Chroot–BIND HOWTO
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This document describes installing the BIND 8 nameserver to run in a chroot jail and as a non-root user, to provide added security and minimise the potential effects of a security compromise.

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1. **Introduction**

This is the Chroot–BIND HOWTO; see Where? for the master site, which contains the latest copy. It is assumed that you already know how to configure and use BIND (the Berkeley Internet Name Domain). If not, I would recommend that you read the DNS HOWTO first. It is also assumed that you have a basic familiarity with compiling and installing software on your UNIX–like system.

1.1 **What?**

This document describes some extra security precautions that you can take when you install BIND. It explains how to configure BIND so that it resides in a `chroot jail`, meaning that it cannot see or access files outside its own little directory tree. We shall also configure it to run as a non–root user.

The idea behind chroot is fairly simple. When you run BIND (or any other process) in a chroot jail, the process is simply unable to see any part of the filesystem outside the jail. For example, in this document, we'll set BIND up to run chrooted to the directory `/chroot/named`. Well, to BIND, the contents of this directory will appear to be `/`, the root directory. Nothing outside this directory will be accessible to it. You've probably encountered a chroot jail before, if you've ever piped into a public system.

1.2 **Why?**

The idea behind running BIND in a chroot jail is to limit the amount of access any malicious individual could gain by exploiting vulnerabilities in BIND. It is for the same reason that we run BIND as a non–root user.

This should be considered as a supplement to the normal security precautions (running the latest version, using access control, etc.), not a replacement for them.

If you're interested in DNS security, you might also be interested in a few other products. Building BIND with StackGuard would probably be a good idea for even more protection. Using it is easy; it's just like using ordinary gcc. Also, DNScache is a secure replacement for BIND, written by Dan Bernstein. Dan is the author of qmail, and DNScache appears to follow a similar philosophy.
1.3 Where?

The latest version of this document is always available from the web site of the Linux/Open Source Users of Regina, Sask., at http://www.losurs.org/docs/howto/Chroot−BIND.html.

BIND is available from the Internet Software Consortium at http://www.isc.org/bind.html. As of this writing, the current version of BIND8 is 8.2.2_P5. BIND 9.0.0 has just been released, but I haven't even looked at it yet, so I don't know how much of this document will be applicable. Unless you like living on the bleeding edge, you may be better off staying with BIND8 for now.

1.4 How?

I wrote this document based on my experiences in setting BIND up in a chroot environment. In my case, I already had an existing BIND installation in the form of a package that came with my Linux distribution. I'll assume that most of you are probably in the same situation, and will simply be transferring over and modifying the configuration files from your existing BIND installation, and then removing the package before installing the new one. Don't remove the package yet, though; we may want some files from it first.

If this is not the case for you, you should still be able to follow this document. The only difference is that, where I refer to copying an existing file, you first have to create it yourself. The DNS HOWTO may be helpful for this.

1.5 Disclaimer

These steps worked for me, on my system. Your mileage may vary. This is but one way to approach this; there are other ways to set the same thing up (although the general approach will be the same). It just happens that this was the first way that I tried that worked, so I wrote it down.

My BIND experience to date has been installing on Linux servers. However, most of the instructions in this document should be easily applicable to other flavours of UNIX as well, and I shall try to point out differences of which I am aware.

2. Preparing the Jail

2.1 Creating a User

As mentioned in the introduction, it's not a good idea to run BIND as root. So, before we begin, let's create a separate user for BIND. Note that you should never use an existing generic user like nobody for this purpose. However, some distributions, such as SuSE and Linux Mandrake have started providing a specific user (generally called named); you can simply adapt this user for our purposes, if you like.
This requires adding a line something like the following to /etc/passwd:

```
named:x:200:200:Nameserver:/chroot/named:/bin/false
```

And one like this to /etc/group:

```
named:x:200:
```

This creates a user and group called named for BIND. Make sure that the UID and GID (both 200 in this example) are unique on your system. The shell is set to /bin/false because this user will never need to log in.

### 2.2 Directory Structure

Now, we must set up the directory structure that we will use for the chroot jail in which BIND will live. This can be anywhere on your filesystem; the truly paranoid may even want to put it on a separate volume. I shall assume that you will use /chroot/named. Let's start by creating the following directory structure:

```
/chroot
  +− named
    +− bin
    +− dev
    +− etc
      |   +− namedb
    +− lib
    +− var
      +− run
```

### 2.3 Placing the BIND Data

Assuming that you have already done a conventional installation of BIND and are using it, you will already have an existing named.conf and zone files. These files must now be moved (or copied, to be safe) into the chroot jail, so that BIND can get at them. named.conf goes in /chroot/named/etc, and the zone files can go in /chroot/named/etc/namedb. For example:

```
# cp −p /etc/named.conf /chroot/named/etc/
# cp −a /var/named/* /chroot/named/etc/namedb/
```

