Abstract

This article describes building an internal FreeBSD Update Server. The \texttt{freebsd-update-server} is written by Colin Percival \texttt{<cperciva@FreeBSD.org>}, Security Officer Emeritus of FreeBSD. For users that think it is convenient to update their systems against an official update server, building their own FreeBSD Update Server may help to extend its functionality by supporting manually-tweaked FreeBSD releases or by providing a local mirror that will allow faster updates for a number of machines.

1. Acknowledgments

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2. Introduction

Experienced users or administrators are often responsible for several machines or environments. They understand the difficult demands and challenges of maintaining such an infrastructure. Running a FreeBSD Update Server makes it easier to deploy security and software patches to selected test machines before rolling them out to production. It also means a number of systems can be updated from the local network rather than a potentially slower Internet connection. This article outlines the steps involved in creating an internal FreeBSD Update Server.

3. Prerequisites

To build an internal FreeBSD Update Server some requirements should be met.

- A running FreeBSD system.
At a minimum, updates require building on a FreeBSD release greater than or equal to the target release version for distribution.

- A user account with at least 4 GB of available space. This will allow the creation of updates for 7.1 and 7.2, but the exact space requirements may change from version to version.
- An `ssh(1)` account on a remote machine to upload distributed updates.
- A web server, like Apache, with over half of the space required for the build. For instance, test builds for 7.1 and 7.2 consume a total amount of 4 GB, and the webserver space needed to distribute these updates is 2.6 GB.
- Basic knowledge of shell scripting with Bourne shell, `sh(1)`.

### 4. Configuration: Installation & Setup

Download the `freebsd-update-server` software by installing `devel/git` and `security/ca_root_nss`, and execute:

```bash
% git clone https://github.com/freebsd/freebsd-update-build.git freebsd-update-server
```

Update scripts/build.conf appropriately. It is sourced during all build operations.

Here is the default build.conf, which should be modified to suit your environment.

```bash
# Main configuration file for FreeBSD Update builds. The
# release-specific configuration data is lower down in
# the scripts tree.

# Location from which to fetch releases
export FTP=ftp://ftp2.freebsd.org/pub/FreeBSD/releases ①

# Host platform
export HOSTPLATFORM=`uname -m`

# Host name to use inside jails
export BUILDHOSTNAME=${HOSTPLATFORM}-builder.daemonology.net ②

# Location of SSH key
export SSHKEY=/root/.ssh/id_dsa ③

# SSH account into which files are uploaded
MASTERACCT=builder@wadham.daemonology.net ④

# Directory into which files are uploaded
MASTERDIR=update-master.freebsd.org ⑤
```

Parameters for consideration would be:
This is the location where ISO images are downloaded from (by the `fetchiso()` subroutine of `scripts/build.subr`). The location configured is not limited to FTP URIs. Any URI scheme supported by standard `fetch(1)` utility should work fine. Customizations to the `fetchiso()` code can be installed by copying the default build.subr script to the release and architecture-specific area at `scripts/RELEASE/ARCHITECTURE/build.subr` and applying local changes.

The name of the build host. This information will be displayed on updated systems when issuing:

```
% uname -v
```

The SSH key for uploading files to the update server. A key pair can be created by typing `ssh-keygen -t dsa`. This parameter is optional; standard password authentication will be used as a fallback authentication method when `SSHKEY` is not defined. The `ssh-keygen(1)` manual page has more detailed information about SSH and the appropriate steps for creating and using one.

Account for uploading files to the update server.

Directory on the update server where files are uploaded to.

The default `build.conf` shipped with the freebsd-update-server sources is suitable for building i386 releases of FreeBSD. As an example of building an update server for other architectures, the following steps outline the configuration changes needed for amd64:

1. Create a build environment for amd64:

```
% mkdir -p /usr/local/freebsd-update-server/scripts/7.2-RELEASE/amd64
```

2. Install a build.conf in the newly created build directory. The build configuration options for FreeBSD 7.2-RELEASE on amd64 should be similar to:

```
# SHA256 hash of RELEASE disc1.iso image.
export RELH=1ea1f6f652d7c5f5eab7ef9f8edbed50cb664b08ed761850f95f48e86cc71ef5 ①
# Components of the world, source, and kernels
export WORLDPARTS="base catpages dict doc games info manpages proflibs lib32"
export SOURCEPARTS="base bin contrib crypto etc games gnu include krb5 \
  lib libexec release rescue sbin secure share sys tools \
  ubin usbin cddl"
export KERNELPARTS="generic"

# EOL date
export EOL=1275289200 ②
```

① The `sha256(1)` hash key for the desired release, is published within the respective release announcement.

② To generate the "End of Life" number for build.conf, refer to the "Estimated EOL" posted on the FreeBSD Security Website. The value of `EOL` can be derived from the date listed on the web site, using the `date(1)` utility, for example:
5. Building Update Code

The first step is to run scripts/make.sh. This will build some binaries, create directories, and generate an RSA signing key used for approving builds. In this step, a passphrase will have to be supplied for the final creation of the signing key.

```
# sh scripts/make.sh
cc -O2 -fno-strict-aliasing -pipe findstamps.c -o findstamps
findstamps.c: In function 'usage':
  findstamps.c:45: warning: incompatible implicit declaration of built-in function 'exit'
cc -O2 -fno-strict-aliasing -pipe unstamp.c -o unstamp
install findstamps ../bin
install unstamp ../bin
rm -f findstamps unstamp
Generating RSA private key, 4096 bit long modulus
................................................................................++
...................++
e is 65537 (0x10001)

Public key fingerprint: 27ef53e48dc869eea6c3136b01cc6ab8589f967559824779e855d58a2294de9e

Encrypting signing key for root
enter aes-256-cbc encryption password:
Verifying - enter aes-256-cbc encryption password:
```

Keep a note of the generated key fingerprint. This value is required in /etc/freebsd-update.conf for binary updates.

