardware available so that the software can run.

---

# Ed

## Contents

The Ed package contains the ed program.

## Description

Ed is a line−oriented text editor. It is used to create, display, modify and otherwise manipulate text files.

# Patch

## Contents

The Patch package contains the patch program.

## Description

The patch program modifies a file according to a patch file. A patch file usually is a list created by the diff program that contains instructions on how an original file needs to be modified. Patch is used a lot for source code patches since it saves time and space. Imagine a package that is 1MB in size. The next version of that package only has changes in two files of the first version. It can be shipped as an entirely new package of 1MB or just as a patch file of 1KB which will update the first version to make it identical to the second version. So if the first version was downloaded already, a patch file avoids a second large download.

# GCC

## Contents

The GCC package contains compilers, preprocessors and the GNU C++ Library.

---

## Description

### Compiler

A compiler translates source code in text format to a format that a computer understands. After a source code file is compiled into an object file, a linker will create an executable file from one or more of these compiler generated object files.

---

### Preprocessor

A preprocessor pre−processes a source file, such as including the contents of header files into the source file. It's a good idea to not do this manually to save a lot of time. Someone just inserts a line like #include <filename>. The preprocessor inserts the contents of that file into the source file. That's one of the things a preprocessor does.

---

### C++ Library

The C++ library is used by C++ programs. The C++ library contains functions that are frequently used in C++ programs. This way the programmer doesn't have to write certain functions (such as writing a string of text to the screen) from scratch every time he creates a program.

---

# Bison

## Contents

The Bison package contains the bison program.

## Description

Bison is a parser generator, a replacement for YACC. YACC stands for Yet Another Compiler Compiler. What is Bison then? It is a program that generates a program that analyzes the structure of a text file. Instead of writing the actual program a user specifies how things should be connected and with those rules a program is constructed that analyzes the text file.

There are a lot of examples where structure is needed and one of them is the calculator.

Given the string :

```
1 + 2 * 3
```

A human can easily come to the result 7. Why? Because of the structure. Our brain knows how to interpret the string. The computer doesn't know that and Bison is a tool to help it understand by presenting the string in the following way to the compiler:

```
    +
   / \
  *   1
 / \
2   3
```

Starting at the bottom of a tree and coming across the numbers 2 and 3 which are joined by the multiplication symbol, the computer multiplies 2 and 3. The result of that multiplication is remembered and the next thing that the computer sees is the result of 2*3 and the number 1 which are joined by the add symbol. Adding 1 to the previous result makes 7. In calculating the most complex calculations can be broken down in this tree format and the computer just starts at the bottom and works it's way up to the top and comes with the correct answer. Of course, Bison isn't only used for calculators alone.

# Mawk

## Contents

The Mawk package contains the mawk program.

## Description

### mawk

Mawk is an interpreter for the AWK Programming Language. The AWK language is useful for manipulation of data files, text retrieval and processing, and for prototyping and experimenting with algorithms.

# Findutils

## Contents

The Findutils package contains the find, locate, updatedb, xargs, frcode, code and bigram programs.

---

## Description

### Find

The find program searches for files in a directory hierarchy which match a certain criteria. If no criteria is given, it lists all files in the current directory and it's subdirectories.

---

### Locate

Locate scans a database which contain all files and directories on a filesystem. This program lists the files and directories in this database matching a certain criteria. If a user is looking for a file this program will scan the database and tell him exactly where the files he requested are located. This only makes sense if the locate database is fairly up−to−date else it will provide out−of−date information.

---

### Updatedb

The updatedb program updates the locate database. It scans the entire file system (including other file system that are currently mounted unless it is told not to do so) and puts every directory and file it finds into the database that's used by the locate program which retrieves this information. It's a good practice to update this database once a day to have it up−to−date whenever it is needed.

---

### Xargs

The xargs command applies a command to a list of files. If there is a need to perform the same command on multiple files, a file can be created that contains all these files (one per line) and use xargs to perform that command on the list.

---

### frcode

updatedb runs a program called frcode to compress the list of file names using front−compression, which reduces the database size by a factor of 4 to 5.

---

## code

code is the ancestor of frcode. It was used in older−style locate databases.

---

## bigram

bigram is used together with code to produce older−style locate databases. To learn more about these last three programs, read the locatedb.5 manual page.

---

# Ncurses

## Contents

The Ncurses package contains the ncurses, panel, menu and form libraries. It also contains the tic, infocmp, clear, tput, toe and tset programs.

---

## Description

### The libraries

The libraries that make up the Ncurses library are used to display text (often in a fancy way) on the screen. An example where ncurses is used is in the kernel's "make menuconfig" process. The libraries contain routines to create panels, menu's, form and general text display routines.

---

### Tic

Tic is the terminfo entry−description compiler. The program translates a terminfo file from source format into the binary format for use with the ncurses library routines. Terminfo files contain information about the capabilities of a terminal.

---

### Infocmp

The infocmp program can be used to compare a binary terminfo entry with other terminfo entries, rewrite a terminfo description to take advantage of the use= terminfo field, or print out a terminfo description from the binary file (term) in a variety of formats (the opposite of what tic does).

---

### clear

The clear program clears the screen if this is possible. It looks in the environment for the terminal type and then in the terminfo database to figure out how to clear the screen.

---

### tput

The tput program uses the terminfo database to make the values of terminal−dependent capabilities and information available to the shell, to initialize or reset the terminal, or return the long name of the requested terminal type.

---

## toe

The toe program lists all available terminal types by primary name with descriptions.

---

## tset

The Tset program initializes terminals so they can be used, but it's not widely used anymore. It's provided for 4.4BSD compatibility.

---

# Less

## Contents

The Less package contains the less program

## Description

The less program is a file pager (or text viewer). It displays the contents of a file with the ability to scroll. Less is an improvement on the common pager called "more". Less has the ability to scroll backwards through files as well and it doesn't need to read the entire file when it starts, which makes it faster when reading large files.

# Groff

## Contents

The Groff packages contains the addftinfo, afmtodit, eqn, grodvi, groff, grog, grohtml, grolj4, grops, grotty, hpftodit, indxbib, lkbib, lookbib, neqn, nroff, pfbtops, pic, psbb, refer, soelim, tbl, tfmtodit and troff programs.

---

## Description

### addftinfo

addftinfo reads a troff font file and adds some additional font−metric information that is used by the groff system.

---

### afmtodit

afmtodit creates a font file for use with groff and grops.

---

### eqn

eqn compiles descriptions of equations embedded within troff input files into commands that are understood by troff.

---

### grodvi

grodvi is a driver for groff that produces TeX dvi format.

