

PlasticFS

Reference Manual

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This document describes PlasticFS version 1.11
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NAME

PlasticFS – The Plastic File System

DESCRIPTION

The Plastic File System is an LD_PRELOAD module for manipulating what the file system looks like for programs. This allows virtual file systems to exist in user space, without kernel hacks or modules.

chroot The *chroot* filter may be used to simulate the effects of the *chroot(2)* system call. It is usually used in combination with other filters.

dos The *dos* filter may be used to simulate an 8.3 DOS filesystem.

downcase

The *downcase* filter may be used to make file names appear to be in lower-case when listed. File names are case-insensitive when being opened, *etc.*

log The *log* filter may be used to transparently log file system access, similar to the *strace(1)* program.

nocase The *nocase* filter may be used to make file names appear to be case-insensitive when being opened, *etc.*

shortname

The *shortname* filter may be used to simulate file systems with shorter filenames.

smartlink

The *smartlink* filter may be used to expand environment variables in symbolic links, using the usual *\$name* notation.

titlecase The *downcase* filter may be used to make file names appear to be capitalized when listed. File names are case-insensitive when being opened, *etc.*

upcase The *upcase* filter may be used to make file names appear to be in upper-case when listed. File names are case-insensitive when being opened, *etc.*

viewpath

The *viewpath* filter may be used to union all the directory trees in a view path, so that they appear to be a single directory tree.

Filters may be piped on into the next to form powerful combinations.

It is possible to extend PlasticFS with loadable file system filter modules from shared object files.

The implementation of PlasticFS is strongly tied to GNU Libc, so it is probably Linux specific.

ARCHIVE SITE

The latest version of *plasticfs* is available on the Web from:

URL:	http://plasticfs.sourceforge.net/	
File:	plasticfs.html	# the plasticfs page
File:	plasticfs-1.11.README	# Description, from the tar file
File:	plasticfs-1.11.lsm	# Description, LSM format
File:	plasticfs-1.11.spec	# RedHat package specification
File:	plasticfs-1.11.tar.gz	# the complete source
File:	plasticfs-1.11.pdf	# Reference Manual

BUILDING PlasticFS

Full instructions for building *plasticfs* may be found in the *BUILDING* file included in this distribution.

USING PlasticFS

See *plasticfs(3)* for how to make use of PlasticFS on your system.

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plasticfs version 1.11

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RELEASE NOTES

This section details the various features and bug fixes of the various releases. For excruciating and complete detail, and also credits for those of you who have generously sent me suggestions and bug reports, see the *etc/CHANGES.** files.

Release 1.11 (7-Jul-2007)

- The problems with tabs in the Makefile have been fixed.

Release 1.10 (6-Jul-2007)

- The following SourceForge bugs have been fixed: 1120110, 1747933, 1747971, and 1748056.
- A problem with the `errno` symbol has been fixed.
- Build problems on machines without `<bits/libc-lock.h>` have been fixed to use pthreads locks instead.
- Build problems on 64-bit machines have been fixed.
- The project has been updated to use version 3 of the GNU GPL.
- There is better use of multithreaded I/O in the open hook.

Release 1.9 (6-Jul-2004)

- A bug has been fixed in the viewpath filter's `readdir` function. It now correctly deals with `.whiteout` and removed entries.
- The code has been updated to compile under GCC 3.4.
- A bug has been fixed in the 64-bit file locking. Not all `fcntl(2)` commands were handled.

Release 1.8 (16-Jan-2004)

- Notes have been added about overcoming the glibc 2.x hidden symbols problem. See the BUILDING file or the Reference Manual for more information.

Release 1.7 (3-Mar-2003)

- Several GCC 3.2 build problems have been fixed.

Release 1.6 (28-Feb-2003)

- A bug has been fixed in the viewpath filter which allowed removed (whiteout-ed) files to be opened, even when `ls` couldn't see them.
- A bug has been fixed in the reference counted string code, which resulted in dereferencing uninitialized pointers, resulting in segfaults.

Release 1.5 (3-Feb-2003)

- The bug on Debian 2.2 (and possibly other distributions) which resulted in a segfault has been fixed.
- Intercept have been added for the `truncate(2)` and `ftruncate(2)` system calls.
- There is a new `shortname` file system filter which may be used to simulate file systems with short file names. By default it imitates V7 unix, with 14 character filenames.
- There is a new `dos` file system filter, which may be used to make a Unix file system look like an 8.3 DOS file system.

