Debian Reference

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Abstract

This Debian Reference (http://qref.sourceforge.net/) is intended to provide a broad overview of the Debian system as a **post-installation user's guide**. It covers many aspects of system administration through **shell-command** examples. Basic tutorials, tips, and other information are provided for topics including fundamental concepts of the Debian system, system installation hints, Debian package management, the Linux kernel under Debian, system tuning, building a gateway, text editors, CVS, programming, and GnuPG for **non-developers**.

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Chapter 1

Preface

This Debian Reference (http://qref.sourceforge.net/) is intended to provide a broad overview of the Debian system as a post-installation user's guide. Its target reader is someone who is willing to read shell scripts. I expect the reader to have gained basic skills in Unix-like systems prior to reading this document.

I made a conscious decision **not** to explain everything in detail if it can be found on a manual page, an info page, or in a HOWTO document. Instead of full explanations, I have tried to give more directly practical information by providing exact command sequences in the main text or example scripts under http://www.debian.org/doc/manuals/debian-reference/examples/. You must understand the content of examples before issuing commands. Your system may require slightly different command sequences.

Much of the information included consists of reminders or pointers to the authoritative references listed in 'References' on page 247.

This document originated as a "quick reference" but it grew. Nevertheless, **Keep It Short and Simple** (KISS) is my guiding principle.

For help with emergency system maintenance, proceed to 'Debian survival commands' on page 83 immediately.

1.1 Official document

The latest official document is in the Debian archives with the package name `debian-reference-en` and is also available from http://www.debian.org/doc/manuals/debian-reference/.

The latest development version is http://qref.sourceforge.net/Debian/. The project is hosted at http://qref.sourceforge.net/, where this document is available for download in plain text, HTML, PDF, SGML, and PostScript formats.

1.2 Document conventions

This Debian Reference provides information through short `bash` shell commands. Here are the conventions used:

```
# command in root account
$ command in user account
... description of action
```

These shell command examples use `PS2="  "`. See 'Bash – **GNU** standard interactive shell' on page 223 for more information on `bash`.

Reference to:

- a UNIX-style **manual page** is given in the form: `bash(1)`.
- a GNU **TEXINFO page** is given in the form: `info libc`.
- a **book** is given in the form: *The C Programming Language*.
- a **URL** is given in the form: `http://www.debian.org/doc/manuals/debian-reference/`.
- a **file** on the system is given in the form: `/usr/share/doc/Debian/reference/`.

The following abbreviations are used:

- **LDP**: Linux Documentation Project (`http://www.tldp.org/`)
- **DDP**: Debian Documentation Project (`http://www.debian.org/doc/`)

Other abbreviations are defined in the text before they are used.

In this document only URL references are given for LDP documents. However, LDP documents have been packaged for Debian; when the packages are installed the documents are available in `/usr/share/doc/HOWTO/`.

See 'References' on page 247.

1.3 Example scripts

Example scripts (`http://www.debian.org/doc/manuals/debian-reference/examples/`) which accompany this document in the `debian-reference-en` package are available in `/usr/share/doc/Debian/reference/examples/`. The initial "." in the filenames of hidden files is converted to underscore "_". An additional extension has been added to filenames when several alternatives are provided.

1.4 Basic setup

If the system is installed with the bare minimum of packages and you want to make the best use of this document then it is advisable to execute the following commands in order to install other packages containing useful documents:

```
# apt-get install info man-db doc-base dhelp apt apt-utils auto-apt \
                  dpkg less mc ssh nano-tiny elvis-tiny vim sash \
                  kernel-package \
                  manpages manpages-dev doc-debian doc-linux-text \
                  debian-policy developers-reference maint-guide \
                  apt-howto harden-doc install-doc \
                  libpam-doc glibc-doc samba-doc exim-doc cvsbook \
                  gnupg-doc
# apt-get install debian-reference # for Sarge, do this too :)
```

For Woody, add `exim-doc-html` to the above list. For Sarge, replace `exim-doc` with `exim4-doc-html` and `exim4-doc-info`.

1.5 Basics of the Debian distributions

Debian maintains three different distributions simultaneously. These are:

- `stable` — Most useful for a production server since it is only updated with security fixes. See 'The `stable` distribution' on page 6.
- `testing` — The preferred distribution for a workstation since it contains recent releases of desktop software which have received a bit of testing. See 'The `testing` distribution' on page 7.
- `unstable` — Cutting edge. The choice of Debian developers. See 'The `unstable` distribution' on page 7.

When packages in `unstable` have no release-critical (RC) bugs filed against them after the first week or so, they are automatically promoted to `testing`.

Debian distributions also have code names as described in 'Debian distribution codenames' on page 8. Before Woody was released in August 2002, the three distributions were, respectively, Potato, Woody, and Sid. After Woody was released the three distributions were, respectively, Woody, Sarge, and Sid. When Sarge is released, the `stable` and `unstable` distributions will be Sarge and Sid; a new `testing` distribution will then be created (initially as a copy of `stable`) and given a new code name.

Subscribe to the low-volume mailing list `debian-devel-announce@lists.debian.org` for important announcements about Debian. See 'The Debian archives' on page 5.

If you want to use versions of packages that are more current than the versions that were released with the distribution you are using, then you can either upgrade to a later distribution as described in 'Upgrading a distribution to `stable`, `testing`, or `unstable`' on page 73, or you can upgrade only selected packages. If the package can't be upgraded easily then you may want to backport it as described in 'Port a package to the `stable` system' on page 90.

Tracking the `testing` distribution can have the side effect of delaying the installation of packages containing security fixes. Such packages are uploaded to `unstable` and migrate to `testing` only after a delay.

If you mix distributions, e.g., `testing` with `stable` or `unstable` with `stable`, you will eventually pull in core packages such as `libc6` from `testing` or `unstable` and there is no guarantee that these will not contain bugs. You have been warned.

Running the `testing` or `unstable` distribution increases your risk of hitting serious bugs. This risk can be managed by deploying a multibooting scheme with a more stable Debian distribution or by deploying the nice trick of using `chroot` as described in '`chroot`' on page 127. The latter will enable running different Debian distributions simultaneously on different consoles.

After an explanation of the fundamentals of the Debian distribution in 'Debian fundamentals' on the next page, you will be given some basic information to help you live happily with the latest software, taking advantage of the `testing` and `unstable` distributions of Debian. The impatient should proceed immediately to 'Debian survival commands' on page 83. Happy upgrading!

Chapter 2

Debian fundamentals

This chapter provides fundamental information on the Debian system for non-developers. For authoritative information, see:

- Debian Policy Manual
- Debian Developer's Reference
- Debian New Maintainers' Guide

listed under 'References' on page 247.

If you are looking for less detailed "how-to" explanations, jump directly to 'Debian package management' on page 77 or other relevant chapters.

This chapter is based on documents taken from the "Debian FAQ", greatly reorganized to allow the ordinary Debian system administrator to get started.

2.1 The Debian archives

2.1.1 Directory structures

The software that has been packaged for Debian is available in one of several directory trees on each Debian mirror site (`http://www.debian.org/mirror/`) through FTP or HTTP.

The following directories can be found on each Debian mirror site under the `debian` directory:

`dists/`: This directory contains the "distributions", and this used to be the canonical way to access the currently available packages in Debian releases and pre-releases. Some old packages, the `Contents-*.gz` and `Packages.gz` files are still in here.

`pool/`: The new physical location for all packages of Debian releases and pre-releases.

`tools/`: DOS utilities for creating boot disks, partitioning your disk drive, compressing/decompressing files, and booting Linux.

`doc/`: The basic Debian documentation, such as the FAQ, the bug reporting system instructions, etc.

indices/: The Maintainers file and the override files.

project/: mostly developer-only materials, such as:

project/experimental/: This directory contains packages and tools which are still being developed, and are still in the alpha testing stage. Users shouldn't be using packages from here, because they can be dangerous and harmful even for the most experienced.

project/orphaned/: Packages that have been orphaned by their old maintainers, and withdrawn from the distribution.

2.1.2 Debian distributions

Normally there are three Debian distributions in the `dists` directory. They are named the `stable` distribution, the `testing` distribution, and the `unstable` distribution. Sometimes there is also a `frozen` distribution. Each distribution is defined as a symlink to the actual directory with a codename in the `dists` directory.

2.1.3 The `stable` distribution

Package entries for the `stable` distribution, Debian Sarge (3.1r0), are recorded into the `stable` (symlink to `sarge/`) directory:

- `stable/main/`: This directory contains the package versions belonging to the most recent official release of the Debian system.

  These packages are all free; that is, they all comply with the Debian Free Software Guidelines (`http://www.debian.org/social_contract#guidelines`) (DFSG) (also available as `/usr/share/doc/debian/social-contract.txt` installed by `debian-doc`).

- `stable/non-free/`: This directory contains packages that fail to qualify as free according to the DFSG.

  For example, some packages have licenses that prohibit commercial distribution. Others can be redistributed but are shareware.

- `stable/contrib/`: Each package in this directory is itself DFSG-free but somehow Depends on a package that is **not** DFSG-free.

Now, in addition to the above locations, new physical packages are located under the `pool` directory ('The `pool` directory' on page 9).

The current status of `stable` distribution bugs is reported on the Stable Problems (`http://ftp-master.debian.org/testing/stable_probs.html`) web page.

2.1.4 The `testing` distribution

Package entries for the `testing` distribution, Debian Etch, are recorded into the `testing` (symlink to `etch/`) directory after they have undergone some degree of testing in `unstable`. Now, in addition to the above locations, new physical packages are located under the `pool` directory ('The `pool` directory' on page 9). There are also `main`, `contrib`, and `non-free` subdirectories in `testing/`, which serve the same functions as in `stable/`.

These packages must be in sync on all architectures where they have been built and must be installable; they must also have fewer release-critical bugs than the versions currently in `unstable`. This way, we hope that `testing` is always close to being a release candidate. More details of the testing mechanism are at `http://www.debian.org/devel/testing`.

The latest status of the `testing` distribution is reported at these sites:

- update excuses (`http://ftp-master.debian.org/testing/update_excuses.html`)
- testing problems (`http://ftp-master.debian.org/testing/testing_probs.html`)
- release-critical bugs (`http://bugs.debian.org/release-critical/`)
- base system bugs (`http://bugs.qa.debian.org/cgi-bin/base.cgi`)
- bugs in standard and task packages (`http://bugs.qa.debian.org/cgi-bin/standard.cgi`)
- other bugs and bug-squashing party notes (`http://bugs.qa.debian.org/`)

2.1.5 The `unstable` distribution

Package entries for the `unstable` distribution, always codenamed "Sid", are recorded into the `unstable` (symlink to `sid/`) directory after they are uploaded to the Debian archive and stay here until they are moved to `testing/`. New physical packages are located under the `pool` directory ('The `pool` directory' on page 9). There are also `main`, `contrib`, and `non-free` subdirectories in `unstable/`, which serve the same functions as in `stable/`.

The `unstable` distribution contains a snapshot of the most current development system. Users are welcome to use and test these packages, but are warned about their state of readiness. The advantage of using the `unstable` distribution is that you are always up-to-date with the latest in the Debian software project—but if it breaks, you get to keep both parts. :-)

The current status of `unstable` distribution bugs is reported on the Unstable Problems (`http://ftp-master.debian.org/testing/unstable_probs.html`) web page.

2.1.6 The `frozen` distribution

When the `testing` distribution is mature enough, it becomes frozen, meaning no new code is accepted anymore, just bugfixes, if necessary. Also, a new testing tree is created in the `dists` directory, assigned a new codename. The frozen distribution passes through a few months of testing, with intermittent updates and deep freezes called "test cycles". (The recent Woody

release process did not create a symbolic link `frozen/`, so `frozen` was not a distribution but just a development stage of the `testing` distribution.)

We keep a record of bugs in the frozen distribution that can delay a package from being released or bugs that can hold back the whole release. Once that bug count lowers to maximum acceptable values, the frozen distribution becomes `stable`, it is released, and the previous stable distribution becomes obsolete (and moves to the archive).

2.1.7 Debian distribution codenames

Physical directory names in the `dists` directory, such as `sarge/` and `etch/`, are just "codenames". When a Debian distribution is in the development stage, it has no version number, but a codename instead. The purpose of these codenames is to make the mirroring of the Debian distributions easier (if a real directory like `unstable` suddenly changed its name to `stable /`, a lot of stuff would have to be needlessly downloaded again).

Currently, `stable/` is a symbolic link to `sarge/`, and `testing/` is a symbolic link to `etch /`. This means that `Sarge` is the current stable distribution and `Etch` is the current testing distribution.

`unstable/` is a permanent symbolic link to `sid/`, as Sid is always the unstable distribution.

2.1.8 Codenames used in the past

Codenames that have already been used are: "Buzz" for release 1.1, "Rex" for release 1.2, "Bo" for releases 1.3.x, "Hamm" for release 2.0, "Slink" for release 2.1, "Potato" for release 2.2, "Woody" for release 3.0, and "Sarge" for release 3.1.

2.1.9 The source for codenames

So far they have been characters taken from the movie *Toy Story* by Pixar.

- **Buzz** (Buzz Lightyear) was the spaceman,
- **Rex** was the tyrannosaurus,
- **Bo** (Bo Peep) was the girl who took care of the sheep,
- **Hamm** was the piggy bank,
- **Slink** (Slinky Dog) was the toy dog,
- **Potato** was, of course, Mr. Potato Head,
- **Woody** was the cowboy,
- **Sarge** was a leader of the Green Plastic Army Men,
- **Etch** (Etch-a-Sketch) was the blackboard,
- **Sid** was a boy next door who destroyed toys.

2.1.10 The pool directory

Historically, packages were kept in the subdirectory of dists corresponding to the distribution that contained them. This turned out to cause various problems, such as large bandwidth consumption on mirrors when major changes were made.

Packages are now kept in a large "pool", structured according to the name of the source package. To make this manageable, the pool is subdivided by section (main, contrib, and non-free) and by the first letter of the source package name. These directories contain several files: the binary packages for each architecture, and the source packages from which the binary packages were generated.

You can find out where each package is placed by executing a command like apt-cache showsrc *mypackagename* and looking at the "Directory:" line. For example, the apache packages are stored in pool/main/a/apache/. Since there are so many lib* packages, these are treated specially: for instance, libpaper packages are stored in pool/main/libp/libpaper/.

The dists directories are still used for the index files used by programs like apt. Also, at the time of writing, older distributions have not been converted to use pools, so you'll see paths containing distribution names such as potato or woody in the "Directory" header field.

Normally, you won't have to worry about any of this, as new apt and probably older dpkg-ftp will handle it seamlessly. If you want more information, see the RFC: implementation of package pools (http://lists.debian.org/debian-devel-announce/2000/debian-devel-announce-200010/msg00007.html).

2.1.11 Historical notes about Sid

When the present-day Sid did not exist, the Debian archive site organization had one major flaw: there was an assumption that when an architecture was created in the current unstable/, it would be released when that distribution became the new stable. For many architectures that wasn't the case, with the result that those directories had to be moved at release time. This was impractical because the move would chew up lots of bandwidth.

The archive administrators worked around this problem for several years by placing binaries for unreleased architectures in a special directory called sid. For those architectures not yet released, the first time they were released there was a link from the current stable/ to sid/, and from then on they were created inside the unstable/ tree as usual. This layout was somewhat confusing to users.

With the advent of package pools (see 'The pool directory' on this page) during the Woody distribution development, binary packages began to be stored in a canonical location in the pool, regardless of the distribution, so releasing a distribution no longer causes large bandwidth consumption on the mirrors (there is, however, a lot of gradual bandwidth consumption throughout the development process).

2.1.12 Uploaded packages in `incoming/`

Uploaded packages are first located at `http://incoming.debian.org/` after being checked to insure that they really come from a Debian developer (and are put in the `DELAYED` subdirectory in the case of a Non-Maintainer Upload (NMU)). Once a day, they are moved out of `incoming/` to `unstable/`.

In an emergency, you may want to install packages from `incoming/` before they reach `unstable/`.

2.1.13 Retrieving an older package

While the most recent Debian distributions are kept under the `debian` directory on each Debian mirror site (`http://www.debian.org/mirror/`), archives for older Debian distributions such as Slink are kept on `http://archive.debian.org/` or under the `debian-archive` directory on each Debian mirror site.

Older `testing` and `unstable` packages can be located at `http://snapshot.debian.net/`.

2.1.14 Architecture sections

Within each of the major directory trees (`dists/stable/main`, `dists/stable/contrib`, `dists/stable/non-free`, `dists/unstable/main`, etc.), the binary package entries reside in subdirectories whose names indicate the chip architecture for which they were compiled.

- `binary-all/`, for packages which are architecture-independent. These include, for example, Perl scripts, or pure documentation.
- `binary-`*`platform`*`/`, for packages which execute on a particular binary platform.

Please note that the actual binary packages for `testing` and `unstable` no longer reside in these directories, but in the top-level `pool` directory. The index files (`Packages` and `Packages.gz`) have been kept, though, for backwards compatibility.

For the actual binary architectures supported, see the Release Notes for each distribution. They can be located at the Release Notes sites for stable (`http://www.debian.org/releases/stable/releasenotes`) and testing (`http://www.debian.org/releases/testing/releasenotes`).

2.1.15 The source code

Source code is included for everything in the Debian system. Moreover, the license terms of most programs in the system **require** that source code be distributed along with the programs, or that an offer to provide the source code accompany the programs.

Normally the source code is distributed in the `source` directories, which are parallel to all the architecture-specific binary directories, or more recently in the `pool` directory (see 'The `pool` directory' on page 9). To retrieve the source code without having to be familiar with the structure of the Debian archive, try a command like `apt-get source` *`mypackagename`*.

Some packages, notably `pine`, are only available in a source package due to their licensing limitations. (Recently the `pine-tracker` package has been provided to facilitate Pine installation.) The procedures described in 'Port a package to the `stable` system' on page 90 and 'Packaging' on page 241 provide ways to build a package manually.

Source code may or may not be available for packages in the `contrib` and `non-free` directories, which are not formally part of the Debian system.

2.2 The Debian package management system

2.2.1 Overview of Debian packages

Packages generally contain all of the files necessary to implement a set of related commands or features. There are two types of Debian packages:

- **Binary packages**, which contain executables, configuration files, man/info pages, copyright information, and other documentation. These packages are distributed in a Debian-specific archive format (see 'Debian package format' on the following page); they are usually distinguished by having a `.deb` file extension. Binary packages can be unpacked using the Debian utility `dpkg`; details are given in its manual page.
- **Source packages**, which consist of a `.dsc` file describing the source package (including the names of the following files), a `.orig.tar.gz` file that contains the original unmodified source in gzip-compressed tar format, and usually a `.diff.gz` file that contains the Debian-specific changes to the original source. The utility `dpkg-source` packs and unpacks Debian source archives; details are provided in its manual page.

Installation of software by the package system uses "dependencies" which are declared by the package maintainers. These dependencies are documented in the `control` file associated with each package. For example, the package containing the GNU C compiler (`gcc`) Depends on the package `binutils` which includes the linker and assembler. If a user attempts to install `gcc` without having first installed `binutils`, the package management system (dpkg) will print an error message that it also needs `binutils`, and stop installing `gcc`. (However, this facility can be overridden by the insistent user; see `dpkg(8)`.) For additional details, see 'Package dependencies' on page 15 below.

Debian's packaging tools can be used to:

- manipulate and manage packages or parts of packages,

- aid the user in the splitting of packages that must be transmitted through a limited-size medium such as floppy disks,
- aid developers in the construction of package archives, and
- aid users in the installation of packages which reside on a remote Debian archive site.

2.2.2 Debian package format

A Debian "package", or a Debian archive file, contains the executable files, libraries, and documentation associated with a particular program suite or set of related programs. Normally, a Debian archive file has a filename that ends in `.deb`. [1]

The internals of this Debian binary package format are described in the `deb(5)` manual page. Because this internal format is subject to change (between major releases of Debian), always use `dpkg-deb(8)` for manipulating `.deb` files.

Through at least the Sarge distribution, all Debian archive files have been manipulable by the standard Unix commands `ar` and `tar`, even when `dpkg` commands are not available.

2.2.3 Naming conventions for Debian package filenames

The Debian package filenames conform to the following convention:

```
foo_ver-rev_arch.deb
```

where, usually, *foo* is the package name, *ver* is the upstream version number, *rev* is the Debian revision number, and *arch* is the target architecture. Files are easily renamed, of course. You can find out what package is really contained in any given file of name *filename* by running the following command:

```
dpkg --info filename
```

The Debian revision number is specified by the Debian developer or by whoever built the package. A change in revision number usually indicates that some aspect of the packaging has changed.

[1] The `debian-installer` project introduced package filenames that ends in `.udeb`. In short, it is a micro-`.deb` format which doesn't need to follow Debian policy exactly, lacks contents such as documentation and is meant to be used only by the `debian-installer`, the new Debian installer being developed for the Sarge release. The file format of `.deb` and `.udeb` are identical. The `udpkg` program used to handle `.udeb` packages has limited capability than standard `dpkg` and supports fewer package relationships. The difference in name is because the Debian archive maintainers weren't happy with `.deb`s in the archive that didn't follow policy, so a different name was chosen to accentuate this and to make it less likely that people would unwittingly install them on real systems. `.udeb`s are used in an initial ramdisk during the base install only to create a very restricted Debian system.

2.2.4 Preservation of local configuration

Files that are intended to be changeable by the local administrator are kept in `/etc/`. Debian policy dictates that all changes to locally configurable files be preserved across package upgrades.

If a default version of a locally configurable file is shipped in the package itself then the file is listed as a "conffile". The package management system does not upgrade conffiles that have been changed by the administrator since the package was last installed without getting the administrator's permission. On the other hand, if the conffile has not been changed by the administrator then the conffile will be upgraded along with the rest of the package. This is almost always desirable and so it is advantageous to minimize changes to conffiles.

To list the conffiles belonging to a package run the following command:

```
dpkg --status package
```

The list follows the "Conffiles:" line.

For more information about conffiles you can read the section of the Debian Policy Manual entitled "Configuration files". (See 'References' on page 247).

2.2.5 Debian maintenance scripts

Debian maintenance scripts are executable scripts which are automatically run before or after a package is installed. Along with a file named `control`, all of these files are part of the "control" section of a Debian archive file.

The individual files are:

preinst This script executes before its package is unpacked from its Debian archive (`.deb`) file. Many "preinst" scripts stop services for packages which are being upgraded until their installation or upgrade is completed (following the successful execution of the "postinst" script).

postinst This script typically completes any required configuration of a package once it has been unpacked from its Debian archive (`.deb`) file. Often, "postinst" scripts ask the user for input, and/or warn the user that if he accepts default values, he should remember to go back and reconfigure the package as the situation warrants. Many "postinst" scripts then execute any commands necessary to start or restart a service once a new package has been installed or upgraded.

prerm This script typically stops any daemons which are associated with a package. It is executed before the removal of files associated with the package.

postrm This script typically modifies links or other files associated with a package, and/or removes files created by it. (Also see 'Virtual packages' on page 15.)

Currently all of the control files can be found in the directory `/var/lib/dpkg/info`. The files relevant to package `foo` begin with the name "foo" and have file extensions of "preinst", "postinst", etc., as appropriate. The file `foo.list` in that directory lists all of the files that were installed with the package `foo`. (Note that the location of these files is a `dpkg` internal, and may be subject to change.)

2.2.6 Package priorities

Each Debian package is assigned a **priority** by the distribution maintainers, as an aid to the package management system. The priorities are:

- **Required** packages are necessary for the proper functioning of the system.

  This includes all tools that are necessary to repair system defects. You must not remove these packages or your system may become totally broken and you may not even be able to use `dpkg` to restore things. Systems with only the Required packages are probably inadequate for most purposes, but they do have enough functionality to allow the sysadmin to boot and install more software.

- **Important** packages should be found on any Unix-like system.

  Other packages without which the system will not run well or be usable will carry this priority. This does **not** include Emacs or X11 or TeX or any other large applications. These packages only constitute the bare infrastructure.

- **Standard** packages are standard on any Linux system, including a reasonably small but not too limited character-mode system.

  This is what will install by default if users do not select anything else. "Standard" does not include many large applications, but it does include Emacs (this is more a piece of infrastructure than an application) and a reasonable subset of TeX and LaTeX (if this turns out to be possible without X).

- **Optional** packages include all those that you might reasonably want to install even if you are unfamiliar with them, and if you don't have specialized requirements.

  This includes X11, a full TeX distribution, and lots of applications.

- **Extra** packages either conflict with others with higher priorities, have little use to users who are unfamiliar with them, or have specialized requirements that make them unsuitable for "Optional".

Please note the differences among "Priority: required", "Section: base" and "Essential: yes" in the package description. "Section: base" means that this package is installed before everything else on a new system. Most of the packages in "Section: base" have the "Priority: required" or at least "Priority: important", and many of them are tagged with "Essential: yes". "Essential: yes" means that this package requires to specify an extra force option to the package management system such as `dpkg` when removing from the system. For example, `libc6`, `mawk`, and `makedev` are "Priority: required" and "Section: base" but are not "Essential: yes".

2.2.7 Virtual packages

A virtual package is a generic name that applies to any one of a group of packages, all of which provide similar basic functionality. For example, both the `tin` and `trn` programs are news readers, and either one should therefore satisfy the need of a program that requires a news reader on the system in order to be useful. They are therefore both said to Provide the "virtual package" called `news-reader`.

Similarly, many packages such as `exim`, `exim4`, `sendmail`, and `postfix`, provide the functionality of a mail transport agent. They are therefore said to Provide the virtual package `mail-transport-agent`. If either one is installed, then any program that Depends on the installation of a mail transport agent will be satisfied by the existence of this virtual package.

Debian has a mechanism such that, if more than one package which Provides the same virtual package is installed on a system, the system administrator can set one as the preferred package. The relevant command is `update-alternatives`, and is described further in 'Alternative commands' on page 94.

2.2.8 Package dependencies

The Debian packaging system handles dependency declarations which are used to express the fact that one package requires another package to be installed in order to work or in order to work better.

- Package A **Depends** on Package B if B absolutely must be installed in order to use A. In some cases, A Depends not only on B, but on a specific version of B. In this case, the version dependency is usually a lower limit, in the sense that A Depends on any version of B more recent than some specified version.
- Package A **Recommends** Package B if the package maintainer judges that most users would not want A without also having the functionality provided by B.
- Package A **Suggests** Package B if B contains files that are related to and enhance the functionality of A. The same relationship is expressed by declaring that Package B **Enhances** Package A.
- Package A **Conflicts** with Package B when A will not operate properly if B is installed on the system. "Conflicts" status is often combined with "Replaces".
- Package A **Replaces** Package B when files installed by B are removed or overwritten by files in A.
- Package A **Provides** Package B when all of the files and functionality of B are incorporated into A.

More detailed information on the use of each these terms can be found in the *Packaging Manual* and the *Policy Manual*.

Note that `dselect` has more fine-grained control over packages specified by **Recommends** and **Suggests** than `apt-get`, which simply pulls all the packages specified by **Depends** and leaves all the packages specified by **Recommends** and **Suggests**. Both programs in modern form use APT as their back end.

2.2.9 The meaning of "Pre-Depends"

`dpkg` always configures a package upon which another package Depends before it configures the package that Depends on it. However, `dpkg` normally unpacks archive files in arbitrary order, independently of dependencies. (Unpacking consists of extracting files from the archive file and putting them in the right place.) If, however, a package **Pre-Depends** on another then the other package is unpacked and configured before the one that Pre-Depends is even unpacked. [2] The use of this dependency is kept to a minimum.

2.2.10 Package status

Package status can be "unknown", "install", "remove", "purge", or "hold". These "want" flags indicate what the user wanted to do with a package (either by making choices in the "Select" section of `dselect`, or by directly invoking `dpkg`).

Their meanings are:

- **unknown** - the user has never indicated whether he wants the package.
- **install** - the user wants the package installed or upgraded.
- **remove** - the user wants the package removed, but does not want to remove any existing configuration files.
- **purge** - the user wants the package to be removed completely, including its configuration files.
- **hold** - the user wants this package not to be processed, i.e., he wants to keep the current version with the current status, whatever that is.

2.2.11 Holding back packages from an upgrade

There are two mechanisms for holding back packages from an upgrade, through `dpkg`, or, beginning with Woody, through APT.

With `dpkg`, first export the list of package selections:

```
dpkg --get-selections \* > selections.txt
```

Then edit the resulting file *`selections.txt`*, changing the line containing the package you wish to hold, e.g. `libc6`, from this:

[2] This mechanism was provided in order to support safe upgrading of systems from `a.out` format to ELF format, where the **order** in which packages were unpacked was critical.

```
libc6                          install
```

to this:

```
libc6                          hold
```

Save the file, and reload it into `dpkg` database with:

```
dpkg --set-selections < selections.txt
```

Or, if you know the package name to hold, simply run:

```
echo libc6 hold | dpkg --set-selections
```

This procedure holds packages at the install process of each package file.

The same effect can be obtained through `dselect`. Simply enter the [S]elect screen, find the package you wish to hold in its present state, and press the '=' key (or 'H'). The changes will take effect immediately after you exit the [S]elect screen.

The APT system in the Woody distribution has a new alternative mechanism for holding packages during the archive retrieval process using `Pin-Priority`. See the manual page `apt_preferences(5)`, along with http://www.debian.org/doc/manuals/apt-howto/ or the `apt-howto` package.

2.2.12 Source packages

Source packages are distributed in a directory called `source`, and you can either download them manually, or use

```
apt-get source foo
```

to fetch them (see the `apt-get(8)` manual page on how to set up APT for doing that).

2.2.13 Building binary packages from a source package

For a package *foo*, you will need all of *foo*`_*.dsc`, *foo*`_*.tar.gz`, and *foo*`_*.diff.gz` to compile the source (note: there is no `.diff.gz` for a Debian native package).

Once you have them, if you have the `dpkg-dev` package installed, the command

```
$ dpkg-source -x foo_version-revision.dsc
```

will extract the package into a directory called *foo-version*.

Issue the following command to build the binary package:

```
$ cd foo-version
$ su -c "apt-get update ; apt-get install fakeroot"
$ dpkg-buildpackage -rfakeroot -us -uc
```

Then,

```
# su -c "dpkg -i ../foo_version-revision_arch.deb"
```

to install the newly built package. See 'Port a package to the `stable` system' on page 90.

2.2.14 Creating new Debian packages

For detailed information on creating new packages, read the *New Maintainers' Guide*, available in the `maint-guide` package, or at http://www.debian.org/doc/manuals/maint-guide/.

2.3 Upgrading a Debian system

One of Debian's goals is to provide a smooth, secure and reliable upgrade process. The packaging system alerts the administrator to important changes and sometimes asks the administrator to take decisions. You should also read the Release Notes; it is shipped on all Debian CDs and is available on the WWW at http://www.debian.org/releases/stable/releasenotes or http://www.debian.org/releases/testing/releasenotes.

A practical guide to upgrades is provided in 'Debian package management' on page 77. This section merely provides an outline, beginning with the packaging tools.

2.3.1 `dpkg`

This is the main program for manipulating package files; read `dpkg(8)` for a full description.

`dpkg` comes with several primitive supplemental programs.

- `dpkg-deb`: Manipulate `.deb` files. `dpkg-deb(1)`
- `dpkg-ftp`: An older package file retrieval command. `dpkg-ftp(1)`
- `dpkg-mountable`: An older package file retrieval command. `dpkg-mountable(1)`
- `dpkg-split`: Splits a large package into smaller files. `dpkg-split(1)`

`dpkg-ftp` and `dpkg-mountable` have been superseded by the introduction of the APT system.

2.3.2 APT

APT (the Advanced Packaging Tool) is an advanced interface to the Debian packaging system consisting of several programs whose names typically begin with "apt-". `apt-get`, `apt-cache`, and `apt-cdrom` are the command-line tools for handling packages. These also function as the user's "back end" programs to other tools, such as `dselect` and `aptitude`.

For more information, install the `apt` package and read `apt-get(8)`, `apt-cache(8)`, `apt-cdrom(8)`, `apt.conf(5)`, `sources.list(5)`, `apt_preferences(5)` (Woody), and `/usr/share/doc/apt/guide.html/index.html`.

An alternative source of information is the APT HOWTO (`http://www.debian.org/doc/manuals/apt-howto/`). This can be installed by `apt-howto` at `/usr/share/doc/Debian/apt-howto/`.

`apt-get upgrade` and `apt-get dist-upgrade` pull only the packages listed under "Depends:" and overlook all the packages listed under "Recommends:" and "Suggests:". To avoid this, use `dselect`.

2.3.3 `dselect`

This program is a menu-driven user interface to the Debian package management system. It is particularly useful for first-time installations and large-scale upgrades. See '`dselect`' on page 80.

For more information, install the `install-doc` package and read `/usr/share/doc/install-doc/dselect-beginner.en.html` or dselect Documentation for Beginners (`http://www.debian.org/releases/woody/i386/dselect-beginner`).

2.3.4 Upgrading a running system

The kernel (filesystem) in Debian systems supports replacing files even while they're being used. When packages are upgraded any services provided by those packages are restarted if they are configured to run in the current runlevel. The Debian system does not require use of the single-user mode to upgrade a running system.

2.3.5 Downloaded and cached `.deb` archive files

If you have manually downloaded package files to your disk (which is not absolutely necessary, see above for the description of `dpkg-ftp` or APT), then after you have installed the packages, you can remove the `.deb` files from your system.

If APT is used, these files are cached in the `/var/cache/apt/archives` directory. You may erase them after installation (`apt-get clean`) or copy them to another machine's `/var/cache/apt/archives` directory to save downloading during subsequent installations.

2.3.6 Record-keeping for upgrades

`dpkg` keeps a record of the packages that have been unpacked, configured, removed, and/or purged, but does not (currently) keep a log of terminal activity that occurred while a package was being so manipulated.

The simplest way to work around this is to run your `dpkg`, `dselect`, `apt-get`, etc., sessions within the `script(1)` program.

2.4 The Debian boot process

2.4.1 The `init` program

Like all Unices, Debian boots up by executing the program `init`. The configuration file for `init` (which is `/etc/inittab`) specifies that the first script to be executed should be `/etc/init.d/rcS`.

What happens next depends on whether the `sysv-rc` package or the `file-rc` package is installed. The following assumes that the `sysv-rc` package is installed. (`file-rc` contains its own `/etc/init.d/rcS` script and uses a file instead of symlinks in rc directories to control which services are started in which runlevels.)

The `/etc/init.d/rcS` file from the `sysv-rc` package runs all of the scripts in `/etc/rcS.d/` in order to perform initialization such as checking and mounting file systems, loading modules, starting the network services, setting the clock, and so on. Then, for compatibility, it also runs all the files (except those with a '.' in the filename) in `/etc/rc.boot/`. The latter directory is reserved for system administrator use, and using it is deprecated. See 'System initialization' on page 133 and System run levels and init.d scripts (`http://www.debian.org/doc/debian-policy/ch-opersys#s-sysvinit`) in the Debian Policy Manual for more info.

Debian does not use a BSD-style `rc.local` directory.

2.4.2 Runlevels

After completing the boot process, `init` starts all services that are configured to run in the default runlevel. The default runlevel is given by the entry for `id` in `/etc/inittab`. Debian ships with `id=2`.

Debian uses the following runlevels:

- 1 (single-user mode),
- 2 through 5 (multiuser modes), and
- 0 (halt the system),
- 6 (reboot the system).

Runlevels 7, 8, and 9 can also be used but their rc directories are not populated when packages are installed.

Switch runlevels using the `telinit` command.

When entering a runlevel all scripts in `/etc/rc`*`runlevel`*`.d/` are executed. The first letter in the name of the script determines the **way** in which the script is run: scripts whose names begin with `K` are run with the argument `stop`. Scripts beginning with `S` are run with the argument `start`. The scripts are run in the alphabetical order of their names; thus "stop" scripts are run before "start" scripts and the two-digit numbers following the `K` or `S` determine the order in which the scripts are run.

The scripts in `/etc/rc`*`runlevel`*`.d` are in fact just symbolic links back to scripts in `/etc/init.d/`. These scripts also accept "restart" and "force-reload" as argument; the latter methods can be used after a system has been booted in order to restart services or force them to reload their configuration files.

For example:

```
# /etc/init.d/exim4 force-reload
```

2.4.3 Customizing runlevels

Customizing runlevels is an advanced system administration task. The following advice holds for most services.

To enable service *service* in runlevel *R* create the symbolic link `/etc/rc`*`R`*`.d/S`*`xyservice`* with target `../init.d/`*`service`*. The sequence number *xy* should be the sequence number that was assigned to the service when the package was installed.

To disable the service, rename the symbolic link so that its name begins with a `K` instead of with an `S` and its sequence number is 100 minus *xy*.

It is convenient to use a runlevel editor such as `sysv-rc-conf` or `ksysv` for these purposes.

It is possible to delete the `S` symlink for a service in a particular runlevel directory instead of renaming it. This does not disable the service but leaves it in a "floating" state as far as the `sysv-rc` init system is concerned: on runlevel changes the service will be neither started nor stopped but will be left as it was, whether running or not running. Note, however, that a service left in such a floating state will be started if its package is upgraded whether or not it was running before the upgrade. This is a known shortcoming of the current Debian system. Note also that you should retain a service's `K` symlinks in runlevels 0 and 6. If you delete all the symlinks for a service then on upgrade the service's package will restore the symlinks to their factory default state.

It is **not** advisable to make any changes to symlinks in `/etc/rcS.d/`.

2.5 Supporting diversity

Debian offers several avenues to accommodate any wishes of the system administrator without breaking the system.

- `dpkg-divert`, see 'The `dpkg-divert` command' on page 93.
- `equivs`, see 'The `equivs` package' on page 94.
- `update-alternative`, see 'Alternative commands' on page 94.
- `make-kpkg` can accommodate many boot loaders. See `make-kpkg(1)` and 'Debian standard method' on page 97.

Any files under `/usr/local/` belong to the system administrator and Debian will not touch them. Most files under `/etc/` are `conffiles` and Debian will not overwrite them upon upgrade unless the system administrator requests so explicitly.

2.6 Internationalization

The Debian system is internationalized and provides support for character display and entry in many languages, both within the console and under X. Many documents, manual pages, and system messages have been translated into a growing number of languages. During installation, Debian prompts the user to choose an installation language (and sometimes a local language variant).

If your installed system does not support all the language features you need, or if you need to change languages or install a different keyboard to support your language, see 'Localization (l10n)' on page 166.

2.7 Debian and the kernel

See 'The Linux kernel under Debian' on page 97.

2.7.1 Compiling a kernel from non-Debian source

One has to understand the Debian policy with respect to headers.

The Debian C libraries are built with the most recent **stable** releases of the **kernel** headers.

For example, the Debian-1.2 release used version 5.4.13 of the headers. This practice contrasts with the Linux kernel source packages distributed at all Linux FTP archive sites, which use even more recent versions of the headers. The kernel headers distributed with the kernel source are located in `/usr/include/linux/include/`.

If you need to compile a program with kernel headers that are newer than those provided by `libc6-dev`, then you must add `-I/usr/src/linux/include/` to your command line when compiling. This came up at one point, for example, with the packaging of the automounter daemon (`amd`). When new kernels changed some internals dealing with NFS, `amd` needed to know about them. This required the inclusion of the latest kernel headers.

2.7.2 Tools to build custom kernels

Users who wish to (or must) build a custom kernel are encouraged to download the package `kernel-package`. This package contains the script to build the kernel package, and provides the capability to create a Debian kernel-image package just by running the command

```
# make-kpkg kernel_image
```

in the top-level kernel source directory. Help is available by executing the command

```
# make-kpkg --help
```

and through the manual page `make-kpkg(8)` and 'The Linux kernel under Debian' on page 97.

Users must separately download the source code for the most recent kernel (or the kernel of their choice) from their favorite Linux archive site, unless a kernel-source-*version* package is available (where *version* stands for the kernel version). The Debian `initrd` boot script requires a special kernel patch called `initrd`; see `http://bugs.debian.org/149236`.

Detailed instructions for using the `kernel-package` package are given in the file `/usr/share/doc/kernel-package/README.gz`.

2.7.3 Alternative boot loaders

To employ alternative boot loaders such as `grub` or `loadlin`, copy the compiled Linux kernel `bzimage` to other locations (e.g., to `/boot/grub` or to an MS-DOS partition).

2.7.4 Custom boot floppies

The task of making a custom boot floppy was greatly aided by the Debian package `boot-floppies`, used to be found in the `admin` section of the Debian FTP archive for Potato and older. Shell scripts in this package produce boot floppies in `syslinux` format. These are MS-DOS formatted floppies whose master boot records have been altered so that they directly boot Linux (or whatever other operating system has been defined in the `syslinux.cfg` file on the floppy). Other scripts in this package produce emergency root disks and can even reproduce the base disks.

You will find more information about this in the `/usr/doc/boot-floppies/README` file after installing the `boot-floppies` package.

2.7.5 Special provisions for dealing with modules

Debian's `modconf` package provides a shell script (`/usr/sbin/modconf`) which can be used to customize the configuration of modules. This script presents a menu-based interface, prompting the user for particulars on the loadable device drivers in his system. The responses are used to customize the file `/etc/modules.conf` (which lists aliases, and other arguments that must be used in conjunction with various modules) through files in `/etc/modutils/`, and `/etc/modules` (which lists the modules that must be loaded at boot time).

Like the (new) `Configure.help` files that are now available to support the construction of custom kernels, the `modconf` package comes with a series of help files (in `/usr/share/modconf/`) which provide detailed information on appropriate arguments for each of the modules. See 'The modularized 2.4 kernel' on page 99 for examples.

2.7.6 De-installing an old kernel package

The `kernel-image-`*`NNN`*`.prerm` script checks to see whether the kernel you are currently running is the same as the kernel you are trying to de-install. Therefore you can safely remove unwanted kernel image packages using this command:

```
# dpkg --purge --force-remove-essential kernel-image-NNN
```

(Replace *NNN* with your kernel version and revision number, of course.)

Chapter 3

Debian System installation hints

Official documentation for installing Debian is located at http://www.debian.org/releases/stable/ and http://www.debian.org/releases/stable/installmanual.

The development versions are located at http://www.debian.org/releases/testing/ and http://www.debian.org/releases/testing/installmanual (work in progress, sometimes this may not exist).

Although this chapter was initially written during the days of the Potato installer, most of the contents have been updated to the Woody installer and they are very similar installers. Since Sarge will use a totally new installer, please use this as a reference point for the Sarge installer. Also some key packages have changed names and priorities. For example, default MTA of Sarge is `exim4` instead of `exim`, and `coreutils` has been introduced to replace several packages. You may need to adjust actions.

3.1 General Linux system installation hints

Do not forget to check http://www.debian.org/CD/netinst/ if you are looking for a compact CD image of the Debian installer.

Running the `testing` or `unstable` distribution increases the risk of hitting serious bugs. This risk can be managed by deploying a multibooting scheme with a more stable Debian distribution or by using the nice trick provided by `chroot` as described in '`chroot`' on page 127. The latter will enable running different Debian distributions simultaneously on different consoles.

3.1.1 Hardware compatibility basics

Linux is compatible with most PC hardware and can be installed to almost any system. For me it was as easy as installing Windows 95/98/Me. The hardware compatibility list just seems to keep growing.

If you have a laptop PC, check Linux on Laptops (http://www.linux-laptop.net/) for installation pointers by brand and model.

My recommendation for desktop PC hardware is "Just be conservative":

- SCSI rather than IDE for work, IDE/ATAPI HD for private use.
- IDE/ATAPI CD-ROM (or CD-RW).
- PCI rather than ISA, especially for the network card (NIC).
- Use a cheap NIC. Tulip for PCI, NE2000 for ISA are good.
- Avoid PCMCIA (notebook) as your first Linux install.
- No USB keyboard, mouse, ... unless you want a challenge.

If you have a slow machine, yanking out the hard drive and plugging it into another faster machine for installation is a good idea.

3.1.2 Determining a PC's hardware and chip set

During installation, one will be asked to identify the hardware or chip set of the PC. Sometimes that information may not seem easy to find. Here is one method:

1. Open your PC's case and look inside.
2. Record the product ID codes on the large chips on the graphics card, network card, chip near serial ports, chip near IDE ports.
3. Record card names printed on the back of the PCI and ISA cards.

3.1.3 Determining a PC's hardware via Debian

The following commands on a Linux system should give some idea of actual hardware and configuration.

```
$ pager /proc/pci
$ pager /proc/interrupts
$ pager /proc/ioports
$ pager /proc/bus/usb/devices
```

These commands can be run during the install process from the console screen by pressing Alt-F2.

After the initial installation, with the installation of optional packages such as `pciutils`, `usbutils`, and `lshw`, you can obtain more extensive system information.

```
$ lspci -v |pager
$ lsusb -v |pager
# lshw  |pager
```

Typical uses of interrupts:

- IRQ0: timer output (8254)
- IRQ1: keyboard controller
- IRQ2: cascade to IRQ8–IRQ15 on PC-AT
- IRQ3: secondary serial port (io-port=0x2F8) (`/dev/ttyS1`)
- IRQ4: primary serial port (io-port=0x3F8) (`/dev/ttyS0`)
- IRQ5: free [sound card (SB16: io-port=0x220, DMA-low=1, DMA-high=5)]
- IRQ6: floppy disk controller (io-port=0x3F0) (`/dev/fd0`, `/dev/fd1`)
- IRQ7: parport (io-port=0x378) (`/dev/lp0`)
- IRQ8: rtc
- IRQ9: software interrupt (int 0x0A), redirect to IRQ2
- IRQ10: free [network interface card (NE2000: io-port=0x300)]
- IRQ11: free [(SB16-SCSI: io-port=0x340, SB16-IDE: io-port=0x1E8,0x3EE)]
- IRQ12: PS/2 Mouse
- IRQ13: free (was 80287 math coprocessor)
- IRQ14: primary IDE controller (`/dev/hda`, `/dev/hdb`)
- IRQ15: secondary IDE controller (`/dev/hdc`, `/dev/hdd`)

For old non-PnP ISA cards, you may want to set IRQ5, IRQ10, and IRQ11 as non-PnP from the BIOS.

For USB devices, device classes are listed in `/proc/bus/usb/devices` as `Cls=`*nn*:

- Cls=00 : Unused
- Cls=01 : Audio (speaker etc.)
- Cls=02 : Communication (MODEM, NIC, . . .)
- Cls=03 : HID (Human Interface Device: KB, mouse, joystick)
- Cls=07 : Printer
- Cls=08 : Mass storage (FDD, CD/DVD drive, HDD, Flash, . . .)
- Cls=09 : Hub (USB hub)
- Cls=255 : Vendor specific

If the device class of a device is not 255, Linux supports the device.

3.1.4 Determining a PC's hardware via other OSs

Hardware information can also be obtained from other OSs:

Install another commercial Linux distribution. Hardware detection on those tends to be better than on Debian as of now. (This situation should even out once `debian-installer` is introduced with Sarge.)

Install Windows. Hardware configuration can be obtained by right-clicking "My Computer" to get to Properties / Device Manager. Record all resource information such as IRQ, I/O port address, and DMA. Some old ISA cards may need to be configured under DOS and used accordingly.

3.1.5 A Lilo myth

"Lilo is limited to 1024 cylinders." Wrong!

The newer `lilo` used after Debian Potato has lba32 support. If the BIOS of your motherboard is recent enough to support lba32, `lilo` should be able to load beyond the old 1024-cylinder limitation.

Just make sure to add a line reading "lba32" somewhere near the beginning of your `lilo.conf` file if you have kept an old `lilo.conf`. See `/usr/share/doc/lilo/Manual.txt.gz`.

3.1.6 GRUB

The new boot loader `grub` from the GNU Hurd project can be installed on a Debian Woody system:

```
# apt-get update
# apt-get install grub-doc
# mc /usr/share/doc/grub-doc/html/
... read contents
# apt-get install grub
# pager /usr/share/doc/grub/README.Debian
... read it :)
```

To edit the GRUB menu, edit `/boot/grub/menu.lst`. See 'Setting GRUB boot parameters' on page 108 for how to set boot parameters during the boot process since it is slightly different from `lilo` configuration.

3.1.7 Choice of boot floppies

For Potato, I liked the IDEPCI disk set for normal install to a desktop. For Woody, I like the bf2.4 boot disk set. They both use a version of `boot-floppies` to create boot floppies.

If you have a PCMCIA network card, you need to use the standard boot disk set (largest number of floppies but all driver modules available) and configure the NIC in the PCMCIA setup; do not try to set up an NIC card in the standard network setup dialog.

For special systems, you may need to create a custom rescue disk. This can be done by replacing the kernel image named "linux" on the Debian rescue disk by overwriting it with another compressed kernel image compiled off-site for the machine. Details are documented in `readme.txt` on the rescue disk. The rescue floppy uses the MS-DOS filesystem, so you can use any system to read and edit it. This should make life easier for people with a special network card, etc.

For Sarge, `debian-installer` and/or `pgi` is expected to be used for creating boot floppies.

3.1.8 Installation

Follow the official instructions found in http://www.debian.org/releases/stable/installmanual or http://www.debian.org/releases/testing/installmanual (work in progress, sometimes this may not exist).

If you are installing a system using `boot-floppies` in the `testing` distribution, you may need to open a console terminal during the install process by pressing Alt-F2 and manually edit `/etc/apt/sources.list` entries, changing "stable" to "testing" to adjust APT sources.

I tend to install `lilo` into places like `/dev/hda3`, while installing `mbr` into `/dev/hda`. This minimizes the risk of overwriting boot information.

Here is what I choose during the install process.

- MD5 passwords "yes"
- shadow passwords "yes"
- Install "advanced" (dselect **) and select
  - Exclude emacs (if selected), nvi, tex, telnet, talk(d);
  - Include mc, vim, either one of nano-tiny or elvis-tiny. See 'dselect' on page 80. Even if you are an Emacs fan, avoid it now and be content with nano during install. Also avoid installing other large packages such as TeX (Potato used to do this) at this stage. See 'Rescue editors' on page 209 for the reason for installing nano-tiny or elvis-tiny here.
- All configuration questions = "y" (replace current) during each package install dialog.
- `exim`: select 2 for machine since I send mail through my ISP's SMTP server.

For more information on dselect, see 'dselect' on page 80.

3.1.9 Hosts and IP to use for LAN

Example of LAN configuration (C subnet: 192.168.1.0/24):

```
Internet
   |
   +--- External ISP provides POP service (accessed by fetchmail)
   |
  Access point ISP provides DHCP service and SMTP relay service
   |                    :
  Cable modem         (Dialup)
   |                    :
LAN Gateway machine external port: eth0 (IP given by ISP's DHCP)
 use old notebook PC (IBM Thinkpad, 486 DX2 50MHz, 20MB RAM)
 run Linux 2.4 kernel with ext3 filesystem.
 run "ipmasq" package (with stronger patch, NAT, and firewall)
 run "dhcp-client" package configured for eth0 (override DNS setting)
 run "dhcp" package configured for eth1
 run "exim" as the smarthost (mode 2)
```

```
 run "fetchmail" with a long interval (fallback)
 run "bind" as the cache nameserver for Internet from LAN
           as authoritative nameserver for LAN domain from LAN
 run "ssh" on port 22 and 8080 (connect from anywhere)
 run "squid" as the cache server for the Debian archive (for APT)
LAN Gateway machine internal port: eth1 (IP = 192.168.1.1, fixed)
                          |
         +--- LAN Switch (100base T) ---+
         |                              |
Some fixed IP clients on LAN     Some DHCP clients on LAN
(IP = 192.168.1.2-127, fixed)    (IP = 192.168.1.128-200, dynamic)
```

See 'Network configuration' on page 179 for the details of configuring the network. See 'Building a gateway router' on page 204 for the details of configuring the LAN gateway server.

3.1.10 User accounts

In order to have a consistent feel across machines, the first few accounts are always the same in my system.

I always create a first user account with a name like "admin" (uid=1000). I forward all root email there. This account is given membership in the `adm` group (see "'Why GNU `su` does not support the `wheel` group"' on page 136), which can be given a good amount of root privilege through `su` using PAM or the `sudo` command. See 'Add a user account' on page 47 for details.