---

### groff

groff is a front−end to the groff document formatting system. Normally it runs the troff program and a post−processor appropriate for the selected device.

---

### grog

grog reads files and guesses which of the groff options −e, −man, −me, −mm, −ms, −p, −s, and −t are required for printing files, and prints the groff command including those options on the standard output.

---

## grohtml

grohtml translates the output of GNU troff to html

## grolj4

grolj4 is a driver for groff that produces output in PCL5 format suitable for an HP Laserjet 4 printer.

## grops

grops translates the output of GNU troff to Postscript.

## grotty

grotty translates the output of GNU troff into a form suitable for typewriter−like devices.

## hpftodit

hpftodit creates a font file for use with groff −Tlj4 from an HP tagged font metric file.

## indxbib

indxbib makes an inverted index for the bibliographic databases a specified file for use with refer, lookbib, and lkbib.

## lkbib

lkbib searches bibliographic databases for references that contain specified keys and prints any references found on the standard output.

## lookbib

lookbib prints a prompt on the standard error (unless the standard input is not a terminal), reads from the standard input a line containing a set of keywords, searches the bibliographic databases in a specified file for references containing those keywords, prints any references found on the standard output, and repeats this process until the end of input.

## neqn

It is currently not known what neqn is and what it does.

---

## nroff

The nroff script emulates the nroff command using groff.

---

## pfbtops

pfbtops translates a Postscript font in .pfb format to ASCII.

---

## pic

pic compiles descriptions of pictures embedded within troff or TeX input files into commands that are understood by TeX or troff.

---

## psbb

psbb reads a file which should be a Postscript document conforming to the Document Structuring conventions and looks for a %%BoundingBox comment.

---

## refer

refer copies the contents of a file to the standard output, except that lines between .[ and .] are interpreted as citations, and lines between .R1 and .R2 are interpreted as commands about how citations are to be processed.

---

## soelim

soelim reads files and replaces lines of the form *.so file* by the contents of *file*.

---

## tbl

tbl compiles descriptions of tables embedded within troff input files into commands that are understood by troff.

---

## tfmtodit

tfmtodit creates a font file for use with **`groff -Tdvi`**

## troff

troff is highly compatible with Unix troff. Usually it should be invoked using the groff command, which will also run preprocessors and post–processors in the appropriate order and with the appropriate options.

# Man

## Contents

The Man package contains the man, apropos whatis and makewhatis programs.

## Description

### man

man formats and displays the on−line manual pages.

### apropos

apropos searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output.

### whatis

whatis searches a set of database files containing short descriptions of system commands for keywords and displays the result on the standard output. Only complete word matches are displayed.

### makewhatis

makewhatis reads all the manual pages contained in given sections of manpath or the pre−formatted pages contained in the given sections of catpath. For each page, it writes a line in the whatis database; each line consists of the name of the page and a short description, separated by a dash. The description is extracted using the content of the NAME section of the manual page.

# Perl

## Contents

The Perl package contains Perl – Practical Extraction and Report Language

## Description

Perl combines the features and capabilities of C, awk, sed and sh into one powerful programming language.

# M4

## Contents

The M4 package contains the M4 processor

## Description

M4 is a macro processor. It copies input to output expanding macros as it goes. Macros are either built−in or user−defined and can take any number of arguments. Besides just doing macro expansion m4 has built−in functions for including named files, running UNIX commands, doing integer arithmetic, manipulating text in various ways, recursion, etc. M4 can be used either as a front−end to a compiler or as a macro processor in its own right.

# Texinfo

## Contents

The Texinfo package contains the info, install–info, makeinfo, texi2dvi and texindex programs

## Description

### info

The info program reads Info documents, usually contained in the /usr/doc/info directory. Info documents are like man(ual) pages, but they tend to be more in depth than just explaining the options to a program.

### install–info

The install–info program updates the info entries. When the info program is run a list with available topics (ie: available info documents) will be presented. The install–info program is used to maintain this list of available topics. If info files are removed manually, it is also necessary to delete the topic in the index file as well. This program is used for that. It also works the other way around when info documents are added.

### makeinfo

The makeinfo program translates Texinfo source documents into various formats. Available formats are: info files, plain text and HTML.

### texi2dvi

The texi2dvi program prints Texinfo documents

### texindex

The texindex program is used to sort Texinfo index files.

# Autoconf

## Contents

The Autoconf package contains the autoconf, autoheader, autoreconf, autoscan, autoupdate and ifnames programs

---

## Description

### autoconf

Autoconf is a tool for producing shell scripts that automatically configure software source code packages to adapt to many kinds of UNIX−like systems. The configuration scripts produced by Autoconf are independent of Autoconf when they are run, so their users do not need to have Autoconf.

---

### autoheader

The autoheader program can create a template file of C #define statements for configure to use

---

### autoreconf

If there are a lot of Autoconf−generated configure scripts, the autoreconf program can save some work. It runs autoconf (and autoheader, where appropriate) repeatedly to remake the Autoconf configure scripts and configuration header templates in the directory tree rooted at the current directory.

---

### autoscan

The autoscan program can help to create a configure.in file for a software package. autoscan examines source files in the directory tree rooted at a directory given as a command line argument, or the current directory if none is given. It searches the source files for common portability problems and creates a file configure.scan which is a preliminary configure.in for that package.

---

### autoupdate

The autoupdate program updates a configure.in file that calls Autoconf macros by their old names to use the current macro names.

---

### ifnames

ifnames can help when writing a configure.in for a software package. It prints the identifiers that the package already uses in C preprocessor conditionals. If a package has already been set up to have some portability, this program can help to figure out what its configure needs to check for. It may help fill in some gaps in a configure.in generated by autoscan.

# Automake

## Contents

The Automake package contains the aclocal and automake programs

## Description

### aclocal

Automake includes a number of Autoconf macros which can be used in packages; some of them are actually required by Automake in certain situations. These macros must be defined in the aclocal.m4−file; otherwise they will not be seen by autoconf.

The aclocal program will automatically generate aclocal.m4 files based on the contents of configure.in. This provides a convenient way to get Automake−provided macros, without having to search around. Also, the aclocal mechanism is extensible for use by other packages.

### automake

To create all the Makefile.in's for a package, run the automake program in the top level directory, with no arguments. automake will automatically find each appropriate Makefile.am (by scanning configure.in) and generate the corresponding Makefile.in.

# Bash

## Contents

The Bash package contains the bash program

## Description

Bash is the Bourne−Again SHell, which is a widely used command interpreter on Unix systems. Bash is a program that reads from standard input, the keyboard. A user types something and the program will evaluate what he has typed and do something with it, like running a program.