Release 1.4 (24-Jan-2003)

- An attempt has been made to fix a problem which sometimes caused `plasticfs::getcwd` to segfault. It appears that it may have been caused by over-zealous optimization by the compiler, so the addition of some strategic "volatile" keywords is an attempt to fix it.
- Several build problems have been fixed.
- A problem has been fixed which caused recent versions of GNU find to work incorrectly.
- The problem which caused the `chroot` filter to constantly print an error message has been fixed.
- A `stafs(2)` intercept has been added, so the `df(1)` command is happier.
- The `nocase`, `upcase`, `downcase` and `titlecase` file system filters have been added. These filters cause filename to appear to be case-insensitive. In addition, each of the filters except `nocase` converts the characters of filenames according to their names (upper-case, lower-case and capitalized, respectively).

Release 1.3 (16-Jan-2003)

- A bug has been fixed with the handling of "." in pathnames.
- The `chroot` file system filter has been added. This may be used to change the apparent root of the file system.
- A bug has been fixed which caused the PLASTICFS environment to be parsed exactly backwards.
- The viewpath copy-on-write functionality now only copies regular files. Devices are not copied when opened for writing. Also, file copies are unlinked if there was any problem with the copying, rather than leave incomplete copies to confuse future operations.

Release 1.2 (13-Jan-2003)

- Code has been added so that if the effective user ID is `root` (0) then PlasticFS does absolutely nothing; the program sees the real file system, not the plastic one. This is to prevent PlasticFS being used to subvert security.
- The viewpath copy-on-write functionality now preserves the file's modification time and last access time.
- An intercept has been added for the `access(2)` system call.
- A bug in the viewpath filter has been fixed which caused it to have problems removing directories.
- A bug in the viewpath filter has been fixed which caused it to incorrectly follow symbolic links *outside* the mount point.
- An intercept has been added for the `execve(2)` system call, and the `execl(3)`, `execlp(3)`, `execle(3)`, `execv(3)` and `execvp(3)` functions.
- The `smartlink` filter has been added, which expands shell variables in symbolic links.
- Intercepts have been added for the `utime(2)`, `ltime(2)` and `futime(2)` system calls.

Release 1.1 (8-Jan-2003)

First public release.

NAME

PlasticFS – The Plastic File System

SPACE REQUIREMENTS

You will need about 3MB to unpack and build the *PlasticFS* package. Your milage may vary.

BEFORE YOU START

There are a few pieces of software you may want to fetch and install before you proceed with your installation of PlasticFS.

GNU Groff

The documentation for the *PlasticFS* package was prepared using the GNU Groff package (version 1.14 or later). This distribution includes full documentation, which may be processed into PostScript or DVI files at install time – if GNU Groff has been installed.

GCC

You may also want to consider fetching and installing the GNU C Compiler if you have not done so already. This is not essential. PlasticFS was developed using the GNU C++ compiler, and the GNU C++ libraries.

Note: There appear to be problems with GCC 3.0 and later. If you are experiencing problems, try turning off all optimization. If you have the option, use one of the older (2.96) versions.

GNU Libtool

The shared library is created using GNU Libtool. It is assumed to be installed in the \$PATH.

The GNU FTP archives may be found at `ftp.gnu.org`, and are mirrored around the world.

SITE CONFIGURATION

The **PlasticFS** package is configured using the *configure* program included in this distribution.

The *configure* shell script attempts to guess correct values for various system-dependent variables used during compilation, and creates the *Makefile* and *include/config.h* files. It also creates a shell script *config.status* that you can run in the future to recreate the current configuration.

Normally, you just *cd* to the directory containing *PlasticFS*'s source code and then type

```
% ./configure
...lots of output...
%
```

If you're using *csh* on an old version of System V, you might need to type

```
% sh configure
...lots of output...
%
```

instead to prevent *csh* from trying to execute *configure* itself.

Running *configure* takes a minute or two. While it is running, it prints some messages that tell what it is doing. If you don't want to see the messages, run *configure* using the quiet option; for example,

```
% ./configure --quiet
%
```

To compile the **PlasticFS** package in a different directory from the one containing the source code, you must use a version of *make* that supports the *VPATH* variable, such as *GNU make*. *cd* to the directory where you want the object files and executables to go and run the *configure* script. *configure* automatically checks for the source code in the directory that *configure* is in and in *..* (the parent directory). If for some reason *configure* is not in the source code directory that you are configuring, then it will report that it can't find the source code. In that case, run *configure* with the option `--srcdir=DIR`, where *DIR* is the directory that contains the source code.

By default, *configure* will arrange for the *make install* command to install the **PlasticFS** package's files in */usr/local/bin*, and */usr/local/man*. There are options which allow you to control the placement of these files.

- `--prefix=PATH`
This specifies the path prefix to be used in the installation. Defaults to `/usr/local` unless otherwise specified.
- `--exec-prefix=PATH`
You can specify separate installation prefixes for architecture-specific files. Defaults to `${prefix}` unless otherwise specified.
- `--bindir=PATH`
This directory contains executable programs. On a network, this directory may be shared between machines with identical hardware and operating systems; it may be mounted read-only. Defaults to `${exec_prefix}/bin` unless otherwise specified.
- `--mandir=PATH`
This directory contains the on-line manual entries. On a network, this directory may be shared between all machines; it may be mounted read-only. Defaults to `${prefix}/man` unless otherwise specified.