3.1.11 Creating filesystems

Hard disk partition

I prefer to use different partitions for different directory trees to limit damage upon system crash. E.g.,

```
/          == (/ + /boot + /bin + /sbin)
           == 50MB+
/tmp       == 100MB+
/var       == 100MB+
/home      == 100MB+
/usr       == 700MB+ with X
/usr/local == 100MB
```

The size of the `/usr` directory is very dependent on X Window applications and documentation. `/usr/` can be 300MB if one runs a console terminal only, whereas 2GB–3GB is not an unusual size if one has installed many Gnome applications. When `/usr/` grows too big, moving out `/usr/share/` to a different partition is the most effective cure. With the new large prepackaged Linux 2.4 kernels, `/` may need more than 200MB.

For example, the current status of my Internet gateway machine is as follows (output of the `df -h` command):

```
Filesystem            Size  Used Avail Use% Mounted on
/dev/hda3             300M  106M  179M  38% /
/dev/hda7             100M   12M   82M  13% /home
/dev/hda8             596M   53M  513M  10% /var
/dev/hda6             100M  834k   94M   1% /var/lib/cvs
/dev/hda9             596M  222M  343M  40% /usr
/dev/hda10            596M  130M  436M  23% /var/cache/apt/archives
/dev/hda11            1.5G  204M  1.2G  14% /var/spool/squid
```

(The large area reserved for `/var/spool/squid/` is for a proxy cache for package downloading.)

Following is `fdisk -l` output to provide an idea of partition structure:

```
# fdisk -l /dev/hda # comment

/dev/hda1             1        41    309928+   6  FAT16 # DOS
/dev/hda2            42        84    325080   83  Linux # (not used)
/dev/hda3   *        85       126    317520   83  Linux # Main
/dev/hda4           127       629   3802680    5  Extended
/dev/hda5           127       143    128488+  82  Linux swap
/dev/hda6           144       157    105808+  83  Linux
/dev/hda7           158       171    105808+  83  Linux
/dev/hda8           172       253    619888+  83  Linux
/dev/hda9           254       335    619888+  83  Linux
/dev/hda10          336       417    619888+  83  Linux
/dev/hda11          418       629   1602688+  83  Linux
```

A few unused partitions exist. These are for installing a second Linux distribution or as expansion space for growing directory trees.

Mount filesystems

Mounting the above filesystems properly is accomplished with the following `/etc/fstab`:

```
# /etc/fstab: static filesystem information.
#
# filesystem    mount point     type    options                 dump pass
/dev/hda3       /               ext2    defaults,errors=remount-ro 0 1
/dev/hda5       none            swap    sw                      0 0
```

```
proc            /proc           proc    defaults                0 0
/dev/fd0        /floppy         auto    defaults,user,noauto    0 0
/dev/cdrom      /cdrom          iso9660 defaults,ro,user,noauto 0 0
#
# keep partitions separate
/dev/hda7       /home           ext2    defaults                0 2
/dev/hda8       /var            ext2    defaults                0 2
/dev/hda6       /var/lib/cvs    ext2    defaults                0 2
# noatime will speed up file access for read access
/dev/hda9       /usr            ext2    defaults,noatime        0 2
/dev/hda10      /var/cache/apt/archives ext2    defaults        0 2

# very big partition for proxy cache
/dev/hda11      /var/spool/squid ext2   rw                      0 2

# backup bootable DOS
/dev/hda1       /mnt/dos        vfat    rw,noauto               0 0
# backup bootable Linux system (not done)
/dev/hda2       /mnt/linux      ext2    rw,noauto               0 0
#
# nfs mounts
mickey:/        /mnt/mickey     nfs     ro,noauto,intr          0 0
goofy:/         /mnt/goofy      nfs     ro,noauto,intr          0 0
# minnie:/ /mnt/minnie smbfs ro,soft,intr,credentials={filename} 0 2
```

For NFS, I use `noauto,intr` combined with the default `hard` option. This way, it is possible to recover from a hung process due to a dead connection using Ctrl-C.

For a Windows machine connected with Samba (smbfs), `rw,auto,soft,intr` may be good idea. See 'Samba configuration' on page 38.

For a floppy drive, using `noauto,rw,sync,user,exec` instead prevents file corruption after accidental disk eject before unmount, but this slows the write process.

Autofs mount

Key points to auto mount:

- Load the `vfat` module to allow `/etc/auto.misc` to contain `-fstype=auto`:

```
# modprobe vfat # prior to the floppy access attempt
 ... or to automate this setting,
# echo "vfat" >> /etc/modules
 ... and reboot the system.
```

- Set `/etc/auto.misc` as follows:

```
floppy -fstype=auto,sync,nodev,nosuid,gid=100,umask=000 :/dev/fd0
 ... where gid=100 is "users".
```

- Create `cdrom` and `floppy` links in `/home/`*`user`*, that point to `/var/autofs/misc/cdrom` and `/var/autofs/misc/floppy` respectively.
- Add *user* to the "users" group.

NFS mount

The external Linux NFS server (goofy) resides behind a firewall (gateway). I have a very relaxed security policy on my LAN since I am the only user. To enable NFS access, the NFS server side needs to add `/etc/exports` as follows:

```
# /etc/exports: the access control list for filesystems which may be
#               exported to NFS clients.  See exports(5).
/       (rw,no_root_squash)
```

This is needed to activate the NFS server in addition to installing and activating the NFS server and client packages.

For simplicity, I usually create a single partition of 2GB for an experimental or secondary lazy Linux install. I optionally share swap and `/tmp` partitions for these installs. A multipartition scheme is too involved for these usages. If only a simple console system is needed, 500MB may be more than sufficient.

3.1.12 DRAM memory guidelines

Following are rough guidelines for DRAM.

```
  4MB:  Bare minimum for Linux kernel to function.
 16MB:  Minimum for reasonable console system.
 32MB:  Minimum for simple X system.
 64MB:  Minimum for X system with GNOME/KDE.
128MB:  Comfortable for X system with GNOME/KDE.
256MB (or more): Why not if you can afford it?  DRAM is cheap.
```

Using the boot option `mem=4m` (or lilo `append="mem=4m"`) will show how the system would perform with 4MB of memory installed. A lilo boot parameter is needed for a system containing more than 64MB of memory with an old BIOS.

3.1.13 Swap space

I use the following guidelines for swap space:

- Each swap partition is < 128MB (if using an old 2.0 kernel), < 2GB (with recent kernels)
- Total = either (1 to 2 times installed RAM) or (128MB to 2GB) as a guideline

- Spread them on different drives and mount all of them with `sw,pri=1` options in `/etc/fstab`. This ensures that the kernel does a striping RAID of the swap partitions and offers the maximum swap performance.
- Use a central portion of the hard disk when possible.

Even if you never need it, some swap space (128MB) is desirable so the system will slow down before it crashes hard with a program which leaks memory.

3.2 Bash configuration

I modify shell startup scripts to my taste across the system:

```
/etc/bash.bashrc        Replace with private one
/etc/profile            Keep distribution copy ( \w -> \W)
/etc/skel/.bashrc       Replace with private copy
/etc/skel/.profile      Replace with private copy
/etc/skel/.bash_profile Replace with private copy
~/.bashrc               Replace with private copy for all accounts
~/.profile              Replace with private copy for all accounts
~/.bash_profile         Replace with private copy for all accounts
```

See details in my example scripts (http://www.debian.org/doc/manuals/debian-reference/examples/). I like a transparent system, so I set `umask` to 002 or 022.

`PATH` is set by the following configuration files in this order:

```
/etc/login.defs  - before the shell sets PATH
/etc/profile     (may call /etc/bash.bashrc)
~/.bash_profile  (may call ~/.bashrc)
```

3.3 Mouse configuration

3.3.1 PS/2 mice

In the case of a PS/2-connector mouse on an ATX motherboard, the signal flow should be:

```
mouse -> /dev/psaux -> gpm -> /dev/gpmdata = /dev/mouse -> X
```

Here, a symlink `/dev/mouse` is created and is pointing to `/dev/gpmdata` to make some configuration utilities happy and to make reconfiguration easy. (E.g., if you decide not to use the `gpm` daemon after all, just point the symlink `/dev/mouse` to `/dev/psaux` after getting rid of the `gpm` daemon.)

This signal flow allows the keyboard and mouse to be unplugged and reinitialized by restarting `gpm` upon reconnect. X will stay alive!

The protocol of the signal flow between `gpm` output and X input can be implemented in either of two ways, as "ms3" (use the Microsoft 3-button serial mouse protocol) or "raw" (use the same protocol as the mouse that is connected), and this choice dictates the choice of protocol used in X configuration.

I will demonstrate the configuration examples using a Logitech 3-button (traditional Unix-style mouse) PS/2 mouse as an example in the following.

If you are one of the unfortunate whose graphics card is not supported by the new X4 and need to use the old X3 (some ATI 64 bit cards), configure `/etc/X11/XF86Config` instead of `/etc/X11/XF86Config-4` in the following examples while installing X3 packages.

The ms3 protocol approach

```
/etc/gpm.conf             | /etc/X11/XF86Config-4
==========================+=====================================
device=/dev/psaux         | Section "InputDevice"
responsiveness=           |  Identifier "Configured Mouse"
repeat_type=ms3           |  Driver     "mouse"
type=autops2              |  Option     "CorePointer"
append=""                 |  Option     "Device"   "/dev/mouse"
sample_rate=              |  Option     "Protocol" "IntelliMouse"
                          | EndSection
```

If this approach is used, the mouse type adjustment is done only by editing `gpm.conf` and X configuration stays constant. See my example scripts (http://www.debian.org/doc/manuals/debian-reference/examples/).

The raw protocol approach

```
/etc/gpm.conf             | /etc/X11/XF86Config-4
==========================+=====================================
device=/dev/psaux         | Section "InputDevice"
responsiveness=           |  Identifier "Configured Mouse"
repeat_type=raw           |  Driver     "mouse"
type=autops2              |  Option     "CorePointer"
append=""                 |  Option     "Device"   "/dev/mouse"
sample_rate=              |  Option     "Protocol" "MouseManPlusPS/2"
                          | EndSection
```

If this approach is used, the mouse type adjustment is done by editing `gpm.conf` as well as adjusting X configuration.

How to adjust to different mice

The gpm device type autops2 is supposed to autodetect most of the PS/2 mice in the market. Unfortunately it doesn't always work and it isn't available in pre-Woody versions. Try using ps2, or imps2 in gpm.conf instead of autops2 for such cases. To find out the specific types of mouse gpm knows about, type: gpm -t help. See gpm(8).

If a 2-button PS/2 mouse is used, set the X protocol to enable Emulate3Buttons. The difference of protocol between the 2-button mouse and the 3-button mouse is autodetected and auto-adjusted for gpm after tapping the middle button once.

For X protocol with 'The raw protocol approach' on the page before or without gpm, use:

- IntelliMouse: serial port mouse (gpm repeater with "ms3")
- PS/2: PS/2 port mouse (always test this first)
- IMPS/2: any PS/2 port mice (2, 3, or scroll mice, better)
- MouseManPlusPS/2: Logitech PS/2 port mouse
- ...

See more at Mouse Support in XFree86 (http://www.xfree86.org/current/mouse.html).

A typical Microsoft scroll mouse is reported to work best with:

```
/etc/gpm.conf             | /etc/X11/XF86Config-4
==========================+======================================
device=/dev/psaux         | Section "InputDevice"
responsiveness=           |  Identifier "Configured Mouse"
repeat_type=raw           |  Driver     "mouse"
type=autops2              |  Option     "CorePointer"
append=""                 |  Option     "Device"   "/dev/mouse"
sample_rate=              |  Option     "Protocol" "IMPS/2"
                          |  Option     "Buttons" "5"
                          |  Option  "ZAxisMapping" "4 5"
                          | EndSection
```

For some recent thin Toshiba notebook PCs, activating gpm before PCMCIA in the System-V init script may help prevent system lockup. Weird but true.

3.3.2 USB mice

Make sure you have all required kernel functions activated through kernel compile time configuration or modules:

- Under "Input core support":
  - "Input core support" (CONFIG_INPUT, input.o),
  - "Mouse support" (CONFIG_INPUT_MOUSEDEV, mousedev.o),
- Under "USB support":
  - "Support for USB" (CONFIG_USB, usbcore.o),

- "Preliminary USB device filesystem" (CONFIG_USB_DEVICEFS),
- "UHCI" or "OHCI" (CONFIG_USB_UHCI || CONFIG_USB_UHCI_ALT || CONFIG_USB_OHCI, `usb-uhci.o` || `uhci.o` || `usb-ohci.o`),
- "USB Human Interface Device (full HID) support" (CONFIG_USB_HID, `hid.o`), and
- "HID input layer support" (CONFIG_USB_HIDINPUT)

Here, lower case names are module names.

If you're not using devfs, create a device node `/dev/input/mice` with major 13 and minor 63 as follows:

```
# cd /dev
# mkdir input
# mknod input/mice c 13 63
```

For typical scroll **USB** mice, configuration combinations should be:

```
/etc/gpm.conf             | /etc/X11/XF86Config-4
==========================+=======================================
device=/dev/input/mice    | Section "InputDevice"
responsiveness=           |  Identifier "Generic Mouse"
repeat_type=raw           |  Driver     "mouse"
type=autops2              |  Option     "SendCoreEvents" "true"
append=""                 |  Option     "Device"   "/dev/input/mice"
sample_rate=              |  Option     "Protocol" "IMPS/2"
                          |  Option     "Buttons" "5"
                          |  Option  "ZAxisMapping" "4 5"
                          | EndSection
```

See the Linux USB Project (http://www.linux-usb.org/) for more information.

3.3.3 Touchpad

Although the touchpad on a laptop computer emulates a 2-button PS/2 mouse as the default behavior, the `tpconfig` package enables full control of the device. For example, setting `OPTIONS="--tapmode=0"` in `/etc/default/tpconfig` will disable pesky "click by tap" behavior. Set `/etc/gpm.conf` as follows to use both touchpad and USB external mouse on the console:

```
device=/dev/psaux
responsiveness=
repeat_type=ms3
type=autops2
append="-M -m /dev/input/mice -t autops2"
sample_rate=
```

3.4 NFS configuration

Set up NFS by setting `/etc/exports`.

```
# apt-get install nfs-kernel-server
# echo "/ *.domainname-for-lan-hosts(rw,no_root_squash,nohide)" \
        >> /etc/exports
```

See my example scripts for details (http://www.debian.org/doc/manuals/debian-reference/examples/).

3.5 Samba configuration

References:

- http://www.samba.org/
- `samba-doc` package

Setting up Samba with "share" mode is much easier since this creates WfW-type share drives. But it is preferable to set it up with "user" mode.

Samba can be configured through `debconf` or `vi`:

```
# dpkg-reconfigure --priority=low samba # in Woody
# vi /etc/samba/smb.conf
```

See my example scripts for details (http://www.debian.org/doc/manuals/debian-reference/examples/).

Adding a new user to the `smbpasswd` file can be done via `smbpasswd`:

```
$ su -c "smbpasswd -a username"
```

Make sure to use encrypted passwords for optimum compatibility.

Set `os level` according to the following system equivalences (the larger the number, the higher the priority as server):

```
0:      Samba with a loose attitude (will never become a master browser)
1:      WfW 3.1, Win95, Win98, Win/Me?
16:     Win NT WS 3.51
17:     Win NT WS 4.0
32:     Win NT SVR 3.51
33:     Win NT SVR 4.0
255:    Samba with mighty power
```

Make sure that users are members of the group owning the directory that gives shared access and that the directory path has its execution bit set to access.

3.6 Printer configuration

The traditional method is `lpr/lpd`. There is a new CUPS™ system (Common UNIX Printing System). PDQ is another approach. See the Linux Printing HOWTO (http://www.tldp.org/HOWTO/Printing-HOWTO.html) for more information.

3.6.1 lpr/lpd

For the `lpr/lpd` type spoolers (`lpr`, `lprng`, and `gnulpr`), set up `/etc/printcap` as follows if they are connected to a PostScript or text-only printer (the basics):

```
lp|alias:\
        :sd=/var/spool/lpd/lp:\
        :mx#0:\
        :sh:\
        :lp=/dev/lp0:
```

Meaning of the above lines:

- Head line: *lp* – name of spool, *alias* = alias
- mx#0 – max file size unlimited
- sh – suppress printing of burst page header
- lp=/dev/lp0 – local printer device, or port@host for remote

This is a good configuration if you are connected to a PostScript printer. Also, when printing from a Windows machine through Samba, this is a good configuration for any Windows-supported printer (no bidirectional communication is supported). You have to select the corresponding printer configuration on the Windows machine.

If you do not have a PostScript printer, you need to set up a filtering system using `gs`. There are many autoconfiguration tools provided for setting up `/etc/printcap`. Any of these combinations is an option:

- `gnulpr`, (`lpr-ppd`) and `printtool`—I use this.
- `lpr` and `apsfilter`
- `lpr` and `magicfilter`
- `lprng` and `lprngtool`
- `lprng` and `apsfilter`
- `lprng` and `magicfilter`

In order to run GUI configuration tools such as `printtool`, see 'Getting root in X' on page 154 to gain root privilege. Printer spools created with `printtool` use `gs` and act like PostScript printers. So when accessing them, use PostScript printer drivers. On the Windows side, "Apple LaserWriter" is the standard one.

3.6.2 CUPS™

The Common UNIX Printing System (or CUPS™) is installed by using `aptitude` and installing all packages under "Tasks" -> "Servers" -> "Print Server". (Sarge) For the best result,

you should set `aptitude` with "F10" -> "Options" -> "Dependency handling" -> "[X] Install Recommended packages automatically".

KDE and Gnome Desktop Environments provide easy printer configuration. Alternatively, you can configure the system using any web browser if `swat` is installed:

```
$ mybrowser http://localhost:631
```

For example, to add your printer on some port to the list of accessible printers:

- click "Printers" from the main page, and then "Add Printer",
- enter "root" for the username and its password,
- proceed to add the printer following the prompts,
- go back to the "Printers" page and click "Configure Printer", and
- proceed to configure the paper size, resolution, and other parameters.

See more information at `http://localhost:631/documentation.html` and `http://www.cups.org/cups-help.html`.

For a 2.4 kernel, see also 'Parallel port support' on page 103.

3.7 Other host installation hints

3.7.1 Install a few more packages after initial install

Once you have made it this far, you have a small but functioning Debian system. It is a good time to install bigger packages.

- Run `tasksel`. See 'Installing tasks' on page 79.

  You may choose these if you need them:
  - End-user – X Window System
  - Development – C and C++
  - Development – Python
  - Development – Tcl/Tk
  - Miscellaneous – TeX/LaTeX environment
  - For others, I prefer to use `tasksel` as a guide by looking into their components listed under <Task Info> and installing them selectively through `dselect`.

- Run `dselect`.

  Here the first thing you may want to do is select your favorite editor and any programs you need. You can install many Emacs variants at the same time. See '`dselect`' on page 80 and 'Popular editors' on page 209.

  Also you may replace some of the default packages with full-featured ones.

  - lynx-ssh (instead of lynx)
  - ...

- ...

I usually edit `/etc/inittab` for easy shutdown.

```
...
# What to do when CTRL-ALT-DEL is pressed.
ca:12345:ctrlaltdel:/sbin/shutdown -t1 -a -h now
...
```

3.7.2 Modules

Modules for the device drivers are configured during the initial installation. `modconf` provides menu-driven module configuration afterward. This program is quite useful when some modules were left out during the initial installation or a new kernel was installed after the initial installation.

All preloading module names need to be listed in `/etc/modules`. I also use `lsmod` and `depmod` to control them manually.

Also make sure to add a few lines in `/etc/modules` to handle IP masquerading (FTP, etc.) for 2.4 kernels. See 'The modularized 2.4 kernel' on page 99, specifically 'Network function' on page 100.

3.7.3 CD-RW basic setup

For IDE connected CD-RW drive with 2.4 kernel, edit the following files:

```
/etc/lilo.conf  (add append="hdc=ide-scsi ignore=hdc",
                 run lilo to activate)
/dev/cdrom      (symlink # cd /dev; ln -sf scd0 cdrom)
/etc/modules    (add "ide-scsi" and "sg". If needed "sr" after this.)
```

See 'CD writers' on page 138 for details.

3.7.4 Large memory and auto power-off

Edit `/etc/lilo.conf` as follows to set boot-prompt parameters for large memory (for 2.2 kernels) and auto power-off (for APM):

```
append="mem=128M apm=on apm=power-off noapic"
```

Run `lilo` to install these settings. `apm=power-off` is needed for a SMP kernel and `noapic` is needed to avoid problems for my buggy SMP hardware. The same can be done directly by entering options at the boot prompt. See 'Other boot tricks with the boot prompt' on page 107.

If APM is compiled as a module, as in Debian default 2.4 kernels, run `insmod apm power_off=1` after boot or set `/etc/modules` by:

```
# echo "apm power_off=1" >>/etc/modules
```

Alternatively, compiling ACPI support achieves the same goal with newer kernels and seems to be more SMP-friendly (this requires a newer motherboard). The 2.4 kernel on newer motherboards should detect large memory correctly.

```
CONFIG_PM=y
CONFIG_ACPI=y
...
CONFIG_ACPI_BUSMGR=m
CONFIG_ACPI_SYS=m
```

and add the following lines in `/etc/modules` in this order:

```
ospm_busmgr
ospm_system
```

Or recompile the kernel with all of the kernel options above set to "y". In any case, none of the boot-prompt parameters are needed with ACPI.

3.7.5 Strange access problems with some websites

Recent Linux kernels enable ECN by default, which may cause access problems with some websites on bad routers. To check ECN status:

```
# cat /proc/sys/net/ipv4/tcp_ecn
 ... or
# sysctl net.ipv4.tcp_ecn
```

To turn it off, use:

```
# echo "0" > /proc/sys/net/ipv4/tcp_ecn
 ... or
# sysctl -w net.ipv4.tcp_ecn=0
```

To disable TCP ECN on every boot, edit `/etc/sysctl.conf` and add:

```
net.ipv4.tcp_ecn = 0
```

3.7.6 Dialup PPP configuration

Install the `pppconfig` package to set up dialup PPP access.

```
# apt-get install pppconfig
# pppconfig
 ... follow the directions to configure dialup PPP
# adduser user_name dip
 ... allow user_name to access dialup PPP
```

Dialup PPP access can be initiated by the user (*user_name*):

```
$ pon ISP_name  # start PPP access to your ISP
 ... enjoy the Internet
$ poff ISP_name # stop PPP access, ISP_name optional
```

See 'Configuring a PPP interface' on page 183 for more details.

3.7.7 Other configuration files to tweak in `/etc/`

You may want to add an `/etc/cron.deny` file, missing from the standard Debian install (you can copy `/etc/at.deny`).

Chapter 4

Debian tutorials

This section provides a basic orientation to the Debian world for the real newbie. If you have been using any Unix-like system for a while, you probably know everything I explained here. Please use this as a reality check.

4.1 Getting started

After the installation of the Debian system on your PC, you need to learn few things to make it useful. Let us give you an express training.

4.1.1 Login to a shell prompt as root

Upon rebooting the system, you will be presented either the graphical login screen or the character based login screen depending on your initial selection of packages. For the sake of simplicity, if you are presented with the graphical login screen, press Ctrl-Alt-F1 [1] to gain the character based login screen.

Suppose your hostname is *foo*, the login prompt looks like:

```
foo login:
```

Type `root` , press the Enter-key and type the password which you selected during the install process. In the Debian system, following the Unix tradition, the password is case sensitive. Then the system starts with the greeting message and presents you with the root command prompt waiting for your input. [2]

```
foo login: root
```

[1] The left-Ctrl-key, the left-Alt-key, and the F1-key are pressed together.
[2] Note that if you edited the greeting message in `/etc/motd`, this will be different.

```
Password:
Last login: Sun Oct 26 19:04:09 2003 on tty3
Linux foo 2.4.22-1-686 #6 Sat Oct 4 14:09:08 EST 2003 i686 GNU/Linux

Most of the programs included with the Debian GNU/Linux system are
freely redistributable; the exact distribution terms for each program
are described in the individual files in /usr/share/doc/*/copyright

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

root@foo:root#
```

You are ready to perform the system administration from this root command prompt. This root account is also called superuser or privileged user. From this account, you can do anything:

- read, write, and remove any files on the system irrespective of their file permissions
- set file ownership and permission of any files on the system
- set the password of any non-privileged users on the system
- login to any accounts without their passwords

It is extremely bad idea to share the access to the root account by sharing the password. Use of program such as `sudo(8)` is the good way to share the administrative privileges.

Please note that it is considered a good Unix habit to login to the non-privileged user account first even when you plan to perform administrative activities. Use commands `sudo`, `super`, or `su -c` to gain the limited root privileged when needed. See 'Working more safely – `sudo`' on page 137. [3]

4.1.2 Set up minimal newbie environment

I think learning a computer system is like learning a new foreign language. Although tutorial books are helpful, you have to practice it with helper tools. In this context, I think it is a good idea to install few additional packages such as `mc`, `vim`, `lynx`, `doc-linux-text`, and `debian-policy`. [4]

```
# apt-get update
 ...
# apt-get install mc vim lynx doc-linux-text debian-policy
 ...
```

If you already had these packages installed, nothing will be installed.

[3] I have to admit I used to use the superuser account more often than needed just because it was easy and I was sloppy.

[4] It may also be a good idea to install `gpm`, `emacs21`, and `doc-linux-html`. See 'Mouse configuration' on page 34 and 'Editors' on page 209.

4.1.3 Add a user account

During the installation, you usually created a non-privileged user account who receives e-mails sent to the root account. [5] Since you do not want to use this special user account for the following training activities either, you should create another new user account.

Suppose you wish this new username to be *penguin*, type:

```
root@foo:root# adduser penguin
... answer all the questions
```

will create it. [6] Before going further, let's learn few things first.

4.1.4 Switch between virtual console

In the default Debian system, there are six independent pseudo-terminals available, i.e., you can use the PC's VGA character console screen as 6 switchable VT-100 terminals. Switch from one to another by pressing the Left-Alt-key and one of the F1–F6 keys simultaneously. Each pseudo-terminal allows independent login to accounts. The multiuser environment is a great Unix feature, and very addictive.

If you accidentally typed Alt-F7 on a system running the X Window System and the console screen displays graphic screen, regain the access to the character console by pressing Ctrl-Alt-F1. Just try to move to different console and come back to the original one to get used to this.

4.1.5 How to shut down

Just like any other modern OSs where the file operation involves caching data in the memory, the Debian system needs the proper shutdown procedure before power can safely be turned off to maintain the integrity of files. Use the following command from the root command prompt to shutdown the system:

```
# shutdown -h now
```

This is for the normal multiuser mode. If you are in the single-user mode, use following from the root command prompt:

```
# poweroff -i -f
```

[5] I tend to name this account created during installation as `admin` but this can be any arbitrary name.

[6] You may want to add this user *penguin* to the `adm` group to enable read access to the many logfiles in `/var/log/`. See `passwd(5)`, `group(5)`, `shadow(5)`, `group(5)`, `vipw(8)`, and `vigr(8)`. For the official meanings of users and groups, see a recent version of the Users and Groups (`/usr/share/doc/base-passwd/users-and-groups.html`) document.

Alternatively, you may type Ctrl-Alt-Delete to shutdown. [7]

Wait until the system displays "System halted" then shut off power. If the APM or ACPI function has been turned on by the BIOS and Linux properly, the system will power down by itself. See 'Large memory and auto power-off' on page 41 for the detail.

4.1.6 Play time

Now you are ready to play with the Debian system without risks as long as you use this non-privileged user account *penguin*. [8]

Let's login to the *penguin*. If you are at root shell prompt, type Ctrl-D [9] at the root command prompt to close the root shell activity and return to the login prompt. Enter your newly created username *penguin* and the corresponding password. [10] You will be presented with the following command prompt.

```
penguin@foo:penguin$
```

From here on, the example given will use simplified command prompt for the sake of simplicity. I will use:

- `#` : root shell prompt
- `$` : non-privileged user shell prompt

We will start learning the Debian system first with the easy way 'Midnight Commander (MC)' on the current page and later with the proper way 'Unix-like work environment' on page 51.

4.2 Midnight Commander (MC)

Midnight Commander (MC) is a GNU "Swiss army knife" for the Linux console and other terminal environments. This gives newbie a menu driven console experience which is much easier to learn than standard Unix commands.

Use this command to explore the Debian system. This is the best way to learn. Please explore few key locations just using the cursor keys and Enter key:

- `/etc` and its subdirectories.

[7] The left-Ctrl-key, the left-Alt-Key, and the Delete are pressed together from the console. In the default system, this will cause system reboot. You need to modify `/etc/inittab` to have `shutdown` command with `-h` option as described in 'Install a few more packages after initial install' on page 40.

[8] This is because the Debian system is, even just after the default installation, configured with the proper file permissions which prevent non-privileged user to damage the system. Of course, there may still exist some holes which can be exploited but those who worry about this issue should not be reading this section but should be reading Securing Debian Manual (`http://www.debian.org/doc/manuals/securing-debian-howto/`).

[9] The left-Ctrl-key and the d-key are pressed together. No need to press the Shift-key even though these control characters are referred as "control D" with the upper case.

[10] If you enter `root` instead of *penguin* here and the corresponding password, you will gain the access to the `root` account. This procedure will be needed to regain the access to the `root` account.

- `/var/log` and its subdirectories.
- `/usr/share/doc` and its subdirectories.
- `/sbin` and `/bin`

4.2.1 Enhance MC

In order to make MC to change working directory upon exit, you need to modify `~/.bashrc` (or `/etc/bash.bashrc`, called from `.bashrc`), as detailed in its manual page, `mc(1)`, under the `-P` option. [11]

4.2.2 Start MC

```
$ mc
```

MC takes care of all file operations through its menu, requiring minimal user effort. Just press F1 to get the help screen. You can play with MC just by pressing cursor-keys and function-keys. [12]

4.2.3 File manager in MC

The default is two directory panels containing file lists. Another useful mode is to set the right window to "information" to see file access privilege information, etc. Following are some essential keystrokes. With the `gpm` daemon running, one can use a mouse, too. (Make sure to press the shift-key to obtain the normal behavior of cut and paste in MC.)

- F1: Help menu
- F3: Internal file viewer
- F4: Internal editor
- F9: Activate pulldown menu
- F10: Exit Midnight Commander
- Tab: Move between two windows
- Insert: Mark file for a multiple-file operation such as copy
- Del: Delete file (be careful—set MC to safe delete mode)
- Cursor keys: Self-explanatory

4.2.4 Command-line tricks in MC

- Any `cd` command will change the directory shown on the selected screen.
- Ctrl-Enter or Alt-Enter will copy a filename to the command line. Use this with the `cp` or `mv` command together with command-line editing.
- Alt-Tab will show shell filename expansion choices.

[11] If you do not understand what exactly I am talking here, you can do this later.

[12] If one is in a terminal, such as `kon` and `kterm` for Japanese, that has issues with certain graphics characters, adding `-a` to MC's command line may help prevent problems.

- One can specify the starting directory for both windows as arguments to MC; for example, `mc /etc /root`.
- Esc + *numberkey* == F*n* (i.e., Esc + '1' = F1, etc.; Esc + '0' = F10)
- Esc-key == Alt-key (= Meta, M-); i.e., type Esc + 'c' for Alt-C.

4.2.5 Editor in MC

The internal editor has an interesting cut-and-paste scheme. Pressing F3 marks the start of a selection, a second F3 marks the end of selection and highlights the selection. Then you can move your cursor. If you press F6, the selected area will be moved to the cursor location. If you press F5, the selected area will be copied and inserted at the cursor location. F2 will save the file. F10 will get you out. Most cursor keys work intuitively.

This editor can be directly started on a file:

```
$ mc -e filename_to_edit
$ mcedit filename_to_edit
```

This is not a multi-window editor, but one can use multiple Linux consoles to achieve the same effect. To copy between windows, use Alt-F*n* keys to switch virtual consoles and use "File->Insert file" or "File->Copy to file" to move a portion of a file to another file.

This internal editor can be replaced with any external editor of choice.

Also, many programs use environment variables `EDITOR` or `VISUAL` to decide which editor to use. If you are uncomfortable with `vim`, set these to `mcedit` by adding these lines to `~/.bashrc`:

```
...
export EDITOR=mcedit
export VISUAL=mcedit
...
```

I do recommend setting these to `vim` if possible. Getting used to `vim` commands is the right thing to do, since Vi-editor is always there in the Linux/Unix world. [13]

4.2.6 Viewer in MC

Very smart viewer. This is a great tool for searching words in documents. I always use this for files in the `/usr/share/doc` directory. This is the fastest way to browse through masses of Linux information. This viewer can be directly started like so:

[13] Actually, `vi` or `nvi` are the programs you find everywhere. I chose `vim` instead for newbie since it offers you help through F1 key while it is similar enough and more powerful. If you are uncomfortable with `vim`, you can keep using `mcedit` for most system maintenance tasks. Since `mcedit` is 8-bit clean and dumb (it does not care about text encodings), it sometimes has advantages when editing unknown encoding files. `mcedit` cannot display UTF-8 files correctly.

```
$ mc -v filename_to_view
```

4.2.7 Auto-start features of MC

Press Enter on a file, and the appropriate program will handle the content of the file. This is a very convenient MC feature.

```
executable file:   Execute command
man, html file:    Pipe content to viewer software
tar.gz, deb file:  Browse its contents as if subdirectory
```

In order to allow these viewer and virtual file features to function, viewable files should not be set as executable. Change their status using the `chmod` command or via the MC file menu.

4.2.8 FTP virtual filesystem of MC

MC can be used to access files over the Internet using FTP. Go to the menu by pressing F9, then type 'p' to activate the FTP virtual filesystem. Enter a URL in the form `username:passwd@hostname.domainname`, which will retrieve a remote directory that appears like a local one.

Try `http.us.debian.org/debian` as URL and browse Debian file archive. See 'The Debian archives' on page 5 for how these are organized.

4.3 Unix-like work environment

Although MC enables you to do almost everything, it is very important for you to learn how to use the command line tools invoked from the shell prompt and become familiar with the Unix-like work environment. [14]

4.3.1 Special key strokes

In the Unix-like environment, there are few key strokes which have special meanings. [15]

- Ctrl-U: Erase line before cursor.
- Ctrl-H: Erase a character before cursor.
- Ctrl-D: Terminate input. (exit shell if you are using shell)
- Ctrl-C: Terminate a running program.
- Ctrl-Z: Temporarily stop program. (put it to the background job, see '`command &`' on page 59)

[14] In this tutorial chapter, the shell means `bash`. For more insight into the different shells, see 'Shell' on page 223.
[15] On a normal Linux character console, only the left-hand Ctrl and Alt keys work as expected.

- Ctrl-S: Halt output to screen. [16]
- Ctrl-Q: Reactivate output to screen.

The default shell, `bash`, has history-editing and tab-completion capabilities to aide the interactive use.

- up-arrow: Start command history search.
- Ctrl-R: Start incremental command history search.
- TAB: Complete input of the filename to the command line.
- Ctrl-V TAB: Input TAB without expansion to the command line.

Other important keystrokes to remember:

- Ctrl-Alt-Del: Reboot/halt the system, see 'Install a few more packages after initial install' on page 40.
- Left-click-and-drag mouse: Select and copy to the clipboard.
- Click middle mouse button: Paste clipboard at the cursor.
- Meta-key (Emacs terminology) is assigned traditionally to Left-Alt-key. Some system may be configured to use Windows-key for Meta-key.

Here, in order to use a mouse in the Linux character console, you need to have `gpm` running as daemon. [17] See 'Mouse configuration' on page 34.

4.3.2 Basic Unix commands

Let's learn the basic Unix commands. [18] Try all the following commands from the non-privileged user account *`penguin`*:

- `pwd`
  - Display name of current/working directory.
- `whoami`
  - Display current user name.
- `file` *`foo`*
  - Display a type of file for the file *foo*.
- `type -p` *`commandname`*
  - Display a file location of command *`commandname`*.
  - `which` *`commandname`* does the same. [19]
- `type` *`commandname`*
  - Display information on command *`commandname`*.
- `apropos` *`key-word`*
  - Find commands related to *`key-word`*.
  - `man -k` *`key-word`* does the same.
- `whatis` *`commandname`*
  - Display one line explanation on command *`commandname`*.

[16] You can disable this terminal feature using `stty(1)`.

[17] In the X Window environment, the mouse functions in the same way with the Xterm program.

[18] Here I use "Unix" in its generic sense. Any Unix clone OSs usually offer the equivalent commands. The Debian system is no exception. Do not worry if some commands do not work as you wish now. These examples are not meant to be executed in this order.

[19] If `alias` is used in the shell, their outputs are different.

- `man -a commandname`
  - Display explanation on command *commandname*. (Unix style)
- `info commandname`
  - Display rather long explanation on command *commandname*. (GNU style)
- `ls`
  - List contents of directory. (non-dot files and directories) [20]
- `ls -a`
  - List contents of directory. (all files and directories)
- `ls -A`
  - List contents of directory. (almost all files and directories, i.e., skip "`..`" and "`.`")
- `ls -la`
  - List all contents of directory with detail information. See 'The filesystem concept in Debian' on page 64.
- `ls -d`
  - List all directories under the current directory.
- `lsof foo`
  - List open status of file *foo*.
- `mkdir foo`
  - Make a new directory *foo* in the current directory.
- `rmdir foo`
  - Remove a directory *foo* in the current directory.
- `cd foo`
  - Change directory to the directory *foo* in the current directory or in the directory listed in the variable `CDPATH`. See `cd` command in `builtins(7)`.
- `cd /`
  - Change directory to the root directory.
- `cd`
  - Change directory to the current user's home directory.
- `cd /foo`
  - Change directory to the absolute path directory */foo*.
- `cd ..`
  - Change directory to the parent directory.
- `cd ~foo`
  - Change directory to the home directory of the user *foo*.
- `cd -`
  - Change directory to the previous directory.
- `</etc/motd pager`
  - Display contents of `/etc/motd` using the default pager. See '`command < foo`' on page 60. [21]
- `touch junkfile`
  - Create a empty file *junkfile*.

[20] Unix has a tradition to hide filenames which start with "`.`". They are traditionally files that contain configuration information and user preferences.

[21] Default pager of the bare bone Debian system is `more` which cannot scroll back. By installing `less` package using command line `apt-get install less`, `less` becomes default pager and you can scroll back with cursor keys.

- `cp foo bar`
  - Copy a existing file *foo* to a new file *bar*.
- `rm junkfile`
  - Remove a file *junkfile*.
- `mv foo bar`
  - Rename an existing file *foo* to a new name *bar*.
- `mv foo bar/baz`
  - Move an existing file *foo* to a new location with a new name *bar/baz*. The directory *bar* must exist.
- `chmod 600 foo`
  - Make an existing file *foo* to be non-readable and non-writable by the other people. (non-executable for all)
- `chmod 644 foo`
  - Make an existing file *foo* to be readable but non-writable by the other people. (non-executable for all)
- `chmod 755 foo`
  - Make an existing file *foo* to be readable but non-writable by the other people. (executable for all)
- `top`
  - Display process information using full screen. Type "q" to quit.
- `ps aux | pager`
  - Display information on all the running processes using BSD style output. See '`command1 | command2`' on page 59.
- `ps -ef | pager`
  - Display information on all the running processes using Unix system-V style output.
- `ps aux | grep -e "[e]xim4*"`
  - Display all processes running `exim` or `exim4`. Learn the regular expression from `grep(1)` manual page by typing `man grep`. [22]
- `ps axf | pager`
  - Display information on all the running processes with ASCII art output.
- `kill 1234`
  - Kill a process identified by the process ID: *1234*. See 'Kill a process' on page 113.
- `grep -e "pattern" *.html`
  - Find a "*pattern*" in all of the files ending with `.html` in current directory and display them all.
- `gzip foo`
  - Compress *foo* to create *foo*`.gz` using the Lempel-Ziv coding (LZ77).
- `gunzip foo.gz`
  - Decompress *foo*`.gz` to create *foo*.
- `bzip2 foo`
  - Compress *foo* to create *foo*`.bz2` using the Burrows-Wheeler block sorting text compression algorithm, and Huffman coding. (Better compression than `gzip`)
- `bunzip2 foo.bz2`

[22] The `[` and `]` in the regular expression enable `grep` to avoid matching itself. The `4*` in the regular expression means 0 or more repeats of character 4 thus enables `grep` to match both `exim` and `exim4`. Although `*` is used in shell filename wild card and regular expression, their meanings are different.

  - Decompress *foo*.bz2 to create *foo*.
- tar -xvvf *foo.tar*
  - Extract files from *foo*.tar archive.
- tar -xvvzf *foo*.tar.gz
  - Extract files from gzipped *foo*.tar.gz archive.
- tar -xvvf --bzip2 *foo.tar.bz2*
  - Extract files from *foo*.tar.bz2 archive. [23]
- tar -cvvf *foo*.tar *bar/*
  - Archive contents of folder *bar/* in *foo*.tar archive.
- tar -cvvzf *foo*.tar.gz *bar/*
  - Archive contents of folder *bar/* in compressed *foo*.tar.gz archive.
- tar -cvvf --bzip2 *foo*.tar.bz2 *bar/*
  - Archive contents of folder *bar/* in *foo*.tar.bz2 archive. [24]
- zcat README.gz | pager
  - Display contents of compressed README.gz using the default pager.
- zcat README.gz > foo
  - Create a file foo with the decompressed content of README.gz.
- zcat README.gz >> foo
  - Append the decompressed content of README.gz to the end of the file foo. (If it does not exist, create it first.)
- find . -name *pattern*
  - find matching filenames using shell *pattern*. (slower)
- locate -d . *pattern*
  - find matching filenames using shell *pattern*. (quicker using regularly generated database)

Please traverse directories and peek into the system using above commands as a training. If you have questions on any of the console commands, please make sure to read the manual page. For example, these commands are the good start:

```
$ man man
$ man bash
$ man ls
```

Also this is a good timing to start vim and press F1-key. You should at least read the first 35 lines. Then do the online training course by moving cursor to |tutor| and pressing Ctrl-]. See 'Editors' on page 209 to learn more about editors.

Please note that many Unix-like commands including ones from GNU and BSD will display brief help information if you invoke them in one of the following ways (or without any arguments in some cases):

```
$ commandname --help
$ commandname -h
```

[23] --bzip2 is used here instead of new short option -j to ensure this to work with old version of tar in Potato.

[24] --bzip2 is used here again to ensure compatibility.

Try also examples in 'Debian tips' on page 105 as your self training.

4.3.3 The command execution

Now you have some feel on how to use the Debian system. Let's look deep into the mechanism of the command execution in the Debian system. [25]

4.3.4 Simple command

A simple command is a sequence of
1 variable assignments (optional)
2 command name
3 arguments (optional)
4 redirections (optional: `>` , `>>` , `<` , `<<` , etc.)
5 control operator (optional: `&&` , `||` ; <newline> , `;` , `&` , `(` , `)`)

For more complex commands with quotations and substitutions, see 'Command-line processing' on page 227.

4.3.5 Command execution and environment variable

Typical command execution uses a shell line sequence like the following: [26]

```
$ date
Sun Oct 26 08:17:20 CET 2003
$ LC_ALL=fr_FR date
dim oct 26 08:17:39 CET 2003
```

Here, the program `date` is executed in the foreground job. The environment variable `LC_ALL` is:
- unset (system default, same as `C`) for the first command
- set to `fr_FR` (French locale) for the second command

Most command executions usually do not have preceding environment variable definition. For the above example, you can alternatively execute:

```
$ LC_ALL=fr_FR
$ date
dim oct 26 08:17:39 CET 2003
```

[25] Here, I have simplified reality for the newbie. See `bash(1)` for the exact explanation.

[26] To obtain the following output, you need to install French locale, see 'Locales' on page 168. This is not essential for the tutorial. This is done only to indicate its potential effects.

As you can see here, the output of command is affected by the environment variable to produce French output. If you want the environment variable to be inherited to the subprocesses (e.g., when calling shell script), you need to "export" it instead by using:

```
$ export LC_ALL
```

4.3.6 Command search path

When you type a command into the shell, the shell searches the command in the list of directories contained in the `PATH` environment variable. The value of the `PATH` environment variable is also called the shell's search path.

In the default Debian installation, the `PATH` environment variable of user accounts may not include `/sbin/`. So if you want to run any commands such as `ifconfig` from `/sbin/`, you must change the `PATH` environment variable to include it. The `PATH` environment variable is usually set by the initialization file `~/.bash_profile`, see 'Bash configuration' on page 34.

4.3.7 Command line options

Some commands take arguments. The arguments starting with − or −− are called options and control the behavior of the command.

```
$ date
Mon Oct 27 23:02:09 CET 2003
$ date -R
Mon, 27 Oct 2003 23:02:40 +0100
```

Here the command-line argument `-R` changes the `date` command behavior to output RFC-2822 compliant date string.

4.3.8 Shell wildcards

Often you want a command to work with a group of files without typing all of them. The filename expansion pattern using the shell **wildcards** facilitate this needs.

- `*`
  - This matches any group of 0 or more characters.
  - This does not match a filename started with "`.`".
- `?`
  - This matches exactly one character.
- `[...]`
  - This matches exactly one character with any character enclosed in brackets
- `[a-z]`
  - This matches exactly one character with any character between `a` and `z`.

- `[^...]`
  - This matches exactly one character other than any character enclosed in brackets (excluding "^").

For example, try the following and think yourself:

```
$ mkdir junk; cd junk; touch 1.txt 2.txt 3.c 4.h .5.txt
$ echo *.txt
1.txt 2.txt
$ echo *
1.txt 2.txt 3.c 4.h
$ echo *.[hc]
3.c 4.h
$ echo .*
. .. .5.txt
$ echo .[^.]*
.5.txt
$ echo [^1-3]*
4.h
$ cd ..; rm -rf junk
```

4.3.9 Return value of the command

Each command returns its exit status as the return value.

- return value = 0 if the command executes successfully.
- return value = non-zero if the command exits with error.

This return value can be accessed by the `$?` shell variable immediately after the execution.

```
$ [ 1 = 1 ] ; echo $?
0
$ [ 1 = 2 ] ; echo $?
1
```

Please note that, when the return value is used in the logical context for the shell, **success** is treated as the logical **TRUE**. This is somewhat non-intuitive since **success** bears value **zero**.

See 'Shell conditionals' on page 226.

4.3.10 Typical command sequences

Let's try to remember following shell command idioms. See 'Shell parameters' on page 225, 'Shell redirection' on page 225, 'Shell conditionals' on page 226, and 'Command-line processing' on page 227 after reading these idioms.

`command &`

The `command` is executed in the subshell in the **background**. Background jobs allow users to run multiple programs in a single shell.

The management of the background process involves the shell built-ins: `jobs`, `fg`, `bg`, and `kill`. Please read the sections of the `bash(1)` manual page under "SIGNALS", "JOB CONTROL", and "SHELL BUILTIN COMMANDS". [27]

`command1 | command2`

The standard output of `command1` is fed to the standard input of `command2` . Both commands may be running **concurrently**. This is called **pipeline**.

`command1 ; command2`

The `command1` and `command2` are executed **sequentially**.

`command1 && command2`

The `command1` is executed. If successful, `command2` is also executed **sequentially**. Return success if both `command1` **and** `command2` are successful.

`command1 || command2`

The `command1` is executed. If not successful, `command2` is also executed **sequentially**. Return success if `command1` **or** `command2` are successful.

`command > foo`

Redirect standard output of `command` to a file *`foo`*. (overwrite)

`command >> foo`

Redirect standard output of `command` to a file *`foo`*. (append)

`command > foo 2>&1`

Redirect both standard output and standard error of `command` to a file *`foo`*.

[27] The Debian system is a multi-tasking system.

`command < foo`

Redirect standard input of `command` to a file *`foo`*. Try:

```
$ </etc/motd pager
 ... (the greetings)
$ pager </etc/motd
 ... (the greetings)
$ pager /etc/motd
 ... (the greetings)
$ cat /etc/motd | pager
 ... (the greetings)
```

Although all 4 syntaxes display the same thing, the last example runs extra `cat` command and wastes resources with no reason.

4.3.11 Command alias

You can set an alias for the frequently used command. For example:

```
$ alias la='ls -la'
```

Now, `la` works as a short hand for `ls -la` which lists all files in the long listing format.

You can identity exact path or identity of the command using `type` command. For example:

```
$ type ls
ls is hashed (/bin/ls)
$ type la
la is aliased to `ls -la'
$ type echo
echo is a shell builtin
$ type file
file is /usr/bin/file
```

Here `ls` was recently searched while `file` was not, thus `ls` is "hashed", i.e., the shell has an internal record for the quick access to the location of the `ls` command.

4.4 Unix-like text processing

There are few standard text processing tools which are used very often on the Unix-like system.

- No regular expression is used:

  - `head` outputs the first part of files.
  - `tail` outputs the last part of files.
  - `sort` sorts lines of text files.
  - `uniq` removes duplicate lines from a sorted file.
  - `tr` translates or deletes characters.
  - `diff` compares files line by line.
- Basic regular expression (BRE) is used:
  - `grep` matches text with the pattern.
  - `ed` is a primitive line editor.
  - `sed` is a stream editor.
  - `vi` is a screen editor.
  - `emacs` is a screen editor.
- Extended regular expression (ERE) is used:
  - `egrep` matches text with pattern.
  - `awk` does simple text processing. See 'Awk' on page 228.
  - `perl` does every conceivable text processing. See 'Perl' on page 229.

See 'Regular-expression substitution' on page 118, 'Script snippets for piping commands' on page 120, and 'Perl short script madness' on page 122 for some script examples.

4.4.1 Regular expressions

Regular expressions are used in many text processing tools. They are analogous to the shell wildcards (see 'Shell wildcards' on page 57), but they are both more complicated and more powerful.

The regular expression describes the matching pattern and is made up of text characters and **metacharacters**. The metacharacter is just a character with a special meaning. There are 2 major styles, BRE and ERE, depending on the text tools as described in 'Unix-like text processing' on the facing page.

For the EREs, the **metacharacters** include "`\ . [ ] ^ $ * + ? ( ) { } |`". The regular expression means:

- `c`
  - This matches the non-metacharacter "`c`".
- `\c`
  - This matches the literal character "`c`".
- `.`
  - This matches any character including newline.
- `^`
  - This matches the beginning of a string.
- `$`
  - This matches the end of a string.
- `\<`
  - This matches the beginning of a word.
- `\>`
  - This matches the end of a word.

- `[abc...]`
  - This character list matches any of the characters "`abc...`".
- `[^abc...]`
  - This negated character list matches any of the characters except "`abc...`".
- `r*`
  - This matches zero or more regular expressions identified by "`r`".
- `r+`
  - This matches one or more regular expressions identified by "`r`".
- `r?`
  - This matches zero or one regular expressions identified by "`r`".
- `r1|r2`
  - This matches one of the regular expressions identified by "`r1`" or "`r2`".
- `(r1|r2)`
  - This matches one of the regular expressions identified by "`r1`" or "`r2`" and treats it as a **bracketed** regular expression.

In BREs the **metacharacters** "`+ ? ( ) { } |`" lose their special meaning; instead use the backslashed versions "`\+ \? \( \) \{ \} \|`". Thus the grouping construct `(r1|r2)` needs to be quoted as `\(r1|r2\)` in BREs. Since `emacs`, although being basically BRE, treats "`+ ?`" as the **metacharacters**. Thus there are no needs to quote them. See 'Replacement expressions' on the current page for how the grouping construct is used.

For example, `grep` can be used to perform the text search using the regular expression:

```
$ egrep 'GNU.*LICENSE|Yoyodyne' /usr/share/common-licenses/GPL
                    GNU GENERAL PUBLIC LICENSE
                    GNU GENERAL PUBLIC LICENSE
  Yoyodyne, Inc., hereby disclaims all copyright interest in the program
```

4.4.2 Replacement expressions

For the replacement expression, following characters have special meanings:

- `&`
  - This represents what the regular expression matched. (use `\&` in `emacs`)
- `\n`
  - This represents what the *n*-th **bracketed** regular expression matched.