# Flex

## Contents

The Flex package contains the flex program

## Description

Flex is a tool for generating programs which recognizes patterns in text. Pattern recognition is very useful in many applications. A user sets up rules what to look for and flex will make a program that looks for those patterns. The reason people use flex is that it is much easier to set up rules for what to look for than to write the actual program that finds the text.

# Binutils

## Description

The Binutils package contains the gasp, gprof, ld, as, ar, nm, objcopy, objdump, ranlib, readelf, size, strings, strip, c++filt and addr2line programs

---

## Description

### gasp

Gasp is the Assembler Macro Preprocessor.

---

### gprof

gprof displays call graph profile data.

---

### ld

ld combines a number of object and archive files, relocates their data and ties up symbol references. Often the last step in building a new compiled program to run is a call to ld.

---

### as

as is primarily intended to assemble the output of the GNU C compiler gcc for use by the linker ld.

---

### ar

The ar program creates, modifies, and extracts from archives. An archive is a single file holding a collection of other files in a structure that makes it possible to retrieve the original individual files (called members of the archive).

---

### nm

nm lists the symbols from object files.

---

## objcopy

objcopy utility copies the contents of an object file to another. objcopy uses the GNU BFD Library to read and write the object files. It can write the destination object file in a format different from that of the source object file.

---

## objdump

objdump displays information about one or more object files. The options control what particular information to display. This information is mostly useful to programmers who are working on the compilation tools, as opposed to programmers who just want their program to compile and work.

---

## ranlib

ranlib generates an index to the contents of an archive, and stores it in the archive. The index lists each symbol defined by a member of an archive that is a relocatable object file.

---

## readelf

readelf displays information about elf type binaries.

---

## size

size lists the section sizes −−and the total size−− for each of the object files objfile in its argument list. By default, one line of output is generated for each object file or each module in an archive.

---

## strings

For each file given, strings prints the printable character sequences that are at least 4 characters long (or the number specified with an option to the program) and are followed by an unprintable character. By default, it only prints the strings from the initialized and loaded sections of object files; for other types of files, it prints the strings from the whole file.

strings is mainly useful for determining the contents of non−text files.

---

## strip

strip discards all or specific symbols from object files. The list of object files may include archives. At least one object file must be given. strip modifies the files named in its argument, rather than writing modified copies under different names.

---

## c++filt

The C++ language provides function overloading, which means that it is possible to write many functions with the same name (providing each takes parameters of different types). All C++ function names are encoded into a low−level assembly label (this process is known as mangling). The c++filt program does the inverse mapping: it decodes (demangles) low−level names into user−level names so that the linker can keep these overloaded functions from clashing.

---

## addr2line

addr2line translates program addresses into file names and line numbers. Given an address and an executable, it uses the debugging information in the executable to figure out which file name and line number are associated with a given address.

---

# Bzip2

## Contents

The Bzip2 packages contains the bzip2, bunzip2, bzcat and bzip2recover programs.

---

## Description

### Bzip2

bzip2 compresses files using the Burrows−Wheeler block sorting text compression algorithm, and Huffman coding. Compression is generally considerably better than that achieved by more conventional LZ77/LZ78−based compressors, and approaches the performance of the PPM family of statistical compressors.

---

### Bunzip2

Bunzip2 decompresses files that are compressed with bzip2.

---

### bzcat

bzcat (or bzip2 −dc) decompresses all specified files to the standard output.

---

### bzip2recover

bzip2recover recovers data from damaged bzip2 files.

---

# Diffutils

## Contents

The Diffutils package contains the cmp, diff, diff3 and sdiff programs.

---

## Description

### cmp and diff

cmp and diff both compare two files and report their differences. Both programs have extra options which compare files in different situations.

---

### diff3

The difference between diff and diff3 is that diff compares 2 files, diff3 compares 3 files.

---

### sdiff

sdiff merges two files and interactively outputs the results.

---

# E2fsprogs

## Contents

The e2fsprogs package contains the chattr, lsattr, uuidgen, badblocks, debugfs, dumpe2fs, e2fsck, e2label, fsck, fsck.ext2, mke2fs, mkfs.ext2, mklost+found and tune2fs programs.

---

## Description

### chattr

chattr changes the file attributes on a Linux second extended file system.

---

### lsattr

lsattr lists the file attributes on a second extended file system.

---

### uuidgen

The uuidgen program creates a new universally unique identifier (UUID) using the libuuid library. The new UUID can reasonably be considered unique among all UUIDs created on the local system, and among UUIDs created on other systems in the past and in the future.

---

### badblocks

badblocks is used to search for bad blocks on a device (usually a disk partition).

---

### debugfs

The debugfs program is a file system debugger. It can be used to examine and change the state of an ext2 file system.

---

### dumpe2fs

dumpe2fs prints the super block and blocks group information for the filesystem present on a specified device.

---

## e2fsck and fsck.ext2

e2fsck is used to check a Linux second extended file system. fsck.ext2 does the same as e2fsck.

## e2label

e2label will display or change the filesystem label on the ext2 filesystem located on the specified device.

## fsck

fsck is used to check and optionally repair a Linux file system.

## mke2fs and mkfs.ext2

mke2fs is used to create a Linux second extended file system on a device (usually a disk partition). mkfs.ext2 does the same as mke2fs.

## mklost+found

mklost+found is used to create a lost+found directory in the current working directory on a Linux second extended file system. mklost+found pre−allocates disk blocks to the directory to make it usable by e2fsck.

## tune2fs

tune2fs adjusts tunable filesystem parameters on a Linux second extended filesystem.

# File

## Contents

The File package contains the file program.

## Description

File tests each specified file in an attempt to classify it. There are three sets of tests, performed in this order: filesystem tests, magic number tests, and language tests. The first test that succeeds causes the file type to be printed.

# Fileutils

## Contents

The Fileutils package contains the chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch and vdir programs.

---

## Description

### chgrp

chgrp changes the group ownership of each given file to the named group, which can be either a group name or a numeric group ID.

---

### chmod

chmod changes the permissions of each given file according to mode, which can be either a symbolic representation of changes to make, or an octal number representing the bit pattern for the new permissions.

---

### chown

chown changes the user and/or group ownership of each given file.

---

### cp

cp copies files from one place to another.

---

### dd

dd copies a file (from the standard input to the standard output, by default) with a user−selectable blocksize, while optionally performing conversions on it.

---

### df

df displays the amount of disk space available on the filesystem containing each file name argument. If no file name is given, the space available on all currently mounted filesystems is shown.