`configure` ignores most other arguments that you give it; use the `--help` option for a complete list.

On systems that require unusual options for compilation or linking that the *PlasticFS* package's `configure` script does not know about, you can give `configure` initial values for variables by setting them in the environment. In Bourne-compatible shells, you can do that on the command line like this:

```
$ CXX='g++ -traditional' LIBS=-lposix ./configure
...lots of output...
$
```

Here are the `make` variables that you might want to override with environment variables when running `configure`.

Variable: CXX

C++ compiler program. The default is `c++`.

Variable: CPPFLAGS

Preprocessor flags, commonly defines and include search paths. Defaults to empty. It is common to use `CPPFLAGS=-I/usr/local/include` to access other installed packages.

Variable: INSTALL

Program to use to install files. The default is `install` if you have it, `cp` otherwise.

Variable: LIBS

Libraries to link with, in the form `-lfoo -lbar`. The `configure` script will append to this, rather than replace it. It is common to use `LIBS=-L/usr/local/lib` to access other installed packages.

If you need to do unusual things to compile the package, the author encourages you to figure out how `configure` could check whether to do them, and mail diffs or instructions to the author so that they can be included in the next release.

BUILDING PlasticFS

All you should need to do is use the

```
% make
...lots of output...
%
```

command and wait.

If you have GNU Groff installed, the build will also create a *etc/reference.ps* file. This contains the README file, this BUILDING file, and all of the man pages.

You can remove the program binaries and object files from the source directory by using the

```
% make clean
...lots of output...
%
```

command. To remove all of the above files, and also remove the *Makefile* and *include/config.h* and *config.status* files, use the

```
% make distclean
...lots of output...
%
```

command.

The file *etc/configure.in* is used to create *configure* by a GNU program called *autoconf*. You only need to know this if you want to regenerate *configure* using a newer version of *autoconf*.

TESTING PlasticFS

The *PlasticFS* package comes with a test suite.

The test *will* fail if you run them as *root*. They are supposed to, because PlasticFS does nothing for *root*, it's a security thing (see *plasticfs(3)* for more information). Run the tests as a normal user.

To run the test suite, use the command

```
% make sure
...lots of output...
Passed All Tests
%
```

The tests take a few seconds each, with a few very fast, and a couple very slow, but it varies greatly depending on your CPU.

If all went well, the message

```
Passed All Tests
```

should appear at the end of the make.

INSTALLING PlasticFS

As explained in the *SITE CONFIGURATION* section, above, the *PlasticFS* package is installed under the */usr/local* tree by default. Use the `--prefix=PATH` option to *configure* if you want some other path. More specific installation locations are assignable, use the `--help` option to *configure* for details.

All that is required to install the *PlasticFS* package is to use the

```
% make install
...lots of output...
%
```

command. Control of the directories used may be found in the first few lines of the *Makefile* file and the other files written by the *configure* script; it is best to reconfigure using the *configure* script, rather than attempting to do this by hand.

GLIBC

The GNU C Library, *glibc*, has some features in version 2.2 and later which make PlasticFS cease to work correctly. These features ensure that the `libc.so` DSO loads as fast as possible, to the benefit of all applications. This is accomplished by using a hidden PLT. This is the default configuration of the GNU C Library. For PlasticFS to work correctly, you need a version of `libc.so` without the hidden PLT.

To build a version of `libc.so` without the hidden PLT, you need to have the sources for the *exact* version of the GNU C Library on your system.

Most people use one of the Linux distributions, such a RedHat Linux. (If you built your own Linux, you probably stopped reading already.) Get your install disks and install the sources for the *glibc* package, the one with *exactly* the same version as is currently installed on your system.

2.3 Series

There is an undocumented `glibc ./configure --disable-hidden-plt` option which causes `glibc not` to use a hidden PLT.

It is necessary to rebuild `glibc` using *exactly* the options used by the distribution maker. In the case of options used by RPM, and all the distributions which use it, it is only necessary to read the `spec` file. The only change is to add the `./configure --disable-hidden-plt` option.

At the end of the build there is a file called `libc.so` in the top-level of the build directory. Install this next to the real `libc.so` as `libc.nohidden.so` to be used at the end of all `LD_PRELOAD` settings. Make sure it has the same owners and modes as the real `libc.so` file.

When you upgrade you system, you will have to remember do do this all over again.

2.2 Series

This is the same as the 2.3 case, except that there is no convenient `glibc ./configure --disable-hidden-plt` option.