For Perl replacement string, `$n` is used instead of `\n` and `&` has no special meaning.

For example:

```
$ echo zzz1abc2efg3hij4 | \
  sed -e 's/\(1[a-z]*\)[0-9]*\(.*\)$/=&=/'
```

```
zzz=1abc2efg3hij4=
$ echo zzz1abc2efg3hij4 | \
  sed -e 's/\(1[a-z]*\)[0-9]*\(.*\)$/\2===\1/'
zzzefg3hij4===1abc
$ echo zzz1abc2efg3hij4 | \
  perl -pe 's/(1[a-z]*)[0-9]*(.*)$/$2===$1/'
zzzefg3hij4===1abc
$ echo zzz1abc2efg3hij4 | \
  perl -pe 's/(1[a-z]*)[0-9]*(.*)$/=&=/'
zzz=&=
```

Here please pay extra attention to the style of the **bracketed** regular expression and how the matched strings are used in the text replacement process on different tools.

These regular expressions can be used for the cursor movements and the text replacement actions in the editors too.

Please read all the related manual pages to learn these commands.

4.5 Unix-like filesystem

In the GNU/Linux and other Unix-like OS systems, the **files** are organized into **directories**. [28] All **files** and **directories** are arranged in one big tree, the file hierarchy, rooted at `/`.

These files and directories can be spread out over several devices. The `mount(8)` command serves to attach the file system found on some device to the big file tree. Conversely, the `umount(8)` command will detach it again.

4.5.1 Unix file basics

Here are the basics:

- Filenames are case sensitive. That is, `MYFILE` and `MyFile` are **different** files.
- The root directory is referred to as simply `/`. Don't confuse this "root" with the root user. See 'Login to a shell prompt as root' on page 45.
- Every directory has a name which can contain any letters or symbols **except** `/`. [29] The root directory is an exception; its name is `/` (pronounced "slash" or "the root directory") and it cannot be renamed.
- Each file or directory is designated by a **fully-qualified filename**, **absolute filename**, or **path**, giving the sequence of directories which must be passed through to reach it. The three terms are synonymous. All absolute filenames begin with the `/` directory, and

[28] **Directories** are called **folders** on some other systems.

[29] While you **can** use almost any letters or symbols in a file name, in practice it's a bad idea. It is better to avoid any characters that often have special meanings on the command line, including spaces, tabs, newlines, and other special characters: `{ } ( ) [ ] ' ` " \ / > < | ; ! # & ^ * % @ $`. If you want to separate words in a name, good choices are the period, hyphen, and underscore. You could also capitalize each word, `LikeThis`.

there's a / between each directory or file in the filename. The first / is the name of a directory, but the others are simply separators to distinguish the parts of the filename. The words used here can be confusing. Take the following example:

```
/usr/share/keytables/us.map.gz
```

This is a fully-qualified filename; some people call it a **path**. However, people will also refer to `us.map.gz` alone as a filename. [30]

- The root directory has a number of branches, such as `/etc/` and `/usr/`. These subdirectories in turn branch into still more subdirectories, such as `/etc/init.d/` and `/usr/local/`. The whole thing together is called the **directory tree**. You can think of an absolute filename as a route from the base of the tree (/) to the end of some branch (a file). You'll also hear people talk about the directory tree as if it were a **family** tree: thus subdirectories have **parents**, and a path shows the complete ancestry of a file. There are also relative paths that begin somewhere other than the root directory. You should remember that the directory `..` / refers to the parent directory.
- There's no directory that corresponds to a physical device, such as your hard disk. This differs from CP/M, DOS, and Windows, where all paths begin with a device name such as `C:\`. See 'The filesystem concept in Debian' on this page.

The detailed best practices for the file hierarchy are described in the Filesystem Hierarchy Standard (`/usr/share/doc/debian-policy/fhs/fhs.txt.gz`). You should remember the following facts as the starter:

- `/`
  - A simple / represents the root directory.
- `/etc/`
  - This is the place for the system wide configuration files.
- `/var/log/`
  - This is the place for the system log files.
- `/home/`
  - This is the directory which contains all the home directories for all non-privileged users.

4.5.2 The filesystem concept in Debian

Following the Unix tradition, the Debian system provides the filesystem under which physical data on harddisks and other storage devices, and the interaction with the hardware devices such as console screens and remote serial consoles are represented in an unified manner.

Each file, directory, named pipe, or physical device on a Debian system has a data structure called an **inode** which describes its associated attributes such as the user who owns it (owner), the group that it belongs to, the time last accessed, etc. See `/usr/include/linux/fs.h` for the exact definition of `struct inode` in the Debian GNU/Linux system.

This unified representation of physical entities is very powerful since this allows us to use the same command for the same kind of operation on many totally different devices.

[30] There is also another use for the word **path**. See 'Command search path' on page 57. The intended meaning is usually clear from the context.

All your files could be on one disk — or you could have 20 disks, some of them connected to a different computer elsewhere on the network. You can't tell just by looking at the directory tree, and nearly all commands work just the same way no matter what physical device(s) your files are really on.

4.5.3 File and directory access permissions

File and directory access permissions are defined separately for the following three categories of affected users:

- the **user** who owns the file (u),
- other users in the **group** which the file belongs to (g), and
- all **other** users (o).

For a file, each corresponding permission allows:

- **read** (r): to examine contents of the file,
- **write** (w): to modify the file, and
- **execute** (x): to run the file as a command.

For a directory, each corresponding permission allows:

- **read** (r): to list contents of the directory,
- **write** (w): to add or remove files in the directory, and
- **execute** (x): to access files in the directory.

Here, **execute** permission on the directory means not only to allow reading of files in its directory but also to allow viewing their attributes, such as the size and the modification time.

To display permission information (and more) for files and directories, `ls` is used. See `ls(1)`. When `ls` invoked with the `-l` option, it displays the following information in the order given:

- the **type of file** (first character)
  - `-`: normal file
  - `d`: directory
  - `l`: symlink
  - `c`: character device node
  - `b`: block device node
  - `p`: named pipe
  - `s`: socket
- the file's access **permissions** (the next nine characters, consisting of three characters each for user, group, and other in this order)
- the **number of hard links** to the file
- the name of the **user** who owns the file
- the name of the **group** which the file belongs to
- the **size** of the file in characters (bytes)
- the **date and time** of the file (mtime)
- the **name** of the file.

To change the owner of the file, `chown` is used from the root account. To change the group of the file, `chgrp` is used from the file's owner or root account. To change file and directory access permissions, `chmod` is used from the file's owner or root account. Basic syntax to manipulate

`foo` file is:

```
# chown newowner foo
# chgrp newgroup foo
# chmod  [ugoa][+-=][rwx][,...] foo
```

See `chown(1)`, `chgrp(1)`, and `chmod(1)` for the detail.

For example, in order to make a directory tree to be owned by a user *foo* and shared by a group *bar*, issue the following commands from the root account:

```
# cd /some/location/
# chown -R foo:bar .
# chmod -R ug+rwX,o=rX .
```

There are three more special permission bits:

- **set user ID** (s or S instead of user's x),
- **set group ID** (s or S instead of group's x), and
- **sticky bit** (t or T instead of other's x).

Here the output of `ls -l` for these bits is capitalized if execution bits hidden by these outputs are unset.

Setting **set user ID** on an executable file allows a user to execute the executable file with the owner ID of the file (for example **root**). Similarly, setting **set group ID** on an executable file allows a user to execute the executable file with the group ID of the file (for example **root**). Because these settings can cause security risks, enabling them requires extra caution.

Setting **set group ID** on a directory enables the BSD-like file creation scheme where all files created in the directory belong to the **group** of the directory.

Setting the **sticky bit** on a directory prevents a file in the directory from being removed by a user who is not the owner of the file. In order to secure the contents of a file in world-writable directories such as `/tmp` or in group-writable directories, one must not only set **write** permission off for the file but also set the **sticky bit** on the directory. Otherwise, the file can be removed and a new file can be created with the same name by any user who has write access to the directory.

Here are a few interesting examples of the file permissions.

```
$ ls -l /etc/passwd /etc/shadow /dev/ppp /usr/sbin/pppd
crw-rw----    1 root     dip      108,   0 Jan 18 13:32 /dev/ppp
-rw-r--r--    1 root     root         1051 Jan 26 08:29 /etc/passwd
-rw-r-----    1 root     shadow        746 Jan 26 08:29 /etc/shadow
-rwsr-xr--    1 root     dip        234504 Nov 24 03:58 /usr/sbin/pppd
$ ls -ld /tmp /var/tmp /usr/local /var/mail /usr/src
drwxrwxrwt    4 root     root         4096 Feb  9 16:35 /tmp
drwxrwsr-x   10 root     staff        4096 Jan 18 13:31 /usr/local
```

```
drwxrwsr-x    3 root     src          4096 Jan 19 08:36 /usr/src
drwxrwsr-x    2 root     mail         4096 Feb  2 22:19 /var/mail
drwxrwxrwt    3 root     root         4096 Jan 25 02:48 /var/tmp
```

There is an alternative numeric mode to describe file permissions in `chmod(1)` commands. This numeric mode uses 3 to 4 digit wide octal (radix=8) numbers. Each digit corresponds to:

- 1st optional digit: sum of **set user ID** (=4), **set group ID** (=2), and **sticky bit** (=1)
- 2nd digit: sum of **read** (=4), **write** (=2), and **execute** (=1) permissions for **user**
- 3rd digit: ditto for **group**
- 4th digit: ditto for **other**

This sounds complicated but it is actually quite simple. If you look at the first few (2-10) columns from `ls -l` command output and read it as a binary (radix=2) representation of file permissions ("-" being "0" and "rwx" being "1"), this numeric mode value should make sense as an octal (radix=8) representation of file permissions to you. [31] For example, try:

```
$ touch foo bar
$ chmod u=rw,go=r foo
$ chmod 644 bar
$ ls -l foo bar
-rw-r--r--    1 penguin  penguin  0 Nov  3 23:30  foo
-rw-r--r--    1 penguin  penguin  0 Nov  3 23:30  bar
```

The default file permission mask can be set by using the `umask` shell built-in command. See `builtins(7)`.

4.5.4 Timestamps

There are three types of timestamps for a GNU/Linux file:

- **mtime**: the modification time (`ls -l`),
- **ctime**: the status change time (`ls -lc`), and
- **atime**: the last access time (`ls -lu`).

Note that **ctime** is not file creation time.

- Overwriting a file will change all of **mtime**, **ctime**, and **atime** of the file.
- Changing permission or owner of a file will change **ctime** and **atime** of the file.
- Reading a file will change **atime** of the file.

Note that even simply reading a file on the Debian system will normally cause a file write operation to update **atime** information in the **inode**. Mounting a filesystem with the `noatime` option will let the system skip this operation and will result in faster file access for the read. See `mount(8)`.

Use `touch(1)` command to change timestamps of existing files.

[31] Of course this method works only for 3 digit wide numeric mode.

4.5.5 Links

There are two methods of associating a file *foo* with a different filename *bar*.

- a **hard link** is a duplicate name for an existing file (`ln foo bar`),
- a **symbolic link**, or "symlink", is a special file that points to another file by name (`ln -s foo bar`).

See the following example for the changes in link counts and the subtle differences in the result of the `rm` command.

```
$ echo "Original Content" > foo
$ ls -l foo
-rw-r--r--    1 osamu    osamu           4 Feb  9 22:26 foo
$ ln foo bar     # hard link
$ ln -s foo baz  # symlink
$ ls -l foo bar baz
-rw-r--r--    2 osamu    osamu           4 Feb  9 22:26 bar
lrwxrwxrwx    1 osamu    osamu           3 Feb  9 22:28 baz -> foo
-rw-r--r--    2 osamu    osamu           4 Feb  9 22:26 foo
$ rm foo
$ echo "New Content" > foo
$ cat bar
Original Content
$ cat baz
New Content
```

The symlink always has nominal file access permissions of "rwxrwxrwx", as shown in the above example, with the effective access permissions dictated by the permissions of the file that it points to.

The `.` directory links to the directory that it appears in, thus the link count of any new directory starts at 2. The `..` directory links to the parent directory, thus the link count of the directory increases with the addition of new subdirectories.

4.5.6 Named pipes (FIFOs)

A named pipe is a file that acts like a pipe. You put something into the file, and it comes out the other end. Thus it's called a FIFO, or First-In-First-Out: the first thing you put in the pipe is the first thing to come out the other end.

If you write to a named pipe, the process which is writing to the pipe doesn't terminate until the information being written is read from the pipe. If you read from a named pipe, the reading process waits until there's something to read before terminating. The size of the pipe is always zero — it doesn't store data, it just links two processes like the shell `|`. However, since this pipe has a name, the two processes don't have to be on the same command line or even be run by the same user.

You can try it by doing the following:

```
$ cd; mkfifo mypipe
$ echo "hello" >mypipe & # put into background
[1] 5952
$ ls -l mypipe
prw-r--r--    1 penguin penguin  0 2003-11-06 23:18 mypipe
$ cat mypipe
hello
[1]+  Done                    echo hello >mypipe
$ ls mypipe
prw-r--r--    1 penguin penguin  0 2003-11-06 23:20 mypipe
$ rm mypipe
```

4.5.7 Sockets

The socket is similar to the named pipe (FIFO) and allows processes to exchange information. For the socket, those processes do not need to be running at the same time nor need to be the children of the same ancestor process. This is the endpoint for the inter process communication. The exchange of information may occur over the network between different hosts.

4.5.8 Device files

Device files refer to physical or virtual devices on your system, such as your hard disk, video card, screen, or keyboard. An example of a virtual device is the console, represented by `/dev/console`.

There are two types of devices:

- **character device**
  - This can be accessed one character at a time, that is, the smallest unit of data which can be written to or read from the device is a character (byte).
- **block device**
  - This must be accessed in larger units called blocks, which contain a number of characters. Your hard disk is a block device.

You can read and write device files, though the file may well contain binary data which may be an incomprehensible-to-humans gibberish. Writing data directly to these files is sometimes useful for the troubleshooting of hardware connections. For example, you can dump a text file to the printer device `/dev/lp0` or send modem commands to the appropriate serial port `/dev/ttyS0`. But, unless this is done carefully, it may cause a major disaster. So be cautious.

`/dev/null` etc.

`/dev/null` is a special device file that discards anything you write to it. If you don't want something, throw it in `/dev/null`. It's essentially a bottomless pit. If you read `/dev/null`, you'll get an end-of-file (EOF) character immediately.

`/dev/zero` is similar, only if you read from it you get the `\0` character (not the same as the number zero ASCII). See 'Dummy files' on page 127.

Device node number

The device node number are displayed by executing `ls` as:

```
$ ls -l /dev/hda /dev/ttyS0 /dev/zero
brw-rw----    1 root     disk       3,   0 Mar 14  2002 /dev/hda
crw-rw----    1 root     dialout    4,  64 Nov 15 09:51 /dev/ttyS0
crw-rw-rw-    1 root     root       1,   5 Aug 31 03:03 /dev/zero
```

Here,

- `/dev/hda` has the major device number 3 and the minor device number 0. This is read/write accessible by the user who belongs to `disk` group,
- `/dev/ttyS0` has the major device number 4 and the minor device number 64. This is read/write accessible by the user who belongs to `dialout` group, and
- `/dev/zero` has the major device number 1 and the minor device number 5. This is read/write accessible by anyone.

In the older system, the installation process creates the device nodes using `/sbin/MAKEDEV` command. See `MAKEDEV(8)`.

In the newer system, the filesystem under in the `/dev` is automatically populated by the device filesystem similar to the `/proc` filesystem.

4.5.9 `/proc` filesystem

The `/proc` filesystem is a pseudo-filesystem and contains information about the system and running processes.

People frequently panic when they notice one file in particular - `/proc/kcore` - which is generally huge. This is (more or less) a copy of the contents of your computer's memory. It's used to debug the kernel. It doesn't actually exist anywhere, so don't worry about its size.

See 'Tuning the kernel through the proc filesystem' on page 103 and `proc(5)`.

4.6 X Window System

See 'X' on page 143.

4.6.1 Start the X Window System

The X Window System can be started automatically with `xdm`-like graphical login daemon or type following from the console.

```
$ exec startx
```

4.6.2 Menu in the X Window System

Since X environment can accommodate many window managers, their user interfaces vary quite a bit. Please remember that right-clicking the root window will bring up menu selections. This is always available.

- To gain the shell command prompt, start Xterm from menu:
  - "XShells" –> "XTerm".
- For graphical browsing of the web pages, start Mozilla from menu:
  - "Apps" –> "Net" –> "Mozilla Navigator".
- For graphical browsing of the PDF files, start Xpdf from menu:
  - "Apps" –> "Viewers" –> "Xpdf".

If you do not find menu entry, install the pertinent packages. See 'Beginning Debian package management' on page 78.

4.6.3 Keyboard sequence for the X Window System

Followings are the important keystrokes to remember when running the X Window System.

- Ctrl-Alt-F1 through F6: Switch to other pseudo-terminals (from an X window, DOSEMU, etc.)
- Alt-F7: Switch back to X window
- Ctrl-Alt-minus: Change screen resolution in X window (minus refers to the keys on the numeric keypad)
- Ctrl-Alt-plus: Change screen resolution opposite way in X window (plus refers to the keys on the numeric keypad)
- Ctrl-Alt-Backspace: Terminate the X Server program
- Alt-X, Alt-C, Alt-V: Usual Windows/Mac Cut, Copy, Paste keys combinations with Ctrl- keys are replaced by these Alt- keys in some programs such as Netscape Composer.

4.7 Further study

At this moment, I recommend you to read the key guide books from The Linux Documentation Project: Guides (`http://www.tldp.org/guides.html`):

- "The Linux System Administrators' Guide",
  - This covers all of the aspects of keeping the system running, handling user accounts, backups, configuration of the system.

  - package: `sysadmin-guide`
  - file: `/usr/share/doc/sysadmin-guide/html/index.html`
  - web: `http://www.tldp.org/LDP/sag/index.html`
- "The Linux Network Administrator's Guide, Second Edition",
  - This is a single reference for network administration in a Linux environment.
  - package: `(not available)`
  - file: `(notapplicable)`
  - web: `http://www.tldp.org/LDP/nag2/index.html`
- "Linux: Rute User's Tutorial and Exposition"
  - A nice online and hardcover book covering GNU/Linux system administration.
  - By Paul Sheer
  - Published by Prentice Hall
  - Package: `rutebook` (from `non-free`)
  - File: `/usr/share/doc/rutebook/`
  - Web: `http://www.icon.co.za/~psheer/book/index.html.gz`

See 'Support for Debian' on page 247 for more learning resources.

Chapter 5

Upgrading a distribution to `stable`, `testing`, or `unstable`

Official release notes for upgrading are located at http://www.debian.org/releases/stable/releasenotes and http://www.debian.org/releases/testing/releasenotes (work in progress).

Upgrading a system to the `stable`, `testing`, or `unstable` distribution may require several steps which must be in the following order:

- Upgrade to Woody (if your system is older than Woody)
- Upgrade to `stable`
- Upgrade to `testing`
- Upgrade to `unstable`

Debian does not support upgrades that skip intermediate releases.

5.1 Upgrading from Potato to Woody

This procedure is described separately because Potato's APT did not have all the features described in the current `apt_preferences(5)` manpage.

After including only Woody sources in `/etc/apt/sources.list`, upgrade APT and required core packages to Woody versions by doing the following:

```
# apt-get update
# apt-get install libc6 perl libdb2 debconf
# apt-get install apt apt-utils dselect dpkg
```

Then upgrade the rest of the system to Woody.

```
# apt-get upgrade
# apt-get dist-upgrade
```

5.2 Preparing for upgrade

You can upgrade from one distribution to another one by fetching packages over the network. This can be done as follows.

Get a clean list of repositories for stable:

```
# cd /etc/apt
# cp -f sources.list sources.list.old
# :>sources.list
# apt-setup noprobe
```

If you want to upgrade to testing then add testing sources to this new list. If you want to upgrade to unstable then also add unstable sources.

```
# cd /etc/apt
# grep -e "^deb " sources.list >srcs
# :>sources.list
# cp -f srcs sources.list
# sed -e "s/stable/testing/" srcs >>sources.list
# sed -e "s/stable/unstable/" srcs >>sources.list
# apt-get update
# apt-get install apt apt-utils
```

See 'Beginning Debian package management' on page 78 for the art of tuning /etc/apt/sources.list and /etc/apt/preferences.

5.3 Upgrading

After properly setting up /etc/apt/sources.list and /etc/apt/preferences as described above you can begin the upgrade.

Note that tracking the testing distribution of Debian can have the side effect of delaying the installation of packages containing security fixes, since such packages are uploaded to unstable and only later migrate to testing.

See 'Debian package management' on page 77 for the basics, and see 'APT upgrade troubleshooting' on page 84 if you encounter problems.

5.3.1 Using dselect

If a system has many packages which include -dev packages, etc., the following method using dselect is recommended for fine-grained package control.

```
# dselect update  # always do this before upgrade
# dselect select  # select additional packages
```

All your current packages will be selected when dselect starts. dselect may prompt you with additional packages based on Depends, Suggests, and Recommends. If you do not want to add any packages, just type Q to exit dselect again.

```
# dselect install
```

You will have to answer some package configuration questions during this part of the process, so have your notes ready and allow some time for this part. See 'dselect' on page 80.

Use dselect. **It always works :)**

5.3.2 Using apt-get

```
# apt-get update
# apt-get -t stable upgrade
# apt-get -t stable dist-upgrade
# apt-get -t testing upgrade
# apt-get -t testing dist-upgrade
# apt-get -t unstable upgrade
# apt-get -t unstable dist-upgrade
```

Once your system has reached Sarge it is advisable to use aptitude instead of apt-get. (aptitude accepts many of the options that apt-get accepts, including those above.)

To upgrade and stay with current dselect settings:

```
# apt-get dselect-upgrade
```

See 'Package dependencies' on page 15.

Chapter 6

Debian package management

`aptitude` is now the preferred text front end for APT, the Advanced Package Tool. It remembers which packages you deliberately installed and which packages were pulled in through dependencies; the latter packages are automatically de-installed by `aptitude` when they are no longer needed by any deliberately installed packages. It has advanced package-filtering features but these can be difficult to configure.

`synaptic` is now the preferred Gtk GUI front end for APT. Its package filtering capability is easier to use than `aptitude`'s. It also has experimental support for Debian Package Tags (`http://debtags.alioth.debian.org/`).

To reduce the network load on the Debian repositories and to speed up your downloads you should get packages from Debian mirror sites.

If you need to install the same package on several machines on your local network then you can set up a local HTTP proxy using `squid` for packages downloaded through APT. If necessary, set the `http_proxy` environment variable or set the `http` value in `/etc/apt/apt.conf`.

Although APT's pinning feature, described in `apt_preferences(5)`, is powerful, its effects can be difficult to understand and manage. You should consider it an Advanced Feature.

The use of the method described in '`chroot`' on page 127 is desirable for simultaneously securing both system stability and access to the latest versions of software.

This chapter is based on a post-Woody system. Some features may require a Sarge system or later.

6.1 Introduction

If reading all the developer documentation is too much for you, read this chapter first and start enjoying the full power of Debian with `testing/unstable` :-)

6.1.1 Main package management tools

```
dpkg      - Debian package file installer
apt-get   - Command line front end for APT
aptitude  - Advanced text and command line front end for APT
synaptic  - Gtk GUI front end for APT
dselect   - Menu-driven package manager
tasksel   - Task installer
```

These tools aren't all alternatives to one another. For example, `dselect` uses both APT and `dpkg`.

APT uses `/var/lib/apt/lists/*` for tracking available packages while `dpkg` uses `/var/lib/dpkg/available`. If you have installed packages using `aptitude` or other APT front ends and you want to use `dselect` to install packages then the first thing you should do is update `/var/lib/dpkg/available` by selecting `[U]pdate` from `dselect`'s menu (or by running "`dselect update`").

`apt-get` automatically installs all packages upon which a requested package Depends. It does not install the packages that a requested package merely Recommends or Suggests.

`aptitude`, in contrast, can be configured to install packages that a requested package Recommends or Suggests.

`dselect` presents the user with a list of packages that a selected package Recommends or Suggests and allows these to be selected or deselected individually. See 'Package dependencies' on page 15.

6.1.2 Convenience tools

```
dpkg-reconfigure  - reconfigure an already installed package
                    (if it uses debconf)
dpkg-source       - manage source package file
dpkg-buildpackage - automate the building of a package file
apt-cache         - check package archive in local cache
```

6.2 Beginning Debian package management

6.2.1 Set up APT

Set up `sources.list` as described in 'Preparing for upgrade' on page 74. [1] Also refer to 'Debian System installation hints' on page 25, 'Upgrading a distribution to `stable`, `testing`, or `unstable`' on page 73, and 'Rescue editors' on page 209.

[1] If you track `testing` or `unstable` you can remove references to `stable` from `/etc/apt/sources.list` and `/etc/apt/preferences` because `testing` starts as a copy of `stable`.

6.2.2 Installing tasks

You can install sets of packages typically required in order to put a Debian system to a certain use. These sets of packages are called “tasks”.

The simplest way to install tasks at the time of initial installation is to use `tasksel`. Note that you must run

```
dselect update
```

before using it.

`aptitude` can also install tasks and is the tool recommended for this purpose. It enables you to deselect individual packages within tasks before proceeding to the installation step.

6.2.3 `aptitude`

`aptitude` is a new menu-driven package installer similar to `dselect` but built from scratch on top of APT. It can be used as an alternative to `apt-get` for most commands. See `aptitude(1)` and `/usr/share/doc/aptitude/README`.

Once you start using `aptitude` it is best to continue using it rather than alternative methods of installing packages; otherwise you lose the advantage of `aptitude` keeping track of which packages you have deliberately installed.

`aptitude` in full screen mode accepts single-key commands which are usually lowercase. Notable key strokes are:

```
Keystroke   Action
F10         Menu
?           Help for keystroke (complete listing)
u           Update package archive information
+           Mark the package to be upgraded or newly installed
-           Mark the package to be removed (keep config)
_           Mark the package to be purged (remove config)
=           Place the package on hold
U           Mark all upgradable packages to be upgraded
g           Download and install selected packages
q           Quit current screen and save changes
x           Quit current screen and discard changes
Enter       View information about a package
C           View a package's changelog
l           Change the limit for the displayed packages
/           Search for the first match
\           Repeat the last search
```

Like `apt-get`, `aptitude` installs packages upon which a selected package Depends. `aptitude` also offers the option to pull in packages that a to-be-installed package Recommends or Suggests. You can change the default behavior by choosing `F10 -> Options -> Dependency handling` in its menu.

Other advantages of `aptitude` are:

- `aptitude` offers access to all versions of a package.
- `aptitude` logs its actions in `/var/log/aptitude`.
- `aptitude` makes it easy to keep track of obsolete software by listing under "Obsolete and Locally Created Packages".
- `aptitude` includes a fairly powerful system for searching particular packages and limiting the package display. Users familiar with `mutt` will pick up quickly, as mutt was the inspiration for the expression syntax. See "SEARCHING, LIMITING, AND EXPRESSIONS" in `/usr/share/doc/aptitude/README`.
- `aptitude` in full screen mode has `su` functionality embedded and can be run from normal user until you really need administrative privileges.

6.2.4 `dselect`

In stable releases up to and including Potato, `dselect` was the principal package maintenance tool. For Sarge, you should consider using `aptitude` instead.

When started, `dselect` automatically selects all "Required", "Important", and "Standard" packages.

`dselect` has a somewhat strange user interface. Most people get used to it, however. It has four commands (Capital means CAPITAL!):

```
Key-stroke  Action
Q           Quit. Confirm current selection and quit anyway.
            (override dependencies)
R           Revert! I did not mean it.
D           Damn it! I do not care what dselect thinks.  Just Do it!
U           Set all to sUggested state
```

With `D` and `Q`, you can select conflicting selections at your own risk. Handle these commands with care.

Add a line containing the option "expert" in `/etc/dpkg/dselect.cfg` to reduce noise.

If your machine runs `dselect` slowly then you might consider running `dselect` on another (faster) machine in order to determine the packages you want to install, then use `apt-get install` on the slow machine to install them.

6.2.5 Tracking a distribution using APT

To track the `testing` distribution as it changes, make your `/etc/apt/preferences` file look like this:

```
Package: *
Pin: release a=testing
Pin-Priority: 800

Package: *
Pin: release a=stable
Pin-Priority: 600
```

Note that tracking the `testing` distribution can have the side effect of delaying the installation of packages containing security fixes. Such packages are uploaded to `unstable` and migrate to `testing` only after a delay.

See `apt_preferences(5)` for more complicated examples which will allow you, for example, to track `testing` while installing selected packages from `unstable`.

Examples which lock particular packages at particular versions while tracking other packages as they are released are available in the examples subdirectory (http://www.debian.org/doc/manuals/debian-reference/examples/) as `preferences.testing` and `preferences.unstable`.

If you mix distributions, e.g., `testing` with `stable` or `unstable` with `stable`, you will eventually pull in core packages such as `libc6` from `testing` or `unstable` and there is no guarantee that these will not contain bugs. You have been warned.

Another example, `preferences.stable`, forces all packages to be downgraded to `stable`.

Downgrading from a later release of a **package** to an earlier one is not officially supported in Debian. However, you may find that you have to downgrade a specific package in order to re-install a version of a package that works when a new version malfunctions. You may find these previous package files locally in `/var/cache/apt/archives/` or remotely at http://snapshot.debian.net/. See also 'Rescue using `dpkg`' on page 84.

Downgrading from a later release of a **distribution** to an earlier one is not officially supported either and is very likely to cause problems. However, this may be worth trying as a last resort if you are desperate.

6.2.6 `aptitude`, `apt-get` and `apt-cache` commands

While tracking `testing` as described in the above example you can manage the system by using the following commands:

- `aptitude upgrade` (or `apt-get upgrade` or `aptitude dist-upgrade` or `apt-get dist-upgrade`)

  These track the `testing` distribution — they upgrade each package on the system, after installing versions of packages upon which it Depends, from the `testing` distribution. [2]

[2] The difference between `upgrade` and `dist-upgrade` only appears when new versions of packages stand in

- `apt-get dselect-upgrade`

  This tracks the `testing` distribution — it upgrades each package on the system according to the selections of `dselect`.

- `aptitude -R -G install` *`package`* (or `apt-get install` *`package`*)

  This installs *package* and packages upon which it Depends from the `testing` distribution.

- `aptitude -r -G install` *`package`*

  This installs *package* and packages upon which it Depends and packages that it Recommends from the `testing` distribution.

- `aptitude -r -g install` *`package`*

  This installs *package* and packages upon which it Depends and packages that it Recommends or Suggests from the `testing` distribution.

- `aptitude install` *`package`*`/unstable`

  This installs *package* from the `unstable` distribution while installing its dependencies from the `testing` distribution.

- `aptitude install -t unstable` *`package`*

  This installs *package* from the `unstable` distribution while installing its dependencies also from the `unstable` distribution by setting the Pin-Priority of `unstable` to 990.

- `apt-cache policy` *`foo bar ...`*

  This checks the status of packages *foo bar ...*.

- `aptitude show` *`foo bar ...`* `| less` (or `apt-cache show` *`foo bar ...`* `| less`)

  This checks the information for packages *foo bar ...*.

- `aptitude install` *`foo=2.2.4-1`*

  This installs the particular version *2.2.4-1* of the *foo* package.

- `aptitude install` *`foo bar-`*

  This installs the *foo* package and removes the *bar* package

- `aptitude remove` *`bar`*

  This removes the *bar* package but not its configuration files.

- `aptitude purge` *`bar`*

  This removes the *bar* package together with all its configuration files.

different dependency relationships from old versions of those packages. See `apt-get(8)` for details. `aptitude upgrade` and `aptitude dist-upgrade` start `aptitude` in the commandline mode. You can switch these to full screen mode by pressing `e` key.

In the above examples, giving `apt-get` the `-u` option causes it to print a list of all packages that are to be upgraded and to prompt the user before taking action. The following makes `apt-get` always do this:

```
$ cat >> /etc/apt/apt.conf << .
// Always show packages to be upgraded (-u)
APT::Get::Show-Upgraded "true";
.
```

Use the `--no-act` option to simulate actions without actually installing, removing, etc., any packages.

6.3 Debian survival commands

With this knowledge you can live the life of eternal upgrade :-)

6.3.1 Check bugs in Debian and seek help

If you are experiencing problems with a specific package, make sure to check out these sites first before you seek help or file a bug report. (`lynx`, `links`, and `w3m` work equally well):

```
$ lynx http://bugs.debian.org/
$ lynx http://bugs.debian.org/package-name  # if you know package name
$ lynx http://bugs.debian.org/bugnumber     # if you know bug number
```

Search Google (www.google.com) with search words including “site:debian.org”.

When in doubt, read the fine manual. Set `CDPATH` as follows:

```
export CDPATH=.:/usr/local:/usr/share/doc
```

and type

```
$ cd packagename
$ pager README.Debian # if this exists
$ mc
```

More support resources are listed at ‘Support for Debian’ on page 247.

6.3.2 APT upgrade troubleshooting

Package dependency problems may occur when upgrading in `unstable` or `testing` as described in 'Upgrading' on page 74. Most of the time this is because a package that will be upgraded Depends on a package that is not yet available. These problems are fixed by using

```
# aptitude dist-upgrade
```

If this does not work, then repeat one of the following until the problem resolves itself:

```
# aptitude -f upgrade         # continue upgrade even after error
... or
# aptitude -f dist-upgrade    # continue dist-upgrade even after error
```

Some really broken upgrade scripts may cause persistent trouble. It is usually better to resolve this type of situation by inspecting the `/var/lib/dpkg/info/`*`packagename`*`.{post,pre}{inst,rm}` scripts of the offending package and then running:

```
# dpkg --configure -a     # configures all partially installed packages
```

If a script complains about a missing configuration file, look in `/etc/` for the corresponding configuration file. If one exists with an extension of `.dpkg-new` (or something similar), `mv` it to remove the suffix.

Package dependency problems may occur when installing in `unstable` or `testing`. There are ways to circumvent dependencies.

```
# aptitude -f install package # override broken dependencies
```

An alternative method to fix these situations is to use the `equivs` package. See `/usr/share/doc/equivs/README.Debian` and 'The `equivs` package' on page 94.

6.3.3 Rescue using `dpkg`

If you reach a dead end using APT you can download package files from Debian mirrors and install them using `dpkg`. If you do have not access to the network you can look for cached copies of package files in `/var/cache/apt/archives/`.

```
# dpkg -i fetchmail_6.2.5-4_i386.deb
```

If attempting to install a package this way fails due to dependency violations and you really need to install the package then you can override dependency checks using `dpkg`'s `--ignore-depends`, `--force-depends` and other options. See `dpkg(8)` for details.

6.3.4 Recover package selection data

If `/var/lib/dpkg/status` becomes corrupt for any reason, the Debian system loses package selection data and suffers severely. Look for the old `/var/lib/dpkg/status` file at `/var/lib/dpkg/status-old` or `/var/backups/dpkg.status.*`.

Keeping `/var/backups/` in a separate partition may be a good idea since this directory contains lots of important system data.

If no old `/var/lib/dpkg/status` file is available, you can still recover information from directories in `/usr/share/doc/`.

```
# ls /usr/share/doc | \
  grep -v [A-Z] | \
  grep -v '^texmf$' | \
  grep -v '^debian$' | \
  awk '{print $1 " install"}' | \
  dpkg --set-selections
# dselect --expert # reinstall system, de-select as needed
```

6.3.5 Rescue system after crashing `/var`

Since the `/var` directory contains regularly updated data such as mail, it is more susceptible of corruption than, e.g., `/usr/`. Putting `/var/` on a separate partition reduces risks. If disaster happens, you may have to rebuild the `/var` directory to rescue your Debian system.

Obtain the skeleton content of the `/var` directory from a minimum working Debian system based on the same or older Debian version, for example `var.tar.gz` (http://people.debian.org/~osamu/pub/), and place it in the root directory of the broken system. Then

```
# cd /
# mv var var-old      # if any useful contents are left
# tar xvzf var.tar.gz # use Woody skeleton file
# aptitude            # or dselect
```

This should provide a working system. You can expedite the recovery of package selections by using the technique described in 'Recover package selection data' on the current page. ([FIXME]: This procedure needs more experiments to verify.)

6.3.6 Install a package into an unbootable system

Boot into Linux using a Debian rescue floppy/CD or an alternative partition in a multiboot Linux system. See 'Booting the system' on page 105. Mount the unbootable system on `/target` and use the chroot install mode of `dpkg`.

```
# dpkg --root /target -i packagefile.deb
```

Then configure and fix problems.

By the way, if a broken `lilo` is all that prevents booting, you can boot using a standard Debian rescue disk. At boot prompt, assuming the root partition of your Linux installation is in `/dev/hda12` and you want runlevel 3, enter:

```
boot: rescue root=/dev/hda12 3
```

Then you are booted into an almost fully functional system with the kernel on floppy disk. (There may be minor glitches due to lack of kernel features or modules.)

6.3.7 What to do if the `dpkg` command is broken

A broken `dpkg` may make it impossible to install any `.deb` files. A procedure like the following will help you recover from this situation. (In the first line, you can replace "links" with your favorite browser command.)

```
$ links http://http.us.debian.org/debian/pool/main/d/dpkg/
  ... download the good dpkg_version_arch.deb
$ su
password: *****
# ar x dpkg_version_arch.deb
# mv data.tar.gz /data.tar.gz
# cd /
# tar xzfv data.tar.gz
```

For `i386`, `http://packages.debian.org/dpkg` may also be used as the URL.

6.4 Debian nirvana commands

Enlightenment with these commands will save a person from the eternal karmic struggle of upgrade hell and let him reach Debian **nirvana**. :-)

6.4.1 Information on a file

To find the package to which a particular filename pattern belongs in the installed packages:

```
$ dpkg {-S|--search} pattern
```

Or to find the similar in the Debian archive:

```
$ wget http://ftp.us.debian.org/debian/dists/sarge/Contents-i386.gz
$ zgrep -e pattern Contents-i386.gz
```

Or use specialized package commands:

```
# aptitude install dlocate
                 # conflicts with slocate (secure version of locate)
$ dlocate filename          # fast alternative to dpkg -L and dpkg -S
...
# aptitude install auto-apt # on-demand package installation tool
# auto-apt update           # create db file for auto-apt
$ auto-apt search pattern
                # search for pattern in all packages, installed or not
```

6.4.2 Information on a package

Search and display information from package archives. Make sure to point APT to the proper archive(s) by editing `/etc/apt/sources.list`. If you want to see how packages in `testing/unstable` do against the currently installed one, use `apt-cache policy`—quite nice.

```
# apt-get   check           # update cache and check for broken packages
$ apt-cache search  pattern # search package from text description
$ apt-cache policy  package # package priority/dists information
$ apt-cache show -a package # show description of package in all dists
$ apt-cache showsrc package # show description of matching source package
$ apt-cache showpkg package # package information for debugging
# dpkg  --audit|-C          # search for partially installed packages
$ dpkg {-s|--status} package ... # description of installed package
$ dpkg -l package ...       # status of installed package (1 line each)
$ dpkg -L package ...       # list filenames installed by the package
```

`apt-cache showsrc` is not documented as of the Woody release but works :)

You can also find package information in (I use `mc` to browse these):

```
/var/lib/apt/lists/*
/var/lib/dpkg/available
```

The comparison of the following files provides information on what exactly has happened in the last few install sessions.

```
/var/lib/dpkg/status
/var/backups/dpkg.status*
```

6.4.3 Unattended installation with APT

For an unattended installation, add the following line in `/etc/apt/apt.conf`:

```
Dpkg::Options {"--force-confold";}
```

This equivalent to running `aptitude -y install` *`packagename`* or `apt-get -q -y install` *`packagename`*. Because this automatically answers "yes" to all prompts, it may cause problems, so use this trick with care. See `apt.conf(5)` and `dpkg(1)`.

You can configure any particular packages later by following 'Reconfigure installed packages' on the current page.

6.4.4 Reconfigure installed packages

Use the following to reconfigure any already-installed package.

```
# dpkg-reconfigure --priority=medium package [...]
# dpkg-reconfigure --all   # reconfigure all packages
# dpkg-reconfigure locales # generate any extra locales
# dpkg-reconfigure --p=low xserver-xfree86 # reconfigure X server
```

Do this for `debconf` if you need to change the `debconf` dialog mode permanently.

Some programs come with special configuration scripts. [3]

```
apt-setup     - create /etc/apt/sources.list
install-mbr   - install a Master Boot Record manager
tzconfig      - set the local time zone
gpmconfig     - set gpm mouse daemon
sambaconfig   - configure Samba in Potato (Woody uses debconf)
eximconfig    - configure Exim (MTA)
texconfig     - configure teTeX
apacheconfig  - configure Apache (httpd)
cvsconfig     - configure CVS
sndconfig     - configure sound system
...
update-alternatives - set default command, e.g., vim as vi
update-rc.d         - System-V init script management
update-menus        - Debian menu system
...
```

[3] Some `*config` scripts are disappearing in the newer Sarge release and the package configuration functionality is moved to the `debconf` system.

6.4.5 Remove and purge packages

Remove a package while maintaining its configuration:

```
# aptitude remove package ...
# dpkg   --remove package ...
```

Remove a package and all configuration:

```
# aptitude purge  package ...
# dpkg   --purge  package ...
```

6.4.6 Holding older packages

For example, holding of `libc6` and `libc6-dev` for `dselect` and `aptitude install` *`package`* can be done as follows:

```
# echo -e "libc6 hold\nlibc6-dev hold" | dpkg --set-selections
```

`aptitude install` *`package`* will not be hindered by this "hold". To hold a package through forcing automatic downgrade for `aptitude upgrade` *`package`* or `aptitude dist-upgrade`, add the following to `/etc/apt/preferences`:

```
Package: libc6
Pin: release a=stable
Pin-Priority: 2000
```

Here the "`Package:`" entry cannot use entries such as "`libc6*`". If you need to keep all binary packages related to the `glibc` source package in a synchronized version, you need to list them explicitly.

The following will list packages on hold:

```
dpkg --get-selections "*"|grep -e "hold$"
```

6.4.7 Mixed `stable`/`testing`/`unstable` system

`apt-show-versions` can list available package versions by distribution.

```
$ apt-show-versions | fgrep /testing | wc
... how many packages you have from testing
$ apt-show-versions -u
... list of upgradeable packages
$ aptitude install `apt-show-versions -u -b | fgrep /unstable`
... upgrade all unstable packages to their newest versions
```

6.4.8 Prune cached package files

Package installation with APT leaves cached package files in `/var/cache/apt/archives/` and these need to be cleaned.

```
# aptitude autoclean # removes only useless package files
# aptitude clean     # removes all cached package files
```

6.4.9 Record/copy system configuration

To make a local copy of the package selection states:

```
$ dpkg --get-selections "*" >myselections   # or use \*
```

`"*"` makes *`myselections`* include package entries for "purge" too.

You can transfer this file to another computer, and install it there with:

```
# dselect update
# dpkg --set-selections <myselections
# apt-get -u dselect-upgrade    # or dselect install
```

6.4.10 Port a package to the `stable` system

For partial upgrades of the `stable` system, rebuilding a package within its environment using the source package is desirable. This avoids massive package upgrades due to their dependencies. First, add the following entries to `/etc/apt/sources.list`:

```
deb-src http://http.us.debian.org/debian testing \
 main contrib non-free
deb-src http://non-us.debian.org/debian-non-US testing/non-US \
 main contrib non-free
deb-src http://http.us.debian.org/debian unstable \
 main contrib non-free
deb-src http://non-us.debian.org/debian-non-US unstable/non-US \
 main contrib non-free
```

Here each entry for `deb-src` is broken into two lines because of printing constraints, but the actual entry in `sources.list` should consist of a single line.

Then get the source and make a local package:

```
$ apt-get update  # update the source package search list
$ apt-get source package
$ dpkg-source -x package.dsc
$ cd package-version
  ... inspect required packages (Build-Depends in .dsc file) and
      install them too.  You need the "fakeroot" package also.

$ dpkg-buildpackage -rfakeroot

  ...or (no sig)
$ dpkg-buildpackage -rfakeroot -us -uc # use "debsign" later if needed

  ...Then to install
$ su -c "dpkg -i packagefile.deb"
```

Usually, one needs to install a few packages with the "-dev" suffix to satisfy package dependencies. `debsign` is in the `devscripts` package. `auto-apt` may ease satisfying these dependencies. Use of `fakeroot` avoids unnecessary use of the root account.

In Woody, these dependency issues can be simplified. For example, to compile a source-only `pine` package:

```
# apt-get build-dep pine
# apt-get source -b pine
```

6.4.11 Local package archive

In order to create a local package archive which is compatible with APT and the `dselect` system, `Packages` needs to be created and package files need to be populated in a particular directory tree.

A local `deb` repository similar to an official Debian archive can be made in this way:

```
# aptitude install dpkg-dev
# cd /usr/local
# install -d pool # physical packages are located here
# install -d dists/unstable/main/binary-i386
# ls -1 pool | sed 's/_.*$/ priority section/' | uniq > override
# editor override # adjust priority and section
# dpkg-scanpackages pool override /usr/local/ \
   > dists/unstable/main/binary-i386/Packages
# cat > dists/unstable/main/Release << EOF
Archive: unstable
Version: 3.0
Component: main
```

```
Origin: Local
Label: Local
Architecture: i386
EOF
# echo "deb file:/usr/local unstable main" \
   >> /etc/apt/sources.list
```

Alternatively, a quick-and-dirty local `deb` repository can be made:

```
# aptitude install dpkg-dev
# mkdir /usr/local/debian
# mv /some/where/package.deb /usr/local/debian
# dpkg-scanpackages /usr/local/debian /dev/null | \
  gzip - > /usr/local/debian/Packages.gz
#  echo "deb file:/usr/local/debian ./" >> /etc/apt/sources.list
```

These archives can be remotely accessed by providing access to these directories through either HTTP or FTP methods and changing entries in `/etc/apt/sources.list` accordingly.

6.4.12 Convert or install an alien binary package

`alien` enables the conversion of binary packages provided in Red Hat `rpm`, Stampede `slp`, Slackware `tgz`, and Solaris `pkg` file formats into a Debian `deb` package. If you want to use a package from another Linux distribution than the one you have installed on your system, you can use `alien` to convert it to your preferred package format and install it. `alien` also supports LSB packages.

6.4.13 Automatically install command

`auto-apt` is an on-demand package installation tool.

```
$ sudo auto-apt update
 ... update database
$ auto-apt -x -y run
Entering auto-apt mode: /bin/bash
Exit the command to leave auto-apt mode.
$ less /usr/share/doc/med-bio/copyright # access non-existing file
 ...  Install the package which provide this file.
 ... Also install dependencies
```

6.4.14 Verify installed package files

`debsums` enables verification of installed package files against MD5 checksums. Some packages do not have available MD5 checksums. A possible temporary fix for sysadmins:

```
# cat >>/etc/apt/apt.conf.d/90debsums
DPkg::Post-Install-Pkgs {"xargs /usr/bin/debsums -sg";};
^D
```

per Joerg Wendland <`joergland@debian.org`> (untested).

6.4.15 Optimized `sources.list`

In short, fancy efforts to create an optimized `sources.list` did not produce a significant improvement for me from a location in the USA. I manually chose a nearby site using `apt-setup`.

`apt-spy` creates `sources.list` automatically, based on latency and bandwidth. `netselect-apt` creates a more complete `sources.list`, but uses an inferior method of choosing the best mirror (ping time comparison).

```
# aptitude install apt-spy
# cd /etc/apt ; mv sources.list sources.list.org
# apt-spy -d testing -l sources.apt
```

6.5 Other Debian peculiarities

6.5.1 The `dpkg-divert` command

File **diversions** are a way of forcing `dpkg` not to install a file into its default location, but to a **diverted** location. Diversions can be used through the Debian package scripts to move a file away when it causes a conflict. System administrators can also use a diversion to override a package's configuration file, or whenever some files (which aren't marked as conffiles) need to be preserved by `dpkg`, when installing a newer version of a package which contains those files (see 'Preservation of local configuration' on page 13).

```
# dpkg-divert [--add]  filename # add "diversion"
# dpkg-divert --remove filename # remove "diversion"
```

It's usually a good idea not to use `dpkg-divert` unless it is absolutely necessary.

6.5.2 The `equivs` package

If you compile a program from source, it is best to make it into a real local debianized package (`*.deb`). Use `equivs` as a last resort.

```
Package: equivs
Priority: extra
Section: admin
Description: Circumventing Debian package dependencies
 This is a dummy package which can be used to create Debian
 packages, which only contain dependency information.
```

6.5.3 Alternative commands

To make the command `vi` run `vim`, use `update-alternatives`:

```
# update-alternatives --display vi
...
# update-alternatives --config vi
  Selection    Command
-----------------------------------------------
      1        /usr/bin/elvis-tiny
      2        /usr/bin/vim
*+    3        /usr/bin/nvi

Enter to keep the default[*], or type selection number: 2
```

Items in the Debian alternatives system are kept in `/etc/alternatives/` as symlinks.

To set your favorite X Window environment, apply `update-alternatives` to `/usr/bin/x-session-manager` and `/usr/bin/x-window-manager`. For details, see 'Custom X sessions' on page 149.

`/bin/sh` is a direct symlink to `/bin/bash` or `/bin/dash`. It's safer to use `/bin/bash` to be compatible with old Bashism-contaminated scripts but better discipline to use `/bin/dash` to enforce POSIX compliance. Upgrading to a 2.4 Linux kernel tends to set this to `/bin/dash`.

6.5.4 Runlevel usage

When installed, most Debian packages configure their services to run in runlevels 2 through 5. Thus, there are no differences between runlevels 2, 3, 4 and 5 on a Debian system that has not been customized; Debian leaves it up to the local administrator to customize runlevels as described in 'Customizing runlevels' on page 21. This differs from the way runlevels are used by some other popular GNU/Linux distributions. One change you may want to make is to

disable `xdm` or `gdm` in runlevel 2 so that the X display manager is not started at the end of the boot sequence; you can then start it by switching to runlevel 3.

For more information about runlevels see 'Runlevels' on page 20.

6.5.5 Disabled daemon services

Debian developers take system security seriously. Many daemon services are installed with the fewest services and features enabled.

Run `ps aux` or check the contents of `/etc/init.d/*` and `/etc/inetd.conf`, if you have any doubts (about Exim, DHCP, ...). Also check `/etc/hosts.deny` as in 'Restricting logins with PAM' on page 135. The `pidof` command is also useful (see `pidof(8)`).

X11 doesn't allow TCP/IP (remote) connections by default in recent versions of Debian. See 'Using X over TCP/IP' on page 152. X forwarding in SSH is also disabled. See 'Connecting to a remote X server – `ssh`' on page 152.

Chapter 7

The Linux kernel under Debian

Debian has its own method of recompiling the kernel and related modules. See also 'Debian and the kernel' on page 22.

7.1 Kernel recompile

The use of `gcc`, `binutils`, and `modutils` from Debian `unstable` may help when compiling the latest Linux kernel. See `/usr/share/doc/kernel-package/README.gz`, especially the bottom of this, for the official information.

Since it is a moving target, kernel compilation is a difficult subject that may confuse even the most admired developer:
Manoj Srivastava wrote: `--initrd` requires a Debian-only cramfs patch.
Herbert Xu wrote: No it does not, all you have to do to use a filesystem other than CRAMFS is to set MKIMAGE in `/etc/mkinitrd/mkinitrd.conf`.

Be careful and always rely on the `/usr/share/doc/kernel-package/README.gz` by Manoj and Kent. Make sure to obtain the latest unstable version of the `kernel-package` package if you are to compile the latest version of the kernel.

`initrd` is not needed for a kernel compiled only for one machine. I use it since I want my kernel to be almost the same as the one provided by the kernel-image packages. If you use `initrd`, make sure to read `mkinitrd(8)` and `mkinitrd.conf(5)`. See also `http://bugs.debian.org/149236`.

7.1.1 Debian standard method

Watch out for bug reports on `kernel-package`, `gcc`, `binutils`, and `modutils`. Use new versions of them as needed.