---

## ls, dir and vdir

dir and vdir are versions of ls with different default output formats. These programs list each given file or directory name. Directory contents are sorted alphabetically. For ls, files are by default listed in columns, sorted vertically, if the standard output is a terminal; otherwise they are listed one per line. For dir, files are by default listed in columns, sorted vertically. For vdir, files are by default listed in long format.

---

## dircolors

dircolors outputs commands to set the LS_COLOR environment variable. The LS_COLOR variable is use to change the default color scheme used by ls and related utilities.

---

## du

du displays the amount of disk space used by each argument and for each subdirectory of directory arguments.

---

## install

install copies files and sets their permission modes and, if possible, their owner and group.

---

## ln

ln makes hard or soft (symbolic) links between files.

---

## mkdir

mkdir creates directories with a given name.

---

## mkfifo

mkfifo creates a FIFO with each given name.

---

## mknod

mknod creates a FIFO, character special file, or block special file with the given file name.

---

### mv

mv moves files from one directory to another or renames files, depending on the arguments given to mv.

### rm

rm removes files or directories.

### rmdir

rmdir removes directories, if they are empty.

### shred

shred deletes a file securely, overwriting it first so that its contents can't be recovered.

### sync

sync forces changed blocks to disk and updates the super block.

### touch

touch changes the access and modification times of each given file to the current time. Files that do not exist are created empty.

# Gettext

## Contents

The gettext package contains the gettext, gettextize, msgcmp, msgcomm, msgfmt, msgmerge, msgunfmt and xgettext programs.

---

## Description

### gettext

The gettext package is used for internationalization (also known as i18n) and for localization (also known as l10n). Programs can be compiled with Native Language Support (NLS) which enable them to output messages in the users native language rather than in the default English language.

---

# Grep

## Contents

The grep package contains the egrep, fgrep and grep programs.

---

## Description

### egrep

egrep prints lines from files matching an extended regular expression pattern.

---

### fgrep

fgrep prints lines from files matching a list of fixed strings, separated by newlines, any of which is to be matched.

---

### grep

grep prints lines from files matching a basic regular expression pattern.

---

# Gzip

## Contents

The Gzip package contains the compress, gunzip, gzexe, gzip, uncompress, zcat, zcmp, zdiff, zforece, zgrep, zmore and znew programs.

---

## Description

### gunzip

gunzip decompresses files that are compressed with gzip.

---

### gzexe

gzexe allows to compress executables in place and have them automatically uncompress and execute when they are run (at a penalty in performance).

---

### gzip

gzip reduces the size of the named files using Lempel−Ziv coding (LZ77).

---

### zcat

zcat uncompresses either a list of files on the command line or its standard input and writes the uncompressed data on standard output

---

### zcmp

zcmp invokes the cmp program on compressed files.

---

### zdiff

zdiff invokes the diff program on compressed files.

---

### zforce

zforce forces a .gz extension on all gzip files so that gzip will not compress them twice. This can be useful for files with names truncated after a file transfer.

## zgrep

zgrep invokes the grep program on compressed files.

## zmore

Zmore is a filter which allows examination of compressed or plain text files one screen at a time on a soft–copy terminal (similar to the more program).

## znew

Znew re–compresses files from .Z (compress) format to .gz (gzip) format.

# Libtool

## Contents

The Libtool package contains the libtool and libtoolize programs. It also contains the ltdl library.

## Description

### libtool

Libtool provides generalized library−building support services.

### libtoolize

libtoolize provides a standard way to add libtool support to a package.

### ltdl library

Libtool provides a small library, called `libltdl', that aims at hiding the various difficulties of dlopening libraries from programmers.

# Bin86

## Contents

The Bin86 contains the as86, as86_encap, ld86, objdump86, nm86 and size86 programs.

---

## Description

### as86

as86 is an assembler for the 8086...80386 processors.

---

### as86_encap

as86_encap is a shell script to call as86 and convert the created binary into a C file prog.v to be included in or linked with programs like boot block installers.

---

### ld86

ld86 understands only the object files produced by the as86 assembler, it can link them into either an impure or a separate I&D executable.

---

### objdump86

No description available.

---

### nm86

No description available.

---

### size86

No description available.

---

# Lilo

## Contents

The Lilo package contains the lilo program.

## Description

lilo installs the Linux boot loader which is used to start a Linux system.

# Make

## Contents

The Make package contains the make program.

## Description

make determine automatically which pieces of a large program need to be recompiled, and issue the commands to recompile them.

# Shellutils

## Contents

The Shellutils package contains the basename, chroot, date, dirname, echo, env, expr, factor, false, groups, hostid, hostname, id, logname, nice, nohup, pathchk, pinky, printenv, printf, pwd, seq, sleep, stty, su, tee, test, true, tty, uname, uptime, users, who, whoami and yes programs.

---

## Description

### basename

basename strips directory and suffixes from filenames.

---

### chroot

chroot runs a command or interactive shell with special root directory.

---

### date

date displays the current time in a specified format, or sets the system date.

---

### dirname

dirname strips non–directory suffixes from file name.

---

### echo

echo displays a line of text.

---

### env

env runs a program in a modified environment.

---

### expr

expr evaluates expressions.

---

## factor

factor prints the prime factors of all specified integer numbers.

---

## false

false always exits with a status code indicating failure.

---

## groups

groups prints the groups a user is in.

---

## hostid

hostid prints the numeric identifier (in hexadecimal) for the current host.

---

## hostname

hostname sets or prints the name of the current host system

---

## id

id prints the real and effective UIDs and GIDs of a user or the current user.

---

## logname

logname prints the current user's login name.

---

## nice

nice runs a program with modified scheduling priority.

---

## nohup

nohup runs a command immune to hangups, with output to a non−tty

---

## pathchk

pathchk checks whether file names are valid or portable.

## pinky

pinky is a lightweight finger utility which retrieves information about a certain user

## printenv

printenv prints all or part of the environment.

## printf

printf formats and print data (the same as the printf C function).

## pwd

pwd prints the name of the current/working directory

## seq

seq prints numbers in a certain range with a certain increment.

## sleep

sleep delays for a specified amount of time.

## stty

stty changes and prints terminal line settings.

## su

su runs a shell with substitute user and group IDs

## tee

tee reads from standard input and write to standard output and files.

## test

test checks file types and compares values.

## true

True always exits with a status code indicating success.

## tty

tty prints the file name of the terminal connected to standard input.

## uname

uname prints system information.

## uptime

uptime tells how long the system has been running.

## users

users prints the user names of users currently logged in to the  current host.

## who

who shows who is logged on.