It is necessary to patch `include/libc-symbols.h` as follows

```
--- libc-symbols.h.orig 2003-07-07 21:31:22.000000000 +1000
+++ libc-symbols.h      2003-07-07 21:31:43.000000000 +1000
@@ -470,8 +470,7 @@
     versioned_symbol (libc, __real_foo, foo, GLIBC_2_1);
     libc_hidden_ver (__real_foo, foo) */

-#if defined SHARED && defined DO_VERSIONING \
-    && !defined HAVE_BROKEN_ALIAS_ATTRIBUTE
+#if 0
+    # ifndef __ASSEMBLER__
+    #  ifdef HAVE_BROKEN_VISIBILITY_ATTRIBUTE
+    #    define __hidden_proto_hiddenattr
```

This is the net result of the `NO_HIDDEN` define present in `glibc 2.3`, and activated by the `./configure --disable-hidden-plt` option. It isn't available in 2.2, so we have to fake it.

It is then necessary to rebuild `glibc` using *exactly* the options used by the distribution maker. In the case of options used by RPM, and all the distributions which use it, it is only necessary to read the `glibc spec` file.

At the end of the build there is a file called `libc.so` in the top-level of the build directory. Install this next to the real `libc.so` as `libc.nohidden.so` to be used at the end of all `LD_PRELOAD` settings.

Using `libc.nohidden.so`

The `LD_PRELOAD` environment variable is actually a space-separated list of file names (see `ld.so(8)` for more information), searched in the order given. To use `PlasticFS` you need to see the `LD_PRELOAD` environment variable as follows:

```
LD_PRELOAD="libplasticfs.so libc.nohidden.so"
```

Note that of you are going to preserve any existing preloaded modules, you need to ensure that `libc.nohidden.so` remains at the *end*, and you new module is at the beginning, something like

```
LD_PRELOAD="libplasticfs.so $LD_PRELOAD libc.nohidden.so"
```

should do what you need.

Debian

To rebuild `glibc` for a Debian based system, follow the usual instructions about building packages.

```
apt-get install fakeroot dpkg-dev
apt-get build-deps glibc
apt-get source glibc
cd glibc-2.3.6
```

At this point you should see a `glibc-2.3.6` directory (or whatever the appropriate version number is).

You need to edit the `debian/rules.d/build.mk` file

```
--- rules.d/build.mk      2006-07-22 11:42:22.000000000 +1000
+++ rules.d/build.mk      2006-07-22 11:07:49.000000000 +1000
```

```
@@ -62,6 +62,7 @@
--build=$$configure_build --prefix=/usr --without-cvs
```

```
touch $@
```

and then build as normal...

```
dpkg-buildpackage -rfakeroot -b
```

Once it is built, extract the `libc.so` file, and install it as `libc.nohidden.so`

```
cp build-tree/i386-i686/libc.so /lib/libc.nohidden.so
```

you should be all set.

Replacing libc.so

This is *dangerous*. This will make your system *slower*. Still want to? Make sure you have a rescue disk handy in case your system no longer works after the reboot and you have to put the original `libc.so` back. You did keep a copy, didn't you?

GETTING HELP

If you need assistance with the *PlasticFS* package, please do not hesitate to contact the author at

```
Peter Miller <millerp@canb.auug.org.au>
```

Any and all feedback is welcome.

When reporting problems, please include the version number given by the

```
% PlasticFS -version
```

```
PlasticFS version 1.11.D002
```

```
...warranty disclaimer...
```

```
%
```

command. Please do not send this example; run the program for the exact version number.

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PlasticFS version 1.11

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Version 3, 29 June 2007

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1. Source Code.

The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work.

A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

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NAME

plasticfs – The Plastics File System

SYNOPSIS

```
LD_PRELOAD=libplasticfs.so PLASTICFS="..."
```

DESCRIPTION

The Plastic File System is an LD_PRELOAD module for manipulating what the file system looks like for programs. This allows virtual file systems to exist in user space, without kernel hacks or modules.

LD_PRELOAD

In order to have the Plastics File System operate, you must set the LD_PRELOAD environment variable to include `libplasticfs.so`, so that it is loaded when you rprogram is loaded, and intercepts the system calls which operate on files. The values of LD_PRELOAD is a space separated list of such modules (see *ld.so(8)* for more information). Set it like this:

```
LD_PRELOAD="$LD_PRELOAD libplasticfs.so"
```

You may need to *export* the definition, too, but it is more usually used as a program prefix (see *sh(1)* for more information).

Note that programs which are set-uid or set-gid will see no effect. This is to ensure that PlasticFS cannot be used to subvert operating system security. All programs executed by *root* will also see no effect, for the same reason.

PLASTICFS

By default, PlasticFS does nothing at all. In order to have PlasticFS change the appearance of your file system, you must specify a list of filters using the PLASTICFS environment variable.

