Plural Operating System
Volume 1:
User's Manual

Table of Contents

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2 Introduction

Welcome to the world of high performance, real-time distributed computing. Plural offers advanced second-generation μ-kernel architecture, SMP optimized modules and utilities, and seamlessly integrated distributed computing in a POSIX environment. Furthermore, Plural is freely distributed under the GNU General Public License and includes full source code.

Throughout this document text in the following format means that it is output from the system and is displayed on your screen.

```
This is an example of output from the system
```

Text that is intented to be typed on the command line is written in the following format and is usually preceded by the $ symbol:

```
$ this is an example of something you have to type
```

2.1 System Requirements

Plural can run on older machines without a lot of resources, the minimum system requirements for running Plural include:

- i386
- 8Mb RAM
- 20Mb disk space

To get the most out of plural it is recommended that you have at least the following:

- Pentium III or better
- 64Mb RAM
- 100Mb disk space

2.2 Getting Help

3 Installation

Installation will be written later when the system begins to become stable.

3.1 Making an install CD-ROM

3.1.1 Using an ISO image

4 Getting Started

4.1 Logging into the system

The first step to using the system is to log in. To log into the system you need to type in your user name and password at the prompts given. Note that your user name and password are case sensitive. During the installation you were asked to set the root password and had the option of setting up user accounts. It is recommended that you use your user account most of the time while using the root account only when needed. If you did not create any user accounts during the installation, you can log in at the prompt with the user name `root` and the password that you specified during installation. It is recommended that after you log in as root you create a user account and then log in as that user instead of using the root account. See section 4.3 Setting up a user account on page 14 for more information.

```
Plural version 0.0.20 (build 43 by brad@plural-os.org on 01/03/03 at 13:38)
2 - Pentium III @ 1022Mhz

beast login:
password:
```

The top line tells the version number and who and when the kernel was built. The second line tells what processors are in the machine and what clock speed they run at. When you type your password, the characters will be displayed as * so that no one that may be looking over your shoulder can read what you typed.

```
beast:~$
```

After you log into the system you will get a command prompt. For user accounts, the command prompt will end with $, for the root account the command prompt will end with #. The word *beast* in the example about is the network hostname that the computer is on. If the computer is not on a network and does not have a hostname, *localhost* is used instead. The part after the colon, the ~ in this example is current working directory that you are at. In Plural, as in most Unix system, ~ represents the users home directory.

4.2 Logging out of the system

To log out of the system, just type *logout*, or *exit* at the command prompt.

```
beast:~$ logout
```

This will end your session and bring you back to the login screen.

4.3 Setting up a user account

If you did not setup a user account during installation, you can do so by logging in as root and typing the following command:

```
beast:~# adduser tom
enter password:********
re-enter password:********
user 'tom' added
beast:~#
```

Now you can log out of the root account and log back in using your new user account.

4.4 Shutting down your machine

Turning off your machine without properly shutting down the operating system can cause damage to the file system. To properly shut down the system you can either press the CTRL, ALT, and DEL keys, or you can use the *shutdown* command. Either way, a series of messages will appear on your screen and then the system will reboot. At

this point it is safe to turn off the computer. For example:

```
beast:~: shutdown
The system is going down for reboot
Terminating all processes...done
Unmounting file systems...done
Rebooting...
```

At this point the machine will reboot.

4.5 Customizing your system

5 File System

5.1 Files

5.1.1 File Permissions

File permissions, as shown in the *ls* (section 6.1.1 Getting a file listing on page 19) command are represented as nine letters. A typical regular files permission bits would appear as:

```
-rw-r--r--
```

And a directory entry might appear as:

```
drwxr-xr-x
```

The first letter describes special attributes of the file. The following letters are used for file types:

b	File is a block device
c	File is a character device
d	File is a directory
h	File is a hard link
s	File is a soft link

Table 5.1 File Types

If the file is a directory, then the letter 'd' will be in this first column. If this field is a '-' then the entry is a regular file. The meanings of other letters in this field are discussed later in this document. The next three letters describe the permissions that the owner of the file has to the file. The second three letters descibe the permissions that the group that controls the file has and the last three letters descibe the permissions that all other users have to the file. The three letters are in groupings of the letters 'rwx' . 'r' means that the file can be read, 'w' means the file can be written to and 'x' means the file can be executed. If any of these three are replaced by a '-' then the action for that letter is not allowed. For example, a letter grouping of 'r--' means that the file is read-only.

5.2 Directories

The directory structure of Plural is much the same as a typical Unix® system. The root directory is represented with the */* symbol. All other directories are located within the root directory. Even when there is more than one hard disk in the system.