Compiling a custom kernel from source under a Debian system requires special care. Use the new `--append_to_version` with `make-kpkg` to build multiple kernel-images.

```
# apt-get install debhelper modutils kernel-package libncurses5-dev
# apt-get install kernel-source-2.4.18   # use latest version
# apt-get install fakeroot
# vi /etc/kernel-pkg.conf                # input name and email
$ cd /usr/src                            # build directory
$ tar --bzip2 -xvf kernel-source-2.4.18.tar.bz2
$ cd kernel-source-2.4.18                # if this is your kernel source
$ cp /boot/config-2.4.18-386 .config     # get current config as default
$ make menuconfig                        # customize as one wishes
$ make-kpkg clean                        # must run (per: man make-kpkg)
$ fakeroot make-kpkg --append_to_version -486 --initrd \
       --revision=rev.01 kernel_image \
       modules_image # modules_image is for pcmcia-cs* etc.
$ cd ..
# dpkg -i kernel-image*.deb pcmcia-cs*.deb # install
```

`make-kpkg kernel_image` actually does `make oldconfig` and `make dep`. Do not use `--initrd` if initrd is not used.

If one wants to use modules from pcmcia-cs or non of the modules from kernel pcmcia source, one should select "General setup" —> "PCMCIA/CardBus support" in `make menuconfig` dialogue and set the configuration to "< > PCMCIA/CardBus support" (i.e., uncheck the box).

On an SMP machine, set CONCURRENCY_LEVEL according to `kernel-pkg.conf(5)`.

7.1.2 Classic method

Get pristine sources from:

- Linux: http://www.kernel.org/
- pcmcia-cs: http://pcmcia-cs.sourceforge.net/

or use equivalent sources in Debian and do the following:

```
# cd /usr/src
# tar xfvz linux-whatever.tar.gz
# rm -rf linux
# ln -s linux-whatever linux
# tar xfvz pcmcia-cs-whatever.tar.gz
# ln -s pcmcia-cs-whatever pcmcia
# cd linux
# make menuconfig
... configure stuff ...
# make dep
# make bzImage
... edits for lilo / grub ...
... move /usr/src/linux/arch/i386/boot/bzImage to boot ...
```

```
... /sbin/lilo or whatever you do for grub
# make modules; make modules_install
# cd ../pcmcia
# make config
# make all
# make install
... add needed module names to /etc/modules
# shutdown -r now
... boot to new kernel ...
```

7.1.3 Kernel headers

Most "normal" programs don't need kernel headers and in fact may break if you use them directly; instead they should be compiled against the headers with which **`glibc` was built**, which are the versions in `/usr/include/linux` and `/usr/include/asm` of the Debian system.

So do not put symlinks to the directories in `/usr/src/linux` from `/usr/include/linux` and `/usr/include/asm`, as suggested by some outdated documents.

If you **need** particular kernel headers for some kernel-specific application programs, alter the makefile(s) so that their include path points to *`dir-of-particular-kernel-headers`*`/include/linux` and *`dir-of-particular-kernel-headers`*`/include/asm`.

7.2 The modularized 2.4 kernel

The new Debian 2.4 kernels provided by `kernel-image-2.4.`*`NN`* are very modularized. You have to make sure those modules are activated to make the kernel function as you intend.

Although I have many examples for `/etc/modules` in the following section as a quick fix, I hear that the correct way to fix these module-related issues is to provide an alias for the device in a file in `/etc/modutils/` since there are enough aliases available with current kernels. Some modules may be auto activated by hardware detection programs such as `discover`. See also 'Hardware detection for X' on page 145.

See 'Special provisions for dealing with modules' on page 24 and `Documentation/*.txt` in the Linux source for the precise information.

7.2.1 PCMCIA

`/etc/modules` may need to contain the following for some old PCMCIA to function:

```
# ISA PnP driver
isa-pnp
```

```
# New Low level PCMCIA driver
# yenta_socket # does not seem to be needed in my case
```

The rest is taken care of by PCMCIA scripts (from the `pcmcia-cs` package), `depmod` and `kmod`. I think I needed `isa-pnp` because my laptop is an old ISA-PCMCIA. Recent laptops with CardBus/PCMCIA may not require this.

Voice of the genius Miquel van Smoorenburg `<miquels@cistron.nl>`:

"I simply removed the entire pcmcia stuff from the laptop here at work, including the cardmgr etc and just installed a 2.4 kernel with cardbus support, and the new `hotplug` package from woody.

As long as you only have 32-bit cards you don't need the pcmcia package; 2.4 has card services built in. And the standard tulip driver should work fine with your dlink card.

—Mike."

See Linux PCMCIA HOWTO (`http://www.tldp.org/HOWTO/PCMCIA-HOWTO.html`) and 'Network configuration and PCMCIA' on page 200.

7.2.2 SCSI

[NOT TESTED] `/etc/modules` needs to contain the following for SCSI to function:

```
# SCSI core
scsi_mod
# SCSI generic driver
sg
# SCSI disk
sd_mod
# All other needed HW modules
...
```

`depmod` may take care of some of the above modules.

7.2.3 Network function

`/etc/modules` needs to contain the following for extra network function:

```
# net/ipv-4
ip_gre
ipip

# net/ipv-4/netfilter
```

```
# iptable (in order)
ip_tables
ip_conntrack
ip_conntrack_ftp
iptable_nat
iptable_filter
iptable_mangle
#
ip_nat_ftp
ip_queue
#
ipt_LOG
ipt_MARK
ipt_MASQUERADE
ipt_MIRROR
ipt_REDIRECT
ipt_REJECT
ipt_TCPMSS
ipt_TOS
ipt_limit
ipt_mac
ipt_mark
ipt_multiport
ipt_owner
ipt_state
ipt_tcpmss
ipt_tos
ipt_unclean
#
#ipchains
#ipfwadm
```

The preceding may not be optimized. `depmod` may take care of some of the above modules.

7.2.4 EXT3 filesystem (> 2.4.17)

Enabling a journaling filesystem with the EXT3 FS involves the following steps using a Debian precompiled kernel-image (> 2.4.17) package:

```
# cd /etc; mv fstab fstab.old
# sed 's/ext2/ext3,ext2/g' <fstab.old >fstab
# vi /etc/fstab
... set root filesystem type to "auto" instead of "ext3,ext2"
# cd /etc/mkinitrd
```

```
# echo jbd >>modules
# echo ext3 >>modules
# echo ext2 >>modules
# cd /
# apt-get update; apt-get install kernel-image-2.4.17-686-smp
... install latest kernel and set up boot (lilo is run here)
# tune2fs -j -i 0 /dev/hda1
# tune2fs -j -i 0 /dev/hda2
... For all EXT2 FS's converted to EXT3
# shutdown -r now
```

Now EXT3 journaling is enabled. Using `ext3,ext2` as the `fstab` "type" entry ensures safe fallback to EXT2 if the kernel does not support EXT3 for non-root partitions.

If you have previously installed a 2.4 kernel and do not wish to reinstall, perform the above steps up to the `apt-get` commands, then:

```
# mkinitrd -o /boot/initrd.img-2.4.17-686-smp /lib/modules/2.4.17-686-smp
# lilo
# tune2fs -j -i 0 /dev/hda1
# tune2fs -j -i 0 /dev/hda2
... for all EXT2 FS's converted to EXT3
# shutdown -r now
```

Now EXT3 journaling is enabled.

If `/etc/mkinitrd/modules` was not set when `mkinitrd` was run and you would like to add some modules at boot time:

```
... at initrd prompt to gain shell (5 sec.), type RETURN
# insmod jbd
# insmod ext3 # modprobe ext3 may take care of everything
# insmod ext2
# ^D
... continue booting
```

At the system boot screen (`dmesg`), "cramfs: wrong magic" may appear but this is known to be harmless. This issue has been resolved in Sarge (2002/10). See http://bugs.debian.org/135537 and the EXT3 File System mini-HOWTO (http://www.zip.com.au/~akpm/linux/ext3/ext3-usage.html) or `/usr/share/doc/HOWTO/en-txt/mini/extra/ext3-mini-HOWTO.gz` for more information.

Some systems are reported to experience severe kernel lockup if EXT3 is enabled but I had no problem (as of 2.4.17).

7.2.5 Realtek RTL-8139 support in 2.4

For whatever reason, the RTL-8139 support module is no longer called rtl8139, it's now called 8139too. Just edit your `/etc/modules` to reflect this change when upgrading a 2.2 kernel to a 2.4 kernel.

7.2.6 Parallel port support

For `kernel-image-2.4.*`, parallel port support is provided as a module. Enable it by:

```
# modprobe lp
# echo lp >> /etc/modules
```

See `Documentation/parport.txt` in the Linux source.

7.3 Tuning the kernel through the proc filesystem

The behavior of the Linux kernel can be changed on the fly using the proc filesystem.

For basic information on changing kernel parameters through the `/proc` filesystem, read `Documentation/sysctl/*` in the Linux source.

See some examples of kernel parameter manipulations in `/etc/init.d/networking` and 'Strange access problems with some websites' on page 42.

See `sysctl.conf(5)` for how to set up the boot time kernel configuration through `/proc` filesystem with `/etc/init.d/procps.sh` script usually run from `/etc/rcS.d/S30procps.sh`.

7.3.1 Too many open files

The Linux kernel may complain "Too many open files". This is due to the small default value (8096) for `file-max`. To fix this problem, run the following command as root:

```
# echo "65536"  > /proc/sys/fs/file-max  # for 2.2 and 2.4 kernel
# echo "131072" > /proc/sys/fs/inode-max # for 2.2 kernel only
```

or put the following into `/etc/sysctl.conf` for the permanent change:

```
file-max=65536   # for 2.2 and 2.4 kernel
inode-max=131072 # for 2.2 kernel only
```

7.3.2 Disk flush intervals

You can change disk flush intervals through the proc filesystem. The following will shorten its interval from the default five seconds to one second.

```
# echo "40 0 0 0 100 30000 60 0 0"  > /proc/sys/vm/bdflush
```

This may negatively impact file I/O performance a little bit. But this secures file contents except for the last one second which is shorter than the default five seconds. This is true even for journaling filesystems.

7.3.3 Sluggish old low memory machines

For some old low memory systems, it may still be useful to enable over-commit of memory through the proc filesystem:

```
# echo 1 > /proc/sys/vm/overcommit_memory
```

7.4 The 2.6 kernel with udev

The udev is a dynamic replacement for `/dev/`. Device names can be chosen to be very short ones. The devfs used in the 2.4 kernel is now obsolete.

Installing the new Debian 2.6 kernel provided by `kernel-image-2.6.`*`NN`* with `udev` package will enable this.

Chapter 8

Debian tips

8.1 Booting the system

See the LDP BootPrompt-HOWTO (http://www.tldp.org/HOWTO/BootPrompt-HOWTO.html) for detailed information on the boot prompt.

8.1.1 "I forgot the root password!" (1)

It is possible to boot a system and log on to the root account without knowing the root password as long as one has access to the console keyboard. (This assumes there are no password requests from the BIOS or from a boot loader such as `lilo` that would prevent one from booting the system.)

This is a procedure which requires no external boot disks and no change in BIOS boot settings. Here, "Linux" is the label for booting the Linux kernel in the default Debian install.

At the `lilo` boot screen, as soon as `boot:` appears (you must press a shift key at this point on some systems to prevent automatic booting and when `lilo` uses the framebuffer you have to press TAB to see the options you type), enter:

```
boot: Linux init=/bin/sh
```

This causes the system to boot the kernel and run `/bin/sh` instead of its standard `init`. Now you have gained root privileges and a root shell. Since `/` is currently mounted read-only and many disk partitions have not been mounted yet, you must do the following to have a reasonably functioning system.

```
init-2.03# mount -n -o remount,rw /
init-2.03# mount -avt nonfs,noproc,nosmbfs
init-2.03# cd /etc
init-2.03# vi passwd
init-2.03# vi shadow
```

(If the second data field in `/etc/passwd` is "x" for every username, your system uses shadow passwords, and you must edit `/etc/shadow`.) To disable the root password, edit the second data field in the password file so that it is empty. Now the system can be rebooted and you can log on as root without a password. When booting into runlevel 1, Debian (at least after Potato) requires a password, which some older distributions did not.

It is a good idea to have a minimal editor in `/bin/` in case `/usr/` is not accessible (see 'Rescue editors' on page 209).

Also consider installing the `sash` package. When the system becomes unbootable, execute:

```
boot: Linux init=/bin/sash
```

`sash` serves as an interactive substitute for `sh` even when `/bin/sh` is unusable. It's statically linked, and includes many standard utilities as built-ins (type "help" at the prompt for a reference list).

8.1.2 "I forgot the root password!" (2)

Boot from any emergency boot/root disk set. If */dev/hda3* is the original root partition, the following will let one edit the password file just as easily as the above.

```
# mkdir fixit
# mount /dev/hda3 fixit
# cd fixit/etc
# vi shadow
# vi passwd
```

The advantage of this approach over the previous method is one does not need to know the `lilo` password (if any). But to use it one must be able to access the BIOS setup to allow the system to boot from floppy disk or CD, if that is not already set.

8.1.3 Cannot boot the system

No problem, even if you didn't bother to make a boot disk during install. If `lilo` is broken, grab the boot disk from the Debian installation set and boot your system from it. At the boot prompt, assuming the root partition of your Linux installation is on */dev/hda12* and you want runlevel 3, enter:

```
boot: rescue root=/dev/hda12 3
```

Then you are booted into an almost fully functional system using the kernel on the floppy. (There may be minor glitches due to lack of kernel features or modules.)

See also 'Install a package into an unbootable system' on page 85 if you have a broken system.

If you need a custom boot floppy, follow `readme.txt` on the rescue disk.

8.1.4 "Let me disable X on boot!"

Chasing `unstable/sid` is fun, but buggy `xdm`, `gdm`, `kdm`, and `wdm` started during the boot process can bite you bad.

First get the root shell by entering the following at the boot prompt:

```
boot: Linux vga=normal s
```

Here, *Linux* is the label for the kernel image you are booting; "vga=normal" will make sure `lilo` runs in normal VGA screen, and "s" (or "S") is the parameter passed to `init` to invoke single-user mode. Enter the root password at the prompt.

There are few ways to disable all the X starting daemons:

- run `update-rc.d ?dm stop 99 1 2 3 4 5 6 .`
- insert "exit 0" at the start of all `/etc/init.d/?dm` files.
- rename all `/etc/rc2.d/S99?dm` files to `/etc/rc2.d/K99?dm`.
- remove all `/etc/rc2.d/S99?dm` files.
- run `:>/etc/X11/default-display-manager`

Here, number in `rc2.d` must correspond to the runlevel specified in the `/etc/inittab`. Also `?dm` means that you need to run the command multiple times by substituting it with all of the `xdm`, `gdm`, `kdm`, and `wdm`.

Only the first one in the list is "the one true way" in Debian. The last one is easy but only works on Debian and requires you to set the display manager again later using `dpkg-reconfigure`. Others are generic methods to disable daemons.

You can still start X with the `startx` command from any console shell.

8.1.5 Other boot tricks with the boot prompt

The system can be booted into a particular runlevel and configuration using the `lilo` boot prompt. Details are given in the BootPrompt-HOWTO (http://www.tldp.org/HOWTO/BootPrompt-HOWTO.html) (LDP).

If you want to boot the system into runlevel 4, use the following input at the `lilo` boot prompt.

```
boot: Linux 4
```

If you want to boot the system into normally functioning single-user mode and you know the root password, one of the following examples at the `lilo` boot prompt will work.

```
boot: Linux S
boot: Linux 1
boot: Linux -s
```

If you want to boot the system with less memory than system actually has (say 48MB for a system with 64MB), use this input at the `lilo` boot prompt:

```
boot: Linux mem=48M
```

Make sure not to specify more than the actual memory size here, otherwise the kernel will crash. If one has more than 64MB of memory, e.g. 128MB, unless one executes `mem=128M` at the boot prompt or includes a similar append line in `/etc/lilo.conf`, old kernels and/or a motherboard with an old BIOS will not use memory beyond 64MB.

8.1.6 Setting GRUB boot parameters

GRUB is a new boot manager from the GNU Hurd project and is much more flexible than Lilo but has slightly different handling of boot parameters.

```
grub> find /vmlinuz
grub> root (hd0,0)
grub> kernel /vmlinuz root=/dev/hda1
grub> initrd /initrd
grub> boot
```

Here, you must be aware of the Hurd device names:

```
the Hurd/GRUB       Linux               MSDOS/Windows
 (fd0)               /dev/fd0            A:
 (hd0,0)             /dev/hda1           C: (usually)
 (hd0,3)             /dev/hda4           F: (usually)
 (hd1,3)             /dev/hdb4           ?
```

See `/usr/share/doc/grub/README.Debian` and `/usr/share/doc/grub-doc/html/` for details.

8.2 Recording activities

8.2.1 Recording shell activities

System administration involves much more elaborate tasks in a Unix environment than in an ordinary personal computer environment. Make sure to know the most basic means of

configuration in case you need to recover from system trouble. X11-based GUI configuration tools look nice and convenient but are often unsuitable in these emergency situations.

In this context, recording shell activities is a good practice, especially as root.

Emacs: Use M-x `shell` to start recording into a buffer, and use C-x C-w to write the buffer to a file.

Shell: Use the `screen` command with "^A H" as described in 'Console switching with `screen`' on page 124; or use the `script` command.

```
$ script
Script started, file is typescript
 ... do whatever ...
 Ctrl-D
$ col -bx <typescript >savefile
$ vi savefile
```

The following can be used instead of `script`:

```
$ bash -i 2>&1 | tee typescript
```

8.2.2 Recording X activities

If you need to record the graphic image of an X application, including an `xterm` display, use `gimp` (GUI). It can capture each window or the whole screen. Alternatives are `xwd` (`xbase-clients`), `import` (`imagemagick`), and `scrot` (`scrot`).

8.3 Copy and archive a whole subdirectory

These copy and archive commands provide basics for the backup of the system and the data. An example of simple backup script is provided as `backup` in the example scripts (http://www.debian.org/doc/manuals/debian-reference/examples/).

8.3.1 Basic commands for copying a whole subdirectory

If you need to rearrange file structure, move content including file links by:

```
Standard method:
# cp -a /source/directory /dest/directory # requires GNU cp
# (cd /source/directory && tar cf - . ) | \
        (cd /dest/directory && tar xvfp - )
If a hard link is involved, a pedantic method is needed:
```

```
# cd /path/to/old/directory
# find . -depth -print0 | afio -p -xv -0a /mount/point/of/new/directory
If remote:
# (cd /source/directory && tar cf - . ) | \
        ssh user@host.dom (cd /dest/directory && tar xvfp - )
If there are no linked files:
# scp -pr user1@host1.dom:/source/directory \
          user2@host2.dom:/dest/directory
```

Here, `scp` <==> `rcp` and `ssh` <==> `rsh`.

The following comparative information on copying a whole subdirectory was presented by Manoj Srivastava <srivasta@debian.org> to debian-user@lists.debian.org.

8.3.2 cp

Traditionally, `cp` was not really a candidate for this task since it did not dereference symbolic links, or preserve hard links either. Another thing to consider was sparse files (files with holes).

GNU `cp` has overcome these limitations; however, on a non-GNU system, `cp` could still have problems. Also, you can't generate small, portable archives using `cp`.

```
% cp -a . newdir
```

8.3.3 tar

Tar overcame some of the problems that `cp` had with symbolic links. However, although `cpio` handles special files, traditional `tar` doesn't.

`tar`'s way of handling multiple hard links to a file places only one copy of the link on the tape, but the name attached to that copy is the *only* one you can use to retrieve the file; `cpio`'s way puts one copy for every link, but you can retrieve it using any of the names.

The `tar` command changed its option for `.bz2` files between Potato and Woody, so use `--bzip2` in scripts instead of its short form `-I` (Potato) or `-j` (Woody).

8.3.4 pax

The new, POSIX (IEEE Std 1003.2-1992, pages 380–388 (section 4.48) and pages 936–940 (section E.4.48)), all-singing, all-dancing, Portable Archive Interchange utility. `pax` will read, write, and list the members of an archive file, and will copy directory hierarchies. `pax` operation is independent of the specific archive format, and supports a wide variety of different archive formats.

`pax` implementations are still new and wet behind the ears.

```
# apt-get install pax
$ pax -rw -p e . newdir
 or
$ find . -depth  | pax -rw -p e  newdir
```

8.3.5 cpio

`cpio` copies files into or out of a `cpio` or `tar` archive. The archive can be another file on the disk, a magnetic tape, or a pipe.

```
$ find . -depth -print0 | cpio --null --sparse -pvd new-dir
```

8.3.6 afio

`afio` is a better way of dealing with `cpio`-format archives. It is generally faster than `cpio`, provides more diverse magnetic tape options and deals somewhat gracefully with input data corruption. It supports multivolume archives during interactive operation. `afio` can make compressed archives that are much safer than compressed `tar` or `cpio` archives. `afio` is best used as an "archive engine" in a backup script.

```
$ find . -depth -print0 | afio -px -0a new-dir
```

All my backups onto tape use `afio`.

8.4 Differential backup and data synchronization

Differential backup and data synchronization can be implemented with several methods:

- `rcs`: backup and history, text-only
- `rdiff-backup`: backup and history. symlink OK.
- `pdumpfs`: backup and history within a filesystem. symlink OK
- `rsync`: 1-way synchronization
- `unison`: 2-way synchronization
- `cvs`: multi-way synchronization with server backup and history, text-only, mature. See 'Concurrent Versions System (CVS)' on page 215.
- `arch`: multi-way synchronization with server backup and history, no such thing as a "working directory".

- `subversion`: multi-way synchronization with server backup and history, Apache.

Combination of one of these with the archiving method described in 'Copy and archive a whole subdirectory' on page 109 and the automated regular job described in 'Schedule activity (`cron`, `at`)' on page 124 will make a nice backup system.

I will explain three easy-to-use utilities.

8.4.1 Differential backup with rdiff

`rdiff-backup` offers nice and simple backup with differential history for any types of files, including symlinks. To back up most of `~/` to `/mnt/backup`:

```
$ rdiff-backup --include ~/tmp/keep --exclude ~/tmp  ~/ /mnt/backup
```

To restore three-day-old data from this archive to `~/old`:

```
$ rdiff-backup -r 3D /mnt/backup ~/old
```

See `rdiff-backup(1)`.

8.4.2 Daily backup with `pdumpfs`

`pdumpfs` is a simple daily backup system similar to Plan9's `dumpfs` which preserves every daily snapshot. You can access the past snapshots at any time for retrieving a certain day's file. Let's backup your home directory with `pdumpfs` and `cron`!

`pdumpfs` constructs the snapshot `YYYY/MM/DD` in the destination directory. All source files are copied to the snapshot directory when `pdumpfs` is run for the first time. On and after the second time, `pdumpfs` copies only updated or newly created files and stores unchanged files as hard links to the files of the previous day's snapshot in order to save disk space.

```
$ pdumpfs src-dir dest-dir [dest-basename]
```

See `pdumpfs(8)`.

8.4.3 Regular differential backup with RCS

`Changetrack` will record changes to the text-based configuration files in RCS archives regularly. See `changetrack(1)`.

```
# apt-get install changetrack
# vi changetrack.conf
```

8.5 System freeze recovery

8.5.1 Kill a process

Run `top` to see what process is acting funny. Press 'P' to sort by CPU usage, 'M' to sort by memory, and 'k' to kill a process. Alternatively, BSD-style `ps aux | less` or System-V-style `ps -efH | less` may be used. The System-V-style syntax displays parent process IDs (`PPID`) which can be used for killing zombie (defunct) children.

Use `kill` to kill (or send a signal to) a process by process ID, `killall` to do the same by process command name. Frequently used signals:

```
 1: HUP,  restart daemon
15: TERM, normal kill
 9: KILL, kill hard
```

8.5.2 Alt-SysRq

Insurance against system malfunction is provided by the kernel compile option "Magic SysRq key". Pressing Alt-SysRq on an i386, followed by one of the keys `r 0 k e i s u b`, does the magic.

Un'r'aw restores the keyboard after things like X crashes. Changing the console loglevel to '0' reduces error messages. sa'k' (system attention key) kills all processes on the current virtual console. t'e'rminate kills all processes on the current terminal except `init`. k'i'll kills all processes except `init`.

'S'ync, 'u'mount, and re'b'oot are for getting out of really bad situations.

Debian default installation kernels are not compiled with this option at the time this document is written. Recompile the kernel to activate this function. Detailed information is in `/usr/share/doc/kernel-doc-`*`version`*`/Documentation/sysrq.txt.gz` or `/usr/src/`*`kernel-version`*`/Documentation/sysrq.txt.gz`.

8.6 Nifty little commands to remember

8.6.1 Pager

`less` is the default pager (file content browser). Hit 'h' for help. It can do much more than `more`. `less` can be supercharged by executing `eval $(lesspipe)` or `eval $(lessfile)` in the shell startup script. See more in `/usr/share/doc/lessf/LESSOPEN`. The `-R` option allows raw character output and enables ANSI color escape sequences. See `less(1)`.

`w3m` may be a useful alternative pager for some code systems (EUC).

8.6.2 Free memory

`free` and `top` give good information on memory resources. Do not worry about the size of "used" in the "Mem:" line, but read the one under it (38792 in the example below).

```
$ free -k # for 256MB machine
             total       used       free     shared    buffers cached
Mem:        257136     230456      26680      45736     116136 75528
-/+ buffers/cache:      38792     218344
Swap:       264996          0     264996
```

The exact amount of physical memory can be confirmed by `grep '^Memory' /var/log/dmesg`, which in this case gives "Memory: 256984k/262144k available (1652k kernel code, 412k reserved, 2944k data, 152k init)".

```
Total         = 262144k = 256M (1k=1024, 1M=1024k)
Free to dmesg = 256984k = Total - kernel - reserved - data - init
Free to shell = 257136k = Total - kernel - reserved - data
```

About 5MB is not usable by the system because the kernel uses it.

8.6.3 Set time (BIOS)

```
# date MMDDhhmmCCYY
# hwclock --utc --systohc
# hwclock --show
```

This will set system and hardware time to MM/DD hh:mm, CCYY. Times are displayed in local time but hardware time uses UTC.

If the hardware (BIOS) time is set to GMT, change the setting to `UTC=yes` in the `/etc/default/rcS`.

8.6.4 Set time (NTP)

Reference: Managing Accurate Date and Time HOWTO (http://www.tldp.org/HOWTO/TimePrecision-HOWTO/index.html).

Set time with permanent Internet connection

Set system clock to the correct time automatically via a remote server:

```
# ntpdate server
```

This is good to have in `/etc/cron.daily/` if your system has a permanent Internet connection.

Set time with sporadic Internet connection

Use the `chrony` package.

8.6.5 How to control console features such as the screensaver

For disabling the screensaver, use following commands.

In the Linux console:

```
# setterm -powersave off
```

Start the kon2 (kanji) console with:

```
# kon -SaveTime 0
```

While running X:

```
# xset s off
 or
# xset -dpms
 or
# xscreensaver-command -prefs
```

Read the corresponding manpages for controlling other console features. See also `stty(1)` for changing and printing terminal line settings.

8.6.6 Search administrative database

Glibc offers `getent(1)` for searching entries from administrative databases, i.e., passwd, group, hosts, services, protocols, or networks.

```
getent database [key ...]
```

8.6.7 Disable sound (beep)

One can always unplug the PC speaker. ;-) For the Bash shell:

```
echo "set bell-style none">> ~/.inputrc
```

8.6.8 Error messages on the console screen

In order to quiet on-screen error messages, the first place to check is `/etc/init.d/klogd`. Set `KLOGD="-c 3"` in this script and run `/etc/init.d/klogd restart`. An alternative method is to run `dmesg -n3`.

Here error levels mean:

- 0: KERN_EMERG, system is unusable
- 1: KERN_ALERT, action must be taken immediately
- 2: KERN_CRIT, critical conditions
- 3: KERN_ERR, error conditions
- 4: KERN_WARNING, warning conditions
- 5: KERN_NOTICE, normal but significant condition
- 6: KERN_INFO, informational
- 7: KERN_DEBUG, debug-level messages

If one particular useless error message bothers you a lot, consider making a trivial kernel patch like `shutup-abit-bp6` (available in the examples subdirectory (http://www.debian.org/doc/manuals/debian-reference/examples/)).

Another place to look may be `/etc/syslog.conf`; check to see whether any messages are logged to a console device.

8.6.9 Set console to the correct type

Console screens in Unix-like systems are usually accessed using (n)curses library routines. These give the user a terminal-independent method of updating character screens with reasonable optimization. See `ncurses(3X)` and `terminfo(5)`.

On a Debian system, there are quite a lot of predefined entries:

```
$ toe | less                  # all entries
$ toe /etc/terminfo/ | less   # user reconfigurable entries
```

Export your selection as environment variable `TERM`.

If the terminfo entry for `xterm` doesn't work with a non-Debian `xterm`, change your terminal type from "xterm" to one of the feature-limited versions such as "xterm-r6" when you log in to a Debian system remotely. See `/usr/share/doc/libncurses5/FAQ` for more. "dumb" is the lowest common denominator for terminfo.

8.6.10 Get the console back to a sane state

When the screen goes berserk after `cat` *`some-binary-file`* (you may not be able to see the command echoed as you type):

```
$ reset
```

8.6.11 Convert a text file from DOS to Unix style

Convert a DOS text file (end-of-line = ^M^J) to a Unix text file (end-of-line = ^J).

```
# apt-get install sysutils
$ dos2unix dosfile
```

8.6.12 Convert a text file with `recode`

Following will convert text files between DOS, Mac, and Unix line ending styles:

```
$ recode /cl../cr <dos.txt >mac.txt
$ recode /cr.. <mac.txt >unix.txt
$ recode ../cl <unix.txt >dos.txt
```

Free `recode` converts files between various character sets and surfaces with:

```
$ recode charset1/surface1..charset2/surface2 \
  <input.txt >output.txt
```

Common character sets used are (see also 'Introduction to locales' on page 168) [1] :

- `us` — ASCII (7 bits)
- `l1` — ISO Latin-1 (ISO-8859-1, Western Europe, 8 bits)
- `EUCJP` — EUC-JP for Japanese (Unix)
- `SJIS` — Shift-JIS for Japanese (Microsoft)
- `ISO2022JP` — Mail encoding for Japanese (7 bits)
- `u2` — UCS-2 (Universal Character Set, 2 bytes)
- `u8` — UTF-8 (Universal Transformation Format, 8 bits)

Common surfaces used are [2] :

- `/cr` — Carriage return as end of line (Mac text)
- `/cl` — Carriage return line feed as end of line (DOS text)
- `/` — Line feed as end of line (Unix text)
- `/d1` — Human readable bytewise decimal dump
- `/x1` — Human readable bytewise hexidecimal dump
- `/64` — Base64 encoded text
- `/QP` — Quoted-Printable encoded text

For more, see pertinent description in the `info recode`.

There are also more specialized conversion tools:

[1] `recode` allows more convenient aliases than `iconv`.

[2] End of lines:

- Carriage return means ASCII 13, ASCII 0xD, ^M, or \r .
- Line feed means ASCII 10, ASCII 0xA, ^J, or \n .

- character set conversion:
  - `iconv` — locale encoding conversions
  - `konwert` — fancy encoding conversions
- binary file conversion:
  - `uuencode` and `uudecode` — for Unix.
  - `mimencode` — for the mail.

8.6.13 Regular-expression substitution

Replace all instances of *FROM_REGEX* with *TO_TEXT* in all of the files *FILES* ... :

```
$ perl -i -p -e 's/FROM_REGEX/TO_TEXT/g;' FILES ...
```

`-i` is for "in-place editing", `-p` is for "implicit loop over *FILES* ...". If the substitution is complex, you can make recovery from errors easier by using the parameter `-i.bak` instead of `-i`; this will keep each original file, adding `.bak` as a file extension.

8.6.14 Edit a file in place using a script

The following script will remove lines 5–10 and lines 16–20 in place.

```
#!/bin/bash
ed $1 <<EOF
16,20d
5,10d
w
q
EOF
```

Here, `ed` commands are the same as `vi` command-mode commands. Editing from the back of file makes it easy for scripting.

8.6.15 Extract differences and merge updates for source files

Following one of these procedures will extract differences between two source files and create unified diff files *file.patch0* or *file.patch1* depending on the file location:

```
$ diff -u file.old file.new1 > file.patch0
$ diff -u old/file new1/file > file.patch1
```

The diff file (alternatively called patch file) is used to send a program update. The receiving party will apply this update to another *file* by:

```
$ patch -p0 file < file.patch0
$ patch -p1 file < file.patch1
```

If you have three versions of source code, you can merge them more effectively using `diff3`:

```
$ diff3 -m file.mine file.old file.yours > file
```

8.6.16 Convert a large file into small files

```
$ split -b 650m file   # split file into 650MB chunks
$ cat x* >largefile    # merge files into 1 large file
```

8.6.17 Extract data from text file table

Let's consider a text file called `DPL` in which all previous Debian project leader's names and their initiation days are listed in a space-separated format.

```
Ian     Murdock   August  1993
Bruce   Perens    April   1996
Ian     Jackson   January 1998
Wichert Akkerman  January 1999
Ben     Collins   April   2001
Bdale   Garbee    April   2002
Martin  Michlmayr March   2003
```

Awk is frequently used to extract data from these types of files.

```
$ awk '{ print $3 }' <DPL                    # month started
August
April
January
January
April
April
March
$ awk '($1=="Ian") { print }' <DPL           # DPL called Ian
Ian     Murdock   August  1993
Ian     Jackson   January 1998
$ awk '($2=="Perens") { print $3,$4 }' <DPL # When Perens started
April 1996
```

Shells such as Bash can be also used to parse this kind of file:

```
$ while read first last month year; do
    echo $month
  done <DPL
... same output as the first Awk example
```

Here, `read` built-in command uses the characters in $IFS (internal field separators) to split lines into words.

If you change IFS to ":", you can parse `/etc/passwd` with shell nicely:

```
$ oldIFS="$IFS"   # save old value
$ IFS=":"
$ while read user password uid gid rest_of_line; do
    if [ "$user" = "osamu" ]; then
      echo "$user's ID is $uid"
    fi
  done < /etc/passwd
osamu's ID is 1001
$ IFS="$oldIFS"   # restore old value
```

(If Awk is used to do the equivalent, use `FS=":"` to set the field separator.)

IFS is also used by the shell to split results of parameter expansion, command substitution, and arithmetic expansion. These do not occur within double or single quoted words. The default value of IFS is <space>, <tab>, and <newline> combined.

Be careful about using this shell IFS tricks. Strange things may happen, when shell interprets some parts of the script as its **input**.

```
$ IFS=":,"                          # use ":" and "," as IFS
$ echo IFS=$IFS,   IFS="$IFS"       # echo is a Bash built-in
IFS=  , IFS=:,
$ date -R                           # just a command output
Sat, 23 Aug 2003 08:30:15 +0200
$ echo $(date -R)                   # sub shell --> input to main shell
Sat  23 Aug 2003 08 30 36 +0200
$ unset IFS                         # reset IFS to the default
$ echo $(date -R)
Sat, 23 Aug 2003 08:30:50 +0200
```

8.6.18 Script snippets for piping commands

The following scripts will do nice things as a part of a pipe.

```
find /usr | egrep -v "/usr/var|/usr/tmp|/usr/local"
```

```
                        # find all files in /usr excluding some files
xargs -n 1 command      # run command for all items from stdin
xargs -n 1 echo |       # split white-space-separated items into lines
xargs echo      |       # merge all lines into a line
grep -e pattern|        # extract lines containing pattern
cut -d: -f3 -|
        # extract third field separated by : (passwd file etc.)
awk '{ print $3 }' |  # extract third field separated by whitespaces
awk -F'\t' '{ print $3 }' |
        # extract third field separated by tab
col -bx |               # remove backspace and expand tabs to spaces
expand -|               # expand tabs
sort -u|                # sort and remove duplicates

tr '\n' ' '|            # concatenate lines into one line
tr '\r' ''|             # remove CR
tr 'A-Z' 'a-z'|         # convert uppercase to lowercase
sed 's/^/# /'|          # make each line a comment
sed 's/\.ext//g'|       # remove .ext
sed  -n -e 2p|          # print the second line
head -n 2 -|            # print the first 2 lines
tail -n 2 -|            # print the last 2 lines
```

8.6.19 Script snippets for looping over each file

The following ways of looping over each file matching `*.ext` ensures proper handling of funny file names such as ones with spaces and performs equivalent process:

- Shell loop (This is multi line input with `PS2="> "`) [3]:

```
for x in *.ext; do
  if test -f "$x"; then
    command "$x"
  fi
done
```

- `find` and `xargs` combination:

```
find . -type f -maxdepth 1 -name '*.ext' -print0 | \
 xargs -0 -n 1 command
```

- `find` with `-exec` option with a command:

[3] If you type this in one line, you need to add few semicolons, "`;`", to mark the end of shell commands.

```
find . -type f -maxdepth 1 -name '*.ext' \
 -exec command '{}' \;
```

- `find` with `-exec` option with a short shell script:

```
find . -type f -maxdepth 1 -name '*.ext' \
 -exec sh -c "command '{}' && echo 'successful'" \;
```

8.6.20 Perl short script madness

Although any Awk scripts can be automatically rewritten in Perl using `a2p(1)`, one-liner Awk scripts are best converted to one-liner perl scripts manually. For example

```
awk '($2=="1957") { print $3 }' |
```

is equivalent to any one of the following lines:

```
perl -ne '@f=split; if ($f[1] eq "1957") { print "$f[2]\n"}' |
perl -ne 'if ((@f=split)[1] eq "1957") { print "$f[2]\n"}' |
perl -ne '@f=split; print $f[2] if ( $f[1]==1957 )' |
perl -lane 'print $F[2] if $F[1] eq "1957"' |
```

Since all the whitespace in the arguments to `perl` in the line above can be removed, and taking advantage of the automatic conversions between numbers and strings in Perl:

```
perl -lane 'print$F[2]if$F[1]eq+1957' |
```

See `perlrun(1)` for the command-line options. For more crazy Perl scripts, http://perlgolf.sourceforge.net may be interesting.

8.6.21 Get text or a mailing list archive from a web page

The following will read a web page into a text file. Very useful when copying configurations off the Web.

```
$ lynx -dump http://www.remote-site.com/help-info.html >textfile
```

`links` and `w3m` can be used here, too, with slight differences in rendering.

If this is a mailing list archive, use `munpack` to obtain mime contents from text.

8.6.22 Pretty print a web page

The following will print a web page into a PostScript file/printer.

```
$ apt-get install html2ps
$ html2ps URL | lpr
```

See 'lpr/lpd' on page 39. Also check a2ps and mpage packages for creating PostScript files.

8.6.23 Pretty print a manual page

The following will print a manual page into a PostScript file/printer.

```
$ man -Tps some-manpage | lpr
$ man -Tps some-manpage | mpage -2 | lpr
```

8.6.24 Merge two PostScript or PDF files

You can merge two PostScript or PDF files.

```
$ gs -q -dNOPAUSE -dBATCH -sDEVICE=pswrite \
  -sOutputFile=bla.ps -f foo1.ps foo2.ps
$ gs -q -dNOPAUSE -dBATCH -sDEVICE=pdfwrite \
  -sOutputFile=bla.pdf -f foo1.pdf foo2.pdf
```

8.6.25 Time a command

Display time used by a process.

```
# time some-command >/dev/null
real    0m0.035s        # time on wall clock (elapsed real time)
user    0m0.000s        # time in user mode
sys     0m0.020s        # time in kernel mode
```

8.6.26 `nice` command

Use nice (from the GNU shellutils package) to set a command's nice value when starting. renice (bsdutils) and top can renice a process. A nice value of 19 represents the slowest (lowest priority) process; negative values are "not-nice", with -20 being a very fast (high priority) process. Only the superuser can set negative nice values.

```
# nice  -19 top                                                  # very nice
# nice --20 cdrecord -v -eject speed=2 dev=0,0 disk.img # very fast
```

Sometimes an extreme nice value does more harm than good to the system. Use this command carefully.

8.6.27 Schedule activity (cron, at)

Use `cron` and `at` to schedule tasks under Linux. See `at(1)`, `crontab(5)`, `crontab(8)`.

Run the command `crontab -e` to create or edit a crontab file to set up regularly scheduled events. Example of a crontab file:

```
# use /bin/sh to run commands, no matter what /etc/passwd says
SHELL=/bin/sh
# mail any output to 'paul', no matter whose crontab this is
MAILTO=paul
# Min Hour DayOfMonth Month DayOfWeek command (Day... are OR'ed)
# run at 00:05, every day
5  0  *  * *   $HOME/bin/daily.job >> $HOME/tmp/out 2>&1
# run at 14:15 on the first of every month -- output mailed to paul
15 14 1  * *   $HOME/bin/monthly
# run at 22:00 on weekdays(1-5), annoy Joe. % for newline, last % for cc:
0 22 *   * 1-5 mail -s "It's 10pm" joe%Joe,%%Where are your kids?%.%%
23 */2 1 2 *   echo "run 23 minutes after 0am, 2am, 4am ..., on Feb 1"
5  4 *   * sun echo "run at 04:05 every sunday"
# run at 03:40 on the first Monday of each month
40 3 1-7 * *   [ "$(date +%a)" == "Mon" ] && command -args
```

Run the `at` command to schedule a one-time job:

```
$ echo 'command -args' | at 3:40 monday
```

8.6.28 Console switching with screen

The `screen` program allows you to run multiple virtual terminals, each with its own interactive shell, on a single physical terminal or terminal emulation window. Even if you use Linux virtual consoles or multiple `xterm` windows, it is worth exploring `screen` for its rich feature set, which includes

- scrollback history,
- copy-and-paste,
- output logging,
- digraph entry, and
- the ability to **detach** an entire `screen` session from your terminal and reattach it later.

Remote access scenario

If you frequently log on to a Linux machine from a remote terminal or using a VT100 terminal program, `screen` will make your life much easier with the **detach** feature.

1 You are logged in via a dialup connection, and are running a complex `screen` session with editors and other programs open in several windows.
2 Suddenly you need to leave your terminal, but you don't want to lose your work by hanging up.
3 Simply type `^A d` to **detach** the session, then log out. (Or, even quicker, type `^A DD` to have `screen` detach and log you out itself.)
4 When you log on again later, enter the command `screen -r`, and `screen` will magically **reattach** all the windows you had open.

Typical `screen` commands

Once you start `screen`, all keyboard input is sent to your current window except for the command keystroke, by default `^A`. All `screen` commands are entered by typing `^A` plus a single key [plus any parameters]. Useful commands:

```
^A ?     show a help screen (display key bindings)
^A c     create a new window and switch to it
^A n     go to next window
^A p     go to previous window
^A 0     go to window number 0
^A w     show a list of windows
^A a     send a Ctrl-A to current window as keyboard input
^A h     write a hardcopy of current window to file
^A H     begin/end logging current window to file
^A ^X    lock the terminal (password protected)
^A d     detach screen session from the terminal
^A DD    detach screen session and log out
```

This is only a small subset of `screen`'s commands and features. If there's something you want `screen` to be able to do, chances are it can! See `screen(1)` for details.

Backspace and/or Ctrl-H in `screen` session

If you find that backspace and/or Ctrl-H do not work properly when you are running `screen`, edit `/etc/screenrc`, find the line reading

```
bindkey -k kb stuff "\177"
```

and comment it out (i.e., add "#" as the first character).

Equivalent program to `screen` for X

Check out `xmove`. See `xmove(1)`.

8.6.29 Network testing basics

Install `netkit-ping`, `traceroute`, `dnsutils`, `ipchains` (for 2.2 kernel), `iptables` (for 2.4 kernel), and `net-tools` packages and:

```
$ ping yahoo.com            # check Internet connection
$ traceroute yahoo.com      # trace IP packets
$ ifconfig                  # check host config
$ route -n                  # check routing config
$ dig [@dns-server.com] host.dom [{a|mx|any}] |less
      # check host.dom DNS records by dns-server.com
      # for a {a|mx|any} record
$ ipchains -L -n |less      # check packet filter (2.2 kernel)
$ iptables -L -n |less      # check packet filter (2.4 kernel)
$ netstat -a                # find all open ports
$ netstat -l --inet         # find listening ports
$ netstat -ln --tcp         # find listening TCP ports (numeric)
```

8.6.30 Flush mail from local spool

To flush mail from the local spool:

```
# exim -q    # flush waiting mail
# exim -qf   # flush all mail
# exim -qff  # flush even frozen mail
```

`-qff` may be better as an option in the `/etc/ppp/ip-up.d/exim` script. For Sarge, replace `exim` with `exim4`.

8.6.31 Remove frozen mail from local spool

To remove frozen mail from the local spool with a delivery error message:

```
# exim -Mg `mailq | grep frozen | awk '{ print $3 }'`
```

For Sarge, replace `exim` with `exim4`.

8.6.32 Redeliver `mbox` contents

You need to manually deliver mails to the sorted mailboxes in your home directory from `/var/mail/`*username* if your home directory became full and `procmail` failed. After making disk space in the home directory, run:

```
# /etc/init.d/exim stop
# formail -s procmail </var/mail/username
# /etc/init.d/exim start
```

For Sarge, replace `exim` with `exim4`.

8.6.33 Clear file contents

In order to clear the contents of a file such as a logfile, do not use `rm` to delete the file and then create a new empty file, because the file may still be accessed in the interval between commands. The following is the safe way to clear the contents of the file.

```
$ :>file-to-be-cleared
```

8.6.34 Dummy files

The following commands will create dummy or empty files:

```
$ dd if=/dev/zero    of=filename bs=1k count=5 # 5KB of zero content
$ dd if=/dev/urandom of=filename bs=1m count=7 # 7MB of random content
$ touch filename #  create 0B file (if file exists, updates mtime)
```

For example, the following commands executed from the shell of the Debian boot floppy will erase all the content of the hard disk `/dev/hda` completely for most practical uses.

```
# dd if=/dev/urandom of=/dev/hda ; dd if=/dev/zero of=/dev/hda
```

8.6.35 `chroot`

The `chroot` program, `chroot(8)`, enables us to run different instances of the GNU/Linux environment on a single system simultaneously without rebooting.

One may also run a resource hungry program such as `apt-get` or `dselect` under the chroot of a fast host machine while NFS-mounting a slow satellite machine to the host as r/w and the chroot point being the mount point of the satellite machine.

Run a different Debian distribution with `chroot`

A chroot Debian environment can easily be created by the `debootstrap` command in Woody. For example, to create a Sid chroot on */sid-root* while having fast Internet access:

```
main # cd / ; mkdir /sid-root
main # debootstrap sid /sid-root http://ftp.debian.org/debian/
... watch it download the whole system
main # echo "proc-sid /sid-root/proc proc none 0 0" >> /etc/fstab
main # mount proc-sid /sid-root/proc -t proc
main # cp /etc/hosts /sid-root/etc/hosts
main # chroot /sid-root /bin/bash
chroot # apt-setup # set-up /etc/apt/sources.list
chroot # vi /etc/apt/sources.list # point the source to unstable
chroot # dselect  # you may use aptitude, install mc and vim :-)
```

At this point you should have a fully working Debian system, where you can play around without fear of affecting your main Debian installation.

This `debootstrap` trick can also be used to install Debian to a system without using a Debian install disk, but instead one for another GNU/Linux distribution. See http://www.debian.org/releases/stable/i386/ch-preparing#s-linux-upgrade.

Setting up login for `chroot`

Typing `chroot /sid-root /bin/bash` is easy, but it retains all sorts of environment variables that you may not want, and has other issues. A much better approach is to run another login process on a separate virtual terminal where you can log in to the chroot directly.

Since on default Debian systems `tty1` to `tty6` run Linux consoles and `tty7` runs the X Window System, let's set up `tty8` for a chrooted console as an example. After creating a chroot system as described in 'Run a different Debian distribution with `chroot`' on this page, type from the root shell of the main system:

```
main # echo "8:23:respawn:/usr/sbin/chroot /sid-root "\
       "/sbin/getty 38400 tty8"  >> /etc/inittab
main # init q    # reload init
```

Setting up X for `chroot`

You want to run the latest X and GNOME safely in your chroot? That's entirely possible! The following example will make GDM run on virtual terminal `vt9`.

First install a chroot system using the method described in 'Run a different Debian distribution with `chroot`' on the current page. From the root of the main system, copy key configuration files to the chroot system.

```
main # cp /etc/X11/XF86Config-4 /sid-root/etc/X11/XF86Config-4
main # chroot /sid-root # or use chroot console
chroot # apt-get install gdm gnome x-window-system
chroot # vi /etc/gdm/gdm.conf # do s/vt7/vt9/ in [servers] section
chroot # /etc/init.d/gdm start
```

Here, `/etc/gdm/gdm.conf` was edited to change the first virtual console from `vt7` to `vt9`.

Now you can easily switch back and forth between full X environments in your chroot and your main system just by switching between Linux virtual terminals; e.g. by using Ctrl-Alt-F7 and Ctrl-Alt-F9. Have fun!

[FIXME] Add a comment and link to the init script of the chrooted `gdm`.

Run other distributions with `chroot`

A chroot environment for another Linux distribution can easily be created. You install a system into separate partitions using the installer of the other distribution. If its root partition is in */dev/hda9*:

```
main # cd / ; mkdir /other-dist
main # mount -t ext3 /dev/hda9 /other-dist
main # chroot /other-dist /bin/bash
```

Then proceed as in 'Run a different Debian distribution with `chroot`' on the facing page, 'Setting up login for `chroot`' on the preceding page, and 'Setting up X for `chroot`' on the facing page.

Build a package with `chroot`

There is a more specialized chroot package, `pbuilder`, which constructs a chroot system and builds a package inside the chroot. It is an ideal system to use to check that a package's build-dependencies are correct, and to be sure that unnecessary and wrong build dependencies will not exist in the resulting package.

8.6.36 How to check hard links

You can check whether two files are the same file with two hard links by:

```
$ ls -li file1 file2
```

8.6.37 `mount` hard disk image file

If *`file.img`* contains an image of hard disk contents and the original hard disk had a disk configuration which gives *xxxx* = (bytes/sector) * (sectors/cylinder), then the following will mount it to `/mnt`:

```
# mount -o loop,offset=xxxx file.img /mnt
```

Note that most hard disks have 512 bytes/sector.

8.6.38 Samba

Basics of getting files from Windows:

```
# mount -t smbfs -o username=myname,uid=my_uid,gid=my_gid \
        //server/share /mnt/smb  # mount Windows files to Linux
# smbmount //server/share /mnt/smb \
        -o "username=myname,uid=my_uid,gid=my_gid"
# smbclient -L 192.168.1.2 # list the shares on a computer
```

Samba neighbors can be checked from Linux using:

```
# smbclient -N -L ip_address_of_your_PC | less
# nmblookup -T "*"
```

8.6.39 Utilities for foreign filesystems

Many foreign filesystems have Linux kernel support, and can thus be accessed simply by mounting the devices containing the filesystems. For certain filesystems, there are also a few specialized tools to access the filesystems without mounting the devices. This is accomplished with user-space programs so that kernel filesystem support is not needed.

- `mtools`: for MSDOS filesystem (MS-DOS, Windows)
- `cpmtools`: for CP/M filesystem
- `hfsutils`: for HFS filesystem (native Macintosh)
- `hfsplus`: for HFS+ filesystem (modern Macintosh)

In order to create and check an MS-DOS FAT filesystem, `dosfstools` is useful.

8.7 Typical mistakes to be noted

Here are few examples of dangerous actions. The negative impacts will be enhanced if you are using privileged account: `root`.

8.7.1 `rm -rf .*`

In "`rm -rf .*`", "`.*`" expands to include "`.`" and "`..`", and if you happen to have privileges to write to the parent directory then you'll end up removing all directories **next** to your current directory as well.

- "`rm -rf .`" : removes everything under current directory and current directory itself.
- "`rm -rf *`" : removes every non-dot files and non-dot directories under current directory
- "`rm -rf .[^.]*`" : removes every dot files and dot-directories under current directory.
- "`rm -rf .*`" : removes everything under parent directory and parent directory itself.