The value of this environment variable is very similar to a shell pipe specification:

```
filter1 | filter2 | etc
```

That is, if you specify more than one filter, the user's file actions will be passed through the named filters in order, before being passed to the "real" file system calls.

Each filter may be given one or more arguments, each separated by white space, and the meaning of these arguments is specific to that filter.

For example, to log all file system access to a file, you could use

```
PLASTICFS="log /tmp/the-log-file | $PLASTICFS"
```

to set the environment variable. Remember not to throw away any other filters currently in effect, which is why "`| $PLASTICFS`" is added to the end.

THE FILTERS

Each filter is documented with its own *man* page, in section "1" (lower case ell). Use "apropos plasticfs" to obtain a list.

EXAMPLE

The Plastic File System is almost never used casually from the command line. It is usually invoked from a shell script for some special purpose. The heart of such a scell script is going to contain lines similar to this:

```
LD_PRELOAD="$LD_PRELOAD libplasticfs.so" \
PLASTICFS="log /tmp/the-log-file | $PLASTICFS" \
sh
```

which will start a shell which will have a filtered view of the file system, and so will all programs subsequently executed by that shell. It helps if you change the command prompt (the PS1 environment variable) so that users know something is different.

Obviously, you can do much more than just log file system accesses. Your setting of PLASTICFS will differ from the example given here.

GLIBC

The GNU C Library, glibc, has some features in version 2.2 and later which make PlasticFS cease to work correctly. These features ensure that the `libc.so` DSO loads as fast as possible, to the benefit of all applications. This is accomplished by using a hidden PLT. This is the default configuration of the GNU C Library. For PlasticFS to work correctly, you need a version of `libc.so` without the hidden PLT.

To build a version of `libc.so` without the hidden PLT, you need to have the sources for the *exact* version of the GNU C Library on your system.

Most people use one of the Linux distributions, such a RedHat Linux. (If you built your own Linux, you probably stopped reading already.) Get your install disks and install the sources for the *glibc* package, the one with *exactly* the same version as is currently installed on your system.

2.3 Series

There is an undocumented `glibc ./configure --disable-hidden-plt` option which causes glibc *not* to use a hidden PLT.

It is necessary to rebuild glibc using *exactly* the options used by the distribution maker. In the case of options used by RPM, and all the distributions which use it, it is only necessary to read the `spec` file. The only change is to add the `./configure --disable-hidden-plt` option.

At the end of the build there is a file called `libc.so` in the top-level of the build directory. Install this next to the real `libc.so` as `libc.nohidden.so` to be used at the end of all `LD_PRELOAD` settings. Make sure it has the same owners and modes as the real `libc.so` file.

When you upgrade you system, you will have to remember do do this all over again.

2.2 Series

This is the same as the 2.3 case, except that there is no convenient `glibc ./configure --disable-hidden-plt` option.

It is necessary to patch `include/libc-symbols.h` as follows

```
--- libc-symbols.h.orig 2003-07-07 21:31:22.000000000 +1000
+++ libc-symbols.h      2003-07-07 21:31:43.000000000 +1000
@@ -470,8 +470,7 @@
     versioned_symbol (libc, __real_foo, foo, GLIBC_2_1);
     libc_hidden_ver (__real_foo, foo) */

-#if defined SHARED && defined DO_VERSIONING \
-  && !defined HAVE_BROKEN_ALIAS_ATTRIBUTE
+#if 0
+  # ifndef __ASSEMBLER__
+  #  ifdef HAVE_BROKEN_VISIBILITY_ATTRIBUTE
+  #   define __hidden_proto_hiddenattr
```

This is the net result of the `NO_HIDDEN` define present in glibc 2.3, and activated by the `./configure --disable-hidden-plt` option. It isn't available in 2.2, so we have to fake it.

It is then necessary to rebuild glibc using *exactly* the options used by the distribution maker. In the case of options used by RPM, and all the distributions which use it, it is only necessary to read the glibc `spec` file.

At the end of the build there is a file called `libc.so` in the top-level of the build directory. Install this next to the real `libc.so` as `libc.nohidden.so` to be used at the end of all `LD_PRELOAD` settings.

Using `libc.nohidden.so`

The `LD_PRELOAD` environment variable is actually a space-separated list of file names (see `ld.so(8)` for more information), searched in the order given. To use PlasticFS you need to see the `LD_PRELOAD` environment variable as follows:

```
LD_PRELOAD="libplasticfs.so libc.nohidden.so"
```

Note that of you are going to preserve any existing preloaded modules, you need to ensure that `libc.nohidden.so` remains at the *end*, and you new module is at the beginning, something like

```
LD_PRELOAD="libplasticfs.so $LD_PRELOAD libc.nohidden.so"
```

should do what you need.