## whoami

whoami prints the users effective userid.

## yes

yes outputs a string repeatedly until killed.

# Shadow Password Suite

## Contents

The Shadow Password Suite contains the chage, chfn, chsh, expiry, faillog, gpasswd, lastlog, login, newgrp, passwd, sg, su, chpasswd, dpasswd, groupadd, groupdel, groupmod, grpck, grpconv, grpunconv, logoutd, mkpasswd, newusers, pwck, pwconv, pwunconv, useradd, userdel, usermod and vipw programs.

---

## Description

### chage

chage changes the number of days between password changes and the date of the last password change.

---

### chfn

chfn changes user full name, office number, office extension, and home phone number information for a user's account.

---

### chsh

chsh changes the user login shell.

---

### expiry

Checks and enforces password expiration policy.

---

### faillog

faillog formats the contents of the failure log,/var/log/faillog, and maintains failure counts and limits.

---

### gpasswd

gpasswd is used to administer the /etc/group file

---

### lastlog

lastlog formats and prints the contents of the last login log, /var/log/lastlog. The login−name, port, and last login time will be printed.

## login

login is used to establish a new session with the system.

## newgrp

newgrp is used to change the current group ID during a login session.

## passwd

passwd changes passwords for user and group accounts.

## sg

sg executes command as a different group ID.

## su

Change the effective user id and group id to that of a user. This replaces the su programs that's installed from the Shellutils package.

## chpasswd

chpasswd reads a file of user name and password pairs from standard input and uses this information to update a group of existing users.

## dpasswd

dpasswd adds, deletes, and updates dial–up passwords for user login shells.

## groupadd

The groupadd command creates a new group account using the values specified on the command line and the default values from the system.

## groupdel

The groupdel command modifies the system account files, deleting all entries that refer to group.

## groupmod

The groupmod command modifies the system account files to reflect the changes that are specified on the command line.

## grpck

grpck verifies the integrity of the system authentication information.

## grpconv

grpunconv converts to shadow group files from normal group files.

## grpunconv

grpunconv converts from shadow group files to normal group files.

## logoutd

logoutd enforces the login time and port restrictions specified in /etc/porttime.

## mkpasswd

mkpasswd reads a file in the format given by the flags and converts it to the corresponding database file format.

## newusers

newusers reads a file of user name and clear text password pairs and uses this information to update a group of existing users or to create new users.

## pwck

pwck verifies the integrity of the system authentication information.

## pwconv

pwconv converts to shadow passwd files from normal passwd files.

---

## pwunconv

pwunconv converts from shadow passwd files to normal files.

---

## useradd

useradd creates a new user or update default new user information.

---

## userdel

userdel modifies the system account files, deleting all entries that refer to a specified login name.

---

## usermod

usermod modifies the system account files to reflect the changes that are specified on the command line.

---

## vipw and vigr

vipw and vigr will edit the files /etc/passwd and /etc/group, respectively. With the −s flag, they will edit the shadow versions of those files, /etc/shadow and /etc/gshadow, respectively.

---

# Modutils

## Contents

The Modutils package contains the depmod, genksyms, insmod, insmod_ksymoops_clean, kerneld, kernelversion, ksyms, lsmod, modinfo, modprobe and rmmod programs.

---

## Description

### depmod

depmod handles dependency descriptions for loadable kernel modules.

---

### genksyms

genksyms reads (on standard input) the output from gcc –E source.c and generates a file containing version information.

---

### insmod

insmod installs a loadable module in the running kernel.

---

### insmod_ksymoops_clean

insmod_ksymoops_clean deletes saved ksyms and modules not accessed in 2 days.

---

### kerneld

kerneld performs kernel action in user space (such as on–demand loading of modules)

---

### kernelversion

kernelversion reports the major version of the running kernel.

---

### ksyms

ksyms displays exported kernel symbols.

---

## lsmod

lsmod shows information about all loaded modules.

## modinfo

modinfo examines an object file associated with a kernel module and displays any information that it can glean.

## modprobe

Modprobe uses a Makefile–like dependency file, created by depmod, to automatically load the relevant module(s) from the set of modules available in predefined directory trees.

## rmmod

rmmod unloads loadable modules from the running kernel.

# Procinfo

## Contents

The Procinfo package contains the procinfo program.

## Description

procinfo gathers some system data from the /proc directory and prints it nicely formatted on the standard output device.

# Procps

## Contents

The Procps package contains the free, kill, oldps, ps, skill, snice, sysctl, tload, top, uptime, vmstat, w and watch programs.

---

## Description

### free

free displays the total amount of free and used physical and swap memory in the system, as well as the shared memory and buffers used by the kernel.

---

### kill

kills sends signals to processes.

---

### oldps and ps

ps gives a snapshot of the current processes.

---

### skill

skill sends signals to process matching a criteria.

---

### snice

snice changes the scheduling priority for process matching a criteria.

---

### sysctl

sysctl modifies kernel parameters at runtime.

---

### tload

tload prints a graph of the current system load average to the specified tty (or the tty of the tload process if none is specified).

---

## top

top provides an ongoing look at processor activity in real time.

---

## uptime

uptime gives a one line display of the following information: the current time, how long the system has been running, how many users are currently logged on, and the system load averages for the past 1, 5, and 15 minutes.

---

## vmstat

vmstat reports information about processes, memory, paging, block IO, traps, and cpu activity.

---

## w

w displays information about the users currently on the machine, and their processes.

---

## watch

watch runs command repeatedly, displaying its output (the first screen full).

---

# Vim

## Contents

The Vim package contains the ctags, etags, ex, gview, gvim, rgview, rgvim, rview, rvim, view, vim, vimtutor and xxd programs.

---

## Description

### ctags

ctags generate tag files for source code.

---

### etags

etags does the same as ctags but it can generate cross reference files which list information about the various source objects found in a set of language files.

---

### ex

ex starts vim in Ex mode.

---

### gview

gview is the GUI version of view.

---

### gvim

gvim is the GUI version of vim.

---

### rgview

rgview is the GUI version of rview.

---

### rgvim

rgvim is the GUI version of rvim.

---

## rview

rview is a restricted version of view. No shell commands can be started and Vim can't be suspended.

## rvim

rvim is the restricted version of vim. No shell commands can be started and Vim can't be suspended.

## view

view starts vim in read−only mode.

## vim

vim starts vim in the normal, default way.

## vimtutor

vimtutor starts the Vim tutor.

## xxd

xxd makes a hexdump or does the reverse.

# Psmisc

## Contents

The Psmisc package contains the fuser, killall and pstree programs.

## Description

### fuser

fuser displays the PIDs of processes using the specified files or file systems.