8.7.2 `rm /etc/passwd`

Loss of some important files such as `/etc/passwd` through your stupidity is tough. The Debian system makes regular backups of them in `/var/backups/`. When you restore these files, you may manually have to set the proper permissions.

```
# cp /var/backups/passwd /etc/passwd
# chmod 644 /etc/passwd
```

See also 'Recover package selection data' on page 85.

Chapter 9

Tuning a Debian system

This chapter describes only the basics of system configuration through a command-line interface. Before reading this chapter you should read 'Debian System installation hints' on page 25.

If you are concerned about security then you should read the Securing Debian Manual (http://www.debian.org/doc/manuals/securing-debian-howto/) which comes in the harden-doc package.

9.1 System initialization

Debian uses the System V init script system. See 'The init program' on page 20 for an introduction.

9.1.1 Customizing init scripts

The easiest way to control the behavior of an init script is by changing environment variable assignments in the file named like the init script in the /etc/default directory. [1] For example, /etc/default/hotplug can be used to control how /etc/init.d/hotplug works. The /etc/default/rcS file can be used to customize boot-time defaults for motd, sulogin, etc.

If you cannot get the behavior you want by changing such variables then you can modify the init scripts themselves: they are all configuration files.

[1] Files in /etc/default/ contain environment variable assignments **only**. Each file is sourced by the init script to which it corresponds in such a way that these assignments override any default variable settings in the init script itself. The choice of directory name is peculiar (http://lists.debian.org/debian-devel/2003/debian-devel-200308/msg02114.html) to Debian. It is roughly the equivalent of the /etc/sysconfig directory found in Red Hat and other distributions.

9.1.2 Customizing system logging

System log mode can be configured using `/etc/syslog.conf`. Check the `colorize` package for a program to colorize system logfiles. See also `syslogd(8)` and `syslog.conf(5)`.

9.1.3 Optimizing hardware

There are a few hardware optimization configurations that Debian leaves to the sysadmin to take care of.

- `hdparm`
  - Hard disk access optimization. Very effective.
  - Dangerous. You must read `hdparm(8)` first.
  - `hdparm -tT` *`/dev/hda`* to test disk access speed.
  - `hdparm -q -c3 -d1 -u1 -m16` *`/dev/hda`* to speed up a modern IDE system. (It may be dangerous.)

- `setcd`
  - Compact disc drive access optimization.
  - `setcd -x` *`2`* to slow down to 2x speed.
  - See `setcd(1)`.

- `setserial`
  - Collection of tools for serial port management.

- `scsitools`
  - Collection of tools for SCSI hardware management.

- `memtest86`
  - Collection of tools for memory hardware management.

- `hwtools`
  - Collection of tools for low-level hardware management.
    - `irqtune`: changes the IRQ priority of devices to allow devices that require high priority and fast service (e.g. serial ports, modems) to have it. 3x speedup of serial/modem throughput is possible.
    - `scanport`: scans I/O space from 0x100 to 0x3ff looking for installed ISA devices.
    - `inb`: a quick little hack that reads an I/O port and dumps the value in hex and binary.

- `schedutils`
  - Linux scheduler utilities.
  - `taskset`, `irqset`, `lsrt`, and `rt` are included.
  - Together with `nice` and `renice` (not included), they allow full control of process scheduling parameters.

Mounting a filesystem with the `noatime` option is also very effective in speeding up read access to the file. See `fstab(5)` and `mount(8)`.

Some hardware can be tuned directly by the Linux kernel itself through the proc filesystem. See 'Tuning the kernel through the proc filesystem' on page 103.

There are many hardware-specific configuration utilities in Debian. Many of them address needs specific to the laptop PC. Here are some interesting packages available in Debian:

- `tpconfig` - A program to configure touchpad devices
- `apmd` - Utilities for Advanced Power Management (APM)
- `acpi` - displays information on ACPI devices
- `acpid` - Utilities for using ACPI
- `lphdisk` - prepares hibernation partition for Phoenix NoteBIOS
- `sleepd` - puts a laptop to sleep during inactivity
- `noflushd` - allow idle hard disks to spin down
- `big-cursor` - larger mouse cursors for X
- `acme` - Enables the "multimedia buttons" found on laptops
- `tpctl` - IBM ThinkPad hardware configuration tools
- `mwavem` - Mwave/ACP modem support
- `toshset` - Access much of the Toshiba laptop hardware interface
- `toshutils` - Toshiba laptop utilities
- `sjog` - A program to use the "Jog Dial" on Sony Vaio Laptops
- `spicctrl` - Sony Vaio controller program to set LCD backlight brightness

Here, ACPI is a newer framework for the power management system than APM.

Some of these packages require special kernel modules. They are already included in the latest kernel source in many cases. In case of trouble, you may need to apply the latest patch to the kernel yourself.

9.2 Restricting access

9.2.1 Restricting logins with PAM

PAM (Pluggable Authentication Modules) allow you to control how users log in.

```
/etc/pam.d/*              # PAM control files
/etc/pam.d/login          # PAM control file for login
/etc/security/*           # PAM module parameters
/etc/securetty            # this controls root login by console (login)
/etc/login.defs           # this controls login behaviors (login)
```

Change the contents of `/etc/pam.d/login` as follows, if you want insecure but passwordless console terminals at your own risk.

```
#auth       required   pam_unix.so nullok
auth       required   pam_permit.so
```

Similar tricks can be applied for `xdm`, `gdm`, ..., for passwordless console X.

On the other hand, install `cracklib2` and set `/etc/pam.d/passwd` as follows, if you want to enforce a good password policy.

```
password required       pam_cracklib.so retry=3 minlen=6 difok=3
```

A one-time login password for account activation may also help. For this, use the `passwd` command with the `-e` option. See `passwd(1)`.

The maximum number of processes can be set with `ulimit -u 1000` in a Bash shell or with settings in `/etc/security/limits.conf` from PAM. Other parameters such as `core` can be set similarly. The initial value of `PATH` can be set by `/etc/login.defs` before the shell startup script.

The documentation for PAM is packaged in the `libpam-doc` package. The *Linux-PAM System Administrator's Guide* covers configuring PAM, what modules are available, etc. The documentation also includes *The Linux-PAM Application Developers' Guide* and *The Linux-PAM Module Writers' Guide*.

9.2.2 "Why GNU `su` does not support the `wheel` group"

This is the famous phrase at the bottom of the old `info su` page by Richard M. Stallman. Not to worry: the current `su` in Debian uses PAM, so that one can restrict the ability to use `su` to any group using `pam_wheel.so` in `/etc/pam.d/su`. The following will set the `adm` group in a Debian system as an equivalent of the BSD `wheel` group and allow `su` without a password for its members.

```
# anti-RMS configuration in /etc/pam.d/su
auth       required   pam_wheel.so group=adm

# Wheel members to be able to su without a password
auth       sufficient pam_wheel.so trust group=adm
```

9.2.3 Purposes of standard groups

A few interesting groups:

- `root` group is the default wheel group for `su` if `pam_wheel.so` is used without the `group=` argument.
- `adm` group can read logfiles.
- `cdrom` group can be used locally to give a set of users access to a CD-ROM drive.
- `floppy` group can be used locally to give a set of users access to a floppy drive.
- `audio` group can be used locally to give a set of users access to an audio device.
- `src` group owns source code, including files in `/usr/src`. It can be used locally to give a user the ability to manage system source code.

- `staff` membership is useful for helpdesk types or junior sysadmins, giving them the ability to do things in `/usr/local` and to create directories in `/home`.

For a complete list, see the "FAQ" section in the Securing Debian Manual (http://www.debian.org/doc/manuals/securing-debian-howto/), which can also be found as the `harden-doc` package in Woody. Also the new `base-passwd` (>3.4.6) contains an authoritative list: `/usr/share/doc/base-passwd/users-and-groups.html`.

9.2.4 Working more safely – sudo

My usage of `sudo` is mostly a protection from my own stupidity. Personally, I consider using `sudo` a better alternative to always using the system as root.

Install `sudo` and activate it by setting options in `/etc/sudoers` (http://www.debian.org/doc/manuals/debian-reference/examples/). Also check out the `sudo` group feature in `/usr/share/doc/sudo/OPTIONS`.

The sample configuration provides "staff" group members access to any commands run as root under `sudo` and also gives "src" members access to selected commands run as root under `sudo`.

The advantage of `sudo` is that it only requires an ordinary user's password to log in, and activity is monitored. This is a nice way to give some authority to a junior administrator. For example:

```
$ sudo chown -R myself:mygrp .
```

Of course if you know the root password (as most home users do), any command can be run under root from a user account:

```
$ su -c "shutdown -h now"
Password:
```

(I know I should tighten the admin account's `sudo` privileges. But since this is my home server, I have not bothered yet.)

For a different program that allows ordinary users to run commands with root privileges, see the `super` package.

9.2.5 Restricting access to services

The Internet *super-server*, `inetd`, is started at boot time by `/etc/rc2.d/S20inetd` (for RUNLEVEL=2), which is a symlink to `/etc/init.d/inetd`. Essentially, `inetd` allows one running daemon to invoke several others, reducing load on the system.

Whenever a request for service arrives, its protocol and service are identified by looking them up in the databases in `/etc/protocols` and `/etc/services`. `inetd` then looks up a normal Internet service in the `/etc/inetd.conf` database, or a Sun-RPC based service in `/etc/rpc.conf`.

For system security, make sure to disable unused services in `/etc/inetd.conf`. Sun-RPC services need to be active for NFS and other RPC-based programs.

Sometimes, `inetd` does not start the intended server directly but starts the `tcpd` TCP/IP daemon wrapper program with the intended server name as its argument in `/etc/inetd.conf`. In this case, `tcpd` runs the appropriate server program after logging the request and doing some additional checks using `/etc/hosts.deny` and `/etc/hosts.allow`.

If you have problems with remote access in a recent Debian system, comment out "ALL: PARANOID" in `/etc/hosts.deny` if it exists.

For details, see `inetd(8)`, `inetd.conf(5)`, `protocols(5)`, `services(5)`, `tcpd(8)`, `hosts_access(5)`, and `hosts_options(5)`.

For more information on Sun-RPC, see `rpcinfo(8)`, `portmap(8)`, and `/usr/share/doc/portmap/portmapper.txt.gz`.

9.2.6 Centralizing authentication – LDAP

Use Lightweight Directory Access Protocol (LDAP). References:

- OpenLDAP (http://www.openldap.org/)
- OpenLDAP Admin Guide in the `openldap-guide` package
- LDP: LDAP Linux HOWTO (http://www.tldp.org/HOWTO/LDAP-HOWTO/index.html)
- LDP: LDAP Implementation HOWTO (http://www.tldp.org/HOWTO/LDAP-Implementation-HOWTO/index.html)
- OpenLDAP, extensive use reports (http://portal.aphroland.org/~aphro/ldap-docs/ldap.html)
- Open LDAP with Courier IMAP and Postfix (http://alinux.washcoll.edu/docs/plc/postfix-courier-howto.html)

9.3 CD writers

CD-writers with ATAPI/IDE interfaces have recently become a very popular option. It is a nice medium for system backup and archiving for the home user needing < 640MB capacity. For the most authoritative information, see the LDP CD-Writing-HOWTO (http://www.tldp.org/HOWTO/CD-Writing-HOWTO.html).

9.3.1 Introduction

First, any disruption of data sent to the CD-writer will cause irrecoverable damage to the CD. Get a CD-writer with as large a buffer as possible. If money is no object, do not bother with ATAPI/IDE, just get a SCSI version. If you have a choice of IDE interface to be connected, use the one on the PCI-bus (i.e., on the motherboard) rather than one on the ISA-bus (an SB16 card, etc.).

When a CD-writer is connected to IDE, it has to be driven by the IDE-SCSI driver instead of an ordinary IDE CD driver for Linux 2.2 and 2.4 kernels. Also, the SCSI generic driver needs to be activated. There are two possible approaches to doing this, assuming a kernel distributed with modern distributions (as of March 2001).

For Linux 2.6 kernel, you should use ordinary IDE driver and access CD-RW device directly with device name such as `/dev/hdx` instead. You can use DMA this way.

9.3.2 Approach 1: modules + `lilo`

Add the following line to `/etc/lilo.conf` if you are using a stock Debian kernel. If multiple options are used, list them separated by spaces:

```
append="hdx=ide-scsi ignore=hdx"
```

Here the location of the CD-writer, which is accessed through the ide-scsi driver, is indicated by `hdx`, where *x* represents one of the following:

```
hda           for a master on the first IDE port
hdb           for a slave on the first IDE port
hdc           for a master on the second IDE port
hdd           for a slave on the second IDE port
hde ... hdh   for a drive on an external IDE port or ATA66/100 IDE port
```

Type the following commands as root to activate after finishing all the configuration:

```
# lilo
# shutdown -h now
```

9.3.3 Approach 2: recompile the kernel

Debian uses `make-kpkg` to create a kernel. Use the new `--append_to_version` with `make-kpkg` to build multiple kernel images. See 'The Linux kernel under Debian' on page 97.

Use the following setup through `make menuconfig`:

- bzImage
- Exclude the IDE CD driver (not a must, but simpler to do this)
- Compile in ide-scsi and sg, or make them modules

9.3.4 Post-configuration steps

Kernel support for the CD-writer can be activated during booting by the following:

```
# echo ide-scsi >>/etc/modules
# echo sg       >>/etc/modules
# cd /dev; ln -sf scd0 cdrom
```

Manual activation can be done by:

```
# modprobe ide-scsi
# modprobe sg
```

After reboot, you can check installation by:

```
$ dmesg|less
# apt-get install cdrecord
# cdrecord -scanbus
```

[Per Warren Dodge] Sometimes there may be conflicts between `ide-scsi` and `ide-cd` if there are both CD-ROM and CD-R/RW on the system. Try adding the following line to your `/etc/modutils/aliases`, running `update-modules`, and rebooting.

```
pre-install      ide-scsi      modprobe ide-cd
```

This causes the IDE driver to load before `ide-scsi`. The IDE driver `ide-cd` takes control of the ATAPI CD-ROM—anything that it hasn't been told to **ignore**. That leaves just the ignored devices for `ide-scsi` to control.

9.3.5 CD-image file (bootable)

To create a CD-image of files under `target-directory/` as `cd-image.raw` (bootable, Joliet TRANS.TBL-enabled format; if not bootable, take out `-b` and `-c` options), insert a boot floppy in the first floppy drive and

```
# dd if=/dev/fd0 target-directory/boot.img
# mkisofs -r -V volume_id -b boot.img -c bootcatalog -J -T \
        -o cd-image.raw target_directory/
```

One funny hack is to make a bootable DOS CD-ROM. If an ordinary DOS boot floppy disk image is in the above *boot.img*, the CD-ROM will boot as if a DOS floppy were in the first floppy drive (A:). Doing this with freeDOS may be more interesting.

This CD-image file can be inspected by mounting it on the loop device.

```
# mount -t iso9660 -o ro,loop cd-image.raw /cdrom
# cd /cdrom
# mc
# umount /cdrom
```

9.3.6 Write to the CD-writer (R, RW):

First test with (assuming double speed)

```
# nice --10 cdrecord -dummy speed=2 dev=0,0 disk.img
```

Then if OK, write to CD-R with

```
# nice --10 cdrecord -v -eject speed=2 dev=0,0 disk.img
```

Or write to a CD-RW disk with

```
# nice --10 cdrecord -v -eject blank=fast speed=2 dev=0,0 disk.img
```

Some CD-RW drives work better with

```
# nice --10 cdrecord -v blank=all speed=2 dev=0,0 disk.img
```

followed by

```
# nice --10 cdrecord -v -eject speed=2 dev=0,0 disk.img
```

Two steps are needed to prevent SCSI timeouts during blanking from interfering with the burning step. The argument value to `nice` may require some adjustments.

9.3.7 Make an image file of a CD

Some CD-Rs and commercial CDs have junk sectors at the end that make copying by `dd` impossible (the Windows 98 CD is one of them). The `cdrecord` package comes with the `readcd` command. Use this to copy any CD contents to an image file. If it is a data disk, mount it and run `df` to see its actual size. Divide the number shown in blocks (1 block = 1024 bytes) by 2 to get the number of actual CD sectors (1 sector = 2048 bytes). Run `readcd` with options and use this disk image to burn the CD-R/RW.

```
# readcd dev=target,lun,scsibusno # select function 11
```

Here, set all three parameters to 0 for most cases. Usually the number of sectors given by `readcd` is excessive! Use the above number from an actual mount for better results.

It should be noted that the use of `dd` has a few problems if used on CD-ROM. The first run of the `dd` command may cause an error message and may yield a shorter disk image with a lost tail-end. The second run of `dd` command may yield a larger disk image with garbage data attached at the end on some systems if the data size is not specified. Only the second run of the `dd` command with the correct data size specified, and without ejecting the CD after an error message, seems to avoid these problems. If for example the image size displayed by `df` is `46301184` blocks, use the following command twice to get the right image (this is my empirical information):

```
# dd if=/dev/cdrom of=cd.img bs=2048 count=$((46301184/2))
```

9.3.8 Debian CD images

To obtain the latest information on Debian CDs, visit the Debian CD site (http://www.debian.org/CD/).

If you have a fast Internet connection, think about installing over the network using:

- a few floppy images (http://www.debian.org/distrib/floppyinst).
- a minimal bootable CD image (http://www.debian.org/CD/netinst/).

If you do not have a fast Internet connection, think about purchasing CDs from a CD vendor (http://www.debian.org/CD/vendors/).

Please do not waste bandwidth by downloading standard CD images unless you are a CD image tester (even with the new jigdo method).

One noteworthy CD image is KNOPPIX - Live Linux Filesystem On CD (http://www.knopper.net/knoppix/index-en.html). This CD will boot a functioning Debian system without installing itself to the hard disk.

9.3.9 Back up the system to CD-R

To copy key configuration files and data files to CD-R, use the example backup script `backup` (`http://www.debian.org/doc/manuals/debian-reference/examples/`). Also see 'Copy and archive a whole subdirectory' on page 109 and 'Differential backup and data synchronization' on page 111.

9.3.10 Copy a music CD to CD-R

Not tested by me:

```
# apt-get install cdrecord cdparanoia
# cdparanoia -s -B
# cdrecord dev=0,0,0 speed=2 -v -dao -eject defpregap=1 -audio *.wav
```

or,

```
# apt-get install cdrdao #disk at once
# cdrdao read-cd --device /dev/cdrom --paranoia-mode 3 my_cd # read cd
# cdrdao write --device /dev/cdrom --speed 8 my_cd    # write a new CD
```

`cdrdao` does a real copy (no gaps, etc...).

9.3.11 Writing DVD-R, DVD-RW, and DVD+RW

For DVD writing, you have 2 approaches:

- Use `growisofs` with `mkisofs`.
- Recompile `cdrecord` with dvd option to create local package following `/usr/share/doc/cdrecord/README.DVD.Debian`.

9.4 X

The X Window System is provided by XFree86 (`http://www.xfree86.org/`). There are two major versions of X server available on the Debian system: XFree86 Version 3.3 (XF3) and XFree86 Version 4.x series (XF4) both based on X11R6 specifications by X.Org (`http://www.x.org/`).

For the basics of X, refer to `X(7)`, the LDP XWindow-User-HOWTO (`http://www.tldp.org/HOWTO/XWindow-User-HOWTO.html`), and the Remote X Apps mini-HOWTO (`http://www.tldp.org/HOWTO/mini/Remote-X-Apps.html`). For a Debian-specific user guide, read `/usr/share/doc/xfree86-common/FAQ.gz` provided in the `xfree86-common` package. This contains an interesting and authoritative review of the key binding issues by Branden Robinson.

'The X server' on the facing page a program on a local host that displays an X window and/or desktop on a user's monitor (CRT, LCD) and accepts keyboard and mouse input.

'X clients' on page 147 a program on a (local or remote) host that runs X-compatible application software.

This reverses the ordinary use of "server" and "client" in other contexts.

There are several ways of getting the "X server" (display side) to accept remote connections from an "X client" (application side):

- `xhost` method
  - the host list mechanism (very insecure).
  - non-encrypted protocol (prone to eavesdropping attack).
  - Do not use this, if possible.
  - See 'Connecting to a remote X server – `xhost`' on page 152 and `xhost(1x)`.

- **`xauth`** method
  - the MIT magic cookie mechanism (insecure but better than `xhost`).
  - non-encrypted protocol (prone to eavesdropping attack).
  - use this only for local connection since it is less CPU-intensive than `ssh -X`.
  - See 'Getting root in X' on page 154 and `xauth(1x)`.

- `xdm`, `wdm`, `gdm`, `kdm`, ... methods
  - the MIT magic cookie mechanism (insecure as `xauth`).
  - See `xdm(1x)` and `Xsecurity(7)` for the basics of X display access control.
  - See `wdm(1x)`, `gdm(8)`, and `kdm.options(5)` for more information, if these are installed.
  - See 'Customizing runlevels' on page 21 for how to disable `xdm` to gain a Linux console upon boot without purging the `xdm` package.

- **`ssh -X`** method
  - port forwarding mechanism through secure shell (**secure**).
  - encrypted protocol (a waste of resources if used locally).
  - use this for remote connections.
  - See 'Connecting to a remote X server – `ssh`' on page 152.

All remote connection methods, except `ssh`, require TCP/IP connection enabled on the X server. See 'Using X over TCP/IP' on page 152.

9.4.1 X packages

There are a few (meta)packages provided to ease installation of the X system in Woody.

x-window-system-core This metapackage provides the essential components for a standalone workstation running the X Window System. It provides the X libraries, an X server (xserver-xfree86), a set of fonts, and a group of basic X clients and utilities.

x-window-system This metapackage provides substantially all the components of the X Window System as developed by the XFree86 Project, as well as a set of historically popular accessory programs. (Notably, it depends on x-window-system-core, twm, and xdm, i.e., no need to install x-window-system-core if you install this.)

xserver-common-v3 Files and utilities common to XFree86 3.x X servers (XF3)

xserver-* Supplemental XF3 server packages to support hardware not supported by the new XF4 server (xserver-xfree86) for whatever reason. Some old ATI mach64 cards are not supported in XF4, other cards hang badly in the Woody version of XF4, etc. (For available packages, use apt-cache search xserver-|less. All of these XF3 servers depend on xserver-common-v3.)

For most cases, x-window-system is the package to install. (If you want console login, be sure to disable xdm as described in "'Let me disable X on boot!"' on page 107.)

9.4.2 Hardware detection for X

To enable hardware detection during the X configuration stage, install the following packages prior to installing the X system:

- discover – hardware identification system.
- mdetect – mouse device autodetection tool.
- read-edid – hardware information-gathering tool for VESA PnP monitors.

9.4.3 The X server

See XFree86(1x) for X server information.

Invoke X server from a local console:

```
$ startx -- :<display> vtXX
e.g.:
$ startx -- :1 vt8 -bpp 16
... start on vt8 connected to localhost:1 with 16 bpp mode
```

Arguments given after -- are for the X server.

Note, when using a ~/.xserverrc script to customize the X server startup process, be sure to exec the real X server. Failing to do this can make the X server slow to start and exit. For example:

```
#!/bin/sh
exec /usr/bin/X11/X -dpi 100 -nolisten tcp
```

Configuring the X server (version 4)

To (re-)configure an XF4 server,

```
# dpkg-reconfigure --priority=low xserver-common
# dpkg-reconfigure --priority=low xserver-xfree86
```

will generate `/etc/X11/XF86Config-4` file and configure X using the script `dexconf`.

Configuring the X server (version 3)

To (re-)configure an XF3 server, for example, for ATI mach64,

```
# dpkg-reconfigure --priority=low xserver-common-v3
# dpkg-reconfigure --priority=low xserver-mach64
```

will generate `/etc/X11/XF86Config` file and configure X using the script `xf86config-v3`.

Configuring the X server manually

For Woody, to add user customizations to `/etc/X11/XF86Config-4` file, **do not edit the configuration file between the text**:

```
### BEGIN DEBCONF SECTION
[snip]
### END DEBCONF SECTION
```

Instead, **add the customizations before the text**. For example, to use a custom video device, add something resembling the following text to the *top* of the file:

```
Section "Device"
  Identifier        "Custom Device"
  Driver            "ati"
  Option            "NoAccel"
EndSection

Section "Screen"
  Identifier  "Custom Screen"
```

```
    Device      "Custom Device"
    Monitor     "Generic Monitor"
    DefaultDepth 24
    Subsection "Display"
      Depth       8
      Modes       "1280x960" "1152x864" "1024x768" "800x600" "640x480"
    EndSubsection
    Subsection "Display"
      Depth       16
      Modes       "1280x960" "1152x864" "1024x768" "800x600" "640x480"
    EndSubsection
    Subsection "Display"
      Depth       24
      Modes       "1280x960" "1152x864" "1024x768" "800x600" "640x480"
    EndSubsection
EndSection

Section "ServerLayout"
    Identifier        "Custom"
    Screen            "Custom Screen"
    InputDevice       "Generic Keyboard" "CoreKeyboard"
    InputDevice       "Configured Mouse" "CorePointer"
EndSection
```

For Sarge (`testing` at the time of writing), if you wish to retain user customizations to `/etc/X11/XF86Config` file through upgrade, run the following commands as root:

```
# cp /etc/X11/XF86Config-4 /etc/X11/XF86Config-4.custom
# md5sum /etc/X11/XF86Config-4 > /var/lib/xfree86/XF86Config-4.md5sum
# dpkg-reconfigure xserver-xfree86
```

In order to achieve **font de-uglification**, you need to edit `/etc/X11/XF86Config-4` as described in 'TrueType fonts in X' on page 156.

Please also check the other parts of your X configuration. Bad monitor settings can be even more of a headache than bad fonts, so make sure your refresh rate is as high as your monitor can handle (85 Hz is great, 75 Hz is OK, 60 Hz is painful).

9.4.4 X clients

Most X client programs can be started with a command like this:

```
client $ xterm -geometry 80x24+30+200 -fn 6x10 -display hostname:0 &
```

Here, the optional command-line arguments mean:

- `-geometry` *`WIDTH`*`x`*`HEIGHT`*`+`*`XOFF`*`+`*`YOFF`*: the initial size and location of the window.
- `-fn` *`FONTNAME`*: the font to use for displaying text. *`FONTNAME`* can be:
  - a14: Normal size font
  - a24: Large size font
  - ... (check available fonts with `xlsfont`.)
- `-display` *`displayname`*: the name of the X server to use. *`displayname`* can be:
  - *`hostname`*`:`*`D.S`* means screen *`S`* on display *`D`* of host *`hostname`*; the X server for this display is listening to TCP port 6000+D.
  - *`host`*`/unix:`*`D.S`* means screen *`S`* on display *D* of host *`host`*; the X server for this display is listening to UNIX domain socket `/tmp/.X11-unix/XD` (so it's only reachable from *`host`*).
  - *`:D.S`* is equivalent to *`host`*`/unix:`*`D.S`*, where *`host`* is the local hostname.

The default *`displayname`* for the X client program (application side) can be set by the DISPLAY environment variable. For example, prior to running an X client program, executing one of the following commands achieves this:

```
$ export DISPLAY=:0
        # The default, local machine using the first X screen
$ export DISPLAY=hostname.fulldomain.name:0.2
$ export DISPLAY=localhost:0
```

Its startup can be customized by `~/.xinitrc`. For example:

```
xrdb -load $HOME/.Xresources
xsetroot -solid gray &
xclock -g 50x50-0+0 -bw 0 &
xload -g 50x50-50+0 -bw 0 &
xterm -g 80x24+0+0 &
xterm -g 80x24+0-0 &
twm
```

As described in 'Custom X sessions' on the next page, this overrides everything normal execution of `Xsession` does when started from `startx`. Use `~/.xsession` instead and use this approach only as the last resort. See `xsetroot(1x)`, `xset(1x)`, and 'X resources' on page 153.

9.4.5 X sessions

An X session (X server + X client) can be started by:

- `startx`: wrapper script command for `xinit` to start an X server and client from a Linux character console. If `~/.xinitrc` does not exist, `/etc/X11/Xsession` is executed through `/etc/X11/xinit/xinitrc`.

- `xdm`, `gdm`, `kdm`, or `wdm`: X display manager daemons to start the X server and client, and to control login via a GUI screen. `/etc/X11/Xsession` is directly executed.

The console can be made available as in "'Let me disable X on boot!"' on page 107.

Custom X sessions

The default startup script `/etc/X11/Xsession` is effectively a combination of `/etc/X11/Xsession.d/50xfree86-common_determine-startup` and `/etc/X11/Xsession.d/99xfree86-common_start`.

Execution of `/etc/X11/Xsession` is somewhat affected by `/etc/X11/Xsession.options` and is essentially an execution of a program which was first found in the following order with the `exec` command:

1 `~/.xsession` or `~/.Xsession`, if it is defined.
2 `/usr/bin/x-session-manager`, if it is defined.
3 `/usr/bin/x-window-manager`, if it is defined.
4 `/usr/bin/x-terminal-emulator`, if it is defined.

The exact meaning of these commands is determined by the Debian alternative system described in 'Alternative commands' on page 94. For example:

```
# update-alternatives --config x-session-manager
... or
# update-alternatives --config x-window-manager
```

In order to make any X window manager a default while keeping GNOME and KDE session managers installed, replace `/etc/X11/Xsession.d/50xfree86-common_determine-startup` with the one attached in the second bug report at `http://bugs.debian.org/168347` (I hope this will be included soon) and edit `/etc/X11/Xsession.options` as follows to disallow the X session manager:

```
# /etc/X11/Xsession.options
#
# configuration options for /etc/X11/Xsession
# See Xsession.options(5) for an explanation of the available options.
# Default enabled
allow-failsafe
allow-user-resources
allow-user-xsession
use-ssh-agent
# Default disabled (enable them by uncommenting)
do-not-use-x-session-manager
#do-not-use-x-window-manager
```

Without the above mentioned modification to the system, `gnome-session` and `kdebase` are the packages containing these X session managers. Removing them allows X window manager to be a default. (Yack, any better idea?)

On a system where `/etc/X11/Xsession.options` contains a line `allow-user-xsession` without preceding characters, any user who defines `~/.xsession` or `~/.Xsession` will be able to customize the action of `/etc/X11/Xsession`.

The last command in the `~/.xsession` file should use form of `exec` *`some-window/session-manager`* to start your favorite X window/session manager.

A good example of an `~/.xsession` script is given at `/usr/share/doc/xfree86-common/examples/xsession.gz`.

I use this to set the window manager, screen access, and language support for each user account. See 'Starting an X session for a user' on the current page, 'Getting root in X' on page 154, and 'Example for a multilingual X window system' on page 171.

If you wish to have several X client programs started automatically, see 'X clients' on page 147 examples and invoke them from `~/.xsession` instead of `~/.xinitrc`.

User-specific additional X resources can be stored in `~/.Xresources`. See 'X resources' on page 153.

User-customized keymaps and pointer button mappings in X can also be specified in the user's start up script. See 'Keymaps and pointer button mappings in X' on page 154.

Starting an X session for a user

Following the principle described at 'Custom X sessions' on the page before, a user-specific X session/window manager can be activated by installing the package indicated and setting the contents at the end of `~/.xsession` file as follows. (I like `blackbox`/`fluxbox` for its simple style and fast speed.):

- default X session manager
  - See 'Alternative commands' on page 94
  - `exec /usr/bin/x-session-manager`
- default X window manager
  - See 'Alternative commands' on page 94
  - `exec /usr/bin/x-window-manager`
- GNOME session manager (loaded)
  - Install package: `gnome-session`
  - `exec /usr/bin/gnome-session`
- KDE session manager (loaded)
  - Install package: `kdebase` (or `kdebase3` for KDE3)
  - `exec /usr/bin/kde2`

- Blackbox window manager (lightweight, slick)
  - Install package: `blackbox`
  - `exec /usr/bin/blackbox`

- Fluxbox window manager (lightweight, new blackbox)
  - Install package: `fluxbox`
  - `exec /usr/bin/fluxbox`

- Xfce window manager (Mac OS-X, SUN CDE–like)
  - Install package: `xfce`
  - `exec /usr/bin/xfwm`

- IceWM window manager (lightweight, GNOME alternative)
  - Install package: `icewm`
  - `exec /usr/bin/X11/icewm`

- FVWM2 virtual window manager (lightweight, Win95-like)
  - Install package: `fvwm`
  - `exec /usr/bin/fvwm2`

- Windowmaker window manager (somewhat NexT-like)
  - Install package: `wmaker`
  - `exec /usr/bin/wmaker`

- Enlightenment window manager (loaded)
  - Install package: `enlightenment`
  - `exec /usr/bin/enlightenment`

See Window Managers for X (`http://www.xwinman.org`).

Setting up KDE and GNOME

In order to setup full KDE or GNOME environment, the following metapackages are useful:
- KDE: install the `kde` package
- GNOME: install the `gnome` package

Installing these packages with tools which handle `Recommends`, such as `dselect` and `aptitude`, provides you with richer choices of software than just installing these with `apt-get`.

If you want console login, be sure to disable X display managers, such as `kdm`, `gdm`, and `wdm`, which may be pulled in by the dependencies, as described in "'Let me disable X on boot!"' on page 107.

If you want to have GNOME as the system default over KDE, make sure to configure `x-session-manager` as in 'Alternative commands' on page 94.

9.4.6 Using X over TCP/IP

Because a remote TCP/IP socket connection without encryption is prone to an eavesdropping attack, the default setting for X in recent Debian versions disables the TCP/IP socket. Consider using `ssh` for a remote X connection (see 'Connecting to a remote X server – `ssh`' on this page).

The method described here is not encouraged unless one is in a very secure environment behind a good firewall system with only trusted users present. Use the following command to verify your current X server setting for the TCP/IP socket:

```
# find /etc/X11 -type f -print0 | xargs -0 grep nolisten
/etc/X11/xinit/xserverrc:exec /usr/bin/X11/X -dpi 100 -nolisten tcp
```

Remove `-nolisten` to restore TCP/IP listening on the X server.

9.4.7 Connecting to a remote X server – `xhost`

`xhost` allows access based on hostnames. This is very insecure. The following will disable host checking and allow connections from anywhere if a TCP/IP socket connection is allowed (see 'Using X over TCP/IP' on the current page):

```
$ xhost +
```

You can re-enable host checking with:

```
$ xhost -
```

`xhost` does not distinguish between different users on the remote host. Also, hostnames (addresses actually) can be spoofed.

This method must be avoided even with more restrictive host criteria if you're on an untrusted network (for instance with dial-up PPP access to the Internet). See `xhost(1x)`.

9.4.8 Connecting to a remote X server – `ssh`

The use of `ssh` enables a secure connection from a local X server to a remote application server.

- Set `X11Forwarding` and `AllowTcpForwarding` entries to `yes` in `/etc/ssh/sshd_config` of the remote host, if you want to avoid corresponding command-line options.
- Start the X server on the local host.
- Open an `xterm` in the local host.

- Run `ssh` to establish a connection with the remote site.

```
localname @ localhost $ ssh -q -X -l loginname remotehost.domain
Password:
.....
```

- Run X application commands on the remote site.

```
loginname @ remotehost $ gimp &
```

This method allows the display of the remote X client output as if it were locally connected through a local UNIX domain socket.

9.4.9 The X terminal emulator – `xterm`

Learn everything about `xterm` at http://dickey.his.com/xterm/xterm.faq.html.

9.4.10 X resources

Many older X programs, such as `xterm`, use the X resource database to configure their appearance. The file `~/.Xresources` is used to store user resource specifications. This file is automatically merged into the default X resources upon login. The system-wide defaults of X resources are stored in `/etc/X11/Xresources/*` and application defaults of them are stored in `/etc/X11/app-defaults/*`. Use these settings as the starting points.

Here are some helpful settings to add to your `~/.Xresources` file:

```
! Set the font to a more readable 9x15
XTerm*font: 9x15

! Display a scrollbar
XTerm*scrollBar: true

! Set the size of the buffer to 1000 lines
XTerm*saveLines: 1000

! Large kterm screen
KTerm*VT100*fontList: -*-fixed-medium-r-normal--24-*,\
 -*-gothic-medium-r-normal--24-*,\
 -*-mincho-medium-r-normal--24-*
```

To make these settings take effect immediately, merge them into the database using the command:

```
xrdb -merge ~/.Xresources
```

See `xrdb(1x)`.

9.4.11 Keymaps and pointer button mappings in X

The `xmodmap` program is used to edit and display the keyboard modifier map and keymap table that are used by client applications to convert event keycodes into keysyms in X.

```
$ xmodmap -pm
 ... display the current modifier map
$ xmodmap -pk | pager
 ... display the current keymap table
$ xmodmap -e "pointer = 3 2 1" # set mouse for the left hand.
$ xmodmap ~/.xmodmaprc # set keyboard as in ~/.xmodmaprc
```

It is usually run from the user's session startup script, `~/.xsession`.

To get the `keycode`, run `xev` in X and press keys. To get the meaning of `keysym`, look into the MACRO definition in `/usr/include/X11/keysymdef.h` file. All the `#define` statements in this file are named as `XK_` prepended to the `keysym` names.

See `xmodmap(1x)`.

9.4.12 Getting root in X

If a GUI program needs to be run with root privilege, use the following procedures to display program output on a user's X server. **Never attempt to start an X server directly from the root account** in order to avoid possible security risks.

Start the X server as a normal user and open an `xterm` console. Then:

```
$ XAUTHORITY=$HOME/.Xauthority
$ export XAUTHORITY
$ su root
Password:*****
# printtool &
```

When using this trick to `su` to a non-root user, make sure `~/.Xauthority` is group readable by this non-root user.

To automate this command sequence, create a file `~/.xsession` from the user's account, containing the following lines:

```
# This makes X work when I su to the root account.
if [ -z "$XAUTHORITY" ]; then
        XAUTHORITY=$HOME/.Xauthority
        export XAUTHORITY
fi
```

```
unset XSTARTUP
# If a particular window/session manager is desired, uncomment
# the following and edit it to fit your needs.
#XSTARTUP=/usr/bin/blackbox
# This starts x-window/session-manager program
if [ -z "$XSTARTUP" ]; then
  if [ -x /usr/bin/x-session-manager ]; then
    XSTARTUP=x-session-manager
  elif [ -x /usr/bin/x-window-manager ]; then
    XSTARTUP=x-window-manager
  elif [ -x /usr/bin/x-terminal-emulator ]; then
    XSTARTUP=x-terminal-emulator
  fi
fi
# execute auto selected X window/session manager
exec $XSTARTUP
```

Then run `su` (not `su -`) in an `xterm` window of the user. Now GUI programs started from this `xterm` can display output on this user's X window while running with root privilege. This trick works as long as the default `/etc/X11/Xsession` is executed. If a user set up his customization using `~/.xinitrc` or `~/.xsession`, the above mentioned environment variable `XAUTHORITY` needs to be set similarly in those scripts.

Alternatively, `sudo` can be used to automate the command sequence:

```
$ sudo xterm
... or
$ sudo -H -s
```

Here `/root/.bashrc` should contain:

```
if [ $SUDO_USER ]; then
    sudo -H -u $SUDO_USER xauth extract - $DISPLAY | xauth merge -
fi
```

This works fine even with the home directory of the user on an NFS mount, because root does not read the `.Xauthority` file.

There are also several specialized packages for this purpose: `kdesu`, `gksu`, `gksudo`, `gnome-sudo`, and `xsu`. Some other methods can be used to achieve similar results: creating a symlink from `/root/.Xauthority` to the user's corresponding one; use of the script sux (http://fgouget.free.fr/sux/sux-readme.shtml); or putting "`xauth merge ~`*`USER_RUNNING_X`*`/.Xauthority`" in the root initialization script.

See more on the debian-devel mailing list (http://lists.debian.org/debian-devel/2002/debian-devel-200207/msg00259.html).

9.4.13 TrueType fonts in X

The standard `xfs` in XFree86-4 works fine with TrueType fonts. You have to install a third-party font server such as `xfs-xtt`, if you are using XFree86-3.

You just need to make sure that whatever applications you want to use the TrueType fonts are linked against libXft or libfreetype (you probably don't even have to worry about this if you're using pre-compiled .debs).

First set up font support infrastructure:

- Install `x-ttcidfont-conf` and `defoma` packages. This automates generation of the `fonts.scale` and `fonts.dir` files.

```
# apt-get install x-ttcidfont-conf
```

- Edit `/etc/X11/XF86Config-4` in the `Section "Files"` as:

```
Section "Files"
    FontPath   "/var/lib/defoma/x-ttcidfont-conf.d/dirs/TrueType"
    FontPath   "/usr/share/fonts/truetype"
    FontPath   "/usr/lib/X11/fonts/CID"
    FontPath   "/usr/lib/X11/fonts/Speedo"
    FontPath   "/usr/lib/X11/fonts/misc"
    FontPath   "/usr/lib/X11/fonts/cyrillic"
    FontPath   "/usr/lib/X11/fonts/100dpi:unscaled"
    FontPath   "/usr/lib/X11/fonts/75dpi:unscaled"
    FontPath   "/usr/lib/X11/fonts/Type1"
EndSection
```

  The first line will setup XFree86 to use any TrueType fonts you install from Debian packages. Type1 font entry is moved down since XFree86 does a rather poor job of rendering Type1 fonts. The `:unscaled` trick for bitmap fonts should not be needed for new XF4 anymore but I included it here just be sure. In order to preserve manual changes of `/etc/X11/XF86Config-4` follow instructions in 'Configuring the X server manually' on page 146.

Then install DFSG font packages:

- Western TrueType fonts:
  - `ttf-bitstream-vera`: A set of high-quality TrueType fonts created by Bitstream, Inc. [2]
  - `ttf-freefont`: A set of free high-quality TrueType fonts covering the UCS character set.
  - `ttf-thryomanes`: A TrueType Unicode font covering Latin, Greek, Cyrillic, and IPA.
- Asian fonts:
  - `tfm-arphic-bsmi00lp`: Chinese Arphic "AR PL Mingti2L Big5" TrueType font TeX font metric data
  - `tfm-arphic-bkai00mp`: Chinese Arphic "AR PL KaitiM Big5" TrueType font TeX font metric data

[2] Though this is not available in Woody, you can install this from Sarge.

- `tfm-arphic-gbsn00lp`: Chinese Arphic "AR PL SungtiL GB" TrueType font TeX font metric data
- `tfm-arphic-gkai00mp`: Chinese Arphic "AR PL KaitiM GB" TrueType font TeX font metric data
- `ttf-baekmuk`: Korean Baekmuk series TrueType fonts
- `hbf-jfs56`: Chinese Jianti Fangsong 56x56 bitmap font (GB2312) for CJK
- `hbf-cns40-b5`: Chinese Fanti Song 40x40 bitmap font (Big5) for CJK
- `hbf-kanji48`: Japanese Kanji 48x48 bitmap font (JIS X-0208) for CJK

Since **Free** fonts are sometimes limited, installing or sharing some commercial TrueType fonts is an option for a Debian users. In order to make this process easy for the user, some convenience packages have been created:

- `ttf-commercial`
- `msttcorefonts (>1.1.0)` [3]

You'll have a really good selection of TrueType fonts at the expense of contaminating your **Free** system with non-Free fonts.

All these font packages in Debian should work without any efforts and appear available to all X programs that use the regular "core" font system. This includes things like Xterm, Emacs, and most other non-KDE and non-GNOME applications.

Now, run `xfontsel` and select any TrueType fonts in the fndry menu, you should be able to see many ungrayed out entries in the "fmly" menu.

For KDE2.2 and GNOME1.4 (with libgdkxft0, which is a hack to get GTK 1.2 to do anti-aliased font rendering), you need to setup Xft1, as well. Xft1 is highly deprecated, and is basically only used by GNOME1.4 and KDE2.2. Edit `/etc/X11/XftConfig` and add a line like

```
dir "/var/lib/defoma/x-ttcidfont-conf.d/dirs/TrueType"
```

before the other dir lines. [4]

For GNOME2 and KDE3 (post Sarge release), you need to setup `fontconfig` which Xft2 uses to find fonts. [5] You shouldn't need to install anything extra for this because every package using `fontconfig` Depends on it (indirectly) already.

First, look in `/etc/fonts/fonts.conf`. There should be a line like the one below. If not, open up `/etc/fonts/local.conf` and add this

```
<dir>/var/lib/defoma/x-ttcidfont-conf.d/dirs/TrueType</dir>
```

just after the <fontconfig> line.

[3] The package in Woody does not work as of 8/2002 due to a change in Microsoft's website. Use Sarge version even in Woody instead.

[4] I don't have any xft1 stuff on my machine anymore, so I'm not sure if you need to restart X or not before this change will take effect. I seem to remember that "xftcache" would update the Xft1 cache, but it'd be good if someone could confirm that for me.

[5] `Fontconfig` does not exist in Woody.

`Fontconfig` should pick these up immediately, and "fc-list" should list your new fonts. Another neat feature of `fontconfig` is that you can just drop fonts in `~/.fonts/` and all your fontconfigified programs will have access to them immediately.

If you manually install a new set of TrueType fonts while in X without using Debian package, run

```
# xset fp rehash
```

to get XFree86 to look at the contents of that directory again and to pickup new ones.

9.4.14 Web browsers in X

There are a few web browser packages with graphical display capabilities as of the Woody release:

- `mozilla` The Mozilla browser (new)
- `galeon` Mozilla-based browser with a Gnome UI (new)
- `konqueror` KDE browser
- `dillo` GTK browser
- `amaya-gtk` W3C reference browser
- `amaya-lesstif` W3C reference browser
- `netscape-...` (many, old)
- `communicator-...` (many, old)
- ...

The version of `mozilla` must match the version that `galeon` requires. Although they differ in UI, these two programs share the Gecko HTML rendering engine.

Plug-ins for browsers such as `mozilla` and `galeon` can be enabled by installing "`*.so`" manually in the plug-in directory and restarting the browsers.

Plug-in resources:

- Java plug-in: install binary "J2SE" from `http://java.sun.com`.
- Flash plug-in: install binary "Macromedia Flash Player 5" from `http://www.macromedia.com/software/flashplayer/`.
- `freewrl`: VRML browser and Netscape plug-in
- ...

9.5 SSH

SSH (Secure SHell) is the secure way to connect over the Internet. A free version of SSH called OpenSSH is available as the `ssh` package in Debian.

9.5.1 Basics of SSH

First install the OpenSSH server and client.

```
# apt-get update && apt-get install ssh
```

The non-US entry in the `/etc/apt/source.list` is required. `/etc/ssh/sshd_not_to_be_run` must not be present if one wishes to run the OpenSSH server.

SSH has two authentication protocols:

- SSH protocol version 1:
  - Potato version only supports this protocol.
  - available authentication methods:
    - RSAAuthentication: RSA identity key based user authentication
    - RhostsAuthentication: .rhosts based host authentication (insecure, disabled)
    - RhostsRSAAuthentication: .rhosts authentication combined with RSA host key (disabled)
    - ChallengeResponseAuthentication: RSA challenge-response authentication
    - PasswordAuthentication: password based authentication
- SSH protocol version 2:
  - post-Woody versions use this as the primary protocol.
  - available authentication methods:
    - PubkeyAuthentication: public key based user authentication
    - HostbasedAuthentication: `.rhosts` or `/etc/hosts.equiv` authentication combined with public key client host authentication (disabled)
    - ChallengeResponseAuthentication: challenge-response authentication
    - PasswordAuthentication: password based authentication

Be careful about these differences if you are migrating to Woody or using a non-Debian system.

See `/usr/share/doc/ssh/README.Debian.gz`, `ssh(1)`, `sshd(8)`, `ssh-agent(1)`, and `ssh-keygen(1)` for details.

Following are the key configuration files:

- `/etc/ssh/ssh_config`: SSH client defaults. See `ssh(1)`. Notable entries are:
  - `Host`: Restricts the following declarations (up to the next Host keyword) to be only for those hosts that match one of the patterns given after the keyword.
  - `Protocol`: Specifies the SSH protocol versions. The default is "2,1".
  - `PreferredAuthentications`: Specifies the SSH2 client authentication method. The default is "hostbased,publickey,keyboard-interactive,password".
  - `PasswordAuthentication`: If you want to log in with a password, you have to make sure this is not set `no`.
  - `ForwardX11`: The default is disabled. This can be overridden by the command-line option "`-X`".
- `/etc/ssh/sshd_config`: SSH server defaults. See `sshd(8)`. Notable entries are:
  - `ListenAddress`: Specifies the local addresses `sshd` should listen on. Multiple options are permitted.

  - `AllowTcpForwarding`: The default is disabled.
  - `X11Forwarding`: The default is disabled.

- `$HOME/.ssh/authorized_keys`: the lists of the default public keys that clients use to connect to this account on this host. See `ssh-keygen(1)`.

- `$HOME/.ssh/identity`: See `ssh-add(1)` and `ssh-agent(1)`.

The following will start an `ssh` connection from a client.

```
$ ssh username@hostname.domain.ext
$ ssh -1 username@hostname.domain.ext # Force SSH version 1
$ ssh -1 -o RSAAuthentication=no -l username foo.host
    # force password on SSH1
$ ssh -o PreferredAuthentications=password -l username foo.host
    # force password on SSH2
```

For the user, `ssh` functions as a smarter and more secure `telnet` (will not bomb with ^]).

9.5.2 Port forwarding for SMTP/POP3 tunneling

To establish a pipe to connect to port 25 of *remote-server* from port 4025 of localhost, and to port 110 of *remote-server* from port 4110 of localhost through `ssh`, execute on the local machine:

```
# ssh -q -L 4025:remote-server:25 4110:remote-server:110 \
          username@remote-server
```

This is a secure way to make connections to SMTP/POP3 servers over the Internet. Set the `AllowTcpForwarding` entry to `yes` in `/etc/ssh/sshd_config` of the remote host.

9.5.3 Connecting with fewer passwords – RSA

One can avoid having to remember a password for each remote system by using RSAAuthentication (SSH1 protocol) or PubkeyAuthentication (SSH2 protocol).

On the remote system, set the respective entries, "RSAAuthentication yes" or "PubkeyAuthentication yes", in `/etc/ssh/sshd_config`.

Then generate authentication keys locally and install the public key on the remote system:

```
$ ssh-keygen          # RSAAuthentication: RSA1 key for SSH1
$ cat .ssh/identity.pub | ssh user1@remote \
       "cat - >>.ssh/authorized_keys"
...
```

```
$ ssh-keygen -t rsa   # PubkeyAuthentication: RSA key for SSH2
$ cat .ssh/id_rsa.pub | ssh user1@remote \
        "cat - >>.ssh/authorized_keys"
...
$ ssh-keygen -t dsa   # PubkeyAuthentication: DSA key for SSH2
$ cat .ssh/id_dsa.pub | ssh user1@remote \
        "cat - >>.ssh/authorized_keys"
```

One can change the passphrase later with "`ssh-keygen -p`". Make sure to verify settings by testing the connection. In case of any problem, use "`ssh -v`".

You can add options to the entries in `authorized_keys` to limit hosts and to run specific commands. See `sshd(8)` for details.

Note that SSH2 has `HostbasedAuthentication`. For this to work, you must adjust the settings of `HostbasedAuthentication` to `yes` in both `/etc/ssh/sshd_config` on the server machine and `/etc/ssh/ssh_config` or `$HOME/.ssh/config` on the client machine.

9.5.4 Dealing with alien SSH clients

There are a few free SSH clients available for non-Unix-like platforms.

Windows puTTY (http://www.chiark.greenend.org.uk/~sgtatham/putty/) (GPL)

Windows (cygwin) SSH in cygwin (http://www.cygwin.com/) (GPL)

Macintosh Classic macSSH (http://www.macssh.com/) (GPL) [Note that Mac OS X includes OpenSSH; use `ssh` in the Terminal application]

See also SourceForge.net, site documentation (http://www.sourceforge.net/docman/?group_id=1), "6. CVS Instructions".

9.5.5 Setting up `ssh-agent`

It is safer to protect your SSH authentication key with a passphrase. If it was not set, use `ssh-keygen -p` to set it.