Debian

To rebuild glibc for a Debian based system, follow the usual instructions about building packages.

```
apt-get install fakeroot dpkg-dev
apt-get build-deps glibc
apt-get source glibc
cd glibc-2.3.6
```

At this point you should see a `glibc-2.3.6` directory (or whatever the appropriate version number is).

You need to edit the `debian/rules.d/build.mk` file

```
--- rules.d/build.mk      2006-07-22 11:42:22.000000000 +1000
+++ rules.d/build.mk      2006-07-22 11:07:49.000000000 +1000
@@ -62,6 +62,7 @@
                                --build=$$configure_build --prefix=/usr --without-cvs
```

```
                                touch $@
```

and then build as normal...

```
dpkg-buildpackage -rfakeroot -b
```

Once it is built, extract the `libc.so` file, and install it as `libc.nohidden.so`

```
cp build-tree/i386-i686/libc.so /lib/libc.nohidden.so
```

you should be all set.

Replacing libc.so

This is *dangerous*. This will make your system *slower*. Still want to? Make sure you have a rescue disk handy in case your system no longer works after the reboot and you have to put the original `libc.so` back.

You did keep a copy, didn't you?

SEE ALSO

`ld.so(8)` Loads the shared libraries needed by a program, prepares the program to run, and then runs it.

`sh(1)` A command language interpreter that executes commands read from the standard input or from a file.

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plasticfs_chroot – change the root of the file system

SYNOPSIS

```
PLASTICFS="chroot /directory"
```

DESCRIPTION

The PlasticFS *chroot* filter is used to change the apparent root of the file system.

EXAMPLE

To construct what appears to be a user-writable simulation of the entire file system, make a suitable directory and then use the `viewpath` filter to place it "in front of" the whole file system, and then use `chroot` to make this view path appear to actually be the whole file system. This may be achieved as follows:

```
mkdir /tmp/example
cd /tmp/example
PLASTICFS="chroot /tmp/example | \
viewpath /tmp/example /" \
LD_PRELOAD=libplasticfs.so \
bash
```

You should now be able to `cd` to an open source package you wish to install, and issue the `ke install`

command. All effect will actually be realized in the directory tree below `/tmp/example`, and it's not necessary to be *root* during the install.

SECURITY

PlasticFS does nothing at all if the executing user is root, or if the program is set-uid or set-gid. This is for security reasons.

Imagine, in our above example, the `/etc/passwd` file was edited to give `root` no password (remember, the whole file system is now writable) and then the `su(8)` program is used. If PlasticFS permitted `su(8)` to run with the simulated file system, it would completely compromise the security of the whole system.

This would be bad. PlasticFS presents the real file system in situations which in any way could involve system security.

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plasticfs_dos – DOS-like file system

SYNOPSIS

```
PLASTICFS="dos /directory"
```

DESCRIPTION

The *dos* file system filter is used to make the files under *directory* appear to be a DOS file system with 8.3 filenames (eight characters before the first dot, three characters after the dot). Only alphanumerics, minus (-) and dot (.) are allowed in filenames.

When files are searched for (*open(2)*, *lstat(2)*, *etc*) they will be searched for ignoring the case of the characters in their names.

When files are created, the case of the characters presented will be preserved into the deeper file system, although they will appear in upper-case when listed via the filter.

The filenames will be converted to DOS-like names when reading directory contents (via *ls(1)*, *readdir(3)*, *etc*).

Text vs Binary

This file system *does not* alter file contents. File contents are treated just as they are for all Unix files.

It is a possible future extension to The Plastic File System to implement *dos2unix* and *unix2dos* filters. Which you would want combined with the DOS *file name* filter depends on what you are trying to simulate. However, this is complicated by a lack of O_BINARY, so there is no hint to *open(2)* as to whether the file is expected to be text or binary.

EXAMPLE

You wish to make a CD-Rom for use on a DOS-like operating system, and you don't want to see all of the warnings *mkisofs(1)* is going to spew out. The following command

```
LD_PRELOAD="libplasticfs.so" \  
PLASTICFS="dos /tmp/example" \  
mkisofs -o ~/example.iso /tmp/example
```

will make *mkisofs(1)* think the file names are already in the correct DOS-like form. Note that the *mkisofs(1)* file name mangling is done in a very different way to that done by *plasticfs(3)*.

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plasticfs_downcase – lower-case file system

SYNOPSIS

```
PLASTICFS="downcase /directory"
```

DESCRIPTION

The *downcase* file system filter is used to make the files under *directory* appear to be lower-case.

When files are searched for (*open(2)*, *lstat(2)*, *etc*) they will be searched for ignoring the case of the characters in their names.

When file are created, the case of the characters presented will be preserved into the deeper file system, although they will appear in lower-case when listed via the filter.