5.2.1 The . and the .. directory

The . directory refers to the current directory and the .. directory refers to the parent of the working directory. For example, if the current directory is */usr/bin*, then the . directory refers to the */usr/bin* directory and the .. directory referes to the */usr* directory.

5.2.2 Directory Structure

5.2.2.1 /bin

This directory contains system programs. These programs are the basic utilities needed for normal system operation.

5.2.2.2 /boot

This directory contains the files that are necessary to boot the operating system.

5.2.2.3 /dev

This directory contains special device files that represent actual devices connected to your computer.

5.2.2.4 /etc

This directory contains configuration files for the system.

5.2.2.5 /home

This directory is where each user of the systems personal files are stored.

5.2.2.6 /lib

This directory contains library files that are needed for normal system operation.

5.2.2.7 /mnt

This directory is where other file systems may be mounted. Usually floppy drives, and cdrom drives are mounted here. File systems are not limited to being mounted to this directory however.

5.2.2.8 /proc

The files in this directory are not real files and do not exist on your hard drive. They represent information and variables in the operating system kernel. The files that are read-only contain information about your system. The files that are writable can change kernel variables and settings.

5.2.2.9 /sbin

This directory contains system programs. The programs that are in this directory are required for normal system operation. Many of these programs can change vital system settings and therefore only executable by the superuser.

5.2.2.10 /tmp

This directory is for temporary files that programs use during execution. The contents of this directory is deleted every time the system boots.

5.2.2.11 /usr

This directory is for user programs and data. It contains several subdirectories.

5.2.2.11.1 /usr/bin

This directory contains the executable files for user programs.

5.2.2.11.2 /usr/doc

This directory contains documentation files for various programs on the system.

5.2.2.11.3 /usr/lib

This directory contains library files used by user level programs

5.2.2.11.4 /usr/local

For systems that have a */usr* directory on a network shared by multiple machines, this directories represents the */usr* directory for the local machine. When a system is not on a network or does not have a remote */usr* directory, this directory is often unused, or is often used to install a second version of a program already installed in the */usr* directory. This is a safe place to install a program without risk of corrupting the system.

5.2.2.11.5 /usr/man

This directory contains the system manuals that are viewable by the *man* command.

5.2.2.11.6 /usr/share

This directory contains data that can be shared among several programs.

5.2.2.12 /var

5.2.2.12.1 /var/log

This directory is where logs are saved by programs and by the operating system.

6 Commands

The $ symbol is used to represent the command line prompt. The actual command line prompt will vary from system to system. Most commands have many options that are not fully covered in this document. The option -help will give a brief description of what the command does, how the command is to be used, and the options that it supports. Also, for a complete description of a command, read the man page by entering the following command:

```
$ man command
```

Replace the word *command* with the name of the command that you wish to get help on and a manual page for the given command will be displayed.

6.1 Working with files and directories

6.1.1 Getting a file listing

The *ls* command list can tell you what files are on your system. For example, the following will give a listing of all files and directories that are in your current directory:

```
beast:~$ ls
total 24576
drwxr-xr-x   4 tom       tom          4096 Jan 02 2003 .
drwxr-xr-x  32 tom       tom          4096 Jan 02 2003 ..
drwxr-xr-x   2 tom       tom          4096 Jan 02 2002 memos/
drwxr-xr-x   2 tom       tom          4096 Jan 02 2002 work/
-rw-r--r--   1 tom       tom           153 Jan 02 2002 memo-1.txt
-rw-r--r--   1 tom       tom           489 Jan 02 2002 memo-2.txt
```

The first line tells the total number of bytes used on disk for this directory. This number will vary depending on the file system that is used. For the example above, files take a minimum of 4Kb each. So a file like *memo-1.txt* which is 153 bytes in size actually takes 4,096 bytes on the disk. The rest of the rows of the listing give information about each file or directory.

- The first column tells the permission bits. The permission bits are described in the section 5.1.1 File Permissions on page 16.

- The second column tells the number of entries that are in a directory. If the entry is a file, then this field will be 1.

- The third column tells the owner of the file.

- The fourth column tells what group controls the file.

- The fifth column tells the file size in bytes.

- The sixth column tells the date and/or time that the file was last modified. If the file was modified today, then only the time will be shown. If the file was modified this year, then the month, day and time will be shown. Otherwise, the month, day, and year will be shown.

- The last column is the name of the file.