Place your public key (e.g. `~/.ssh/id_rsa.pub`) into `~/.ssh/authorized_keys` on a remote host using a password-based connection to the remote host as described in 'Connecting with fewer passwords – RSA' on the preceding page.

```
$ ssh-agent bash # or run zsh/tcsh/pdksh program instead.
$ ssh-add ~/.ssh/id_rsa
Enter passphrase for /home/osamu/.ssh/id_rsa:
```

```
Identity added: /home/osamu/.ssh/id_rsa (/home/osamu/.ssh/id_rsa)
$ scp foo user@remote.host:foo
 ... no passphrase needed from here on :-)
$^D
 ... terminating ssh-agent session
```

For the X server, normal Debian startup scripts execute `ssh-agent` as parent process. So you only need to execute `ssh-add` once.

For more, read `ssh-agent(1)` and `ssh-add(1)`.

9.5.6 Troubleshooting SSH

If you have problems, check the permissions of configuration files and run `ssh` with the "`-v`" option.

Use the "`-P`" option if you are root and have trouble with a firewall; this avoids the use of server ports 1–1023.

If `ssh` connections to a remote site suddenly stop working, it may be the result of tinkering by the sysadmin, most likely a change in `host_key` during system maintenance. After making sure this is the case and nobody is trying to fake the remote host by some clever hack, one can regain a connection by removing the `host_key` entry from `$HOME/.ssh/known_hosts` on the local machine.

9.6 Mail

Mail configuration divides into three categories:

- mail transfer agent (MTA): `exim4`, `exim`, `postfix`, `sendmail`, `qmail`, `ssmtp`, `nullmailer`,...
- mail utilities: `procmail`, `fetchmail`, `mailx`, `crm114`,...
- mail user agent (MUA): `mutt`, `emacs+gnus`,...

9.6.1 Mail transport agents (MTAs)

For a full-featured MTA, use `exim` in Woody and use `exim4` in Sarge. [6] References:

- `exim-doc` and `exim-doc-html` packages for `exim`
- `exim4-doc-info` and `exim4-doc-html` packages for `exim4`
- http://www.exim.org/

[6] Following sections use `exim` in examples. For Sarge replace this with `exim4` as needed.

The only reasonable alternative MTA is `postfix` if you care about security. `sendmail` and `qmail` are available as Debian packages but are not recommended.

If you do not need the relay capability of an MTA as in the case of a satellite system such as a laptop PC, you may consider using one of these lightweight packages:

- `ssmtp`: needs an SMTP connection and is alias-capable, or
- `nullmailer`: can spool but is not alias-capable.

At this moment, I find `exim` to be more suitable even for my personal workstation machine, which is a laptop PC.

You may need to remove `exim` for the installation of these conflicting packages:

```
# dpkg -P --force-depends exim
# apt-get install nullmailer          # or ssmtp
```

Smarthost

If you are running `exim4` or `exim` on a host which is connected through the consumer grade services, please make sure to send outgoing mail through a smarthost offered by your ISP or some others. [7] There are few good reasons:

- to ensure SMTP retries since your ISP's smarthost usually have more reliably connection.
- to avoid sending mail directly from a **dynamic IP address** which will likely be blocked by dial-up spam lists.
- to save your local bandwidth to send mails with multiple recipients.

The only conceivable exceptions are:

- the emergency cure for your ISP's SMTP service trouble.
- an experiment for the educational purpose.
- your host being a professionally hosted server.

Basic configuration of Exim

In order to use `exim4` or `exim` as your MTA, configure the following:

```
/etc/exim/exim.conf     "eximconfig" to create and edit (exim)
/etc/exim4/*            "dpkg-reconfigure exim4" to create and edit (exim4)
/etc/inetd.conf         comment out smtp to run exim as daemon
/etc/email-addresses    Add spoofed source address lists
```

check filters using `exim4` or `exim` with `-brw, -bf, -bF, -bV, ...` etc.

[7] You must follow this rule for any hosts on dial-up, DSL, cable services or LAN through some broadband router. Even if your home host has a fixed IP from your ISP, it is still a good idea to follow this rule. Most workstations and home servers fall into this category.

Setting up a catchall for nonexistent email addresses under Exim

In `/etc/exim/exim.conf` (Woody or later), in the DIRECTORS part, at the end (after the localuser: director) add a catch-all director that matches all addresses that the previous directors couldn't resolve (per Miquel van Smoorenburg):

```
catchall:
  driver = smartuser
    new_address = webmaster@mydomain.com
```

If one wants to have more a detailed recipe for each virtual domain, etc., add the following at the end of `/etc/exim/exim.conf` (per me, not well tested):

```
*@yourdomain.com ${lookup{$1}lsearch*{/etc/email-addresses} \
        {$value}fail} T
```

Then have an "*" entry in `/etc/email-addresses`.

Configuring selective address rewriting for outgoing mail under Exim

Selective address rewrite for outgoing mail to produce proper "From:" headers can be done using `exim` by configuring near the end of `/etc/exim/exim.conf`:

```
*@host1.something.dyndns.org \
  "${if eq {${lookup{$1}lsearch{/etc/passwd}{1}{0}}} {1}  \
   {$0}{$1@something.dyndns.org}}"  frFs
```

This rewrites all addresses matching `*@host1.something.dyndns.org`.

1 It searches through `/etc/password` to see if the local part ($1) is a local user or not.

2 If it is a local user, it rewrites the address to the same thing it was in the first place ($0).

3 If it is not a local user, it rewrites the domain part.

Configuring SMTP authentication under Exim

Some SMTP services such as yahoo.com require SMTP auth. Configure `/etc/exim/exim.conf` as follows:

```
remote_smtp:
  driver = smtp
  authenticate_hosts = smtp.mail.yahoo.com
...

smarthost:
  driver = domainlist
  transport = remote_smtp
  route_list = "* smtp.mail.yahoo.com bydns_a"
...

plain:
  driver = plaintext
  public_name = PLAIN
  client_send = "^cmatheson3^this_is_my_password"
```

Do not forget double quotes in the last line.

9.6.2 Fetching mail – Fetchmail

`fetchmail` is run in daemon mode to fetch mail from a POP3 account with an ISP into the local mail system. Configure:

```
/etc/init.d/fetchmail
/etc/rc?.d/???fetchmail run update-rc.d fetchmail default priority 30
/etc/fetchmailrc        configuration file (chown 600, owned by fetchmail)
```

Information on how to start `fetchmail` as a daemon from the `init.d` script for Potato is confusing (Woody fixed this). See the sample `/etc/init.d/fetchmail` and `/etc/fetchmailrc` files in the example scripts (http://www.debian.org/doc/manuals/debian-reference/examples/).

If your email headers are contaminated by ^M due to your ISP's mailer, add "stripcr" to your options in `$HOME/.fetchmailrc`:

```
options fetchall no keep stripcr
```

9.6.3 Processing mail – Procmail

`procmail` is a local mail delivery and filter program. One needs to create `$HOME/.procmailrc` for each account that uses it. Example: _procmailrc (http://www.debian.org/doc/manuals/debian-reference/examples/)

9.6.4 Processing spam with `crm114`

`crm114` package provides `/usr/share/crm114/mailfilter.crm` script which is written in CRM114. This script provides a very effective spam filter which can be trained by feeding the spam and the ham.

CRM114 is a small language designed to write filters in; consider it to be a version of grep with super powers. See `crm(1)`.

9.6.5 Reading mail – Mutt

Use `mutt` as the mail user agent (MUA) in combination with `vim`. Customize with `~/.muttrc`; for example:

```
# use visual mode and "gq" to reformat quotes
set editor="vim -c 'set tw=72 et ft=mail'"
#
# header weeding taken from the manual (Sven's Draconian header weeding)
#
ignore *
unignore from: date subject to cc
unignore user-agent x-mailer
hdr_order from subject to cc date user-agent x-mailer
auto_view application/msword
....
```

Add the following to `/etc/mailcap` or `$HOME/.mailcap` to display HTML mail and MS Word attachments inline:

```
text/html; lynx -force_html %s; needsterminal;
application/msword; /usr/bin/antiword '%s'; copiousoutput;
description="Microsoft Word Text"; nametemplate=%s.doc
```

9.7 Localization (l10n)

Debian is internationalized, offering support for a growing number of languages and local usage conventions. The next subsection lists some of the forms of diversity that Debian currently supports, and the following subsections discuss **localization**, the process of customizing your working environment to allow current input and output of your chosen language(s) and conventions for dates, numeric and monetary formats, and other aspects of a system that differ according to your region.

9.7.1 Basics of localization

There are several aspects to customizing for localization and national language support.

Localizing the keyboard

Debian is distributed with keymaps for nearly two dozen keyboards. In Woody, reconfigure the keyboard by:

- `dpkg-reconfigure --priority=low console-data # console`
- `dpkg-reconfigure --priority=low xserver-xfree86 # XF4`
- `dpkg-reconfigure --priority=low xserver-common-v3 # XF3`

Localizing data files

The vast majority of Debian software packages support data handling of non-US-ASCII characters through the LC_CTYPE environment variable offered by the **locale** technology in glibc.

- 8-bit clean: practically all programs
- other Latin character sets (e.g. ISO-8859-1 or ISO-8859-2): the majority of programs
- multibyte languages such as Chinese, Japanese, or Korean: many new applications

Localizing the display

X can display any coding, including UTF-8, and supports all fonts. The list includes not only all the 8-bit fonts but also 16-bit fonts such as Chinese, Japanese, or Korean. Multibyte character input method is supported by the 'Alternative X input methods' on page 174 mechanism. See 'Example for a multilingual X window system' on page 171 and 'UTF-8 support for the X terminal emulator' on page 175.

Japanese EUC code display is also available in a (S)VGA graphics console through the `kon2` package. There is an alternative new Japanese display, `jfbterm`, which uses a frame-buffer console, too. In these console environments, the Japanese input method must be supplied by the application. Use `egg` package for Emacs and use japanized `jvim` package for a Vim environment.

Installation of non Unicode fonts to X will help in displaying documents with any encoding in X. So do not worry too much about encoding of fonts.

Localizing messages and documentation

Translations exist for many of the text messages and documents that are displayed in the Debian system, such as error messages, standard program output, menus, and manual pages. Currently, support for manual pages in German, Spanish, Finnish, French, Hungarian, Italian, Japanese, Korean, Polish, Portuguese, Chinese, and Russian is provided through the

`manpages-`*`LANG`* packages (where *LANG* is a comma-separated list of two-letter ISO country codes. Use `apt-cache search manpages-|less` to get a list of available Unix manual pages.)

To access an NLS manual page, the user must set the environment variable LC_MESSAGES to the appropriate string. For example, in the case of the Italian-language manual pages, LC_MESSAGES needs to be set to `it`. The `man` program will then search for Italian manual pages under `/usr/share/man/it/`.

9.7.2 Locales

Debian supports **locale** technology. Locale is a mechanism that allows programs to provide suitable output and functionality according to local conventions such as character set, format for date and time, currency symbol, and so on. It uses environment variables to determine the appropriate behavior. For example, assuming you have both the American English and German locales installed on your system, the error messages of many programs can be multilingual:

```
$ LANG="en_US" cat foo
cat: foo: No such file or directory
$ LANG="de_DE" cat foo
cat: foo: Datei oder Verzeichnis nicht gefunden
```

Glibc offers support for this functionality to programs as a library. See `locale(7)`.

9.7.3 Introduction to locales

Full locale description consists of 3 parts: `xx_YY.ZZZZ`.

- **`xx`**: ISO 639 language codes (lower case)
- **`YY`**: ISO 3166 country codes (upper case)
- **`ZZZZ`**: codeset, i.e., character set or encoding identifier.

For language codes and country codes, see pertinent description in the `info gettext`.

Please note this codeset part may be normalized internally to achieve cross platform compatibility by removing all – and by converting all characters into lower case. Typical codesets are:

- **UTF-8**: Unicode for all regions, mostly in 1-3 Octets (new de facto standard)
- **ISO-8859-1**: western Europe (de facto old standard)
- **ISO-8859-2**: eastern Europe (Bosnian, Croatian, Czech, Hungarian, Polish, Romanian, Serbian, Slovak, Slovenian)
- **ISO-8859-3**: Maltese
- **ISO-8859-5**: Macedonian, Serbian
- **ISO-8859-6**: Arabic
- **ISO-8859-7**: Greek

- **ISO-8859-8**: Hebrew
- **ISO-8859-9**: Turkish
- **ISO-8859-11**: Thai (=TIS-620)
- **ISO-8859-13**: Latvian, Lithuanian, Maori
- **ISO-8859-14**: Welsh
- **ISO-8859-15**: western Europe with euro
- **KOI8-R**: Russian
- **KOI8-U**: Ukrainian
- **CP1250**: Czech, Hungarian, Polish (MS Windows origin)
- **CP1251**: Bulgarian, Byelorussian (MS Windows origin)
- **eucJP**: Unix style Japanese (=ujis)
- **eucKR**: Unix style Korean
- **GB2312**: Unix style Simplified Chinese (=GB, =eucCN) for zh_CN
- **Big5**: Traditional Chinese for zh_TW
- **sjis**: Microsoft style Japanese (Shift-JIS)

As for the meaning of basic encoding system jargons:

- **ASCII**: 7 bits (0-0x7f)
- **ISO-8859-?**: 8 bits (0-0xff)
- **ISO-10646-1**: Universal Character Set (UCS) (31 bits, 0-0x7fffffff)
- **UCS-2**: First 16 bit of UCS as straight 2 Octets (Unicode: 0-0xffff)
- **UCS-4**: UCS as straight 4 Octets (UCS: 0-0x7fffffff)
- **UTF-8**: UCS encoded in 1-6 Octets (mostly in 3 Octets)
- **ISO-2022**: 7 bits (0-0xff) with the escape sequence. ISO-2022-JP is the most popular encoding for the Japanese e-mail.
- **EUC**: 8 bits + 16 bits combination (0-0xff), Unix style
- **Shift-JIS**: 8 bits + 16 bits combination (0-0xff), Microsoft style.

ISO-8859-?, EUC, ISO-10646-1, UCS-2, UCS-4, and UTF-8 share the same code with ASCII for the 7 bit characters. EUC or Shift-JIS uses high-bit characters (0x80-0xff) to indicate that part of encoding is 16 bit. UTF-8 also uses high-bit characters (0x80-0xff) to indicate non 7 bit character sequence bytes and this is the most sane encoding system to handle non-ASCII characters.

Please note the byte order difference of Unicode implementation:

- **Standard UCS-2, UCS-4**: big endian
- **Microsoft UCS-2, UCS-4**: little endian for ix86 (machine-dependent)

See 'Convert a text file with `recode`' on page 117 for conversion between various character sets. For more see Introduction to i18n (`http://www.debian.org/doc/manuals/intro-i18n/`).

9.7.4 Activating locale support

Debian does **not** come with all available locales pre-compiled. Check `/usr/lib/locale` to see which locales (besides the default "C") are compiled for your system. If the one you need is not present, you have two options:

- Edit `/etc/locale.gen` to add the desired locale, then run `locale-gen` as root to compile it. See `locale-gen(8)` and the manpages listed in its "SEE ALSO" section.

- Run `dpkg-reconfigure locales` to reconfigure the `locales` package. Or if it is not already installed, installing `locales` will invoke the debconf interface to let you choose needed locales and compile the database.

9.7.5 Activating a particular locale

The following environment variables are evaluated in this order to provide particular locale values to programs:

1 LANGUAGE: This environment variable consists of a colon-separated list of locale names in order of priority. Used only if the POSIX locale is set to a value other than "C" [in Woody; the Potato version always has priority over the POSIX locale]. (GNU extension)

2 LC_ALL: If this is non-null, the value is used for all locale categories. (POSIX.1) Usually "" (null).

3 LC_*: If this is non-null, the value is used for the corresponding category (POSIX.1). Usually "C".

   LC_* variables are:
   - LC_CTYPE: Character classification and case conversion.
   - LC_COLLATE: Collation order.
   - LC_TIME: Date and time formats.
   - LC_NUMERIC: Non-monetary numeric formats.
   - LC_MONETARY: Monetary formats.
   - LC_MESSAGES: Formats of informative and diagnostic messages and interactive responses.
   - LC_PAPER: Paper size.
   - LC_NAME: Name formats.
   - LC_ADDRESS: Address formats and location information.
   - LC_TELEPHONE: Telephone number formats.
   - LC_MEASUREMENT: Measurement units (Metric or Other).
   - LC_IDENTIFICATION: Metadata about the locale information.

4 LANG: If this is non-null and LC_ALL is undefined, the value is used for all LC_* locale categories with undefined values. (POSIX.1) Usually "C".

Note that some applications (e.g., Netscape 4) ignore LC_* settings.

The `locale` program can display active locale settings and available locales; see `locale(1)`. (NOTE: `locale -a` lists all the locales that your system knows about; this does *not* mean that all of them are compiled! See 'Activating locale support' on the preceding page.)

9.7.6 ISO 8601 date format locale

The locale support for the international date standard of `yyyy-mm-dd` (ISO 8601 date format) is provided by the locale called `en_DK`, "English in Denmark", which is a bit of joke :-) This seems to work only in a console screen for `ls`.

9.7.7 Example for the US (ISO-8859-1)

Add the following lines to `~/.bash_profile`:

```
LC_CTYPE=en_US.ISO-8859-1
export LC_CTYPE
```

9.7.8 Example for France with Euro sign (ISO-8859-15)

Add the following lines to `~/.bash_profile`:

```
LANG=fr_FR@euro
export LANG
LC_CTYPE=fr_FR@euro
export LC_CTYPE
```

Configure the keyboard for French "AZERTY" as described in 'Localizing the keyboard' on page 167; add French manual pages by installing `manpages-fr`. The Right-Alt key in the US is called Alt-Gr in Europe. Pressing this together with other keys creates numerous accented and special characters. For example, Alt-Gr+E creates a Euro sign.

Most western European languages can be configured similarly.

See Debian Euro HOWTO (`http://www.debian.org/doc/manuals/debian-euro-support/`) for adding support for the new Euro currency and Utiliser et configurer Debian pour le français (`http://www.debian.org/doc/manuals/fr/debian-fr-howto/`) for more details in French.

9.7.9 Example for a multilingual X window system

Let us set up a multilingual X window system which simultaneously supports Japanese, English, German, and French with EUC, UTF-8, and ISO-8859-1 encodings in different consoles.

I will show you a customization using the Debian menu system. See the details of Debian menu system in `/usr/share/doc/menu/html/index.html`. I also create a shortcut to the `mozilla` web browser in this example. [8]

[8] In this example, 2 bug workarounds are deployed for the version of `blackbox` in 2003. I use `sh -c` in command. Also `~/.menu/*` entry is not used but root requiring `/etc/menu/*` was used instead.

- add locale support for the Japanese ja_JP.eucJP locale and other required locales using the method described at 'Localization (l10n)' on page 166. (for all)
- install Kana-to-Kanji conversion system and dictionary (for Japanese):
  - `canna` – Local server ("free-beer" license), or
  - `freewnn-jserver` – Network-extensible server (Public Domain)
- install Japanese input method system (for Japanese):
  - `kinput2-canna` – for X, or
  - `kinput2-canna-wnn` – for X, and
  - `egg` – directly works with Emacsen even in console (optional)
- Install compatible terminals (for all):
  - `xterm` – X (for ISO-8859-1 and UTF-8),
  - `kterm` – X (for Japanese EUC), and
  - `mlterm` – X (multilingual).
- add all the required font packages. (for all)
- create the `~/.xsession` that sets the user-specific X environment as described in 'Custom X sessions' on page 149 (for all):

```
#!/bin/sh
# This makes X work when I su to root.
if [ -z "$XAUTHORITY" ]; then
        XAUTHORITY=$HOME/.Xauthority
        export XAUTHORITY
fi

# Set specific environment through debian menu system.
# Reset locale
unset LC_CTYPE LC_NUMERIC LC_TIME LC_COLLATE LC_MONETARY LC_MESSAGES
unset LC_PAPER LC_NAME LC_ADDRESS LC_TELEPHONE LC_MEASUREMENT
unset LC_IDENTIFICATION LC_ALL LANG LANGUAGE PAGER
# set locale default in X
LANG=C
# export locale
export LC_CTYPE LC_NUMERIC LC_TIME LC_COLLATE LC_MONETARY LC_MESSAGES
export LC_PAPER LC_NAME LC_ADDRESS LC_TELEPHONE LC_MEASUREMENT
export LC_IDENTIFICATION LC_ALL LANG LANGUAGE PAGER
###
# activate input method for Japanese with kinput2
kinput2 &
XMODIFIERS="@im=kinput2"
export XMODIFIERS
# How about blackbox window manager (lightweight)
exec blackbox
```

```
#exec xfwm
#exec wmaker
```

- set locale in `~/.bash_profile` for Linux consoles (for all).
- remove locale settings from `~/.bashrc`, if existed (for all).
- create few files in `/etc/menu/` (for all).
  - `/etc/menu/xterm-local`: (add new entries to menu) [9]

```
?package(xterm):\
 needs=x11\
 section=XShells\
 longtitle="XTerm: terminal emulator (en_US.ISO-8859-1)"\
 title="XTerm (en_US.ISO-8859-1)"\
 command="sh -c 'LC_ALL=en_US.ISO-8859-1 xterm'"
?package(xterm):\
 needs=x11\
 section=XShells\
 longtitle="XTerm: terminal emulator (de_DE.ISO-8859-1)"\
 title="XTerm (de_DE.ISO-8859-1)"\
 command="sh -c 'LC_ALL=de_DE.ISO-8859-1 xterm -T xterm-de'"
?package(xterm):\
 needs=x11\
 section=XShells\
 longtitle="XTerm: terminal emulator for X with Unicode support (Jap
 title="UXTerm (ja_JP.UTF-8)"\
 command="sh -c 'LC_ALL=ja_JP.UTF-8 uxterm'"
```

  - `/etc/menu/kterm`: (override the system default) [10]

```
?package(kterm):\
 needs="x11"\
 section="XShells"\
 command="sh -c 'LC_ALL=ja_JP.eucJP PAGER=w3m /usr/X11R6/bin/kterm -
 title="Kanji Terminal"
?package(kterm):\
 needs="x11"\
 section="XShells"\
 command="sh -c 'LANG=ja_JP.eucJP \
          LC_MESSAGES=en_US.ISO-8859-1 PAGER=w3m /usr/X11R6/bin/kter
 title="Kanji Terminal (bilingal)"
```

  - `/etc/menu/mozilla-local`: (add a new shortcut) [11]

```
?package(mozilla-browser):needs="x11" section="/" \
        title=" Mozilla Navigator" command="mozilla-1.5" hints="Web
```

[9] Use a file name which does not overwrap with any package names.

[10] Use a file name which overwraps with the package name.

[11] The slash in `section="/"` enables entry to the initial menu, and the leading space in `title=" Mozilla Navigator"` enables entry to the top of the list.

```
                    icon=/usr/share/pixmaps/mozilla.xpm
```

  - run `update-menus` from the root account.

- add the following lines to `~/.muttrc` (for Japanese):

```
# UTF-8 support is not popular in popular Japanese EMACS environment
# 7-bit encoding of iso-2022-jp is easier for everyone.
# default encoding order = us-ascii --> iso-8859-1 --> iso-2022-jp
set send_charset="us-ascii:iso-8859-1:iso-2022-jp"
set allow_8bit=no
```

- activate XIM `kinput2` for X applications (for Japanese):
  - add `*inputMethod: kinput2` and `KTerm*VT100*OpenIm: true` to your X resources file, `~/.Xresources` (it looks like Debian takes care of this automatically somehow).
  - Some applications (such as `mlterm`) also allow you to set up `*inputMethod:` and other information dynamically at runtime (press **Ctrl-MouseButton-3** in `mlterm`).

- start X by typing `startx` or from one of the display managers (`xdm`, `gdm`, `kdm`, `wdm`, ...) (for all).

- start a Japanese-compatible application such as Vim 6, (x)emacs21, mc-4.5, mutt-1.4, ... in `kterm` (for Japanese). (Emacs seems to be the most popular platform, though I do not use it.)

- press **Shift+Space** to toggle Japanese character input mode on and off (for Japanese).

- read the localized manual page by starting command in localized console (for all).

For other CJK language supports, see the following sections and SuSE pages for CJK (http://www.suse.de/~mfabian/suse-cjk/suse-cjk.html).

9.7.10 Alternative X input methods

There are many alternative X input methods support packages available:

```
Language   LC_CTYPE     XIM server XMODIFIERS              Start key
Japanese   ja_JP*       kinput2    "@im=kinput2"           Shift-Space
Korean     ko_KR*       ami        "@im=Ami"               Shift-Space
Chinese(T) zh_TW.Big5   xcin       "@im=xcin-zh_TW.big5"   Ctrl-Space
Chinese(S) zh_CN.GB2312 xcin       "@im=xcin-zh_CN.GB2312" Ctrl-Space
```

Japanese input method `kinput2` is offered by the packages such as `kinput2-canna-wnn`, `kinput2-canna`, and `kinput2-wnn`. Japanese needs dictionary server such as `canna` and `freewnn-jserver` to be practical.

9.7.11 X terminal emulators

There are many X consoles which support simple 8 bit encodings when pertinent font packages are installed:

- `xterm` – The X terminal emulator
- `gnome-terminal` – `xterm` for Gnome
- `konsole` – `xterm` for KDE
- `rxvt` – VT102 terminal (lighter)
- `aterm` – VT102 for Afterstep WM
- `eterm` – VT102 for Enlightment WM
- `wterm` – VT102 for WindowMaker WM

Multi-byte encoding supports of X console are provided by `xterm` through UTF-8 encoding ('UTF-8 support for the X terminal emulator' on this page). Other traditional encoding supports are in progress (as of 2003). Following packages offer traditional encoding supports:

- `aterm-ml` – Multi-lingual
- `kterm` – Multi-lingual (Japanese, . . .)
- `rxvt-ml` – Multi-lingual
- `wterm-ml` – Multi-lingual
- `cxterm-big5` – Chinese (Trad., Big5)
- `cxterm-gb` – Chinese (Simp., GB)
- `cxterm-ks` – Chinese (KS)
- `cxterm-jis` – Japanese
- `hanterm-classic` – Korean (Hangul)
- `hanterm-xf` – Korean (Hangul)
- `hztty` – Chinese (GB, Big5, zW/HZ)

For `kterm` (and possibly others), you may want to activate XIM through menu after Ctrl-middle-click mouse action.

9.7.12 UTF-8 support for the X terminal emulator

UTF-8 support for X terminal emulator is provided by the `uxterm` program in the `xterm` package for XFree86 4.x. It enables support for all languages. It is a wrapper around the `xterm(1)` program that invokes the latter program with the "UXTerm" X resource class set.

For example, to enable nice large display of English, Russian, Japanese, Chinese, and Korean characters, add following to your `~/.Xresources` after installing all the pertinent fonts:

```
! set large font
UXTerm*font: -misc-fixed-medium-r-normal-*-18-120-100-100-c-90-iso10646-1
! Use XIM for Japanese
*inputMethod: kinput2
```

Then run `xrdb -merge ~/.Xresources` to update X resources as described in 'X resources' on page 153.

Although most of the popular console program packages such as `vim`, `mutt`, and `emacs` have been made compatible with UTF-8 recently (Woody-Sarge). Program such as `mc` still is not UTF-8 compatible but simply 8-bit clean. If you are editing 7 bit ASCII part of unknown or mixed encoding file, it is safer to use the locale unaware 8-bit clean editor.

See The Unicode HOWTO (`http://www.tldp.org/HOWTO/Unicode-HOWTO.html`).

9.7.13 Example for UTF-8 in a framebuffer console

UTF-8 support on a FB console is provided by `bterm` used in the `debian-installer`.

9.7.14 Beyond locales

When you are first setting the system up for a **national language environment**, please consider using `tasksel` or `aptitude` to find out what packages are selected by choosing the corresponding language environment task. The package choice made is useful even for a multilingual setup. If you encounter any package dependency conflicts during the install to your carefully configured system, avoid installing any software that conflicts with the existing system. You may have to use `update-alternative` to regain the original state for some commands since a newly installed one may have higher priority than existing ones.

Newer major programs are using glibc 2.2 and are mostly internationalized. So a specially localized version such as `jvim` for Vim may not be needed as its functionality is offered by `vim` version 6.0 in X. In reality, it is still somewhat rough-edged. Since `jvim` has a version compiled with direct Japanese input method (`canna`) support even in the console and addresses many other Japanese-specific issues maturely, you may still want it :-)

Programs may need to be configured beyond `locale` configuration to enable a comfortable working environment. The `language-env` package and its command `set-language-env` greatly eases this process.

Also see the internationalization document, Introduction to i18n (`http://www.debian.org/doc/manuals/intro-i18n/`). It is aimed at developers but is also useful for system administrators.

9.8 Multilingualization (m17n)

'Localization (l10n)' on page 166 enabled by `language-env` package and alike are aimed to achieve monolingual localization. These packages also use traditional encodings as the choice for the text encoding. You cannot mix French and Japanese text in such environment since they use incompatible ISO-8859-1 and EUC-JP encodings respectively.

You can obtain multilingualized UTF-8 Desktop using Gnome and KDE programs started under one of the available UTF-8 locales. (Sarge) In such environment, you can mix English, Chinese, Russian, and Japanese characters under UTF-8 compliant softwares.

`m17n-env` is a helper script to set up such environment. The multilingualized UTF-8 environment is configured by running `set-m17n-env` command from the root and the user account. [12]

Under such environment, new multilingualized input method (IM) using `scim` is preferred. IM offered by the `scim` is turned on and off by typing Ctrl-Space together. The input conversion engine can be switched by clicking small SCIM panel.

You can still have easy access to the traditional encoding environment through the custom locale consoles created by `m17n-env`. This comes handy when you need to edit old EUC-JP or ISO-8859-1 encoded files.

[12] `language-env` package is not much useful under the multilingualized environment.

Chapter 10

Network configuration

This chapter focuses on network administration in Debian. For a general introduction to GNU/Linux networking read the Net-HOWTO (http://www.tldp.org/HOWTO/Net-HOWTO/index.html).

In order for a Debian host to be able to access the Internet its network interfaces need to be supported by the kernel and properly configured.

The first requirement is kernel support for network interface devices such as Ethernet cards, Wi-Fi cards, and modems. To obtain this support you may need to recompile the kernel or add modules to it as described in 'The Linux kernel under Debian' on page 97.

Configuration of network devices is explained below. The information in this chapter has been updated for Sarge. Much of it does not apply to earlier releases.

10.1 Basics of IP networking

A Debian host may have several interfaces each with a different Internet Protocol (IP) address. Interfaces may be of several different types, including:

- Loopback: `lo`
- Ethernet: `eth0`, `eth1`, ...
- Wi-Fi: `wlan0`, `wlan1`, ... [1]
- Token Ring: `tr0`, `tr1`, ...
- PPP: `ppp0`, `ppp1`, ...

There is a wide range of other network devices available, including SLIP, PLIP (serial and parallel line IP), "shaper" devices for controlling the traffic on certain interfaces, frame relay, AX.25, X.25, ARCnet, and LocalTalk.

Every network interface connected directly to the Internet (or to any IP-based network) is identified by a unique 32 bit IP address. [2] The IP address can be divided into the part that addresses

[1] Note that a Wi-Fi interface is really an alias for an Ethernet interface that gives access to the configuration parameters peculiar to Wi-Fi. These parameters are controlled using the `iwconfig` program.

[2] This is true if IP version 4 is being used. In IPv6 addresses are 128 bits. See http://www.ipv6.org/.

the network and the part that addresses the host. If you take an IP address, set to 1 the bits that are part of the network address and set to 0 the bits that are part of the host address then you get the net mask of the network.

Traditionally, IP networks were grouped into classes whose net address parts were 8, 16 or 24 bits in length. [3]

```
          IP addresses                    net mask      length
Class A   1.0.0.0     - 126.255.255.255   255.0.0.0     =  /8
Class B   128.0.0.0   - 191.255.255.255   255.255.0.0   = /16
Class C   192.0.0.0   - 223.255.255.255   255.255.255.0 = /24
```

IP addresses not in these ranges are used for special purposes.

There are address ranges in each class reserved for use on local area networks (LANs). These addresses are guaranteed not to conflict with any addresses on the Internet proper. (By the same token, if one of these addresses is assigned to a host then that host must not access the Internet directly but must access it through a gateway that acts as a proxy for individual services or else does Network Address Translation.) These address ranges are given in the following table along with the number of ranges in each class.

```
          network addresses            length  how many
Class A   10.x.x.x                     /8      1
Class B   172.16.x.x -  172.31.x.x     /16     16
Class C   192.168.0.x - 192.168.255.x  /24     256
```

The first address in an IP network is the address of the network itself. The last address is the broadcast address for the network. [4] All other addresses may be allocated to hosts on the network. Of these, the first or the last address is usually allocated to the Internet gateway for the network.

The routing table contains the kernel's information on how to send IP packets to their destinations. Here is a sample routing table printout for a Debian host on a local area network (LAN) with IP address 192.168.50.x/24. Host 192.168.50.1 (also on the LAN) is a router for the corporate network 172.20.x.x/16 and host 192.168.50.254 (also on the LAN) is a router for the Internet at large.

```
# route
Kernel IP routing table
Destination   Gateway         Genmask       Flags Metric Ref Use Iface
127.0.0.0     *               255.0.0.0     U     0      0     2 lo
```

[3] This system was inflexible and wasted many IP addresses, so today IPv4 networks are allocated with network address parts of varying length.

[4] The address of the network can be obtained by bitwise ANDing an address on the network with the net mask. The broadcast address can be obtained by bitwise ORing the network address with the 1's complement of the net mask.

```
192.168.50.0   *               255.255.255.0 U     0      0   137 eth0
172.20.0.0     192.168.50.1    255.255.0.0   UG    1      0     7 eth0
default        192.168.50.254 0.0.0.0       UG    1      0    36 eth0
```

- The first line after the heading says that traffic destined for network `127.x.x.x` will be routed through `lo`, the loopback interface.
- The second line says that traffic destined for hosts on the LAN will be routed through `eth0`.
- The third line says that traffic destined for the corporate network will be routed toward gateway `192.168.50.1` also through `eth0`.
- The fourth line says that traffic destined for the Internet at large will be routed toward gateway `192.168.50.254` also through `eth0`.

IP addresses in the table may also appear as names that are obtained by looking up addresses in `/etc/networks` or by using the C Library resolver.

In addition to routing, the kernel can perform network address translation, traffic shaping and filtering.

See the Net-HOWTO (http://www.tldp.org/HOWTO/Net-HOWTO/index.html) and other networking HOWTOs (http://www.tldp.org/HOWTO/Networking-Overview-HOWTO.html) for more background information.

10.2 Low level network configuration

The traditional low level network configuration tools on GNU/Linux systems are the `ifconfig` and `route` programs which come in the `net-tools` package. These tools have officially been superseded by `ip` which comes in the `iproute` package. The `ip` program works with Linux 2.2 and higher and is more capable than the old tools. However, the old tools still work and are more familiar to many users.

10.2.1 Low level network configuration – `ifconfig` and `route`

Here is an illustration of how to change the IP address of interface `eth0` from `192.168.0.3` to `192.168.0.111` and to make `eth0` the route to network `10.0.0.0` via `192.168.0.1`. We begin by running `ifconfig` and `route` without interface arguments in order to display the current status of all network interfaces and routing.

```
# ifconfig
eth0 Link encap:Ethernet  HWaddr 08:00:46:7A:02:B0
     inet addr:192.168.0.3  Bcast:192.168.255.255  Mask:255.255.0.0
     UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
     RX packets:23363 errors:0 dropped:0 overruns:0 frame:0
     TX packets:21798 errors:0 dropped:0 overruns:0 carrier:0
     collisions:0 txqueuelen:100
```

```
      RX bytes:13479541 (12.8 MiB)  TX bytes:20262643 (19.3 MiB)
      Interrupt:9

lo    Link encap:Local Loopback
      inet addr:127.0.0.1  Mask:255.0.0.0
      UP LOOPBACK RUNNING  MTU:16436  Metric:1
      RX packets:230172 errors:0 dropped:0 overruns:0 frame:0
      TX packets:230172 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:0
      RX bytes:22685256 (21.6 MiB)  TX bytes:22685256 (21.6 MiB)
# route
Kernel IP routing table
Destination  Gateway      Genmask          Flags Metric Ref Use Iface
192.168.0.0  *            255.255.0.0      U     0      0     0 eth0
default      192.168.0.1  255.255.255.255  UG    0      0     0 eth0
```

First we bring down the interface.

```
# ifconfig eth0 inet down
# ifconfig
lo    Link encap:Local Loopback
  ... (no more eth0 entry)
# route
  ... (no more routing table entries)
```

Then we bring it up with the new IP address and new routing.

```
# ifconfig eth0 inet up 192.168.0.111 \
           netmask 255.255.255.0 broadcast 192.168.0.255
# route add -net 10.0.0.0 netmask 255.0.0.0 gw 192.168.0.1 dev eth0
```

The result:

```
# ifconfig
eth0 Link encap:Ethernet  HWaddr 08:00:46:7A:02:B0
      inet addr:192.168.0.111  Bcast:192.168.0.255  Mask:255.255.255.0
      UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
      ...

lo    Link encap:Local Loopback
      inet addr:127.0.0.1  Mask:255.0.0.0
      ...
# route
Kernel IP routing table
```

```
Destination  Gateway      Genmask         Flags Metric Ref Use Iface
192.168.0.0  *            255.255.255.0   U     0      0     0 eth0
10.0.0.0     192.168.0.1  255.0.0.0       UG    0      0     0 eth0
```

For more information see `ifconfig(8)` and `route(8)`.

10.2.2 Low level network configuration – `ip`

The `ip` equivalents of the preceding `ifconfig` and `route` commands are:

- `ip link show`
- `ip route list`
- `ip link set eth0 down`
- `ip addr del dev eth0 local 192.168.0.3`
- `ip addr add dev eth0 local 192.168.0.111/24 broadcast 192.168.0.255`
- `ip link set eth0 up`
- `ip route add dev eth0 to 10.0.0.0/8 src 192.168.0.111 via 192.168.0.1`

The `ip` program prints its command syntax when run with the argument `help`. For example, `ip link help` prints:

```
Usage: ip link set DEVICE { up | down | arp { on | off } |
                      dynamic { on | off } |
                      multicast { on | off } | txqueuelen PACKETS |
                      name NEWNAME |
                      address LLADDR | broadcast LLADDR |
                      mtu MTU }
       ip link show [ DEVICE ]
```

See also `ip(8)`.

10.2.3 Configuring a Wi-Fi interface

For Wi-Fi interfaces the `iwconfig` program which comes in the `wireless-tools` package is used in addition to either `ifconfig` or `ip`.

See `iwconfig(8)`.

10.2.4 Configuring a PPP interface

If you access the Internet through a modem connected to a dial-up telephone line then the connection is negotiated using the Point-to-Point Protocol (PPP). Such connections are accessed as network interface `ppp0`, `ppp1`, and so on.

A PPP interface is managed by the PPP daemon `pppd` which comes in the `ppp` package. Thus, for the user, configuring a PPP interface means configuring `pppd`.

Configuring pppd manually

For a network link to be established, a communication port (usually a serial port) needs to be opened, commands have to be sent to a communication device (usually a modem), a telephone number may have to be dialed, identity has to be authenticated to a foreign PPP daemon, a PPP interface has to be created and then routing tables have to be modified so that traffic can be sent over the link. `pppd` can do all of this and consequently has a very long list of operating options. These options are described in `pppd(8)`.

On a Debian system, global options are set up in `/etc/ppp/options`. User-specific options are set up in `~/.pprc`. Options that must depend on the communication port used are stored in `/etc/ppp/options.`*portname*. For example, suppose you have two modems—a built-in Lucent LT modem accessed through /dev/LT-modem and an external modem accessed through /dev/ttyS0. Create the following two options files.

```
# cat > /etc/ppp/options.LT-modem <<EOF
115200
init "/usr/sbin/chat -f /etc/chatscripts/setup-LT-modem"
EOF
# cat > /etc/ppp/options.ttyS0 <<EOF
115200
init "/usr/sbin/chat -f /etc/chatscripts/setup-ttyS0"
EOF
```

These refer to the following chat scripts. First, `/etc/chatscripts/setup-LT-modem`.

```
ABORT ERROR
'' ATZ
OK 'ATW2X2 S7=70 S11=55'
OK AT
```

Second, `/etc/chatscripts/setup-ttyS0`.

```
ABORT ERROR
'' ATZ
OK 'ATL1M1Q0V1W2X4&C1&D2 S6=4 S7=70 S11=55 S95=63 S109=1 +FCLASS=0'
OK AT
```

The contents of these files must depend on your hardware, of course.

Options can also be given to `pppd` as arguments.

In Debian `pppd` is usually started using the `pon` command. When `pon` is used its first argument names an options file in `/etc/ppp/peers/` which is also read by `pppd`. [5] This is where you set up options that are specific to a particular peer—for example, a particular Internet Service Provider (ISP).

Suppose for example you commute between Amsterdam and Den Haag. In each city you have access to two ISP services—Planet and KPN. First create a basic options file for each ISP.

```
# cat > /etc/ppp/peers/KPN <<EOF
remotename KPN
noauth
user kpn
noipdefault
ipparam KPN
EOF
# cat > /etc/ppp/peers/Planet <<EOF
remotename Planet
auth
user user3579@planet.nl
noipdefault
mru 1000
mtu 1000
ipparam Planet
EOF
```

These files set options that differ between the two ISPs. Options common to both ISPs can be placed in `/etc/ppp/options` or in one of the interface-specific options files as appropriate.

Now create options files for each ISP in each city. In our example the only difference between connecting to an ISP in one location versus connecting in another is the chatscript that is required. (The chatscript is different because the local access telephone number is different.)

```
# cat > /etc/ppp/peers/KPN-Amsterdam <<EOF
connect "/usr/sbin/chat -v -f /etc/chatscripts/KPN-Amsterdam"
file /etc/ppp/peers/KPN
EOF
# cat > /etc/ppp/peers/KPN-DenHaag <<EOF
connect "/usr/sbin/chat -v -f /etc/chatscripts/KPN-DenHaag"
file /etc/ppp/peers/KPN
EOF
# cat > /etc/ppp/peers/Planet-Amsterdam <<EOF
connect "/usr/sbin/chat -v -f /etc/chatscripts/Planet-Amsterdam"
file /etc/ppp/peers/Planet
EOF
```

[5] This options file is included using the `call` option.

```
# cat > /etc/ppp/peers/Planet-DenHaag <<EOF
connect "/usr/sbin/chat -v -f /etc/chatscripts/Planet-DenHaag"
file /etc/ppp/peers/Planet
EOF
```

The `file` directives each include one of the options files shown earlier. The `connect` directive specifies the command that `pppd` uses to make the connection. Normally one uses the `chat` program for this, adapting the chatscript to the ISP. Here are the chatscripts for Den Haag; the chatscripts for Amsterdam might be similar except for the telephone number or they might be different if the ISP offers service through another company there.

```
# cat > /etc/chatscripts/KPN-DenHaag <<EOF
ABORT BUSY
ABORT 'NO CARRIER'
ABORT VOICE
ABORT 'NO DIALTONE'
ABORT 'NO DIAL TONE'
ABORT 'NO ANSWER'
ABORT ERROR
OK-AT-OK ATDT 0676012321
CONNECT \d\c
EOF
# cat > /etc/chatscripts/Planet-DenHaag <<EOF
ABORT BUSY
ABORT 'NO CARRIER'
ABORT VOICE
ABORT 'NO DIALTONE'
ABORT 'NO DIAL TONE'
ABORT 'NO ANSWER'
ABORT ERROR
OK-AT-OK ATDT 0676002505
CONNECT \d\c
EOF
```

To be able to connect to these ISPs you need client names and passwords that `pppd` can supply to the peer on demand. This information is stored either in `/etc/ppp/pap-secrets` (if the PAP protocol is used) or in `/etc/ppp/chap-secrets` (if the CHAP protocol is used). Although CHAP is more secure, PAP is still more widely used. Because these files contain secrets, group and world should not have permission to read or write them. The format of these files is explained in `pppd(8)`. A "secret" (third field) is looked up in the file by finding the client name (first field) and/or the server name (second field). When connecting to an ISP one generally doesn't know the server name, so one supplies a client name instead; this was done on the `user` lines in `peers/KPN` and `peers/Planet` above.

```
# client name       server name  secret
```

```
kpn                 *           kpn
user3579@planet.nl  *           myfavoritepet
```

See `/usr/share/doc/ppp/README.Debian.gz` for more information.

Configuring `pppd` using `pppconfig`

A quick way to configure `pppd` is to use the `pppconfig` program which comes in the package of the same name. `pppconfig` sets up files like those above after asking the user questions through a menu interface.

Configuring a PPP interface using `wvdial`

A different approach to using `pppd` is to run it from `wvdial` which comes in the `wvdial` package. Instead of `pppd` running `chat` to dial in and negotiate the connection, `wvdial` does the dialing and initial negotiating and then starts `pppd` to do the rest. Given only phone number, username, and password `wvdial` succeeds in making the connection in most cases.

10.3 Naming the computer

10.3.1 Hostname

A Debian system sometimes needs to identify itself by name. For this purpose a **hostname** is maintained by the kernel.

The initscript `/etc/init.d/hostname.sh` sets the hostname at boot time (using the `hostname` command) to the name stored in `/etc/hostname`. This file should contain **only** the hostname, not a fully qualified domain name.

To print out the current hostname run `hostname` without an argument.

10.3.2 Mailname

The **mailname** of a host is the name that mail-related programs use to identify the host. The file `/etc/mailname` contains of this name followed by a newline. The mailname is usually one of the host's fully qualified domain names. See `mailname(5)`.

What the recipient of e-mail sees in the `From:` header of mail sent by your Debian host depends on how Mail User Agents (MUA) and Mail Transfer Agents (MTA) are configured. Suppose a local user *`foo`* sends a mail from a host with mailname *`myhost.dom`*. The `From:` header of outgoing e-mail will be:

- "`From:` *`foo@myhost.dom`*" if the MUA has no `From:` header set;
- "`From:` *`bar@myhost.dom`*" if the MUA has "`From:` *`bar`*" set;

- "`From: bar@bogus.dom`" if the MUA has "`From: bar@bogus.dom`" set.

Even when the MUA has a `From:` header set the MTA may add a "`Sender: foo@herman.dom`" header to indicate its true origin.

Of course when any involved MTA performs address rewriting as discussed in 'Setting up a catchall for nonexistent email addresses under Exim' on page 164 and 'Configuring selective address rewriting for outgoing mail under Exim' on page 164, the e-mail address seen by the recipient can be changed to anything.

10.4 Domain Name Service (DNS)

Hosts are referred to by domain name as well as by IP address. DNS is a client-server system in which name resolvers consult nameservers in order to associate domain names with IP addresses and other properties of hosts. The GNU C Library `resolver(3)` can also look up IP addresses in files or consult Network Information Services (NIS).

To see what domain name is associated with the local host, use the `hostname --fqdn` command. This prints out the first fully qualified domain name that the resolver finds for the local hostname. [6]

10.4.1 The resolver

The job of finding out what IP addresses are associated with a particular domain name is the job of a resolver. The most commonly used resolver is the set of functions that go by that name (`resolver(3)`) in the GNU C Library. Another is the FireDNS resolver which comes in the `libfiredns` package.

How the LIBC resolver resolves names is governed by the `hosts` line in the `/etc/nsswitch.conf` configuration file. This line lists the services that should be used to resolve a name: e.g., `dns`, `files`, `nis`, `nisplus`. [7] See `nsswitch.conf(5)`. Insofar as the `files` service is used, the behavior of the resolver is also governed by the `/etc/hosts` configuration file. See `hosts(5)`.

All of the above files are static and can be edited with your favorite editor.

Insofar as the `dns` service is used, the behavior of the resolver is also governed by the `/etc/resolv.conf` configuration file. See `resolv.conf(5)`. One of the important functions of `resolv.conf` is to list the IP addresses of nameservers that will be contacted to resolve the name. This list often has to depend upon the network environment and the network environment may change from time to time while your computer is running. Programs such as

[6] Technically, it is the FQDN returned by `gethostbyname(2)` for the hostname returned by `gethostname(2)`.

[7] How the resolver resolves names is also alleged to be governed by the `/etc/host.conf` configuration file. The `order` line in this file lists the methods that should be used to resolve a name: e.g., `bind`, `hosts`, `nis`. See `host.conf(5)`. I believe that this line has been superseded by the `hosts` line in `nsswitch.conf` but I am not sure.

pppd and dhclient are able to manipulate resolv.conf to add and remove lines, but these features do not always work properly and they conflict with one another. The resolvconf package solves the problem better by providing a standard framework for updating this file. See 'Managing nameserver information – resolvconf' on this page.

10.4.2 Managing nameserver information – resolvconf

The resolvconf package provides a framework for dynamic management of information about available nameservers. It solves the long standing problem of how to maintain dynamic lists of nameservers for the resolver and DNS caches to use. Resolvconf sets itself up as the intermediary between programs that control network interfaces and supply nameserver information, and applications that need nameserver information.

resolvconf is designed to work without any manual configuration needing to be done. However, the package is quite new and may require some manual intervention to get it to work properly. This is certainly true if you have ever customized packages so that they update /etc/resolv.conf: you will need to disable your customizations. See /usr/share/doc/resolvconf/README.gz for details.

10.4.3 Caching looked-up names – nscd, dnsmasq, pdnsd, bind9

If your nameserver is slow to respond then you may want to use nscd to cache the results of things that are looked up using the libc6 resolver.

If you want to cache results for other hosts on your local network then you may want to run a caching forwarding nameserver such as dnsmasq or pdnsd.

If you wish you can also use bind9's named as a caching forwarding nameserver. It is a heavy program, though, so unless you need its advanced features you are better off with one of the packages mentioned earlier.

All of these packages work well with resolvconf.

10.4.4 Providing Domain Name Service – bind

If you need to provide authoritative name service for a domain then you need a fully fledged nameserver such as named which comes in the bind9 package.

If you install bind9 you should also install dnsutils. You may also want to install these utility packages: bind9-host; dns-browse; dnscvsutil; nslint. You may also want to install this documentation package: bind9-doc. You may also want to install these development packages: libbind-dev; libnet-dns-perl. If you configure interfaces using DHCP then you may find this package useful: dhcp-dns.

Install bind9 or dpkg-reconfigure it to do the basic set-up. Configuration consists of editing named.conf. In Debian this file is found in /etc/bind/ and is used mainly to define

the basic DNS zones; it includes two other files: named.conf.local, used for defining local zones, and named.conf.options, used for setting options. (The latter is processed by resolvconf to produce /var/run/bind/named.options which is the same as the original except that the forwarders specification is a list of the currently available non-local nameservers. To make use of this, change the include line in named.conf so that it includes /var/run/bind/named.options. See 'Managing nameserver information – resolvconf' on the page before.)

Database files named in named.conf* without a full pathname will be stored in /var/cache/bind/. This is the right place to store files generated by named: for example, database files for zones for which the daemon is secondary. Static database files in /etc/bind/ are and must be referred to in named.conf by their full path names. See /usr/share/doc/bind9/README.Debian.gz for details.

10.5 Configuring network interfaces using DHCP

Low-level configuration of network interfaces can be automated by means of the Dynamic Host Configuration Protocol (DHCP). Your firewall or router box or your broadband ISP may furnish IP addresses and other parameters this way.

To make this work you must install one of the following packages:

- dhcp3-client (version 3, Internet Software Consortium)
- dhcpcd (Yoichi Hariguchi and Sergei Viznyuk)
- pump (Red Hat)

pump is simple and widely used. dhcp3-client is complex but more configurable. [8]

10.6 High level network configuration in Debian

In order to make network configuration easier Debian provides a standard high level network configuration tool consisting of the ifup and ifdown programs and the /etc/network/interfaces file. [9] If you choose to use ifupdown to do your network configuration then normally you should **not** use low-level commands too. [10] The ifupdown program was written with the intent that it alone be used to configure and deconfigure network interfaces.

To update interface configuration do this:

[8] As of April 2004 there is also a dhcp-client package available. This contains version 2 of the ISC DHCP Client. This has been superseded by version 3 which is currently packaged as dhcp3-client. The maintainers plan to rename dhcp3-client to dhcp-client after the release of Sarge. Make sure you do not have the experimental versions of dhcp-client installed. ifupdown does not work with them.