### killall

killall sends a signal to all processes running any of the specified commands.

### pstree

pstree shows running processes as a tree.

# Sed

## Contents

The Sed package contains the sed program.

## Description

sed is a stream editor. A stream editor is used to perform basic text transformations on an input stream (a file or input from a pipeline).

# Sysklogd

## Contents

The Sysklogd package contains the klogd and syslogd programs.

---

## Description

### klogd

klogd is a system daemon which intercepts and logs Linux kernel messages.

---

### syslogd

Syslogd provides a kind of logging that many modern programs use. Every logged message contains at least a time and a hostname field, normally a program name field, too, but that depends on how trusty the logging program is.

---

# Sysvinit

## Contents

The Sysvinit package contains the pidof, last, lastb, mesg, utmpdump, wall, halt, init, killall5, poweroff, reboot, runlevel, shutdown, sulogin and telinit programs.

## Description

### pidof

Pidof finds the process id's (pids) of the named programs and prints those id's on standard output.

### last

last searches back through the file /var/log/wtmp (or the file designated by the −f flag) and displays a list of all users logged in (and out) since that file was created.

### lastb

lastb is the same as last, except that by default it shows a log of the file /var/log/btmp, which contains all the bad login attempts.

### mesg

Mesg controls the access to the users terminal by others. It's typically used to allow or disallow other users to write to his terminal.

### utmpdump

utmpdumps prints the content of a file (usually /var/run/utmp) on standard output in a user friendly format.

### wall

Wall sends a message to everybody logged in with their mesg permission set to yes.

## halt

Halt notes that the system is being brought down in the file /var/log/wtmp, and then either tells the kernel to halt, reboot or poweroff the system. If halt or reboot is called when the system is not in runlevel 0 or 6, shutdown will be invoked instead (with the flag −h or −r).

---

## init

Init is the parent of all processes. Its primary role is to create processes from a script stored in the file /etc/inittab. This file usually has entries which cause init to spawn gettys on each line that users can log in. It also controls autonomous processes required by any particular system.

---

## killall5

killall5 is the SystemV killall command. It sends a signal to all processes except the processes in its own session, so it won't kill the shell that is running the script it was called from.

---

## poweroff

poweroff is equivalent to shutdown −h −p now. It halts the computer and switches off the computer (when using an APM compliant BIOS and APM is enabled in the kernel).

---

## reboot

reboot is equivalent to shutdown −r now. It reboots the computer.

---

## runlevel

Runlevel reads the system utmp file (typically /var/run/utmp) to locate the runlevel record, and then prints the previous and current system runlevel on its standard output, separated by a single space.

---

## shutdown

shutdown brings the system down in a secure way. All logged−in users are notified that the system is going down, and login is blocked.

---

## sulogin

sulogin is invoked by init when the system goes into single user mode (this is done through an entry in /etc/inittab). Init also tries to execute sulogin when it is passed the −b flag from the boot loader (eg, LILO).

## telinit

telinit sends appropriate signals to init, telling it which runlevel to change to.

# Tar

## Contents

The tar package contains the tar and rmt programs.

---

## Description

### tar

tar is an archiving program designed to store and extract files from an archive file known as a tar file.

---

### rmt

rmt is a program used by the remote dump and restore programs in manipulating a magnetic tape drive through an interprocess communication connection.

---

# Textutils

## Contents

The Textutils package contains the cat, cksum, comm, split, cut, expand, fmt, fold, head, join, md5sum, nl, od, paste, pr, ptx, sort, split, sum, tac, tail, tr, tsort, unexpand, uniq and wc programs.

---

## Description

### cat

cat concatenates file(s) or standard input to standard output.

---

### cksum

cksum prints CRC checksum and byte counts of each specified file.

---

### comm

comm compares two sorted files line by line.

---

### csplit

cplit outputs pieces of a file separated by (a) pattern(s) to files xx01, xx02, ..., and outputs byte counts of each piece to standard output.

---

### cut

cut prints selected parts of lines from specified files to standard output.

---

### expand

expand converts tabs in files to spaces, writing to standard output.

---

### fmt

fmt reformats each paragraph in the specified file(s), writing to standard output.

---

## fold

fold wraps input lines in each specified file (standard input by default), writing to standard output.

---

## head

Print first xx (10 by default) lines of each specified file to standard output.

---

## join

join joins lines of two files on a common field.

---

## md5sum

md5sum prints or checks MD5 checksums.

---

## nl

nl writes each specified file to standard output, with line numbers added.

---

## od

od writes an unambiguous representation, octal bytes by default, of a specified file to standard output.

---

## paste

paste writes lines consisting of the sequentially corresponding lines from each specified file, separated by TABs, to standard output.

---

## pr

pr paginates or columnates files for printing.

---

## ptx

ptx produces a permuted index of file contents.

---

## sort

sort writes sorted concatenation of files to standard output.

---

## split

split outputs fixed–size pieces of an input file to PREFIXaa, PREFIXab, ...

---

## sum

sum prints checksum and block counts for each specified file.

---

## tac

tac writes each specified file to standard output, last line first.

---

## tail

tail print the last xx (10 by default) lines of each specified file to standard output.

---

## tr

tr translates, squeezes, and/or deletes characters from standard input, writing to standard output.

---

## tsort

tsort writes totally ordered lists consistent with the partial ordering in specified files.

---

## unexpand

unexpand converts spaces in each file to tabs, writing to standard output.

---

## uniq

uniq discards all but one of successive identical lines from files or standard input and writes to files or standard output.

---

### wc

wc prints line, word, and byte counts for each specified file, and a total line if more than one file is specified.

# Util Linux

## Contents

The Util−linux package contains the arch, dmesg, kill, more, mount, umount, agetty, blockdev, cfdisk, ctrlaltdel, elvtune, fdisk, fsck.minix, hwclock, kbdrate, losetup, mkfs, mkfs.bfs, mkfs.minix, mkswap, sfdisk, swapoff, swapon, cal, chkdupexe, col, colcrt, colrm, column, cytune, ddate, fdformat, getopt, hexdump, ipcrm, ipcs, logger, look, mcookie, namei, rename, renice, rev, script, setfdprm, setsid, setterm, ul, whereis, write, ramsize, rdev, readprofile, rootflags, swapdev, tunelp and vidmode programs.

---

## Description

### arch

arch prints the machine architecture.

---

### dmesg

dmesg is used to examine or control the kernel ring buffer (boot messages from the kernel).

---

### kill

kill sends a specified signal to the specified process.

---

### more

more is a filter for paging through text one screen full at a time.