6.1.2 Copying files

The *cp* command copies files. In the following example, *memo-1.txt* will be copied to the name *memo-2.txt*:

```
beast:~$ cp memo-1.txt memo-2.txt
```

In this next example the *memo-1.txt* file will be copied to the *memos/* directory. Note that the trailing slash at the end of the word *memo*s is not required but using the slash will prevent overwriting in the case were *memos* was a file and not a directory.

```
beast:~$ cp memo-1.txt memos/
```

The *cp* command can also be used to copy the entire contents of a directory as in this next example, the *memos/* directory and it's contents will be copied into the *work/* directory. The *-r* option tells *cp* to be "recursive," in other words, to copy all files and directories in the *memos/* directory.

```
beast:~$ cp -r memos/ work/
```

Now, all the files in the *memos/* directory are also in the *work/memos/* directory. Note that modifying *memos/memo-1.txt* does not modify *work/memos/memo-1.txt*, they are now two seperate files. To make the same file appear at different locations, refer to the *ln* command (section 6.1.7 Linking Files on page 21).

6.1.3 Removing files

The *rm* command is used for removing files. In the following example the file *memo-1.txt* will be deleted.

```
beast:~$ rm memo-1.txt
```

You can specify multiple files to delete as in this next example,

```
beast:~$ rm memo-1.txt memo-2.txt
```

Which would remove both *memo-1.txt* and *memo-2.txt* files. The *-r* option, as with the *cp* command works recursively and can remove entire directories.

```
beast:~$ rm -r memos/
```

This command would remove all the files in the *memos/* directory as well as the *memos/* directory itself.

6.1.4 Moving Files

The *mv* command is used to move files. To move a file you could copy it using the *cp* command then remove the original with the *rm* command, but the *mv* command does this in one step and is much faster. In the following example, *memo-1.txt* will be moved into the *memos/* directory.

```
beast:~$ mv memo-1.txt memos/
```

The mv command can also move a directory to another directory, for example:

```
beast:~$ mv memos/ work/
```

The *memos/* directory is now located at the *work/memos/* directory. Note that unlike the cp command, after the above command is executed, the *memos/* directory no longer exists, the directory and all the files it contains are now at *work/memos/*.

The *mv* command doubles as a tool to rename files as in this next example, the file was saved with the misspelled name *emo-1.txt* which should have been *memo-1.txt*. This could be corrected by typing the following command:

```
beast:~$ mv emo-1.txt memo-1.txt
```

You can specify multiple files to be moved to one directory with the *mv* command as in the next example.

```
beast:~$ mv memo-1.txt memo-2.txt memos/
```

Both *memo-1.txt* and *memo-2.txt* will now be in the *memos/* directory.

6.1.5 Making Directories

The *mkdir* command is used for creating new directories. In the following example, the directory *memos/* will be created.

```
beast:~$ mkdir memos/
```

6.1.6 Removing Directories

The *rmdir* command is used for removing directories. In the following example the directory *memos/* will be deleted.

```
beast:~$ rmdir memos/
```

This command will delete the directory called *memos/*. The *rmdir* command only removes directories, not files, so if the *memos/* directory has any files in it you will have to delete them first with the *rm* command before you can use the *rmdir* command to remove the directory.   Note that a simpler way of doing removing directories that contain files is to use the *-r* option with the *rm* command. See section 6.1.3 Removing files on page 20 for an explanation on how to do this.

6.1.7 Linking Files

The *ln* command can link files together. By default, the *ln* command creates hard links.

6.1.7.1 Hard Links

Hard linked files have different directory entries, but share the same blocks on the hard disk. If you delete a file that is hard linked to another file, only the directory entry for that file is deleted. When using the ls command, the permission bit set will tell you a file is a hard linked to another file by the 'h' as the first character of the set (see section 5.1.1 File Permissions on page 16 for details).

6.1.7.2 Soft Links

Soft linked files (or symbolic links) are file entries that tell the operating system where to find the real file. When using the *ls* (section 6.1.1 Getting a file listing on page 19) command, the permission bit set will tell you a file is a soft link by the 's' as the first character in the set (see section 5.1.1 File Permissions on page 16 for details).

6.2 Getting information about the system

There are various commands that you can use to get answers to questions about the system that you are on.

6.2.1 What is my user name?

The *whoami* command simply prints your user name. For example,

```
beast:~$ whoami
brad
```

6.2.2 Who is on the system?

The *who* command

The *whois* command

6.2.3 How long has the system been running?

The *uptime* command

```
beast:~$ uptime
4 days, 3 hours, 12 minutes, 22.43 seconds
```

6.2.4 What programs are currently running?

The *ps* command

6.2.5 What terminal am I on?

The *tty* command

6.2.6 What is this machines host name?

The *hostname* command

6.2.7 What is this machines domain name?

The *domainname* command