[9] The /etc/network/interfaces file format for current versions of ifupdown is slightly incompatible with the file format for earlier Potato versions of the package. The ifupdown post-installation script should upgrade the file automatically if necessary. However, it is a good idea to check over the converted file.

[10] This means also that you should not use other high level configuration tools such as whereami that call low level configuration tools.

```
# ifdown eth0
# editor /etc/network/interfaces  # tweak as you wish
# ifup eth0
```

For more information see `interfaces(5)`, `/usr/share/doc/ifupdown/examples/network-interfaces.gz`, and `ifup(8)`.

10.6.1 Configuring an interface with a static IP address

Suppose you want to configure an Ethernet interface such that it has a fixed IP address of `192.168.0.111`. This address begins with `192.168.0` so it must be on a LAN. Suppose further that `192.168.0.1` is the address of the LAN's gateway to the Internet. Edit `/etc/network/interfaces` so that it includes a stanza like this:

```
iface eth0 inet static
        address 192.168.0.111
        netmask 255.255.255.0
        gateway 192.168.0.1
```

You can configure other aspects of the interface or perform other actions after the interface is brought up or before it is brought down by specifying appropriate commands on "up" and "down" lines.

```
iface eth0 inet static
        address 192.168.0.111
        netmask 255.255.255.0
        gateway 192.168.0.1
        up route add -net 10.0.0.0 netmask 255.0.0.0 gw 192.168.0.2 dev $IFACE
        down route del -net 10.0.0.0 netmask 255.0.0.0 gw 192.168.0.2 dev $IFACE
        up echo Interface $IFACE going up | /usr/bin/logger -t ifup
        down echo Interface $IFACE Going down | /usr/bin/logger -t ifdown
```

Alternatively, commands can be inserted into scripts in the `/etc/network/if-up.d` and `/etc/network/if-down.d` directories. Such scripts can also implement extended options. See `interfaces(5)` for details. For example, the `resolvconf` package includes scripts that allow you to add options specifying DNS information to be included in `/etc/resolv.conf` while the interface is up:

```
iface eth0 inet static
        address 192.168.0.111
        netmask 255.255.255.0
        gateway 192.168.0.1
        dns-search somedomain.org
        dns-nameservers 195.238.2.21 195.238.2.22
```

The argument `somedomain.org` of the `dns-search` option corresponds to the argument of a `search` option in `resolv.conf(5)`. The arguments `195.238.2.21` and `195.238.2.22` of the `dns-nameservers` option correspond to the arguments of `nameserver` options. Other recognized options are `dns-domain` and `dns-sortlist`. See 'Managing nameserver information – `resolvconf`' on page 189.

10.6.2 Configuring an interface using DHCP

To configure an interface using DHCP edit `/etc/network/interfaces` so that it includes a stanza like this:

```
iface eth0 inet dhcp
```

In order for this to work you must have installed one of the DHCP clients mentioned in 'Configuring network interfaces using DHCP' on page 190.

10.6.3 Configuring a Wi-Fi interface

The `wireless-tools` package includes a hook script `/etc/network/if-pre-up.d/wireless-tools` which makes it possible to configure Wi-Fi (802.11a/b/g) hardware before the interface is brought up. Configuration is done using the `iwconfig` program; see `iwconfig(8)`. For each possible command parameter of `iwconfig` you can include an option in `/etc/network/interfaces` named like that parameter with a "wireless-" prefix. For example, to set the ESSID of `eth0` to `myessid` and the encryption key to `123456789e` prior to bringing `eth0` up using DHCP, edit `/etc/network/interfaces` so that it includes a stanza like this:

```
iface eth0 inet dhcp
        wireless-essid myessid
        wireless-key 123456789e
```

Note that you should not use this method of setting the ESSID and key if you are running `waproamd` for this interface. By the time `ifup` is run `waproamd` has already set the ESSID and key. See 'Triggering network configuration – `waproamd`' on page 200.

10.6.4 Configuring a PPP interface

The `ifup` and `ifdown` programs use `pon` and `poff` to add and remove PPP interfaces so first read 'Configuring a PPP interface' on page 183.

Suppose you have set up PPP to work with peer `myisp`. Edit `/etc/network/interfaces` so that it includes a stanza like this:

```
iface ppp0 inet ppp
        provider myisp
```

With this stanza in place, `ifup ppp0` does

```
pon myisp
```

Unfortunately it is currently not possible to provide additional `pppd` options in a `ppp` stanza in `/etc/network/interfaces`. [11]

It is currently not possible to use `ifupdown` to perform auxiliary configuration of PPP interfaces. Because `pon` exits before `pppd` has finished making the connection, `ifup` runs `up` scripts before the PPP interface is ready for use. Until this bug [12] is fixed it remains necessary to do auxiliary configuration in `/etc/ppp/ip-up` or `/etc/ppp/ip-up.d/`.

10.6.5 Configuring a PPPoE interface

Many broadband Internet Service Providers (ISPs) use PPP to negotiate connections even though customer machines are connected to them through Ethernet and/or ATM networks. This is accomplished by means of PPP over Ethernet (PPPoE) which is a technique for the encapsulation of PPP streams inside of Ethernet frames. Suppose your ISP is called *`myisp`*. First configure PPP and PPPoE for peer *`myisp`*. The easiest way to do this is to install the `pppoeconf` package and to run `pppoeconf` from the console. Then edit `/etc/network/interfaces` so that it includes a stanza like this:

```
iface eth0 inet ppp
        provider myisp
```

There are sometimes Maximum Transmit Unit (MTU) issues with PPPoE over Digital Subscriber Line (DSL). See DSL-HOWTO (`http://www.tldp.org/HOWTO/DSL-HOWTO/`) for details.

Note that if your broadband modem contains a router then the modem/router handles the PPPoE connection itself and appears on the LAN side as a simple Ethernet gateway to the Internet.

10.6.6 Configuring multiple Ethernet interfaces for a gateway

Suppose `eth0` is connected to the Internet with a DHCP-configured IP address and `eth1` is connected to the LAN with static IP address `192.168.1.1`. Edit `/etc/network/interfaces` so that it includes stanzas like these:

[11] See bug #196877 (`http://bugs.debian.org/196877`).
[12] See bug #127786 (`http://bugs.debian.org/127786`).

```
iface eth0 inet dhcp

iface eth1 inet static
        address 192.168.1.1
        netmask 255.255.255.0
```

If you activate NAT on this host as described in 'Building a gateway router' on page 204 then you can share the Internet connection with all the hosts on the LAN.

10.6.7 Configuring virtual interfaces

Using virtual interfaces you can configure a single Ethernet card to be an interface to several IP subnetworks. For example, suppose your host is on LAN network 192.168.0.x/24. You want to connect the host to the Internet using a public IP address provided via DHCP using your existing Ethernet card. Edit `/etc/network/interfaces` so that it includes stanzas like these:

```
iface eth0 inet static
        address 192.168.0.1
        netmask 255.255.255.0
        network 192.168.0.0
        broadcast 192.168.0.255

iface eth0:0 inet dhcp
```

The interface `eth0:0` is a virtual interface. When it is brought up, so will its parent `eth0`.

10.7 Network configuration using logical interface definitions

In the following it will be important for the reader to understand the difference between a **physical interface** and a **logical interface**. [13] A **physical** interface is what we have been calling "the interface", the thing that the kernel names `eth0`, `eth1`, `ppp0`, or what have you. A **logical** interface is a set of values that can be assigned to the variable parameters of a physical interface. If you find that confusing, replace the expression "configured as logical interface *X*" with the expression "configured with interface profile *X*" as you read.

The `iface` definitions in `/etc/network/interfaces` are actually definitions of logical interfaces, not of physical interfaces. [14] If you never want to reconfigure your interfaces then you can ignore this fact since the physical interface *foo* will by default be configured as logical interface *foo*.

[13] This terminology is used in the `ifupdown` documentation.

[14] Note that the interfaces named on `auto` lines must be physical interfaces, not logical interfaces.

However, suppose your computer is a laptop that you transport between home and work. When you connect the computer to the corporate network or to your home LAN you need to configure `eth0` accordingly.

First define two logical interfaces `home` and `work` (instead of `eth0` as we did earlier) which describe how the interface should be configured for the home network and the work network, respectively.

```
iface home inet static
        address 192.168.0.123
        netmask 255.255.255.0
        gateway 192.168.0.1

iface work inet static
        address 81.201.3.123
        netmask 255.255.0.0
        gateway 81.201.1.1
```

Then physical interface `eth0` can be brought up for the home network with the appropriate configuration by specifying it on the command line:

```
# ifup eth0=home
```

To reconfigure `eth0` for the work network issue the commands:

```
# ifdown eth0
# ifup eth0=work
```

Note that with the `interfaces` file written as above it will no longer be possible to bring up `eth0` by doing `ifup eth0` alone. The reason is that `ifup` uses the physical interface name as the default logical interface name and now in our example no `eth0` logical interface is defined.

10.8 Magic network configuration

Interface names can be "mapped" to other names when `ifup` runs. How names are mapped can be made to depend on circumstances. Thus `ifup` can be so configured that it brings up a given physical interface as the appropriate logical interface among a set of predefined alternatives.

Logical interface name mapping occurs as follows:

- If no logical interface name is given on the `ifup` command line then the physical interface name is used as the initial logical interface name.

- If the logical interface name matches the glob-pattern of a `mapping` stanza then that mapping is applied to generate a new logical interface name. This is done for each mapping stanza in turn.
- If the final logical interface name is the label of a logical interface definition in `/etc/network/interfaces` then the physical interface is brought up as that logical interface. Otherwise `ifup` prints a message that it is "Ignoring unknown interface" and exits.

The syntax of a `mapping` stanza is:

```
mapping glob-pattern
        script script-name
        [map script input]
```

The script named in the `mapping` stanza is always run with the **physical** interface name as its argument and with the contents of all following "map" lines in the stanza (without the word "map" itself) provided to it on its standard input. The script prints the result of the mapping on its standard output before exiting.

For example, the following `mapping` stanza will cause `ifup` to bring up interface `eth0` as the `home` logical interface.

```
mapping eth0
        script /usr/local/sbin/echo-home
```

where `/usr/local/sbin/echo-home` is:

```
#!/bin/sh
echo home
```

Because mapping is done with a script it is possible to select the logical interface automatically — based on some sort of test. See 'Logical interface selection using guessnet' on the current page for an example of this.

10.8.1 Logical interface selection using guessnet

Install `guessnet` and then add a stanza like the following to `/etc/network/interfaces`:

```
mapping eth0
        script guessnet-ifupdown
        map home
        map work
```

Now when you `ifup eth0`, `guessnet` will check whether `eth0` can be brought up as `home` or `work`. To do this it uses information stored in the logical interface definitions.

10.8.2 Automatic network configuration using laptop-net

The `laptop-net` package takes a different approach to automagic network reconfiguration. Laptop-net does not make use of `ifupdown`'s logical interfaces but instead has its own system of configuration "schemes" and system "profiles". Laptop-net still uses `ifup` and `ifdown` to configure physical interfaces, though. For more information consult the well written documentation in `laptop-net-doc`.

10.9 Dealing with inconsistent naming of interfaces by the kernel

The names `eth0`, `eth1`, etc. are assigned by the kernel in the order that the kernel creates the interfaces that go by those names. While adapters that are detected at boot time are usually detected in the same order every time, and are therefore assigned the same names every time, the same is not true of adapters that are hot plugged. These can be detected in any order and end up getting assigned different names by the kernel on different occasions.

Because of this fact, on a system into which network adapters are hot plugged it won't always do to define logical interfaces in `/etc/network/interfaces` with names `eth0`, `eth1`, etc., and to rely on the default mapping. Instead you must give distinct names to the logical interfaces and use one of the following two methods to restrict which logical interfaces can be assigned to which adapters.

One method is to use either the `nameif` utility (in the `net-tools` package) or the more flexible `ifrename` utility (in the `ifrename` package) to make the kernel assign names to interfaces according to properties of the underlying adapters. With this naming scheme in effect, the physical interface name can be used to infer which adapter underlies it.

Another method is to use `ifup`'s mapping mechanism in such a way that a logical interface is chosen for a physical interface being brought up according to some property of the adapter that underlies it.

Suppose, for example, you have two different network adapters which you use with networks `net1` and `net2`, respectively. The `/usr/share/doc/ifupdown/examples/` directory contains a mapping script that can be used to select a logical interface based on the Media Access Controller address (MAC address) of the adapter. First install the script to an appropriate directory.

```
# install -m770 /usr/share/doc/ifupdown/examples/match-mac-address.sh \
   /usr/local/sbin/
```

Then add a stanza like the following to `/etc/network/interfaces`:

```
mapping eth0
        script /usr/local/sbin/match-mac-address.sh
        map 02:23:45:3C:45:3C net1
        map 00:A3:03:63:26:93 net2
```

See 'Multi-stage mapping' on page 202 for a more complex example.

In applying either method the property that is most commonly used to identify the adapter is the MAC address.

10.10 Triggering network configuration

We have seen how interfaces can be configured or reconfigured. This needs to be done at appropriate times.

Traditionally the network was configured during the boot sequence via the `/etc/rcS.d/S40networking` initscript and was rarely reconfigured. Services that depended on networking were started later in the boot sequence. On shutdown or reboot the initscripts were run in the opposite order.

Currently, however, there is a trend in GNU and Linux toward supporting hardware and circumstances that change dynamically. First support was added for hot swappable PCMCIA cards; more recently the `hotplug` mechanism has been added so that many more peripherals can be swapped in and out while the computer is running. This includes networking hardware. Note that services that depend on hardware that is hot swapped must only be started after the hardware is inserted and must be stopped when the hardware is removed. This means that such services must be removed from the control of the System V init system and put under the control of `ifupdown` instead.

For example, suppose service `foo` controlled by initscript `/etc/init.d/foo` depends on dynamically reconfigured network interface `eth0`.

- First remove `foo` from the control of the init system. If you are using the `sysv-rc` init system then do the following. [15]

```
# rm /etc/rc[2345].d/S??foo
```

- Then put `foo` under the control of `ifupdown` by adding `up` and `down` options to the `eth0` stanza in `/etc/network/interfaces` which contain calls to the `foo` initscript:

```
iface eth0 inet dhcp
        up /etc/init.d/foo start
        down /etc/init.d/foo stop
```

10.10.1 Triggering network configuration at boot time

On boot the `/etc/rcS.d/S40networking` init script runs the command `ifup -a`. This brings up all physical interfaces listed in `auto` stanzas in `/etc/network/interfaces`.

These days it is often better to handle network configuration using dynamic methods. Once mechanisms for supporting dynamically changing hardware are in place it becomes simplest to treat static hardware as if it were dynamic too. Booting can then be treated as just another hotplug event. (See 'Triggering network configuration – `hotplug`' on the facing page.)

[15] Note that this leaves the "stop" links (`/etc/rc?.d/K??foo`) behind. See 'Runlevels' on page 20 for more information.

However, in almost all cases one wants at least the loopback interface `lo` to be brought up on boot. Therefore, make sure that `/etc/network/interfaces` includes the following stanzas.

```
auto lo

iface lo inet loopback
```

You can list additional physical interface names in `auto` stanzas if you want them to be brought up on boot too. **Never** list PCMCIA interfaces in `auto` stanzas. The PCMCIA `cardmgr` is started later in the boot sequence than when `/etc/rcS.d/S40networking` runs.

10.10.2 Triggering network configuration – `hotplug`

For hot-plug support install the `hotplug` package.

Networking hardware can be hot plugged either at boot time or after a card (e.g., a PCMCIA card) is inserted into the machine or after a utility such as `discover` runs and loads necessary driver modules.

When the kernel detects new hardware it initializes the driver for the hardware and then runs the `hotplug` program to configure it. Later if the hardware is removed then the kernel runs `hotplug` again with different environment variable settings. In Debian, when `hotplug` is called it runs scripts in `/etc/hotplug/` and `/etc/hotplug.d/`. See `hotplug(8)` for details.

Newly inserted network hardware is configured by the script `/etc/hotplug/net.agent`. [16] Suppose your PCMCIA network card has been inserted resulting in interface `eth0` becoming available for use. `/etc/hotplug/net.agent` does the following [17] :

```
ifup eth0=hotplug
```

Unless you have added a logical interface definition or mapping named `hotplug` to `/etc/network/interfaces`, this command will do nothing. To make it so that the command will configure `eth0`, add the following stanza to `/etc/network/interfaces`:

```
mapping hotplug
        script echo
```

[16] It may also be configured by any hook scripts that have been installed in `/etc/hotplug.d/net/`. The `ifplugd` and `waproamd` packages install hook scripts there, for example.

[17] As of version 0.0.20040329-4 or so, `hotplug` can optionally be put into modes wherein it behaves differently from how it is described here as behaving. One such mode is so-called "all" mode wherein `hotplug` brings up all hot plugged interfaces. The other such mode is so-called "auto" mode wherein `hotplug` brings up interfaces only if they are listed on `auto` lines in `/etc/network/interfaces`. In these alternative modes `ifup` is invoked without the `=hotplug` suffix.

As explained in 'Network configuration using logical interface definitions' on page 194 this will map the command shown above so that it is equivalent to the following:

```
ifup eth0=eth0
```

(Do **not** include a mapping stanza like this if you are using `ifplugd` or `waproamd` instances started by `hotplug` to control the interface.)

If you want only `eth0` and no other interfaces to be brought up on hot plug then use `grep` instead of `echo` as follows:

```
mapping hotplug
        script grep
        map eth0
```

See 'Magic network configuration' on page 195 and `/usr/share/doc/hotplug/README.Debian` for more tips.

10.10.3 Triggering network configuration – `ifplugd`

The `ifplugd` daemon brings an interface up or down according to whether or not its underlying hardware is plugged in to a network. The program can detect a live cable connected to an Ethernet interface or an access point associated to a Wi-Fi interface (although `waproamd` is probably what you want to use in the latter case). When `ifplugd` sees that the state of the link has changed it runs a proxy script which by default calls `ifup` or `ifdown`.

10.10.4 Triggering network configuration – `waproamd`

The `waproamd` daemon is just like `ifplugd` except that it is designed to be used with Wi-Fi cards. It actively scans for access points to which the Wi-Fi hardware is able to associate. When association is achieved, `waproamd` runs `ifup`.

If you are using `waproamd` then in general you configure the Wi-Fi card via `waproamd` and not via `wireless-*` options in `/etc/network/interfaces`.

10.10.5 Network configuration and PCMCIA

There are several possible approaches to configuring PCMCIA network interfaces (for 2.4 and 2.6 kernels).

- For 32 bit PCI (CardBus) PCMCIA network cards:
  - `ifupdown` controlled by `hotplug`
    - In Woody and Sarge you must locally enable `hotplug`'s control of `ifupdown` by adding a mapping stanza to `/etc/network/interfaces` as described in 'Triggering network configuration – `hotplug`' on the page before.

- For 16 bit ISA PCMCIA network cards:
  - `ifupdown` controlled by `hotplug` with `pcmcia-cs` confined to loading modules
    - **Recommended**
    - In Woody and Sarge you must locally disable `pcmcia-cs`'s default behavior of controlling `ifupdown` by adding the line `exit 0` to the beginning of `/etc/pcmcia/network`. Also, you must locally enable `hotplug`'s control of `ifupdown` by adding a mapping stanza to `/etc/network/interfaces` as described in 'Triggering network configuration – `hotplug`' on page 199.
  - `ifupdown` controlled by `pcmcia-cs` via the default `/etc/pcmcia/network`
    - **Deprecated** but still the default for Woody and Sarge
  - low level tools controlled by `pcmcia-cs` via special code in `/etc/pcmcia/network`
    - **Deprecated**
    - In Woody and Sarge the special code is enabled by editing `/etc/pcmcia/network.opts`

The recommended approach for 16 bit cards takes advantage of the fact that the Linux 2.4 hotplug subsystem now supports PCMCIA. [18]

PCMCIA network cards are hot pluggable. Accordingly, any services that require networking through a PCMCIA card should be so configured that they get started on card insertion and get stopped on card removal. This is usually accomplished by arranging for the service to start on `ifup` and stop on `ifdown`. Some people, however, choose to confine themselves to cold plugging their PCMCIA network card: they insert the card before booting the system and they start services that require networking through the card in the boot sequence. If you are such a person then in order to ensure that the card is fully configured before the services are started you should do the following:

- Set `CARDMGR_OPTS="-f"` in `/etc/default/pcmcia` in order to force `cardmgr` to run in the foreground.
- Rename `/etc/rc?.d/S20pcmcia` to something like `/etc/rc?.d/S12pcmcia`.

This hack only works for 16 bit PCMCIA cards.

Note that `pcmcia-cs` is still needed if you use 16 bit PCMCIA cards. The `cardmgr` daemon that the package contains is responsible for managing the sockets and loading driver modules. We just don't want it to call network configuration programs via `/etc/pcmcia/network`.

In order for `cardmgr` to work properly you may need to edit `/etc/pcmcia/config.opts` in order to configure resources assigned to 16 bit PCMCIA cards. See 'PCMCIA' on page 99 and the Linux PCMCIA HOWTO (`http://www.tldp.org/HOWTO/PCMCIA-HOWTO.html`) for more information.

[18] In past releases of Debian the standard way to configure PCMCIA network cards was through the `cardmgr` hook scripts `/etc/pcmcia/network` and `/etc/pcmcia/network.opts`. These hook scripts were developed in the era before Linux acquired a more general purpose hot plug capability. Some people still use the Debian Woody scripts in their default state wherein they simply call `ifup` after the interface is added and `ifdown` when the interface is removed. As noted above, it is now recommended to use `hotplug` to do this. Others still use the special system of calling low level network configuration commands that gets activated when certain variables in `/etc/pcmcia/network.opts` are set to "`y`". This system has several problems. It is afflicted by race conditions; it only works for 16 bit PCMCIA cards; it does what is better left to `ifupdown` to do. Consequently it is deprecated.

10.11 Multi-stage mapping

Suppose your network adapters are hotplugged and you enable automatic configuration as described in 'Triggering network configuration – `hotplug`' on page 199. Suppose further that you need to map logical interfaces to "physical" interfaces depending both on the adapter underlying the physical interface (as described in 'Dealing with inconsistent naming of interfaces by the kernel' on page 197) and on the network connected to the interface (as described, for example, in 'Logical interface selection using guessnet' on page 196). You can accomplish this with multi-stage mapping.

The first mapping stage takes the `hotplug` group name and outputs the kernel-assigned interface name if the interface is to be hot plugged. The second mapping stage takes a kernel-assigned interface name and outputs an adapter name. The third mapping stage maps adapter names to logical interface names based on the network environment.

```
# Allow hotplug to bring up interfaces
mapping hotplug
 script echo

# Determine whether interface is wired or Wi-Fi
mapping eth?
        script /usr/local/sbin/match-mac-address.sh
        map 02:23:45:3C:45:3C wired
        map 00:A3:03:63:26:93 wifi

# Detect which wired network is available
mapping wired
        script guessnet-ifupdown
        map work-wired
        map home

# Detect which Wi-Fi network is available
mapping wifi
        script ifscout
        map starbucks
        map work-wireless

iface work-wired inet static
 ...
```

10.12 Network service configuration

Typical network service configuration on the desktop or home server environment involves:

- The Internet *super-server* and TCP/IP daemon wrapper, see 'Restricting access to services' on page 137.

  - `/etc/inetd.conf`
- `ssh`: OpenSSH secure shell, see 'SSH' on page 158.
  - `/etc/ssh/ssh_config`
  - `/etc/ssh/sshd_config`
- `exim`: mail transport agent, see 'Mailname' on page 187 and 'Mail transport agents (MTAs)' on page 162.
  - `/etc/exim/exim.conf`
  - `/etc/mailname`
  - `/etc/aliases`
  - `/etc/email-addresses`
- `fetchmail`: daemon to fetch mail from a POP3 account, see 'Fetching mail – Fetchmail' on page 165.
  - `/etc/fetchmailrc`
- `procmail`: local mail delivery and filter program, see 'Processing mail – Procmail' on page 165.
  - `~/.procmailrc`
- Hostname and DNS (proxy, cache, ...), see 'Hostname' on page 187 and 'Domain Name Service (DNS)' on page 188.
  - `/etc/host.conf`
  - `/etc/hostname`
  - `/etc/hosts`
  - `/etc/hosts.allow`
  - `/etc/hosts.deny`
  - `/etc/resolv.conf`
  - `/etc/bind/named.conf` (edit)
  - `/etc/bind/db.lan` (add for LAN hosts)
  - `/etc/bind/db.`*`192.168.0`* (add for LAN reverse)
- DHCP, see 'Configuring network interfaces using DHCP' on page 190.
  - `/etc/dhcp3/dhclient.conf` (DHCP client side)
  - `/etc/default/dhcp3-server` (DHCP server side)
  - `/etc/dhcp3/dhcpd.conf` (DHCP server side)
- `cvs`: concurrent versions system, see 'Concurrent Versions System (CVS)' on page 215.
  - `/etc/cvs-cron.conf`
  - `/etc/cvs-pserver.conf`
- `nfs-kernel-server`: network file system, see 'NFS configuration' on page 38. (for unix-like systems)
  - `/etc/exports`
- `samba`: network file and printer share for Windows, see 'Samba configuration' on page 38 and 'Samba' on page 130.
  - `/etc/samba/smb.conf`
- Printer daemon system, see 'Printer configuration' on page 39.
  - `/etc/printcap` (for lpr)
- `apache` and `apache2`: web server.
  - `/etc/apache/*`
  - `/etc/apache2/*`
- `squid`: web proxy cache server.

```
- /etc/squid/*
```

10.13 Network troubleshooting

If you encounter problems then check the output of the following as the first reality check:

```
# ifconfig
# cat /proc/pci
# cat /proc/interrupts
# dmesg | more
```

Also see the sections following 'Network testing basics' on page 126.

If you have problems with certain websites, see 'Strange access problems with some websites' on page 42.

10.14 Building a gateway router

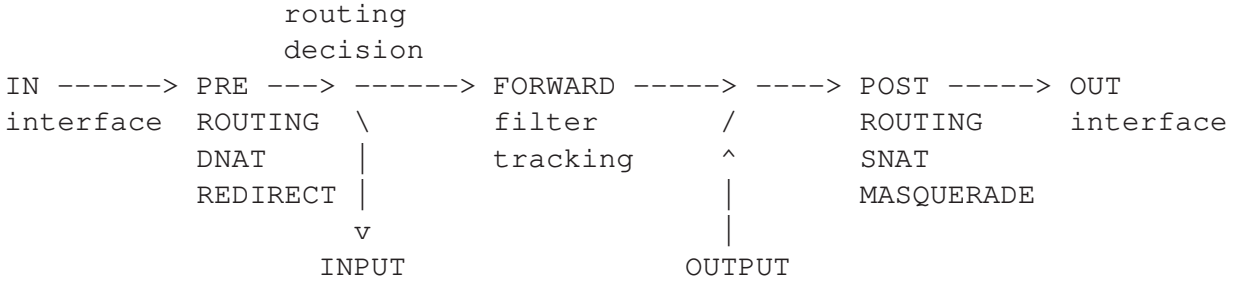
A Debian host can be an all-purpose gateway machine that does Network Address Translation (NAT, also known as masquerading), mail transfer, DHCP, DNS caching, HTTP proxy caching, CVS service, NFS serving, and Samba serving. See 'Hosts and IP to use for LAN' on page 29 for the example of such set up.

10.14.1 Netfilter configuration

The netfilter/iptables project is a firewalling subsystem for Linux 2.4 and after. See Netfilter (http://www.netfilter.org/), where many network configuration issues are explained.

Basics of netfilter

Netfilter process packets use five built-in chains: PREROUTING, INPUT, FORWARD, OUTPUT, and POSTROUTING.



```
| filter              ^ filter,DNAT
v                     |
\--> Local Process --/
     user-space programs
```

Netfilter table

Packets are processed at each built-in chain using the following tables.

- filter (packet filter, default)
  - INPUT (for packets coming into the box itself)
  - FORWARD (for packets being routed through the box)
  - OUTPUT (for locally generated packets).
- nat (network address translation)
  - PREROUTING (for altering packets as soon as they come in)
  - OUTPUT (for altering locally generated packets before routing)
  - POSTROUTING (for altering packets as they are about to go out)
- mangle (network address mangling, good only after 2.4.18)
  - all five built-in chains.

Netfilter target

Firewall rules have several targets:

- four basic targets:
  - ACCEPT means to let the packet through.
  - DROP means to drop the packet.
  - QUEUE means to pass the packet to userspace (if supported by the kernel).
  - RETURN means stop traversing this chain and resume at the next rule in the previous (calling) chain.
- extended targets:
  - LOG turns on kernel logging.
  - REJECT sends back an error packet and drops the packet.
  - SNAT alters the source address of the packet and is used only in the POSTROUTING chain. (nat table only)

    `--to-source ipaddr[-ipaddr][:port-port]`
  - MASQUERADE is the same as SNAT but for dynamically assigned IP (dialup) connections. (nat table only)

    `--to-ports port[-port]`
  - DNAT alters the destination address of the packet and is used in the PREROUTING and OUTPUT chains, and user-defined chains which are only called from those chains. (nat table only)

    `--to-destination ipaddr[-ipaddr][:port-port]`
  - REDIRECT alters the destination IP address to send the packet to the machine itself.

    `--to-ports port[-port]`

Netfilter commands

The basic commands of `iptables` are:

```
iptables -N chain                    # create a chain

iptables -A chain \                  # add rule to chain
         -t table \                  # use table (filter, nat, mangle)
         -p protocol \               # tcp, udp, icmp, or all,
         -s source-address[/mask] \
         --sport port[:port] \       # source port if -p is tcp or udp
         -d destination-address[/mask] \
         --dport port[:port] \       # dest. port if -p is tcp or udp
         -j target \                 # what to do if match
         -i in-interface-name \      # for INPUT,  FORWARD, PREROUTING
         -o out-interface-name       # for FORWARD, OUTPUT, POSTROUTING
```

Network Address Translation

Machines on a LAN can access Internet resources through a gateway that translates IP address on the LAN to IP addresses usable on the Internet.

```
# apt-get install ipmasq
```

Apply example rules to strengthen the `ipmasq` protection. See `/usr/share/doc/ipmasq/examples/stronger/README`. For Debian kernel-image-2.4 under woody, make sure to load the proper modules. Sarge version of ipmasq fixed this issue. See 'Network function' on page 100 for configuration instructions.

For Debian kernel-image-2.2, edit `Z92timeouts.rul` in `/etc/masq/rules` as follows to ensure a longer connection to remote sites (good for large emails, etc.):

```
# tcp, tcp-fin, udp
# 2hr, 10 sec, 160 sec - default
# 1 day, 10 min, 10 min - longer example
$IPCHAINS -M -S 86400 600 600
```

Also, if the network is accessed through a PCMCIA NIC, `ipmasq` needs to be started either from `/etc/pcmcia/network.opts` (read: `/usr/share/doc/ipmasq/ipmasq.txt.gz`) or from `/etc/network/interfaces` (read: 'Network configuration and PCMCIA' on page 200 and 'Triggering network configuration' on page 198).

Redirect SMTP connection (2.4)

Suppose you have a notebook PC which is configured to use other LAN environments and you want to use your mail user agent on the notebook PC without reconfiguring it.

Adding the following rules through the `iptables` command to the gateway machine will redirect the SMTP connection to the gateway machine.

```
# iptables -t nat -A PREROUTING -s 192.168.1.0/24 -j REDIRECT \
           -p tcp --dport smtp --to-port 25 # smtp=25, INPUT is open
```

For a more thorough redirect rule set consider installing the `ipmasq` package and adding `M30redirect.def` (http://www.debian.org/doc/manuals/debian-reference/examples/) to the `/etc/ipmasq/rules/` directory.

10.14.2 Manage multiple net connections

[FIXME] Policy routing (by Phil Brutsche <pbrutsch@tux.creighton.edu>): See the iproute manual (http://lartc.org/) for details. Traffic control (tc) may also be interesting.

Environment:

```
eth0: 192.168.1.2/24; gateway 192.168.1.1
eth1: 10.0.0.2/24; gateway 10.0.0.1
No masquerading on this machine.
```

Special magic:

1. ip rule add from 192.168.1.2 lookup 1
2. ip rule add from 10.0.0.2 lookup 2
3. ip route add to default via 10.0.0.1 metric 0
4. ip route add to default via 192.168.1.1 metric 1
5. ip route add table 1 to 192.168.1.0/24 via eth0
6. ip route add table 1 to 10.0.0.2/24 via eth1
7. ip route add table 1 to default via 192.168.1.1
8. ip route add table 2 to 192.168.1.0/24 via eth0
9. ip route add table 2 to 10.0.0.2/24 via eth1
10. ip route add table 2 to default via 10.0.0.2

[FIXME] I've never done this. How to set up dialup as backup to a fast connection with autodial features? Please send me a patch here :)

Chapter 11

Editors

11.1 Popular editors

Linux offers many alternatives for console text editors. Among them:

- `vim`: Powerful and light BSD-heritage editor. VI iMproved.
- `emacs`: Ultimate and heavy GNU-heritage editor. RMS (Richard M. Stallman) original.
- `xemacs`: Emacs: The Next Generation, originally from Lucid.
- `mcedit`: Newbie GNU editor. Identical to `mc` internal editor. See 'Editor in MC' on page 50.
- `ae`: Default small editor (Potato). Avoid this.
- `nano`: Default small GNU editor (Woody). Emulates `pico`.
- `joe`: For WordStar or TurboPascal old-timers.
- `jed`: Fast, full-featured menu-driven editor with Emacs key bindings.
- `jove`: Very small editor with Emacs key bindings.
- `nvi`: New vi. Bug-for-bug compatible with the original vi.

Use `update-alternatives --config editor` to change the default editor. Also, many programs use environment variables `EDITOR` or `VISUAL` to decide which editor to use. See 'Editor in MC' on page 50.

Also a few X-based text editors are noteworthy:

- `gvim`: Vim with GUI (`vim` and `vim-gtk` package)
- `emacs`: The One True Emacs (auto-detect X).
- `xemacs`: Next generation Emacs (auto-detect X).

These xclient commands take standard options such as `-fn a24`, which makes life easy for older folks like me :) See 'X clients' on page 147.

11.2 Rescue editors

There are a few editors which reside in `/bin/`. One of these should be installed to ease editing files when `/usr/` is not accessible.

- `elvis-tiny`: Minimum vi editor (`vi` to start)
- `nano-tiny`: Minimum non-vi editor (`nano-tiny` to start)
- `nano`: Minimum non-vi editor (`nano` to start) (Sarge)
- `ed`: Minimum editor (always there but tough to use)

11.3 Emacs and Vim

11.3.1 Vim hints

Read the "VIM - main help file" document by pressing <F1> while running the program.

```
<F1>           Help
<esc>          Back to normal mode
V              Visual mode
i              Insert mode
:              Command-line commands
:set tw=72     Set text width to 72
<F11>          Insert (paste) mode
:r! date -R    Insert RFC-822 date
qa             Record keystrokes into register a
q              Stop keystroke recording
@a             Execute keystrokes from register a
:edit foo.txt  Edit another file by loading foo.txt
:wnext         Write current file and edit next file
```

`q` and `@` can be used for simple macro recording and playback. For instance, to create a macro that inserts HTML italics tags around the word at the cursor, you could enter `qii<i>^[ea</i>^[q` (where `^[` is the ESC key). Then typing `@i` at the start of a word would add the tags and .

See also 'Using GnuPG with Vim' on page 245.

11.3.2 Emacs hints

```
<F1>               Help
<F10>              Menu
C-u M-! date -R    Insert RFC-822 date
```

11.3.3 Starting the editor

```
start editor:                    emacs filename  vim filename
start in vi compatible:                          vim -C
start in vi non-compatible:                      vim -N
start with compile default:      emacs -q        vim -N -u NONE
```

11.3.4 Editor command summary (Emacs, Vim)

exit:	C-x C-c	:qa /:wq /:xa /:q!
Get back/command mode:	C-g	<esc>
Backward(left):	C-b	h
Forward(right):	C-f	l
Next(down):	C-n	j
Previous(up):	C-p	k
stArt of line(^):	C-a	0
End of line($):	C-e	$
mUltiple commands:	C-u nnn cmd	nnn cmd
Multiple commands:	M-digitkey cmd	
save File:	C-x C-s	:w file
beginning of buffer:	M-<	1G
end of buffer:	M->	G
scroll forward 1 screen:	C-v	^F
scroll forward 1/2 screen:		^D
scroll forward 1 line:		^E
scroll backward 1 screen:	M-v	^B
scroll backward 1/2 screen:		^U
scroll backward 1 line:		^Y
scroll the other window:	M-C-v	
delete under cursor:	C-d	x
delete from cursor to eol:	C-k	D
iSearch forward:	C-s	
isearch Reverse:	C-r	
Search forward:	C-s enter	/
search Reverse:	C-r enter	?
isearch regexp:	M-C-s	
isearch backward regexp:	M-C-r	
search regexp:	M-C-s enter	/
search backward regexp:	M-C-r enter	?
Help:	C-h C-h	:help
Help Apropos:	C-h a	
Help key Bindings:	C-h b	:help [key]
Help Info:	C-h i	
Help Major mode:	C-h m	
Help tutorial:	C-h t	:help howto
Undo:	C-_	u
Redo:	C-f	^R
Mark cursor position:	C-@	m{a-zA-Z}
eXchange Mark and position:	C-x C-x	
goto mark in current file:		'{a-z}
goto mark in any file:		'{A-Z}
copy region:	M-w	{visual}y
kill region:	C-w	{visual}d

```
Yank and keep buffer:           C-y
Yank from kill buffer:          M-y             p
convert region to Upper:        C-x C-u         {visual}U
convert region to Lower:        C-x C-l         {visual}u
Insert special char:            C-q octalnum/keystroke
                                                ^V decimal/keystroke
replace:                        M-x replace-string      :%s/aaa/bbb/g
replace regexp:                 M-x replace-regexp      :%s/aaa/bbb/g
query replace:                  M-%                     :%s/aaa/bbb/gc
query replace:                  M-x query-replace
query replace regexp:           M-x query-replace-regexp
Open file:                      C-x C-f         :r file
Save file:                      C-x C-s         :w
Save all buffers:               C-x s           :wa
Save as:                        C-x C-w file    :w file
Prompt for buffer:              C-x b
List buffers:                   C-x C-b         :buffers
Toggle read-only:               C-x C-q         :set ro
Prompt and kill buffer:         C-x k
Split vertical:                 C-x 2           :split
Split horizontal:               C-x 3           :vsplit (ver. 6)
Move to other window:           C-x o           ^Wp
Delete this window:             C-x 0           :q
Delete other window(s):         C-x 1           ^Wo
run shell in bg:                M-x compile
kill shell run in bg:           M-x kill-compilation
run make:                                       :make Makefile
check error message:            C-x`            :echo errmsg
run shell and record:           M-x shell       :!script -a tmp
...clean BS, ...                                :!col -b <tmp >record
...save/recall shell record:    C-x C-w record  :r record
run shell:                      M-! sh          :sh
run command:                    M-! cmd         :!cmd
run command and insert:         C-u M-! cmd     :r!cmd
run filter:                     M-| file        {visual}:w file
run filter and insert:          C-u M-| filter  {visual}:!filter
show option                                     :se[t] {option}?
reset option to default                         :se[t] {option}&
reset boolean option                            :se[t] no{option}
toggle boolean option                           :se[t] inv{option}
wrap text at column 72                          :se tw=72
do not wrap                                     :se tw=0
autoindent                                      :se ai
expand tab                                      :se et
specify comment (mail)                          :se comments=n:>,n:\|
```

```
run GDB                              M-x gdb
describe GDB mode                    C-h m
step one line                        M-s
next line                            M-n
step one instruction (stepi)         M-i
finish current stack frame           C-c C-f
continue                             M-c
up arg frames                        M-u
down arg frames                      M-d
copy number from point, insert at the end
                                     C-x &
set break point                      C-x SPC
```

11.3.5 Vim configuration

In order to use all Vim features and syntax highlighting, include the following lines in ~/.vimrc or /etc/vimrc:

```
set nocompatible
set nopaste
set pastetoggle=<f11>
syn on
```

Paste mode enables one to avoid autoindent interfering with cut-and-paste operations on a console terminal. It does more than just a simple ":set noai".

See 'Using GnuPG with Vim' on page 245 for GnuPG integration.

11.3.6 Ctags

`apt-get install exuberant-ctags` and run `ctags` on the source files. Type `:tag` *`function_name`* in Vim to jump to the line where *function_name* starts. The tags work for C, C++, Java, Python, and many other languages.

Emacs has the same ctags capabilities.

11.3.7 Convert a syntax-highlighted screen to HTML source

`so \$VIMRUNTIME/syntax/2html.vim` from Vim command mode will convert highlighted text to HTML text. Save with `:w file.html` and `:q`. Useful for C code, etc.

11.3.8 Split screen with `vim`

`vim` can edit multiple files in a multi-split-screen environment. Type `:help usr_08.txt` for details.

To split the screen display between different files, type at the vi command prompt:

```
:split another-file
:vsplit another-file
```

Or at a shell prompt:

```
$ vi -o file1.txt file2.txt   # Horizontal split
$ vi -O file1.txt file2.txt   # Vertical split
```

will provide multiwindow vi.

```
$ vimdiff file.txt~ file.txt         # check recent changes of file.txt
$ vimdiff file.en.sgml file.fr.sgml  # check changes of translation
$ gvimdiff file.txt~ file.txt        # in X
```

will provide a nice view of differences between an original and a backup file. In SGML it matches tags, so comparing translations in this mode works very well.

Special cursor movements with Ctrl-W commands:

```
Ctrl-W +      increase the size of a window
Ctrl-W -      decrease the size of a window
Ctrl-W h      move to the window left
Ctrl-W j      move to the window below
Ctrl-W k      move to the window above
Ctrl-W l      move to the window right
...
```

Use the following to control screen scrolling:

```
:set scrollbind
:set noscrollbind
```

Chapter 12

Version Control Systems

12.1 Concurrent Versions System (CVS)

Check `/usr/share/doc/cvs/html-cvsclient`, `/usr/share/doc/cvs/html-info`, `/usr/share/doc/cvsbook` with `lynx` or run `info cvs` and `man cvs` for detailed information.

12.1.1 Installing a CVS server

The following setup will allow commits to the CVS repository only by a member of the "src" group, and administration of CVS only by a member of the "staff" group, thus reducing the chance of shooting oneself.

```
# cd /var/lib; umask 002; mkdir cvs # [Woody] FSH
# apt-get install cvs cvs-doc cvsbook
# export CVSROOT=/var/lib/cvs
# cd $CVSROOT
# chown root:src .  # "staff" to restrict more for starting project.
# chmod 3775 .             # If above uses "staff", use 2775
# cvs -d /var/lib/cvs init # safer to specify -d here explicitly!
# cd CVSROOT
# chown -R root:staff .
# chmod 2775 .
# touch val-tags
# chmod 664 history val-tags
# chown root:src history val-tags
```

12.1.2 CVS session examples

The following will set up shell environments for CVS repository access.

Anonymous CVS (download only)

Read-only remote access:

```
$ export CVSROOT=:pserver:anonymous@cvs.sf.net:/cvsroot/qref
$ cvs login
$ cvs -z3 co qref
```

Use local CVS server

Local access from a shell on the same machine:

```
$ export CVSROOT=/var/lib/cvs
```

Use remote CVS pserver

Remote access without SSH (use RSH protocol capability in `cvs`):

```
$ export CVSROOT=:pserver:account@cvs.foobar.com:/var/lib/cvs
$ cvs login
```

This is prone to eavesdropping attack.

Use remote CVS through `ssh`

Remote access with SSH:

```
$ export CVSROOT=:ext:account@cvs.foobar.com:/var/lib/cvs
```

or for SourceForge:

```
$ export CVSROOT=:ext:account@cvs.sf.net:/cvsroot/qref
```

You can also use RSA authentication ('Connecting with fewer passwords – RSA' on page 160), which eliminates the password prompt.

Create a new CVS archive

For,

```
ITEM              VALUE               MEANING
source tree:      ~/project-x         All source codes
Project name:     project-x           Name for this project
Vendor Tag:       Main-branch         Tag for the entire branch
Release Tag:      Release-initial     Tag for a specific release
```

Then,

```
$ cd ~/project-x                # dive into source directory
 ... create a source tree ...
$ cvs import -m "Start project-x" project-x Main-branch Release-initial
$ cd ..; rm -R ~/project-x
```

Work with CVS

To work with *project-x* using the local CVS repository:

```
$ cd                            # move to the work area
$ cvs co project-x              # get sources from CVS to local
$ cd project-x
 ... make changes to the content ...
$ cvs diff -u                   # similar to diff -u repository/ local/
$ cvs up -C modified_file       # undo changes to a file
$ cvs ci -m "Describe change"   # save local sources to CVS
$ vi newfile_added
$ cvs add newfile_added
$ cvs ci -m "Added newfile_added"
$ cvs up                        # merge latest version from CVS
 ... to create all newly created subdirectories from CVS, use
 ... "cvs up -d -P" instead
 ... watch out for lines starting with "C filename"
 ... unmodified code is moved to `.#filename.version'
 ... search for "<<<<<<<" and ">>>>>>>" in filename
$ cvs tag Release-1             # add release tag
 ... edit further ...
$ cvs tag -d Release-1          # remove release tag
$ cvs ci -m "more comments"
$ cvs tag Release-1             # re-add release tag
$ cd                            # move back to the work area
$ cvs co -r Release-initial -d old project-x
```

```
 ... get original version to old directory
$ cd old
$ cvs tag -b Release-initial-bugfixes # create branch (-b) tag
 ... now you can work on the old version (Tag=sticky)
$ cvs update -d -P              # don't create empty directories
 ... source tree now has sticky tag "Release-initial-bugfixes"
 ... work on this branch
$ cvs up -d -P # sync with files modified by others on this branch
$ cvs ci -m "check into this branch"
$ cvs update -kk -A -d -P
 ... remove sticky tag and forget contents
 ... update from main trunk without keyword expansion
$ cvs update -kk -d -P -j Release-initial-bugfixes
 ... Merge from Release-initial-bugfixes branch into the main
 ... trunk without keyword expansion.  Fix conflicts with editor.
$ cvs ci -m "merge Release-initial-bugfixes"
$ cd
$ tar -cvzf old-project-x.tar.gz old  # make archive, -j for bz2
$ cvs release -d old            # remove local source (optional)
```

Nice options to remember (use as first argument(s) to `cvs`):

```
-n      dry run, no effect
-t      display messages showing steps of cvs activity
```

Export files from CVS

To get the latest version from CVS, use "tomorrow":

```
$ cvs ex -D tomorrow module_name
```

Administer CVS

Add alias to a project (local server):

```
$ su - admin           # a member of staff
$ export CVSROOT=/var/lib/cvs
$ cvs co CVSROOT/modules
$ cd CVSROOT
$ echo "px -a project-x" >>modules
$ cvs ci -m "Now px is an alias for project-x"
$ cvs release -d .
$ exit                 # or Ctrl-D to get back from su
```

```
$ cvs co -d project px
 ... check out project-x (alias:px) from CVS to directory project
$ cd project
 ... make changes to the content ...
```

12.1.3 Troubleshooting CVS

File permissions in repository

CVS will not overwrite the current repository file but replaces it with another one. Thus, *write permission to the repository directory* is critical. For every new repository creation, run the following to ensure this condition if needed.

```
# cd /var/lib/cvs
# chown -R root:src repository
# chmod -R ug+rwX   repository
# chmod    2775     repository  # if needed, this and subdirectory
```

Execution bit

A file's execution bit is retained when checked out. Whenever you see execution permission problems in checked-out files, change permissions of the file in the CVS repository with the following command.

```
# chmod ugo-x filename
```

12.1.4 CVS commands

Here are CVS commands with their shortcuts.

```
{add|ad|new} [-k kflag] [-m 'message'] files...
{admin|adm|rcs} [rcs-options] files...
{annotate|ann} [options] [files...]
{checkout|co|get} [options] modules...
{commit|ci|com}   [-lnR]  [-m  'log_message'  |  -f  file] \
        [-r revision] [files...]
{diff|di|dif} [-kl] [rcsdiff_options] [[-r rev1 | -D date1] \
        [-r rev2 |  -D date2]] [files...]
{export|ex|exp} [-flNn] -r rev|-D date [-d dir] [-k kflag] module...
{history|hi|his} [-report] [-flags] [-options args] [files...]
{import|im|imp} [-options] repository vendortag releasetag...
{login|logon|lgn}
```

```
{log|lo|rlog} [-l] rlog-options [files...]
{rdiff|patch|pa} [-flags] [-V vn] [-r t|-D d [-r t2|-D d2]] modules...
{release|re|rel} [-d] directories...
{remove|rm|delete} [-lR] [files...]
{rtag|rt|rfreeze} [-falnR] [-b] [-d] [-r tag | -D date] \
        symbolic_tag modules...
{status|st|stat} [-lR] [-v] [files...]
{tag|ta|freeze} [-lR] [-F] [-b] [-d] [-r tag | -D date] [-f] \
        symbolic_tag [files...]
{update|up|upd} [-AdflPpR] [-d] [-r tag|-D date] files...
```

12.2 Subversion

Subversion is a next-generation version control system that is intended to replace CVS. The developers currently consider it to be in the "alpha" stage, but it is probably stable enough for most uses. At the time of this writing, Subversion is only available in Debian `unstable`.

12.2.1 Installing a Subversion server

The `subversion-server` meta-package depends on the packages needed (`libapache2-dav-svn` and `subversion-tools`) to set up a server.

Setting up a repository

Currently, the `subversion` package does not set up a repository, so one must be set up manually. One possible location for a repository is in `/var/local/repos`.

Create the directory:

```
# mkdir -p /var/local/repos
```

Create the repository database:

```
# svnadmin create /var/local/repos
```

Make the repository writable by the WWW server:

```
# chown -R www-data:www-data /var/local/repos
```

Configuring Apache2

To allow access to the repository via user authentication, add (or uncomment) the following in `/etc/apache2/mods-available/dav_svn.conf`:

```
<Location /repos>
  DAV svn
  SVNPath /var/local/repos
  AuthType Basic
  AuthName "Subversion repository"
  AuthUserFile /etc/subversion/passwd
  <LimitExcept GET PROPFIND OPTIONS REPORT>
    Require valid-user
  </LimitExcept>
</Location>
```

Then, create a user authentication file with the command:

```
htpasswd2 -c /etc/subversion/passwd some-username
```

Restart Apache2, and your new Subversion repository will be accessible with the URL http://*hostname*/repos.

12.2.2 Moving a CVS repository to Subversion

12.2.3 Subversion usage examples

The following sections teach you how to use different commands in Subversion.

Create a new Subversion archive

To create a new Subversion archive, type the following:

```
$ cd ~/your-project          # go to your source directory
$ svn import http://localhost/repos your-project \
  project-name -m "initial project import"
```

This creates a directory named *project-name* in your Subversion repository which contains your project files. Look at http://localhost/repos/ to see if it's there.

Working with Subversion

Working with *project-y* using Subversion:

```
$ cd                              # move to the work area
$ svn co http://localhost/repos/project-y  # Check out sources
$ cd project-y
 ... do some work ...
$ svn diff                        # similar to diff -u repository/ local/
$ svn revert modified_file        # undo changes to a file
$ svn ci -m "Describe changes"  # check in your changes to the repository
$ vi newfile_added
$ svn add newfile_added
$ svn add new_dir                 # recursively add all files in new_dir
$ svn add -N new_dir2             # nonrecursively add the directory
$ svn ci -m "Added newfile_added, new_dir, new_dir2"
$ svn up                          # merge in latest version from repository
$ svn log                         # shows all changes committed
$ svn copy http://localhost/repos/project-y \
      http://localhost/repos/project-y-branch \
      -m "creating my branch of project-y"  # branching project-y
$ svn copy http://localhost/repos/project-y \
      http://localhost/repos/proj-y_release1.0 \
      -m "project-y 1.0 release"    # added release tag
 ... note that branching and tagging are the same. The only difference
 ... is that branches get committed whereas tags do not.

 ... make changes to branch ...

$ # merge branched copy back to main copy
$ svn merge http://localhost/repos/project-y \
   http://localhost/repos/project-y-branch
$ svn co -r 4 http://localhost/repos/project-y # get revision 4
```

Chapter 13

Programming

Do not use "test" as the name of an executable test file. `test` is a shell built-in.