The case of filenames will be converted to lower-case when reading directory contents (via *ls(1)*, *readdir(3)*, *etc*).

EXAMPLE

If you have a PC floppy mounted at `/mnt/floppy` and all of the file names are inconveniently in upper-case. To make the filenames appear to be lower-case, use the

```
PLASTICFS="downcase /mnt/floppy" \  
LD_PRELOAD="libplasticfs.so" \  
bash
```

command to have a shell within which the file names on the floppy appear to be entirely in lower-case. Exit the shell when you are done.

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plasticfs_log – log file system accesses

SYNOPSIS

```
PLASTICFS="log filename"
```

DESCRIPTION

The PlasticFS *log* filter is used to transparently log file system accesses to the named file. The file is created if it does not exist. Each file system access will append a line of text to the log file.

You may specify more than one log filter in your PLASTICFS environment variable. This is useful to see the "before" and "after" effects of other PlasticFS filters.

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plasticfs_nocase – case-insensitive file system

SYNOPSIS

```
PLASTICFS="nocase /directory"
```

DESCRIPTION

The *nocase* file system filter is used to make the files under *directory* appear to be case-insensitive.

When files are searched for (*open(2)*, *lstat(2)*, *etc*) they will be searched for ignoring the case of the characters in their names.

When file are created, the case of the characters presented will be preserved.

The case of filenames will be unaltered when reading directory contents (via *ls(1)*, *readdir(3)*, *etc*).

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plasticfs_shortname – shorten file names

SYNOPSIS

```
PLASTICFS="shortname /directory [ length ] "
```

DESCRIPTION

The *shortname* file system filter is used to make the files under *directory* appear to have a limit of *length* characters. The length limit defaults to 14, to simulate Version 7 Unix.

When files are created, the full filename presented will be preserved into the deeper file system.

The filenames will be shortened when reading directory contents (via *ls*(1), *readdir*(3), *etc*).

EXAMPLE

If you want to simulate a Version 7 Unix file system, use a command like

```
mkdir /tmp/example
cd /tmp/example
LD_PRELOAD=libplasticfs.so \
PLASTICFS="shortname /tmp/example" \
bash
```

To simulate PRIMOS 30 character case-insensitive filenames, use a command like

```
mkdir /tmp/example
cd /tmp/example
LD_PRELOAD=libplasticfs.so \
PLASTICFS="shortname /tmp/example | upcase /tmp/example" \
bash
```

Note that this does *not* simulate the PRIMOS '>' separators, you will have to use Unix '/' separators.

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plasticfs_smartlink – smart symbolic link filter

SYNOPSIS

```
PLASTICFS="smartlink path"
```

DESCRIPTION

The *smartlink* file system filter expands environment variables in symbolic links when files are being accessed.

This is a cute idea from DG/UX. It is done automatically by The DG/UX libc. IIRC they call it "e-links".

EXAMPLE

Say you wanted to support several architectures from the same binary directory

```
/some/package/bin/
  linux/
    progs
  solaris/
    progs
  bsd/
    progs
```

If you add a symbolic link

```
cd bin
ln -s '$ARCH' /some/package/bin/arch
```

(note the *single* quotes) then all that is necessary is to put

```
PATH=${PATH}:/some/package/bin/arch
```

and set the ARCH environment variable appropriately for each system. (And use PlasticFS, of course.)

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plasticfs_titlecase – capitalized file system

SYNOPSIS

```
PLASTICFS="titlecase /directory"
```

DESCRIPTION

The *titlecase* file system filter is used to make the files under *directory* appear to have each word within them capitalized (first letter upper-case and subsequent letters lower-case).

When files are searched for (*open(2)*, *lstat(2)*, *etc*) they will be searched for ignoring the case of the characters in their names.

When file are created, the case of the characters presented will be preserved into the deeper file system, although they will appear in capitalized when listed via the filter.

The case of filenames will be capitailized when reading directory contents (via *ls(1)*, *readdir(3)*, *etc*).

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plasticfs_upcase – upper-case file system

SYNOPSIS

```
PLASTICFS="upcase /directory"
```

DESCRIPTION

The *upcase* file system filter is used to make the files under *directory* appear to be upper-case.

When files are searched for (*open(2)*, *lstat(2)*, *etc*) they will be searched for ignoring the case of the characters in their names.

When file are created, the case of the characters presented will be preserved into the deeper file system, although they will appear in upper-case when listed via the filter.

The case of filenames will be converted to upper-case when reading directory contents (via *ls(1)*, *readdir(3)*, *etc*).

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plasticfs_viewpath – viewpath union file system

SYNOPSIS

```
PLASTICFS="viewpath dir1 dir2"
```

DESCRIPTION

The PlasticFS *viewpath* filter is used to present the union of a set of directory trees as a single directory tree.