---

### mount

mount mounts a filesystem from a device to a directory (mount point).

---

### umount

umount unmounts a mounted filesystem.

---

## agetty

agetty opens a tty port, prompts for a login name and invokes the /bin/login command.

## blockdev

blockdev allows to call block device ioctls from the command line

## cfdisk

cfdisk is an libncurses based disk partition table manipulator.

## ctrlaltdel

ctrlaltdel sets the function of the CTRL+ALT+DEL key combination (hard or soft reset).

## elvtune

elvtune allows to tune the I/O elevator per block device queue basis.

## fdisk

fdisk is a disk partition table manipulator.

## fsck.minix

fsck.minix performs a consistency check for the Linux MINIX filesystem.

## hwclock

hwclock queries and sets the hardware clock (Also called the RTC or BIOS clock).

## kbdrate

kbdrate resets the keyboard repeat rate and delay time.

## losetup

losetup sets up and controls loop devices.

---

## mkfs

mkfs builds a Linux filesystem on a device, usually a harddisk partition.

---

## mkfs.bfs

mkfs.bfs creates a SCO bfs file system on a device, usually a harddisk partition.

---

## mkfs.minix

mkfs.minix creates a Linux MINIX filesystem on a device, usually a harddisk partition.

---

## mkswap

mkswap sets up a Linux swap area on a device or in a file.

---

## sfdisk

sfdisk is a disk partition table manipulator.

---

## swapoff

swapoff disables devices and files for paging an swapping.

---

## swapon

swapon enables devices and files for paging and swapping.

---

## cal

cal displays a simple calender.

---

## chkdupexe

chkdupexe finds duplicate executables.

---

## col

col filters reverse line feeds from input.

---

## colcrt

colcrt filters nroff output for CRT previewing.

---

## colrm

colrm removes columns from a file.

---

## column

column columnates lists.

---

## cytune

cytune queries and modifies the interruption threshold for the Cyclades driver.

---

## ddate

ddate converts Gregorian dates to Discordian dates.

---

## fdformat

fdformat low−level formats a floppy disk.

---

## getopt

getops parses command options the same way as the getopt C command.

---

## hexdump

hexdump displays specified files, or standard input, in a user specified format (ascii, decimal, hexadecimal, octal).

## ipcrm

ipcrm removes a specified resource.

## ipcs

ipcs provides information on IPC facilities.

## logger

logger makes entries in the system log.

## look

look displays lines beginning with a given string.

## mcookie

mcookie generates magic cookies for xauth.

## namei

namei follows a pathname until a terminal point is found.

## rename

rename renames files.

## renice

renice alters priority of running processes.

## rev

rev reverses lines of a file.

---

## script

script makes typescript of terminal session.

---

## setfdprm

setfdprm sets user−provides floppy disk parameters.

---

## setsid

setsid runs programs in a new session.

---

## setterm

setterm sets terminal attributes.

---

## ul

ul reads a file and translates occurrences of underscores to the sequence which indicates underlining for the terminal in use.

---

## whereis

whereis locates a binary, source and manual page for a command.

---

## write

write sends a message to another user.

---

## ramsize

ramsize queries and sets RAM disk size.

---

## rdev

rdev queries and sets image root device, swap device, RAM disk size, or video mode.

## readprofile

readprofile reads kernel profiling information.

## rootflags

rootflags queries and sets extra information used when mounting root.

## swapdev

swapdev queries and sets swap device.

## tunelp

tunelp sets various parameters for the LP device.

## vidmode

vidmode queries and sets the video mode.

# Kbd

## Contents

The Kbd package contains the chvt, deallocvt, dumpkeys, fgconsole, getkeycodes, kbd_mode, kbdrate, loadkeys, loadunimap, mapscrn, psfxtable, resizecons, screendump, setfont, setkeycodes, setleds, setmetamode, setvesablank, showfont, showkey, unicode_start, and unicode_stop programs. There are some other programs that don't get installed by default, as they are very optional. Take a look at the Kbd package contents if you have trouble with your console.

---

## Description

### chvt

chvt changes foreground virtual terminal.

---

### deallocvt

deallocvt deallocates unused virtual terminals.

---

### dumpkeys

dumpkeys dumps keyboard translation tables.

---

### fgconsole

fgconsole prints the number of the active virtual terminal.

---

### getkeycodes

getkeycodes prints the kernel scancode−to−keycode mapping table.

---

### kbd_mode

kbd_mode reports or sets the keyboard mode.

---

## kbdrate

kbdrate sets the keyboard repeat and delay rates.

## loadkeys

loadkeys loads keyboard translation tables.

## loadunimap

loadunimap loads the kernel unicode–to–font mapping table.

## mapscrn

mapscrn loads a user defined output character mapping table into the console driver. Note that it is obsolete and that its features are built into setfont.

## psfxtable

psfxtable is a tool for handling Unicode character tables for console fonts.

## resizecons

resizecons changes the kernel idea of the console size.

## screendump

A screen shot utility for the console.

## setfont

This lets you change the EGA/VGA fonts in console.

## setkeycodes

setkeycodes loads kernel scancode–to–keycode mapping table entries.

## setleds

setleds sets the keyboard LEDs. Many people find it useful to have numlock enabled by default, and it is by using this program that you can achieve this.

---

## setmetamode

setmetamode defines the keyboard meta key handling.

---

## setvesablank

This lets you fiddle with the built−in hardware screensaver (not toasters, only a blank screen).

---

## showfont

showfont displays data about a font. The information shown includes font information, font properties, character metrics, and character bitmaps.

---

## showkey

showkey examines the scancodes and keycodes sent by the keyboard.

---

## unicode_start

unicode_start puts the console in Unicode mode.

---

## unicode_stop

unicode_stop reverts keyboard and console from unicode mode.

---

# Man−pages

## Contents

The Man−pages package contains various manual pages that don't come with the packages.

---

## Description

Examples of provided manual pages are the manual pages describing all the C and C++ functions, few important /dev/ files and more.

---

# Netkit−base

## Contents

The Netkit−base package contains the inetd and ping programs.

## Description

### inetd

inetd is the mother of all daemons. It listens for connections, and transfers the call to the appropriate daemon.

### ping

ping sends ICMP ECHO_REQUEST packets to a host and determines its response time.

# Net−tools

## Contents

The Net−tools package contains the arp, hostname, ifconfig, netstat, plipconfig rarp, route, and slattach programs.

---

## Description

### arp

arp is used to manipulate the kernel's ARP cache, usually to add or delete an entry, or to dump the ARP cache.