13.1 Where to start

References:

- Documents and examples under `/usr/share/doc/`*`package`*
- Unix / Programming Information (`http://arioch.unomaha.edu/~jclark/#info`)
- *Linux Programming Bible* (John Goerzen/IDG books)

Many long info documents can be obtained as paperbacks from GNU (`http://www.gnu.org/`).

The next four sections contain sample scripts in different languages for creating a text file of account information to be added to `/etc/passwd` using a batch processor such as the `newusers` program. Each script requires as input a file with lines of the form `first_name last_name password`. (Actual user home directories will not be created via these scripts.)

13.2 Shell

Reading shell scripts is the **best** way to understand how a Unix-like system works. Here, I give some pointers and reminders for shell programming. See Shell Mistakes (`http://www.greenend.org.uk/rjk/2001/04/shell.html`) to learn from mistakes.

13.2.1 Bash – GNU standard interactive shell

References for Bash:

- `bash(1)`

- `info bash`
- the LDP BASH Programming - Introduction HOWTO (http://www.tldp.org/HOWTO/Bash-Prog-Intro-HOWTO.html) as starter information.
- `mc /usr/share/doc/bash/examples/ /usr/share/doc/bash/` (Install the `bash-doc` package to see the example files.)
- *Learning the bash Shell*, 2nd edition (O'Reilly)

Short program example (creates account entries for `newusers` from standard input):

```
#!/bin/bash
# (C) Osamu Aoki Sun Aug 26 16:53:55 UTC 2001 Public Domain
pid=1000;
while read n1 n2 n3 ; do
if [ ${n1:0:1} != "#" ]; then
let pid=$pid+1
echo ${n1}_${n2}:password:${pid}:${pid}:,,,/home/${n1}_${n2}:/bin/bash
fi
done
```

13.2.2 POSIX shells

Several packages provide a POSIX shell in Debian:

- `dash` (Sarge)
  - Priority: optional
  - Installed-Size: 176
  - Smallest and fastest by far – best for initial boot
- `ash` (Woody)
  - Priority: optional
  - Installed-Size: 180
  - Smaller and much faster – good for initial boot
- `bash`
  - Essential: yes
  - Priority: required
  - Installed-Size: 580
  - Larger and featureful – many extensions implemented
- `pdksh`
  - Priority: optional
  - Installed-Size: 408
  - Complete AT&T ksh look-alike

If you are writing a shell script for portability, it is best to write it as a POSIX shell script. Use `/bin/sh` linked to `ash` (or `dash`) to test its POSIX compliance. Avoid writing scripts with "bashisms" or the "zshisms". For example, avoid:

- `if [ foo == bar ] ; then ...`
- `diff -u file.c{.orig,}`
- `mkdir /foo{bar,baz}`

The description for the shell in this document applies only for the POSIX type shells and thus does not apply for the `csh` type shells including `tcsh`.

13.2.3 Shell parameters

Several **special parameters** to remember:

```
$0      = name of the shell or shell script
$1      = first(1) shell argument
 ...
$9      = ninth(9) shell argument
$#      = number of positional parameters
"$*"    = "$1 $2 $3 $4 ... $n"
"$@"    = "$1" "$2" "$3" "$4" ... "$n"
$?      = exit status of the most recent command
$$      = PID of this shell script
$!      = PID of most recently started background job
```

Basic **parameter expansions** to remember:

Form	If *var* is set	If *var* is not set
`${var:-string}`	`$var`	*string*
`${var:+string}`	*string*	null
`${var:=string}`	`$var`	*string* (and run *var=string*)
`${var:?string}`	`$var`	(echo *string* and then exit)

Here, the colon ':' in all of these operators is actually optional.

- With ':' = operator test for "exist" and "not null".
- Without ':' = operator test for "exist" only.

Basic **parameter substitutions** to remember:

Form	Result
`${var%suffix}`	Remove smallest *suffix* pattern
`${var%%suffix}`	Remove largest *suffix* pattern
`${var#prefix}`	Remove smallest *prefix* pattern
`${var##prefix}`	Remove largest *prefix* pattern

13.2.4 Shell redirection

Basic **redirection** to remember (here the [*n*] is an optional number to specify the file descriptor):

```
[n]> file      Redirect stdout (or n) to file.
[n]>> file     Append stdout (or n) to file.
[n]< file      Redirect stdin (or n) from file.
```

```
[n1]>&n2       Redirect stdout (or n1) to n2.
2> file  >&2   Redirect stdout and stderr to file.
 > file 2>&1   Redirect stdout and stderr to file.
| command      Pipe stdout to command.
2>&1 | command Pipe stderr and stdout to command.
```

Here,

- stdin: standard input (file descriptor = 0)
- stdout: standard output (file descriptor = 1)
- stderr: standard error (file descriptor = 2)

The shell allows you to open files using the `exec` built-in with an arbitrary file descriptor.

```
$ echo Hello >foo
$ exec 3<foo 4>bar  # open files
$ cat <&3 >&4       # redirect stdin to 3, stdout to 4
$ exec 3<&- 4>&-    # close files
$ cat bar
Hello
```

Here *n*`<&-` and *n*`>&-` mean to close the file descriptor *n*.

13.2.5 Shell conditionals

Each command returns an **exit status** which can be used for conditional expressions:

- Success: 0 (True)
- Error: 1–255 (False)

Note that the use here of a 0 value to mean "true" differs from the usual convention in some other areas of computing. Also, '[' is the equivalent of the `test` command, which evaluates its arguments up to ']' as a conditional expression.

Basic **conditional idioms** to remember are:

```
command && if_success_run_this_command_too || true
command || if_not_success_run_this_command_instead

if [ conditional_expression ]; then
 if_success_run_this_command
else
 if_not_success_run_this_command
fi
```

Here `|| true` was needed to ensure this shell script will not exit at this line accidentally when shell is invoked with `-e` flag.

File comparison operators in the conditional expression are:

```
-e file          True if file exists.
-d file          True if file exists and is a directory.
-f file          True if file exists and is a regular file.
-w file          True if file exists and is writable.
-x file          True if file exists and is executable.
file1 -nt file2 True if file1 is newer than file2. (modification)
file1 -ot file2 True if file1 is older than file2. (modification)
file1 -ef file2 True if they are the same device and inode numbers.
```

String comparison operators in the conditional expression are:

```
     -z str    True if the length of str is zero.
     -n str    True if the length of str is non-zero.
str1 == str2   True if the strings are equal.
str1 =  str2   True if the strings are equal.
    ("=" should be used in place of "==" for strict POSIX compliance)
str1 != str2   True if the strings are not equal.
str1 <  str2   True if str1 sorts before str2 (locale dependent).
str1 >  str2   True if str1 sorts after str2 (locale dependent).
```

Arithmetic integer comparison operators in the conditional expression are `-eq`, `-ne`, `-lt`, `-le`, `-gt`, and `-ge`.

13.2.6 Command-line processing

The shell processes a script as follows:

- split into **tokens** by the metacharacters: SPACE, TAB, NEWLINE, ;, (,), <, >, |, &
- check **keyword** if not within "..." or '...' (loop)
- expand **alias** if not within "..." or '...' (loop)
- expand **brace**, `a{1,2}` -> `a1 a2`, if not within "..." or '...'
- expand **tilde**, *~user* -> *user*'s home directory, if not within "..." or '...'
- expand **parameter**, $*PARAMETER*, if not within '...'
- expand **command substitution**, $(*command*), if not within '...'
- split into **words** with $IFS if not within "..." or '...'
- expand *?[] in **pathname** if not within "..." or '...'
- look up **command**
  - function
  - built-in
  - file in $PATH
- loop

Single quotes within double quotes have no effect.

Executing `set -x` in the shell or invoking the shell with `-x` option make the shell to print all of commands executed. This is quite handy for debugging.

13.3 Awk

References for Awk:

- *Effective awk Programming*, 3rd edition (O'Reilly)
- *Sed & awk*, 2nd edition (O'Reilly)
- `mawk(1)` and `gawk(1)`
- `info gawk`

Short program example (creates `newusers` command entry):

```
#!/usr/bin/awk -f
# Script to create a file suitable for use in the 'newusers' command,
# from a file consisting of user IDs and passwords in the form:
# first_name last_name password
# Copyright (c) KMSelf Sat Aug 25 20:47:38 PDT 2001
# Distributed under GNU GPL v 2, or at your option, any later version.
# This program is distributed WITHOUT ANY WARRANTY.

BEGIN {
    # Assign starting UID, GID
    if ( ARGC > 2 ) {
        startuid = ARGV[1]
        delete ARGV[1]
    }
    else {
        printf( "Usage:  newusers startUID file\n" \
          "  where:\n" \
          "    startUID is the starting userid to add, and\n" \
          "    file is an input file in form:\n" \
          "      first_name last_name password\n" \
        )
        exit
    }

    infile = ARGV[1]
    printf( "Starting UID: %s\n\n", startuid )
}

/^#/ { next }

{
    ++record
    first = $1
    last = $2
    passwd = $3
    user= substr( tolower( first ), 1, 1 ) tolower( last )
```

```
        uid = startuid + record - 1
        gid = uid
        printf( "%s:%s:%d:%d:%s %s,,/home/%s:/bin/bash\n",  \
            user, passwd, uid, gid, first, last, user \
            )
}
```

Two packages provide POSIX `awk` in Debian:

- `mawk`
  - Priority: required
  - Installed-Size: 228
  - Smaller and much faster – good for default install
  - Compile-time limits exist
    - NF = 32767
    - sprintf buffer = 1020
- `gawk`
  - Priority: optional
  - Installed-Size: 1708
  - Larger and featureful – many extensions implemented
    - System V Release 4 version of UNIX
    - Bell Labs awk
    - GNU-specific

13.4 Perl

This is **the** interpreter on a Unix-like system.

References for Perl:

- `perl(1)`
- *Programming Perl,* 3rd edition (O'Reilly)
- The Perl Directory (http://www.perl.org/)

Short program example (creates `newusers` command entry):

```
#!/usr/bin/perl
# (C) Osamu Aoki Sun Aug 26 16:53:55 UTC 2001 Public Domain
$pid=1000;
while (<STDIN>) {
        if (/^#/) { next;}
        chop;
        $pid++;
        ($n1, $n2, $n3) = split / /;
        print $n1,"_",$n2,":", $n3, ":",$pid,
                  ":",$pid,",,,/home/",$n1,"_",$n2,":/bin/bash\n"
}
```

Install Perl module *module_name*:

```
# perl -MCPAN -e 'install module_name'
```

13.5 Python

It's a nice object-oriented interpreter.

References for Python:

- `python(1)`
- *Learning Python* (O'Reilly).
- Python Programming Language (http://www.python.org/)

Short program example (creates `newusers` command entry):

```
#! /usr/bin/env python
import sys, string

# (C) Osamu Aoki Sun Aug 26 16:53:55 UTC 2001 Public Domain
# Ported from awk script by KMSelf Sat Aug 25 20:47:38 PDT 2001
# This program is distributed WITHOUT ANY WARRANTY.

def usages():
    print \
"Usage:  ", sys.argv[0], " start_UID [filename]\n" \
"\tstartUID is the starting userid to add.\n" \
"\tfilename is input filename. If not specified, standard input.\n\n" \
"Input file format:\n"\
"\tfirst_name last_name password\n"
                return 1

def parsefile(startuid):
    #
    # main filtering
    #
    uid = startuid
    while 1:
        line = infile.readline()
        if not line:
            break
        if line[0] == '#':
            continue
        (first, last, passwd) = string.split(string.lower(line))
        # above crashes with wrong # of parameters :-)
        user = first[0] + last
```

```
            gid = uid
            lineout = "%s:%s:%d:%d:%s %s,,/home/%s:/bin/bash\n" %  \
                (user, passwd, uid, gid, first, last, user)
            sys.stdout.write(lineout)
            +uid

if __name__ == '__main__':
    if len(sys.argv) == 1:
        usages()
    else:
        uid = int(sys.argv[1])
        #print "# UID start from: %d\n" % uid
        if len(sys.argv) > 1:
            infilename   = string.join(sys.argv[2:])
            infile = open(infilename, 'r')
            #print "# Read file from: %s\n\n" % infilename
        else:
            infile = sys.stdin
        parsefile(uid)
```

13.6 Make

References for Make:

- `info make`
- `make(1)`
- *Managing Projects with make*, 2nd edition (O'Reilly)

Simple automatic variables:

Rule syntax:

```
target: [ prerequisites ... ]
 [TAB]  command1
 [TAB]  -command2 # ignore errors
 [TAB]  @command3 # suppress echoing
```

Here `[TAB]` is a TAB code. Each line is interpreted by the shell after `make` variable substitution. Use `\` at the end of a line to continue the script. Use `$$` to enter `$` for environment values for a shell script.

Implicit rules for the *target* and *prerequisites* can be written, for example, as:

```
%: %.c header.h
```

or,

```
%.o: %.c header.h
```

Here, the *target* contains the character `%` (exactly one of them). The `%` can match any nonempty substring in the actual target filenames. The *prerequisites* likewise use `%` to show how their names relate to the actual target name.

Suffix rules are the **obsolete** way of defining implicit rules for `make`. They are still supported in GNU `make` for compatibility, but use equivalent pattern rules whenever possible:

```
old suffix rule --> new pattern rule
.c:             --> %  : %.c
.c.o:           --> %.o: %.c
```

Automatic variables for the rule:

```
foo.o: new1.c new2.c old1.c new3.c
$@ == foo.o                         (target)
$< == new1.c                        (first one)
$? == new1.c new2.c new3.c          (newer ones)
$^ == new1.c new2.c old1.c new3.c   (all)
$* == '%' matched stem in the target pattern.
```

Variable references:

```
foo1 := bar    # One-time expansion
foo2  = bar    # Recursive expansion
foo3 += bar    # Append
SRCS := $(wildcard *.c)
OBJS := $(foo:c=o)
OBJS := $(foo:%.c=%.o)
OBJS := $(patsubst %.c,%.o,$(foo))
DIRS  = $(dir directory/filename.ext) # Extracts "directory"
 $(notdir NAMES...), $(basename NAMES...), $(suffix NAMES...) ...
```

Run `make -p -f/dev/null` to see automatic internal rules.

13.7 C

Preparation:

```
# apt-get install glibc-doc manpages-dev libc6-dev gcc
```

References for C:

- `info libc` (C library function reference)
- `gcc(1)`
- `each_C_library_function_name(3)`
- Kernighan & Ritchie, *The C Programming Language*, 2nd edition (Prentice Hall).

13.7.1 Simple C program (`gcc`)

A simple example to compile `example.c` with a library `libm` into an executable `run_example`:

```
$ cat > example.c << EOF
#include <stdio.h>
#include <math.h>
#include <string.h>

int main(int argc, char **argv, char **envp){
        double x;
        char y[11];
        x=sqrt(argc+7.5);
        strncpy(y, argv[0], 10); /* prevent buffer overflow */
        y[10] = '\0'; /* fill to make sure string ends with '\0' */
        printf("%5i, %5.3f, %10s, %10s\n", argc, x, y, argv[1]);
        return 0;
}
EOF
$ gcc -Wall -g -o run_example example.c -lm
$ ./run_example
        1, 2.915, ./run_exam,     (null)
$ ./run_example 1234567890qwerty
        2, 3.082, ./run_exam, 1234567890qwerty
```

Here, `-lm` is needed to link library `libm` for `sqrt()`. The actual library is in `/lib/` with filename `libm.so.6`, which is a symlink to `libm-2.1.3.so`.

Look at the last parameter in the output text. There are more than 10 characters even though `%10s` is specified.

The use of pointer memory operation functions without boundary checks, such as `sprintf` and `strcpy`, is deprecated to prevent buffer overflow exploits that leverage the above overrun effects. Instead, use `snprintf` and `strncpy`.

13.7.2 Debugging

Debugging with `gdb`

Preparation:

```
# apt-get install gdb
```

References for gdb:

- info gdb (tutorial)
- gdb(1)
- http://www.unknownroad.com/rtfm/gdbtut/gdbtoc.html

Use gdb to debug a program compiled with the -g option. Many commands can be abbreviated. Tab expansion works as in the shell.

```
$ gdb program
(gdb) b 1                 # set breakpoint at line 1
(gdb) run arg1 arg2 arg3  # run program
(gdb) next                # next line
...
(gdb) step                # step forward
...
(gdb) p parm              # print parm
...
(gdb) p parm=12           # set value to 12
```

For debugging from within Emacs, refer to 'Editor command summary (Emacs, Vim)' on page 211.

Since all installed binaries should be stripped on the Debian system by default, most debugging symbols are removed. In order to make gdb useful for debugging Debian packages, pertinent packages need to be rebuild with following care:

- Edit debian/control to bump the package version (http://www.debian.org/doc/debian-policy/ch-controlfields#s-f-Version).
- Check build scripts and ensure to use CFLAGS=-g -Wall for compiling binaries.
- Export DEB_BUILD_OPTIONS=nostrip,noopt for building the Debian package.

See Policy 10.1 (http://www.debian.org/doc/debian-policy/ch-files#s10.1) for more info.

Check dependency on libraries

Use ldd to find out a program's dependency on libraries:

```
$ ldd /bin/ls
        librt.so.1 => /lib/librt.so.1 (0x4001e000)
        libc.so.6 => /lib/libc.so.6 (0x40030000)
        libpthread.so.0 => /lib/libpthread.so.0 (0x40153000)
        /lib/ld-linux.so.2 => /lib/ld-linux.so.2 (0x40000000)
```

For `ls` to work in a `chroot`ed environment, the above libraries must be available in your `chroot`ed environment.

The following commands will also be useful:

- `strace`: trace system calls and signals
- `ltrace`: trace library calls

Debugging with memory leak detection tools

There are several memory leak detection tools available in Debian.

- `njamd`
- `valgrind`
- `dmalloc`
- `electric-fence`
- `memprof`
- `memwatch` (not packaged, get this from memwatch (`http://directory.fsf.org/devel/debug/memwatch.html`).)
- `mpatrol`
- `leaktracer`
- `libgc6`
- `Insure++` from Parasoft (`http://www.parasoft.com`). (non-free, commercial for fee)

Also check out Debugging Tools for Dynamic Storage Allocation and Memory Management (`http://www.cs.colorado.edu/homes/zorn/public_html/MallocDebug.html`).

13.7.3 Flex – a better Lex

`flex` is a fast lexical analyzer generator.

References for `flex`:

- `info flex` (tutorial)
- `flex(1)`

You need to provide your own `main()` and `yywrap()`, or your `program.l` should look like this to compile without a library (`yywrap` is a macro; `%option main` turns on `%option noyywrap` implicitly):

```
%option main
%%
.|\n    ECHO ;
%%
```

Alternatively, you may compile with the `-lfl` linker option at the end of your `cc` command line (like AT&T-Lex with `-ll`). No `%option` is needed in this case.

13.7.4 Bison – a better Yacc

Several packages provide a Yacc-compatible LALR parser generator in Debian:

- `bison`: GNU LALR parser generator
- `byacc`: The Berkeley LALR parser generator
- `btyacc`: Backtracking parser generator based on `byacc`

References for `bison`:

- `info bison` (tutorial)
- `bison(1)`

You need to provide your own `main()` and `yyerror()`. `main()` calls `yyparse()` which calls `yylex()`, usually created with FleX.

```
%%

%%
```

13.7.5 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 using the entire GNU build system.

`autoconf` produces the configuration script `configure`. `configure` automatically creates a customized `Makefile` using the `Makefile.in` template.

Compile and install a program

Debian does not touch files in `/usr/local/` (see 'Supporting diversity' on page 21). So if you compile a program from source, install it into `/usr/local/` so it will not interfere with Debian.

```
$ cd src
$ ./configure --prefix=/usr/local
$ make
$ make install # this puts the files in the system
```

Uninstall program

If you still have the source and if it uses `autoconf/automake` and if you can remember how you configured it:

```
$ ./configure all-of-the-options-you-gave-it
# make uninstall
```

Alternatively, if you are absolutely sure that the install process puts files only under `/usr/local/` and there is nothing important there, you can erase all its contents by:

```
# find /usr/local -type f -print0 | xargs -0 rm -f
```

If you are not sure where files are installed, you should consider using `checkinstall`, which provides a clean path for the uninstall.

13.8 Web

Basic interactive dynamic web pages can be made as follows:

- Queries are presented to the browser user using HTML forms.
- Filling and clicking on the form entries will send an URL with encoded parameters [1] from the browser to the web server. For example:
  - `http://www.foo.dom/cgi-bin/program.pl?VAR1=VAL1&VAR2=VAL2&VAR3=VAL3`
  - `http://www.foo.dom/cgi-bin/program.py?VAR1=VAL1&VAR2=VAL2&VAR3=VAL3`
  - `http://www.foo.dom/program.php?VAR1=VAL1&VAR2=VAL2&VAR3=VAL3`
- CGI program (any one of `program.*`) on the web server will receive decoded parameters "`VAR1=VAL1 VAR2=VAL2 VAR3=VAL3`" as the contents of environment variable "`QUERY_STRING`" and executes itself.
- `stdout` of CGI program will be sent to the web browser and is presented as an interactive dynamic web page.

For security reasons it is better not to hand craft new hacks for parsing CGI parameters. There are established modules for them in Perl (see 'Perl' on page 229) and Python (see 'Python' on page 230). PHP (`http://www.php.net/`) comes with these functionality. When client data storage is needed, cookies are used. When client side data processing is needed, javascript is frequently used.

For more, see The Common Gateway Interface (`http://hoohoo.ncsa.uiuc.edu/cgi/`), The Apache Software Foundation (`http://www.apache.org/`), and JavaScript (`http://www.mozilla.org/js/`).

Searching "CGI tutorial" on Google by typing encoded URL `http://www.google.com/search?hl=en&ie=UTF-8&q=CGI+tutorial` directly to the browser address is a good way to see the CGI script in action on the Google server.

13.9 Document preparation

13.9.1 `roff` typesetting

Traditionally, `roff` is the main Unix text processing system.

[1] Here `%nn` is used to the encoded character of hexadecimal `nn`.

See `roff(7)`, `groff(7)`, `groff(1)`, `grotty(1)`, `troff(1)`, `groff_mdoc(7)`, `groff_man(7)`,`groff_ms(7)`,`groff_me(7)`,`groff_mm(7)`,and `info groff`.

A good tutorial on `-me` macros exists. If you have `groff` (1.18 or newer), find `/usr/share/doc/groff/meintro.me.gz` and do the following:

```
$ zcat /usr/share/doc/groff/meintro.me.gz | \
     groff -Tascii -me - | less -R
```

The following will make a completely plain text file:

```
$ zcat /usr/share/doc/groff/meintro.me.gz | \
    GROFF_NO_SGR=1 groff -Tascii -me - | col -b -x > meintro.txt
```

For printing, use PostScript output.

```
$ groff -Tps meintro.txt | lpr
$ groff -Tps meintro.txt | mpage -2 | lpr
```

13.9.2 SGML

Preparation:

```
# apt-get install debiandoc-sgml debiandoc-sgml-doc
```

References for `debiandoc-sgml`:

- `/usr/share/doc/debiandoc-sgml-doc`
- `debiandoc-sgml(1)`
- *DocBook: The Definitive Guide* (*`/usr/share/doc/docbook-defguide/html/docbook.html`*), by Walsh and Muellner, (O'Reilly) (package `docbook-defguide`)

SGML enables management of multiple formats of a document. One easy SGML system is Debiandoc, which is used here. This requires minor conversion from original text files for the following characters:

- "<" –> `<`
- ">" –> `>`
- " " –> ` ` (nonbreakable space)
- "&" –> `&`
- "%" –> `%`
- "©" –> `©`
- "–" –> `–`
- "—" –> `—`

To mark a section as a nonprintable comment, enter:

```
<!-- State issue here ... -->
```

To mark a section with a switchable comment, enter:

```
<![ %FIXME; [ State issue here ... ]]>
```

In SGML, the *first definition* of an entity wins. For example:

```
<!entity % qref "INCLUDE">
<![ %qref; [ <!entity param "Data 1"> ]]>
<!entity param "Data 2">
&param;
```

This ends up as “Data 1”. If the first line has “IGNORE” instead of “INCLUDE”, this ends up as “Data 2” (the second line is a conditional statement). Also, repeating phrases can be defined in advance separately from the context.

```
<!entity whoisthis "my">
Hello &whoisthis; friend.
This is &whoisthis; book.
```

This results in the following:

```
Hello my friend.
This is my book.
```

See the short SGML example `sample.sgml` in the examples (http://www.debian.org/doc/manuals/debian-reference/examples/).

When SGML documents become bigger, sometimes TeX which is used as the backend text processor may cause errors. See ‘TeX/LaTeX’ on the current page.

13.9.3 TeX/LaTeX

Preparation:

```
# tasksel # select Miscellaneous  --> TeX/LaTeX environment
```

References for LaTeX:

- The teTeX HOWTO: The Linux-teTeX Local Guide (http://www.tldp.org/HOWTO/TeTeX-HOWTO.html)
- `tex(1)`

- `latex(1)`
- *The TeXbook*, by Donald E. Knuth, (Addison-Wesley) [2]
- *LaTeX - A Document Preparation System*, by Leslie Lamport, (Addison-Wesley)
- *The LaTeX Companion*, by Goossens, Mittelbach, Samarin, (Addison-Wesley)

This is the most powerful typesetting environment. Many SGML processors use this as their back end text processor. Lyx provided by `lyx`, `lyx-xforms`, or `lyx-qt` and GNU TeXmacs provided by `texmacs` package offers nice WYSIWYG editing environment for LaTeX while many use Emacs and Vim as the choice for the source editor.

There are many online resources available:

- teTeX - A Documentation Guide (`/usr/share/doc/texmf/newhelpindex.html`) (`tetex-doc` package)
- A Quick Introduction to LaTeX (`http://www.msu.edu/user/pfaffben/writings/`)
- A Simple Guide to Latex/Lyx (`http://www.stat.rice.edu/~helpdesk/howto/lyxguide.html`)
- Word Processing Using LaTeX (`http://www-h.eng.cam.ac.uk/help/tpl/textprocessing/latex_basic/latex_basic.html`)
- Local User Guide to teTeX/LaTeX (`http://supportweb.cs.bham.ac.uk/documentation/LaTeX/lguide/local-guide/local-guide.html`)

When documents become bigger, sometimes TeX may cause errors. You must increase pool size in `/etc/texmf/texmf.cnf` (or more appropriately edit `/etc/texmf/texmf.d/95NonPath` and run `update-texmf`) to fix this.

13.9.4 Literate Programming

Instead of writing code containing documentation, the literate programmer writes documentation containing code. This approach ensures a good documentation for a program.

For more on literate-programming, see Literate Programming (`http://www.literateprogramming.com/`).

Noweb

Preparation:

```
# apt-get install nowebm
```

References for Noweb:

[2] The TeX source of this book is available at `ftp://ftp.dante.de/pub/tex/systems/knuth/tex/texbook.tex`. `ftp://ftp.dante.de/pub/tex/systems/knuth/lib/manmac.tex` contains most of the required macros. You can process this document with `tex` after commenting lines 7 to 10 and adding `\input manmac \proofmodefalse`. It's strongly recommended to buy this book (and all other books from Donald E. Knuth) instead of using the online version but the source is a great example of TeX input!

- Noweb — A Simple, Extensible Tool for Literate Programming (http://www.eecs.harvard.edu/~nr/noweb/)
- noweb(1)

This is a WEB-like literate-programming tool which is simpler while providing extensibility and language-independence. [3] When noweb is invoked, it writes the program source code to the output files mentioned in the noweb file, and it writes a TeX file for typeset documentation.

The Debian ifupdown package is a fine example.

```
$ apt-get source ifupdown
$ cd ifupdown*
$ make ifupdown.pdf ifupdown.ps
```

Doxygen

Preparation:

```
# apt-get install doxygen doxygen-doc doxygen-gui
```

References for Doxygen (created by doxygen!):

- Homepage (http://www.doxygen.org/)
- /usr/share/doc/doxygen-doc/html/index.html

It can generate HTML, RTF, Unix manual pages, PostScript, and PDF (using LaTeX) documentation for C++, C, Java, IDL, and to some extent PHP and C# programs. Doxygen is compatible to JavaDoc (1.1), Qt-Doc, KDOC and was specifically designed to be used for projects that make use of Troll Tech's Qt (http://www.trolltech.no/qt/) toolkit. It creates include dependency graphs, collaboration diagrams, and graphical class hierarchy graphs even for not documented programs. The output is similar to Qt's documentation.

13.10 Packaging

Preparation:

```
# apt-get install debian-policy developers-reference \
                  maint-guide dh-make debhelper
# apt-get install packaging-manual # if Potato
```

References for packaging:

- 'The Debian package management system' on page 11 (basics)

[3] This WEB has **nothing** to do with World Wide Web. WEB (for PASCAL) and CWEB (for C/C++) are traditional literate-programming tools.

- Debian New Maintainers' Guide (tutorial)
- `dh-make(1)`
- Debian Developer's Reference (best practice)
- Debian Policy Manual (authoritative)
- Packaging Manual (Potato)

13.10.1 Packaging a single binary

Quick-and-dirty method to Package a single binary per Joey Hess.

```
# mkdir -p mypkg/usr/bin mypkg/DEBIAN
# cp binary mypkg/usr/bin
# cat > mypkg/DEBIAN/control
Package: mypackage
Version: 1
Architecture: i386
Maintainer: Joey Hess <joeyh@debian.org>
Description: my little package
 Don't expect much.
^D
# dpkg-deb -b mypkg
```

13.10.2 Packaging with tools

Use `dh_make` from the `dh-make` package to create a baseline package. Then, proceed according to instructions in `dh-make(1)`. This uses `debhelper` in `debian/rules`.

An older approach is to use `deb-make` from the `debmake` package. This uses no `debhelper` scripts and depends only on the shell.

For examples of multiple-source packages, see "mc" (`dpkg-source -x mc_4.5.54.dsc`), which uses "sys-build.mk" by Adam Heath (`<doogie@debian.org>`), and "glibc" (`dpkg-source -x glibc_2.2.4-1.dsc`), which uses another system by the late Joel Klecker (`<espy@debian.org>`).

Chapter 14

GnuPG

References:
- `gpg(1)`.
- `/usr/share/doc/gnupg/README.gz`
- *GNU privacy handbook* in `/usr/share/doc/gnupg-doc/GNU_Privacy_Handbook/` (install `gnupg-doc` package)

14.1 Installing GnuPG

```
# gpg --gen-key                    # generate a new key
# gpg --gen-revoke my_user_ID      # generate revoke key for my_user_ID
# host -l pgp.net | grep www|less # figure out pgp keyservers
```

A good default keyserver set up in `$HOME/.gnupg/gpg.conf` (or old location `$HOME/.gnupg/options`) contains:

```
keyserver hkp://subkeys.pgp.net
```

Here one must be careful **not** to create more than 2 sub-keys. If you do, keyservers on pgp.net will **corrupt** your key. Use the newer `gnupg` (>1.2.1-2) to handle these corrupted subkeys. See http://fortytwo.ch/gpg/subkeys.

14.2 Using GnuPG

File handling:

```
$ gpg [options] command [args]
$ gpg {--armor|-a} {--sign|-s} file # sign file into a text file.asc
```

```
$ gpg --clearsign file                # clear-sign message
$ gpg --clearsign --not-dash-escaped patchfile  # clear-sign patchfile
$ gpg --verify file                   # verify clear-signed file
$ gpg -o file.sig {-b|--detach-sig} file # create detached signature
$ gpg --verify file.sig file          # verify file with file.sig
$ gpg -o crypt_file {--recipient|-r} name {--encrypt|-e} file
       # public-key encryption intended for name
$ gpg -o crypt_file {--symmetric|-c} file # symmetric encryption
$ gpg -o file --decrypt crypt_file  # decryption
```

14.3 Managing GnuPG

Key management:

```
$ gpg --edit-key user_ID                # "help" for help, interactive
$ gpg -o file --exports                 # export all keys to file
$ gpg --imports file                    # import all keys from file
$ gpg --send-keys user_ID               # send key of user_ID to keyserver
$ gpg --recv-keys user_ID               # recv. key of user_ID from keyserver
$ gpg --list-keys user_ID               # list keys of user_ID
$ gpg --list-sigs user_ID               # list sig. of user_ID
$ gpg --check-sigs user_ID              # check sig. of user_ID
$ gpg --fingerprint user_ID             # check fingerprint of user_ID
$ gpg --list-sigs | grep '^sig' | grep '[User id not found]' \
  | awk '{print $2}' | sort -u | xargs gpg --recv-keys # get unknown keys
  # update keys for all unknown sigs.
$ gpg --refresh-keys                    # update local keyring
```

Trust code:

```
-         No ownertrust assigned / not yet calculated.
e         Trust calculation has failed.
q         Not enough information for calculation.
n         Never trust this key.
m         Marginally trusted.
f         Fully trusted.
u         Ultimately trusted.
```

The following will upload my key *"A8061F32"* to the popular keyserver `hkp://subkeys.pgp.net`:

```
$ gpg --keyserver hkp://subkeys.pgp.net --send-keys A8061F32
```

14.4 Using GnuPG with applications

14.4.1 Using GnuPG with Mutt

Add the following to `~/.muttrc` to keep a slow GnuPG from automatically starting, while allowing it to be used by typing '`S`' at the index menu.

```
macro index S ":toggle pgp_verify_sig\n"
set pgp_verify_sig=no
```

14.4.2 Using GnuPG with Vim

Add the contents of `_vimrc` obtained from the examples subdirectory (http://www.debian.org/doc/manuals/debian-reference/examples/) into `~/.vimrc` to run GnuPG transparently.

Chapter 15

Support for Debian

The following resources provide help, advice, and support for Debian. Try your best to use self-help resources before crying out loud in the mailing lists. :)

Note that you can access a lot of documentation on your system by using a WWW browser, via the `dwww` or `dhelp` commands, found in their respective packages.

15.1 References

The following references are available for Debian and Linux in general. If their contents conflict with each other, always rely more on primary information sources than on secondary ones such as this document.

- Installation Manual (primary)
  - Read before installation and upgrade.
  - Web: `http://www.debian.org/releases/stable/installmanual`
  - Web: `http://www.debian.org/releases/testing/installmanual` (work in progress, sometimes this may not exist)
  - Package: `Not available in install-doc: Bug#155374`
  - File: `DebianCDunder/doc/`

- Release Notes (primary)
  - A must-read before installation and upgrade even if you are experienced.
  - Web: `http://www.debian.org/releases/stable/releasenotes`
  - Web: `http://www.debian.org/releases/testing/releasenotes` (work in progress, sometimes this may not exist)
  - Package: `Not available in install-doc: Bug#155374`
  - File: `DebianCDunder/doc/`

- FAQ (secondary)
  - Frequently asked questions

  - Web: http://www.debian.org/doc/manuals/debian-faq/
  - Package: doc-debian
  - File: /usr/share/doc/debian/FAQ/index.html

- Debian Reference (secondary)
  - Most comprehensive post-install user manual
  - Web: http://www.debian.org/doc/manuals/debian-reference/
  - Package: debian-reference-en
  - File: /usr/share/doc/Debian/reference/

- APT HOWTO (secondary)
  - Detailed user guide for Debian package management. (Woody)
  - Web: http://www.debian.org/doc/manuals/apt-howto/
  - Package: apt-howto
  - File: /usr/share/doc/Debian/apt-howto/

- Securing Debian Manual (secondary)
  - Detailed user guide for securing and hardening of the default Debian installation. (Woody)
  - Web: http://www.debian.org/doc/manuals/securing-debian-howto/
  - Package: harden-doc
  - File: /usr/share/doc/harden-doc/html/securing-debian-howto/

- dselect Documentation for Beginners (secondary)
  - Tutorial for dselect
  - Web: http://www.debian.org/releases/woody/i386/dselect-beginner
  - Package: Not available in install-doc: Bug#155374
  - File: DebianCDunder/doc/

- Debian Policy Manual (primary)
  - Technical backbone of Debian.
  - Web: http://www.debian.org/doc/debian-policy/
  - Package: debian-policy
  - File: /usr/share/doc/debian-policy/

- Debian Developer's Reference (primary)
  - Basic knowledge for developers.
  - The rest of us should also browse this once.
  - Web: http://www.debian.org/doc/manuals/developers-reference/
  - Package: developers-reference
  - File: /usr/share/doc/developers-reference/

- Debian New Maintainers' Guide (primary)
  - Practical guide for developers.
  - Packaging tutorials for the rest of us.
  - Web: http://www.debian.org/doc/manuals/maint-guide/

  - Package: `maint-guide`
  - File: `/usr/share/doc/maint-guide/`

- Packaging Manual (Potato)
  - `packaging-manual` package in Potato. (Moved into appendix of *Developer's Reference*.)

- Unix-style manual pages (primary)
  - `dlocate -man` *`package-name`* (list available)
  - `man` *`section command-name`*

- GNU-style info pages (primary)
  - `info` (access top level)
  - `info` *`command-name`*

- Package-specific documents (primary)
  - Find them under `/usr/share/doc/`*`package-name`*

- LDP: Linux Documentation Project (secondary)
  - General Linux HOWTOs and mini-HOWTOs
  - Web: `http://www.tldp.org/`
  - Package: `doc-linux-text` and `doc-linux-html`
  - File: `/usr/share/doc/HOWTO/`

- Linux Gazette (secondary) – new issues monthly
  - The Linux Gazette
  - Web: `http://www.linuxgazette.com/`
  - Package: `lg-all` or `lg-latest-two`
  - File: `/usr/share/doc/lg/`

- DDP: Debian Documentation Project (secondary)
  - Debian-specific manuals
  - Web: `http://www.debian.org/doc/`

- Debian Developers' Corner (secondary)
  - Key information for Debian developers
  - Insightful for end users
  - Web: `http://www.debian.org/devel/`

- Source code (absolutely primary)
  - No one can argue with this :-)
  - Download source code following 'The source code' on page 10

- Internet Assigned Numbers Authority (primary)
  - Web: `http://www.iana.org/`
  - Package: `doc-iana`
  - File: `/usr/share/doc/doc-iana/`

- Internet requests for comments (IETF standards) (primary)
  - Web: http://www.ietf.org/rfc.html
  - Package: doc-rfc
  - File: /usr/share/doc/RFC/

The following references are available for Unix in general. Please note that there are some minor differences between different Unix systems. Device names and init methods need extra attention.

- *The UNIX Programming Environment*
  - The book to read to learn about how UNIX works.
  - By B. W. Kernighan and R. Pike
  - Published by Princeton Hall Software Series

- *The C Programming Language* (second edition)
  - The book to read to learn about ANSI C.
  - By B. W. Kernighan and D. M. Ritchie
  - Published by Princeton Hall Software Series

- *UNIX Power Tools*
  - The book to read to learn Unix tips.
  - By Jerry Peek, Tim O'Reilly, and Mike Loukides
  - Published by O'Reilly and Associates

- *Essential System Administration* (second edition)
  - The book to read to learn about Unix system administration for many Unix flavors.
  - By Aeleen Frisch
  - Published by O'Reilly and Associates

- *Linux: Rute User's Tutorial and Exposition*
  - A nice online and hardcover book covering GNU/Linux system administration.
  - By Paul Sheer
  - Published by Prentice Hall
  - Web: http://www.icon.co.za/~psheer/book/index.html.gz
  - Package: rutebook (from non-free)
  - File: /usr/share/doc/rutebook/

- Bell Labs: Computing Sciences Research
  - Rich archive of Unix history
  - Main: http://cm.bell-labs.com/cm/cs/
  - Selected technical reports: http://cm.bell-labs.com/cm/cs/cstr.html
  - Some papers: http://cm.bell-labs.com/cm/cs/papers.html

- Online Linux general support resources
  - Debian Planet (http://www.debianplanet.org/)
  - debianHELP (http://www.debianhelp.org/)

  - Linux.com (http://linux.com/)
  - The Linux Home Page at Linux Online (http://www.linux.org/)
  - Red Hat (commercial Linux vender) (http://www.redhat.com/) (RPM, Sys-V init)
  - SuSE, Inc. (commercial Linux vender) (http://www.suse.de/) (RPM, Sys-V init)
  - Slackware (http://www.slackware.com/) (TGZ, BSD-style init)

- Online general Unix guide and resources
  - The UNIX System by The Open Group (http://www.unix.org/)
  - A UNIX Introductory Course from Ohio State University (http://www-wks.acs.ohio-state.edu/unix_course/unix.html)
  - UNIXhelp from The University of Edinburgh (http://unixhelp.ed.ac.uk/)
  - Unix / Programming Information (http://arioch.unomaha.edu/~jclark/#info)
  - comp.unix.questions FAQ (http://www.faqs.org/faqs/unix-faq/faq/)
  - comp.unix.user-friendly FAQ (http://www.camelcity.com/~noel/usenet/cuuf-FAQ.htm)
  - FreeBSD Documentation (http://www.freebsd.org/docs.html)
  - The FreeBSD Handbook (http://www.freebsd.org/doc/en_US.ISO8859-1/books/handbook/index.html)
  - UNIX GUIDE (http://ieee.uow.edu.au/documents/)
  - The Unix Heritage Society (http://www.tuhs.org/)

- Free software project home pages
  - GNU Project (http://www.gnu.org/)
  - The Linux Documentation Project (http://www.tldp.org/)
  - The Linux Kernel Archives (http://www.linux.org/)
  - The XFree86 Project, Inc (http://www.xfree86.org/)
  - GNOME (http://www.gnome.org/)
  - K Desktop Environment (http://www.kde.org/)
  - GNU software at Red Hat (http://sources.redhat.com/)
  - Mozilla (http://www.mozilla.org)
  - FreeBSD (http://www.freebsd.org/)
  - OpenBSD (http://www.openbsd.org/)
  - NetBSD (http://www.netbsd.org/)

15.2 Finding the meaning of a word

Many words used in Debian are cryptic jargon or acronyms. The following will solve most questions:

```
$ dict put-a-weird-word-here
```

15.3 Finding the popularity of a Debian package

Many packages exist in Debian and it is sometimes difficult to know which one to try first. See Debian Popularity Contest Results (http://www.debian.org/~apenwarr/popcon/) to get insight into what others are using. Also install the `popularity-contest` package to contribute.

15.4 The Debian bug tracking system

The Debian distribution has a bug tracking system (BTS) (http://bugs.debian.org/) which files details of bugs reported by users and developers. Each bug is given a number, and is kept on file until it is marked as having been dealt with.

You should check to see whether your bug report has already been filed by someone else before submitting it. Lists of currently outstanding bugs are available on the World Wide Web (http://bugs.debian.org/) and elsewhere (http://www.debian.org/Bugs/Access). See also 'Check bugs in Debian and seek help' on page 83.

There may be many release-critical bug reports marked with **FTBFS**. This means "Fails To Build From Source".

Instructions for reporting a bug are given at http://www.debian.org/Bugs/Reporting.

15.5 Mailing lists

Read at least "debian-devel-announce" (English, read-only and low-traffic) to stay current with Debian.

The mailing lists of most interest to Debian users are "debian-user" (English, open and high-traffic) and other "debian-user-*language*" lists (for other languages).

For information on these lists and details of how to subscribe, see http://lists.debian.org/. Please check the archives for answers to your question prior to posting and also adhere to standard list etiquette.

If you do not wish to get CCed for the reply to your mailing list posting, use the `Mail-Followup-To:` header which is a very effective measure. This is the informal convention of mailing lists as explained in http://cr.yp.to/proto/replyto.html.

15.6 Internet Relay Chat (IRC)

IRC (Internet Relay Chat) is a way to chat with people from all over the world in real time. IRC channels dedicated to Debian can be found on the freenode (http://www.freenode.info/) IRC network. To connect, you need an IRC client. Some of the most popular clients are

XChat, BitchX, ircII, irssi, epic4, and KSirc, all of which have been packaged for Debian. Once you have the client installed, you need to tell it to connect to the server. In most clients, you can do that by typing:

```
/server irc.debian.org
```

Once you are connected, join channel #debian by typing

```
/join #debian
```

To leave channel #debian type

```
/part #debian
```

You can quit the irc client by typing

```
/quit
```

To send a private message "Hello Mr. Foo" to *foo* type

```
/msg foo Hello Mr. Foo
```

Note that anything you type without the preceding / is sent to the channel as a message.

Note: clients like XChat often have a different graphical user interface for joining servers/channels.

15.7 Search engines

There are many search engines that serve documentation related to Debian:

- Debian WWW search site (http://search.debian.org/).
- Google (http://www.google.com/): include "site:debian.org" as a search term.
- Google Groups (http://groups.google.com/): a search engine for newsgroups. Include "group:linux.debian.*" as a search term.
- AltaVista (http://www.altavista.com/)

For example, searching on the string "cgi-perl" gives a more detailed explanation of this package than the brief description field in its control file. See 'Check bugs in Debian and seek help' on page 83 for related advice.

15.8 Websites

The following are a few random URLs I collected for specific issues.

- IBM developerWorks: Linux (http://www.ibm.com/developerworks/linux/)
- Adrian Bunk's latest packages (back port to stable) (http://www.fs.tum.de/~bunk/)
- Linux on Laptops (http://www.linux-laptop.net/)
- Xterm FAQ (http://dickey.his.com/xterm/xterm.faq.html)
- EXT3 File System mini-HOWTO (http://www.zip.com.au/~akpm/linux/ext3/ext3-usage.html)
- Large File Support in Linux (http://www.suse.de/~aj/linux_lfs.html)
- Window Managers for X (http://www.xwinman.org)
- Linux USB Project (http://www.linux-usb.org/)
- SuSE pages for CJK (http://www.suse.de/~mfabian/suse-cjk/suse-cjk.html)
- LNX-BBC (Business-card-sized boot CD project) (http://www.lnx-bbc.org/)
- Linux info by Karsten Self (partitioning, backup, browsers...) (http://kmself.home.netcom.com/Linux/index.html)
- Backup info HOWTO by Alvin Oga (http://www.Linux-Backup.net/)
- Security info HOWTO by Alvin Oga (http://www.Linux-Sec.net/)
- Various UNOFFICIAL sources for APT (http://www.apt-get.org/)
- Laptop Ethernet Configuration (http://www.orthogony.com/gjw/lap/lap-ether-intro.html)

Appendix A

Appendix

A.1 Authors

Debian Reference was initiated by Osamu Aoki <osamu@debian.org> as a personal installation memo that was eventually called "Quick Reference . . . ". Many contents came from the archives of the "debian-user" mailing list. Also "Debian Installation Manual" and "Debian Release Notes" were referenced.

Following a suggestion from Josip Rodin, who is very active with the Debian Documentation Project (http://www.debian.org/doc/ddp) (DDP) and is the current maintainer of "The Debian FAQ", this document was renamed as "Debian Reference" and was merged with several chapters from the "The Debian FAQ" with reference-like contents. Then "Debian Quick Reference" was formed as an excerpt.

This document has been edited, translated, and expanded by the following QREF team members:

- English originals for original "Quick Reference. . . "
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  - Thomas Hood <jdthood@yahoo.co.uk> (network related)
  - Brian Nelson <nelson@bignachos.com> (especially X related)
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QREF was short for the original document title, "Quick Reference..." and also is the project name at qref.sourceforge.net.

Many manual pages and info pages on the Debian system were used as the primary references to write this document. To the extent Osamu Aoki considered within the fair quotation stature, many parts of them, especially command definitions, were used as phrase pieces after careful editorial efforts to fit them into the style and the objective of this document.

Most of the contents of 'Debian fundamentals' on page 5 originally came from "The Debian FAQ" (March 2002):

- 5. The Debian FTP archives: `ftparchives.sgml` (entire chapter)
- 6. Basics of the Debian Package Management System: `pkg_basics.sgml` (entire chapter)
- 7. The Debian Package Management Tools: `pkgtools.sgml` (entire chapter)
- 8. Keeping Your Debian System Up To Date: `uptodate.sgml` (entire chapter)
- 9. Debian and the kernel: `kernel.sgml` (entire chapter)
- 10. Customizing your installation of Debian GNU/Linux: `customizing.sgml` (part of chapter)

These sections of "The Debian FAQ" were included in this document after major reorganization to reflect changes in the Debian system. Both documents are updated concurrently now.

The original "Debian FAQ" was made and maintained by J. H. M. Dassen (Ray) and Chuck Stickelman. Authors of the rewritten "Debian FAQ" are Susan G. Kleinmann and Sven Rudolph. After them, "The Debian FAQ" was maintained by Santiago Vila. The current maintainer is Josip Rodin.

Parts of the information for "The Debian FAQ" came from:

- The Debian-1.1 release announcement, by Bruce Perens (`http://www.perens.com/`).
- The Linux FAQ, by Ian Jackson (`http://www.chiark.greenend.org.uk/~ijackson/`).
- Debian Mailing List Archives (`http://lists.debian.org/`),
- the dpkg programmers' manual and the Debian Policy manual (see 'References' on page 247)
- many developers, volunteers, and beta testers, and
- the flaky memories of its authors. :-)

Some parts of "Tutorial" section were derived from

- "Debian Tutorial" by Havoc Pennington, Oliver Elphick, Ole Tetlie, James Treacy, Craig Sawyer, and Ivan E. Moore II. (This document was derived from "Linux User's Guide" by Larry Greenfield.)
- "Debian GNU/Linux: Guide to Installation and Usage" by John Goerzen and Ossama Othman.

The authors would like to thank all those who helped make this document possible.

A.2 Warranties

Since I am not an expert, I do not pretend to be fully knowledgeable about Debian or Linux in general. Security considerations I use may only be applicable for home use.

This document does not replace any authoritative guides.

All warranties are disclaimed. All trademarks are property of their respective trademark owners.

A.3 Feedback

Comments and additions to this document are always welcome. Please send email to the Debian BTS system (`http://bugs.debian.org/`) under the `debian-reference` package or under the respective translation packages. Use of `reportbug` makes it easy to file a thorough bug report. You may still send email to Osamu Aoki (`http://people.debian.org/~osamu/`) at `<osamu@debian.org>` in English or to each translator in their respective language.

Although I used to live in the USA, I am a non-native English user. Any grammatical corrections are welcomed.

The best feedback is a patch against the SGML version, but a patch against the text version is also welcomed. See 'Official document' on page 1 for the official document site.

The original SGML files used to create this document are also available in CVS at: `:pserver:anonymous@cvs.sf.net/cvsroot/qref` or `http://qref.sourceforge.net/Debian/qref.tar.gz`.

A.4 Document format

This document was written using the DebianDoc SGML DTD (rewritten from LinuxDoc SGML). The DebianDoc SGML system enables us to create files in a variety of formats from one source, e.g. this document can be viewed as HTML, plain text, TeX DVI, PostScript, PDF, and GNU info.

Conversion utilities for DebianDoc SGML are available in the Debian package `debiandoc-sgml`.

A.5 The Debian maze

The Linux system is a very powerful computing platform for a networked computer. However, learning how to use all its capabilities is not easy. Setting up the printer is a good example.

There is a complete, detailed map called the "SOURCE CODE". This is very accurate but very hard to understand. There are also references called HOWTO and mini-HOWTO. They are easier to understand but tend to give too much detail and lose the big picture. I sometimes have a problem finding the right section in a long HOWTO when I need a few commands to invoke.

In order to navigate through this maze of Linux system configuration, I started writing down simple reminder memos in text file format as my quick reference. This list of memos grew larger and I learned debiandoc in the meantime. The product is this *Debian Reference*.

A.6 The Debian quotes

Here are some interesting quotes from the Debian mailing list.

- "This is Unix. It gives you enough rope to hang yourself." —Miquel van Smoorenburg `<miquels@cistron.nl>`
- "Unix IS user friendly... It's just selective about who its friends are." —Tollef Fog Heen `<tollef@add.no>`