BIND will likely need to write to the namedb directory, and probably some of the files in it. For example, if your DNS serves as a slave for a zone, it will have to update that zone file. Also, BIND can dump statistical information, and does so in this directory. For that reason, you should probably make the named user the owner of this directory and its contents:
# chown -R named:named /chroot/named/etc/namedb

BIND will also need to write to the /var/run directory, to put its pidfile and ndc socket there, so let's allow it to do so:

# chown named:named /chroot/named/var/run

## 2.4 System Support Files

Once BIND is running in the chroot jail, it will not be able to access files outside the jail at all. However, it needs to access a few key files, such as the system's C library. Exactly what libraries are required will depend on your flavour of UNIX. For most modern Linux systems, the following commands will be sufficient to put the necessary libraries in place:

```bash
# cd /chroot/named/lib
# cp -p /lib/libc-2.*.so .
# ln -s libc-2.*.so libc.so.6
# cp -p /lib/ld-2.*.so .
# ln -s ld-2.*.so ld-linux.so.2
```

As an alternative, you could simply build statically-linked versions of the BIND binaries to put in your chroot jail. You should also copy ldconfig into the jail, and run it to create an etc/ld.so.cache for the jail environment. The following commands could take care of this:

```bash
# cp /sbin/ldconfig /chroot/named/bin/
# chroot /chroot/named /bin/ldconfig -v
```

BIND needs one more system file in its jail: good ol' /dev/null. Again, the exact command necessary to create this device node may vary from system to system; check your /dev/MAKEDEV script to be sure. Some systems may also require /dev/zero. For most Linux systems, we can use the following command:

```bash
# mknod /chroot/named/dev/null c 1 3
```

Finally, you need a couple extra files in the /etc directory inside the jail. In particular, you must copy /etc/localtime (this sometimes known as /usr/lib/zoneinfo/localtime on some systems) in there so that BIND logs things with the right time on them, and you must make a simple group file with the named group in it. The following two commands will take care of this:

```bash
# cp /etc/localtime /chroot/named/etc/
# echo 'named:x:200:' > /chroot/named/etc/group
```

Keep in mind that the GID, 200 in this example, must match the one you defined in the real
2.5 Logging

Unlike a conventional jailbird, BIND can't just scribble its log entries on the walls :-). Normally, BIND logs through syslogd, the system logging daemon. However, this type of logging is performed by sending the log entries to the special socket /dev/log. Since this is outside the jail, BIND can't use it any more. Fortunately, there are a couple options to work around this.

The Ideal Solution

The ideal solution to this dilemma requires a reasonably recent version of syslogd which supports the −a switch introduced by OpenBSD. Check the manpage for your syslogd(8) to see if you have such a version.

If you do, all you have to do is add the switch "−a /chroot/named/dev/log" to the command line when you launch syslogd. On systems which use a full SysV−init (which includes most Linux distributions), this is typically done in the file /etc/rc.d/init.d/syslog. For example, on my Red Hat Linux system, I changed the line

daemon syslogd −m 0

to

daemon syslogd −m 0 −a /chroot/named/dev/log

Then simply restart syslogd, either by killing it and launching it again, or by using the SysV−init script to do it for you:

    # /etc/rc.d/init.d/syslog stop
    # /etc/rc.d/init.d/syslog start

I'm told that on SuSE systems, the best place to add this switch is in the /etc/rc.config file. Changing the line

    SYSLOGD_PARAMS=""

to read

    SYSLOGD_PARAMS="-a /chroot/named/dev/log"

should do the trick.
Once it's been restarted, you should see a ``file'' in /chroot/named/dev called log, that looks something like this:

```
srw-rw-rw-   1 root     root            0 Mar 13 20:58 log
```

## The Other Solutions

If you have an older syslogd, then you'll have to find another way to do your logging. There are a couple programs out there, such as holelogd, which are designed to help by acting as a ``proxy'' and accepting log entries from the chrooted BIND and passing them out to the regular /dev/log socket.

Alternatively, you can simply configure BIND to log to files instead of going through syslog. See the BIND documentation for more details if you choose to go this route.

---

### 3. Compiling BIND

You should be able to find the BIND source by visiting [http://www.isc.org/bind.html](http://www.isc.org/bind.html). You need the bind-src.tar.gz package. Be sure to get the latest version!

#### 3.1 Modifying Paths

Things can get a bit confusing at this point, because different parts of the BIND package will be referring to the same directories by different names (depending on whether or not they're running inside the jail). I'll try not to confuse you too much :—).

The main directory that we have to worry about here is /var/run, because its contents are required for both the main named daemon (inside the jail), and the ndc utility (on the outside). We'll start by setting everything up to find this directory from the outside world. To do this, we need to modify src/port/linux/Makefile.set (substitute your port's directory if you're not running Linux), and change the line

```
DESTRUN=/var/run
```

to

```
DESTRUN=/chroot/named/var/run
```

While you're in there, you may want to change the other destination paths from /usr to /usr/local.