---

### hostname

hostname, with its symlinks domainname, dnsdomainname, nisdomainname, ypdomainname, and nodename, is used to set or show the system's hostname (or other, depending on the symlink used).

---

### ifconfig

The ifconfig command is the general command used to configure network interfaces.

---

### netstat

netstat is a multi−purpose tool used to print the network connections, routing tables, interface statistics, masquerade connections, and multicast memberships.

---

### plipconfig

plipconfig is used to fine−tune the PLIP device parameters, hopefully making it faster.

---

### rarp

Akin to the arp program, the rarp program manipulates the system's RARP table.

---

## route

route is the general utility which is used to manipulate the IP routing table.

## slattach

slattach attaches a network interface to a serial line, i.e.. puts a normal terminal line into one of several "network" modes.

# Appendix B. Resources

# Introduction

A list of books, HOWTOs and other documents that might be useful to download or buy follows. This list is just a small list to start with. We hope to be able to expand this list in time as we come across more useful documents or books.

# Books

- Linux Network Administrator's Guide published by O'Reilly. ISBN: 1−56502−087−2
- Running Linux published by O'Reilly. ISBN: 1−56592−151−8

# HOWTOs and Guides

All of the following HOWTOs can be downloaded from the Linux Documentation Project site at http://www.linuxdoc.org

- Linux Network Administrator's Guide
- Powerup2Bash−HOWTO

# Other

- The various man and info pages that come with the packages

# Appendix C. Official download locations

# Official download locations

Below is the list with packages from chapter 3 with their original download locations. This might help to find a newer version of a package quicker.

Bash (2.05):
ftp://ftp.gnu.org/gnu/bash/

Binutils (2.11):
ftp://ftp.gnu.org/gnu/binutils/

Bzip2 (1.0.1):
ftp://sourceware.cygnus.com/pub/bzip2/

Diff Utils (2.7):
ftp://ftp.gnu.org/gnu/diffutils/

File Utils (4.1):
ftp://ftp.gnu.org/gnu/fileutils/

GCC (2.95.2.1):
ftp://ftp.freesoftware.com/pub/sourceware/gcc/releases/

Linux Kernel (2.4.4):
ftp://ftp.kernel.org/pub/linux/kernel/

Glibc (2.2.1):
ftp://ftp.gnu.org/gnu/glibc/

Glibc−linuxthreads (2.2.1):
ftp://ftp.gnu.org/gnu/glibc/

Grep (2.4.2):
ftp://ftp.gnu.org/gnu/grep/

Gzip (1.2.4a):
ftp://ftp.gnu.org/gnu/gzip/

Gzip Patch (1.2.4a):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Make (3.79.1):
ftp://ftp.gnu.org/gnu/make/

Sed (3.02):
ftp://ftp.gnu.org/gnu/sed/

Sh−utils (2.0):
ftp://ftp.gnu.org/gnu/sh−utils/

Shellutils Patch (2.0):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Tar (1.13):
ftp://ftp.gnu.org/gnu/tar/

Tar Patch (1.13):
http://sourceware.cygnus.com/bzip2/

Text Utils (2.0):
ftp://ftp.gnu.org/gnu/textutils/

MAKEDEV:
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Bison (1.28):
ftp://ftp.gnu.org/gnu/bison/

Mawk (1.3.3):
ftp://ftp.whidbey.net/pub/brennan/

Patch (2.5.4):
ftp://ftp.gnu.org/gnu/patch/

Find Utils (4.1):
ftp://ftp.gnu.org/gnu/findutils/

Find Utils Patch (4.1):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Ncurses (5.2):
ftp://ftp.gnu.org/gnu/ncurses/

Less (358):
ftp://ftp.gnu.org/gnu/less/

Groff (1.17):
ftp://ftp.gnu.org/gnu/groff/

Man (1.5i):
ftp://ftp.win.tue.nl/pub/linux−local/utils/man/

Man Patch (1.5i):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Perl (5.6.1):
http://www.perl.com

M4 (1.4):
ftp://ftp.gnu.org/gnu/m4/

Texinfo (4.0):
ftp://ftp.gnu.org/gnu/texinfo/

Autoconf (2.13):
ftp://ftp.gnu.org/gnu/autoconf/

Automake (1.4−p1):
ftp://ftp.gnu.org/gnu/automake/

Flex (2.5.4a):

ftp://ftp.gnu.org/non−gnu/flex/

File (3.34):
ftp://ftp.gw.com/mirrors/pub/unix/file/

Libtool (1.4):
ftp://ftp.gnu.org/gnu/libtool/

Bin86 (0.15.5):
http://www.cix.co.uk/~mayday/

Gettext (0.10.37):
ftp://ftp.gnu.org/gnu/gettext/

Kbd (1.05):
ftp://ftp.win.tue.nl/pub/linux−local/utils/kbd/

E2fsprogs (1.19):
ftp://download.sourceforge.net/pub/sourceforge/e2fsprogs/

Ed (0.2):
ftp://ftp.gnu.org/gnu/ed/

Lilo (21.7.5):
ftp://metalab.unc.edu/pub/Linux/system/boot/lilo

Modutils (2.4.6):
ftp://ftp.kernel.org/pub/linux/utils/kernel/modutils

Vim−rt (5.7):
ftp://ftp.vim.org/pub/editors/vim/unix/

Vim−src (5.7):
ftp://ftp.vim.org/pub/editors/vim/unix/

Procinfo (18):
ftp://ftp.cistron.nl/pub/people/svm/

Procps (2.0.7):

ftp://people.redhat.com/johnsonm/procps/

Psmisc (20.1):
http://download.sourceforge.net/psmisc/
ftp://download.sourceforge.net/pub/sourceforge/psmisc/

Shadow Password Suite (20001016):
ftp://ftp.pld.org.pl/software/shadow/

Shadow Password Suite Patch (20001016):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Sysklogd (1.4.1):
ftp://ftp.ibiblio.org/pub/Linux/system/daemons/

Sysvinit (2.78):
ftp://ftp.cistron.nl/pub/people/miquels/sysvinit/

Sysvinit Patch (2.78):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Util Linux (2.11b):
ftp://ftp.win.tue.nl/pub/linux−local/utils/util−linux/

Man−pages (1.35):
ftp://ftp.win.tue.nl/pub/linux−local/manpages/

Man−pages Patch (1.35):
ftp://packages.linuxfromscratch.org/3.0−pre3/
http://packages.linuxfromscratch.org/3.0−pre3/

Netkit−base (0.17):
ftp://ftp.uk.linux.org/pub/linux/Networking/netkit/

Net−tools (1.60):
http://www.tazenda.demon.co.uk/phil/net−tools/