If files are to be modified, the first directory tree specified must be writable; all subsequent directories may be read-only.

Accesses to files in the first directory (*dir1*) are searched for in all of the directories specified. Files are created in the first directory only, and files being modified are copied into the first directory (if necessary) before the file is opened for writing.

Directory listings are assembled from the directory contents of the corresponding directory in each of the directory trees. Duplicates are suppressed.

If a file is removed from the view, and it appears later in the view path than the first directory (*dir1*), it is added to a *whiteout* file, and the file effectively disappears. The true file is not affected; this is because *all* modifications *only* occur in the first directory (*dir1*) and later directories are treated as read-only.

Removed Files

When a file is unlinked, its name is added to the *.whiteout* file (at the top level, deeper *.whiteout* files are ignored). It's a simple text file containing one filename per line. Each directory has one (if needed). Some jiggery-pokery is required to suppress the names of unlinked files returned by *getdirenties(3)*, but since we needed jiggery-pokery to suppress duplicates anyway, it is actually very little extra code. When a file is created, its name is removed from the *.whiteout* file.

I'm told this is the way the BSD union filesystem works, too.

Removing the *.whiteout* file is usually a bad idea, because removed files from further along the viewpath will mysteriously reappear.

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How to add a new file system filter

DESCRIPTION

This section describes how to add a new file system filter. It's mostly a set of reminders for the maintainer. If you want a file system filter added to the distribution, use this method and e-mail the maintainer a patch (generated with `diff -u -r`, usually) and it can be added to the sources if appropriate.

New Files

The following files need to be create for a new file system filter.

`lib/plasticfs/filter/name.h`

This is the class declaration. You need to override the appropriate methods from the `plasticfs_filter` class; care should be taken to ensure the signatures match exactly. Override as few methods as possible.

`lib/plasticfs/filter/name.cc`

This is the class definition for the above file.

`man/man1/plasticfs_name.1`

This file describes the new file system filter. Take a look at the other files in the same directory for examples.

Modified Files

The following files need to be updated to mention the new file system filter.

`etc/README.man`

Mention the new file system filter in the section of this file which describes the supported file system filters.

`etc/plasticfs.html`

Mention the new file system filter in the section of this file which describes the supported file system filters.

`include/plasticfs/parse.cc`

Add the new file system filter to the table of filter names and their factory methods.

`Makefile`

Actually, the system the maintainer automatically generates this file, but if you aren't using Aegis you will need to edit this file for your own use.

Use of C++

You probably noticed that PlasticFS is written in C++. There are some things you have to *avoid* using.

- You can't use global constructors and destructors. This requires significant machinery to make them work correctly for loadable modules (not impossible, I just haven't found any real need to introduce the machinery). This means all of your static and global variables need to be of simple types (integers or pointers).
- You can't use `iostreams`. They call out to functions that PlasticFS intercepts, with the result that classes which use `iostreams` get themselves into infinite recursions. Just say no.
- You can't use `stdio`, either, and for the same reasons. General input and output are provided by the `input` and `output` class heirarchies.
- You can't use templates. We don't have the usual linker stage which resolves their non-inline methods into code.
- You can't use any of the Standard Template Library (STL). It uses templates (obviously), and it's failure cases use `iostreams` (not so obviously).
- You can't use exceptions. All of the functions we intercept are C functions, and they shall not throw *anything*.

IDEAS

The range of possible file systems is enormous. Here are just a few ideas...

- trash A trash-can file system filter could move (copy) deleted files to \$(HOME)/.trash so that they can be retrieved if you change your mind.
- cache A caching file system filter could transparently copy files from a remote directory tree to a local copy. Useful for dealing with slow or unreliable networks.
- iconv An iconv file system filter could map file names from one character set encoding to another.
- loopback
 A file system filter which acts like a loopback mount.
- hide A file system filter which hides a directory tree. (May be combined with loopback to appear to move a directory tree.)
- dos A file system that appears to have 8.3 filenames.
- crop A file system that appears to have short (e.g. V7 unix 14 character) filenames.
- RCS
 A file system which presents files as the head revision of RCS files, and accesses other versions as *filename@@version*, much like ClearCase does. E.g.
 diff main.c@@1.1 main.c@@1.2
 You could even have automatic *ci(1)* on close if opened for writing. Possible for CVS and SCCS, etc, as well.
- O(log n)* A file system that transparently turns *something* into *s/so/something* for use with huge mailservers (etc). Number of layers configurable.
- dos2unix
 It is possible to implement *dos2unix* and *unix2dos* filters. This is complicated by a lack of O_BINARY, so there is no hint to *open(2)* as to whether the file is expected to be text or binary.
- zlib A file system that transparently gunzips files.
- ftp And, of course, the transparent FTP access file system is never far from such a list.

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