Now everything should be able to find that directory... except the named daemon itself, to which it's still just /var/run inside the jail. We can get around this by making a small change in the named source. In the file src/bin/named/named.h, find the line
and add the following line immediately after it

#define _PATH_NDCSOCK  

"/var/run/ndc"

This way, named will ignore our definition of DESTRUN over in Makefile.set and use the correct location (from its perspective in the chroot jail). You will notice some warnings about redefinitions of _PATH_NDCSOCK when you do the build; just ignore them.

3.2 Doing the Build

You should now be able to compile BIND as normal, following the instructions in the INSTALL file. At this stage, we only want to compile BIND, not install it. Don't go too far when following the INSTALL file. Essentially, it's just make clean, make depend, and make.

4. Installing Your Shiny New BIND

I should mention that if you have an existing installation of BIND, such as from an RPM, you should probably remove it before installing the new one. On Red Hat systems, this probably means removing the packages bind and bind-utils, and possibly bind-devel and caching-nameserver, if you have them.

You may want to save a copy of the init script (e.g., /etc/rc.d/init.d/named), if any, before doing so; it'll be useful later on.

4.1 Installing the Tools Outside the Jail

This is the easy part :-). Just run make install and let it take care of it for you. You may want to chmod 000 /usr/local/sbin/named afterwards, to make sure you don't accidentally run the non-chrooted copy of BIND. (This is /usr/sbin/named if you didn't tell it to go in /usr/local/sbin like I suggested.)

4.2 Installing the Binaries in the Jail

Only two parts of the package have to live inside the chroot jail: the main named daemon itself, and named-xfer, which it uses for zone transfers. You can simply copy them in from the source tree:

# cp src/bin/named/named /chroot/named/bin
4.3 Setting up the Init Script

If you have an existing init script from your distribution, it would probably be best simply to modify it to run /chroot/named/bin/named, with the appropriate switches. The switches are... *(drumroll please...)*

- `-u named`, which tells BIND to run as the user named, rather than root.
- `-g named`, to run BIND under the group named too, rather than root or wheel.
- `-t /chroot/named`, which tells BIND to chroot itself to the jail that we've set up.

The following is the init script I use with my Red Hat 6.0 system. As you can see, it is almost exactly the same as the way it shipped from Red Hat. I have also modified the `ndc restart` command so that it restarts the server properly, and keeps it chrooted. You should probably do the same in your init script, even if you don't copy this one.

```bash
#!/bin/sh
#
# named           This shell script takes care of starting and stopping
#                 named (BIND DNS server).
#
# chkconfig: 345 55 45
# description: named (BIND) is a Domain Name Server (DNS) \ 
# that is used to resolve host names to IP addresses.
# probe: true
#
# Source function library.
. /etc/rc.d/init.d/functions
#
# Source networking configuration.
. /etc/sysconfig/network
#
# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0
[ −f /chroot/named/bin/named ] || exit 0
[ −f /chroot/named/etc/named.conf ] || exit 0
#
# See how we were called.
case "$1" in
   start)
      # Start daemons.
      echo −n "Starting named: "
      daemon /chroot/named/bin/named −u named −g named −t /chroot/named
      echo
touch /var/lock/subsys/named
   ;;
   stop)
      # Stop daemons.
      echo −n "Shutting down named: "
      killproc named
      rm −f /var/lock/subsys/named
      echo
```
4.4 Configuration Changes

You will also have to add or change a few options in your named.conf to keep the various directories straight. In particular, you should add (or change, if you already have them) the following directives in the options section:

```
directory "/etc/namedb";
pid-file "/var/run/named.pid";
named-xfer "/bin/named-xfer";
```

Since this file is being read by the named daemon, all the paths are of course relative to the chroot jail.

5. The End
5.1 Launching BIND

Everything should be set up, and you should be ready to put your new, more secure BIND into action. Assuming you set up a SysV−style init script, you can simply launch it as:

```
# /etc/rc.d/init.d/named start
```

Make sure you kill any old versions of BIND still running before doing this.

If you take a look at your logs, you should find the initialisation messages that BIND spits out when it loads. (If not, there's a problem with your logging configuration that you need to fix.) Amongst those messages, BIND should tell you that it chrooted successfully, and that it is running as the user and group named. If not, you have a problem.

5.2 That's It!

You can go take a nap now ;−).

6. Appendix − Thanks

I'd like to thank Lonny Selinger <lonny at abyss.za.org> for "testing" this HOWTO and making sure that I didn't miss any steps. I'd also like to thank Chirik <chirik at CastleFur.COM>, Dwayne Litzenberger <dlitz at cheerful.com>, Phil Bambridge <phil.b at cableinet.co.uk>, and others for pointing out errors, omissions, and other useful advice to make this HOWTO even better.

7. Appendix − Document Distribution Policy

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