At this point, we are ready to stage a build.

```
# cd /usr/local/freebsd-update-server
# sh scripts/init.sh amd64 7.2-RELEASE
```

What follows is a sample of an initial build run.

```
# sh scripts/init.sh amd64 7.2-RELEASE
Mon Aug 24 16:04:36 PDT 2009 Starting fetch for FreeBSD/amd64 7.2-RELEASE
/usr/local/freebsd-update-server/work/7.2-RELEASE of 588 MB 359 kbps 00m00s
Mon Aug 24 16:32:38 PDT 2009 Verifying disc1 hash for FreeBSD/amd64 7.2-RELEASE
Mon Aug 24 16:32:44 PDT 2009 Extracting components for FreeBSD/amd64 7.2-RELEASE
```
Then the build of the world is performed again, with world patches. A more detailed explanation may be found in scripts/build.subr.

During this second build cycle, the network time protocol daemon, ntpd(8), is turned off. Per Colin Percival <cperciva@FreeBSD.org>, Security Officer Emeritus of FreeBSD, “the freebsd-update-server build code needs to identify timestamps which are stored in files so that they can be ignored when comparing builds to determine which files need to be updated. This timestamp-finding works by doing two builds 400 days apart and comparing the results.”
Files found which include build stamps:
kernel|generic|/GENERIC/hptrr.ko
kernel|generic|/GENERIC/kernel
world|base|/boot/loader
world|base|/boot/pxeboot
world|base|/etc/mail/freebsd.cf
world|base|/etc/mail/freebsd.submit.cf
world|base|/etc/mail/sendmail.cf
world|base|/etc/mail/submit.cf
world|base|/lib/libcrypto.so.5
world|base|/usr/bin/ntpq
world|base|/usr/include/osreldate.h
world|base|/usr/lib/libalias.a
world|base|/usr/lib/libalias_cuseeme.a
world|base|/usr/lib/libalias_dummy.a
world|base|/usr/lib/libalias_ftp.a
...
FreeBSD/amd64 7.2-RELEASE initialization build complete. Please review the list of build stamps printed above to confirm that they look sensible, then run

```
sh -e approve.sh amd64 7.2-RELEASE
```

to sign the release.

Approve the build if everything is correct. More information on determining this can be found in the distributed source file named USAGE. Execute scripts/approve.sh, as directed. This will sign the release, and move components into a staging area suitable for uploading.

```
# cd /usr/local/freebsd-update-server
# sh scripts/mountkey.sh
```

```
# sh -e scripts/approve.sh amd64 7.2-RELEASE
Wed Aug 26 12:50:06 PDT 2009 Signing build for FreeBSD/amd64 7.2-RELEASE
Wed Aug 26 12:50:06 PDT 2009 Copying files to patch source directories for FreeBSD/amd64 7.2-RELEASE
Wed Aug 26 12:50:06 PDT 2009 Copying files to upload staging area for FreeBSD/amd64 7.2-RELEASE
Wed Aug 26 12:50:07 PDT 2009 Updating databases for FreeBSD/amd64 7.2-RELEASE
Wed Aug 26 12:50:07 PDT 2009 Cleaning staging area for FreeBSD/amd64 7.2-RELEASE
```

After the approval process is complete, the upload procedure may be started.

```
# cd /usr/local/freebsd-update-server
```
In the event update code needs to be re-uploaded, this may be done by changing to the public distributions directory for the target release and updating attributes of the *uploaded* file.

```
# cd /usr/local/freebsd-update-server/pub/7.2-RELEASE/amd64
# touch -t 200801010101.01 uploaded
```

The uploaded files will need to be in the document root of the webserver in order for updates to be distributed. The exact configuration will vary depending on the web server used. For the Apache web server, please refer to the Configuration of Apache servers section in the Handbook.

Update client's *KeyPrint* and *ServerName* in `/etc/freebsd-update.conf`, and perform updates as instructed in the FreeBSD Update section of the Handbook.

In order for FreeBSD Update Server to work properly, updates for both the *current* release and the release *one wants to upgrade to* need to be built. This is necessary for determining the differences of files between releases. For example, when upgrading a FreeBSD system from 7.1-RELEASE to 7.2-RELEASE, updates will need to be built and uploaded to your distribution server for both versions.

For reference, the entire run of `init.sh` is attached.

### 6. Building a Patch

Every time a security advisory or security notice is announced, a patch update can be built.

For this example, 7.1-RELEASE will be used.

A couple of assumptions are made for a different release build:

- Setup the correct directory structure for the initial build.
- Perform an initial build for 7.1-RELEASE.

Create the patch directory of the respective release under `/usr/local/freebsd-update-server/patches/`

```
% mkdir -p /usr/local/freebsd-update-server/patches/7.1-RELEASE/
% cd /usr/local/freebsd-update-server/patches/7.1-RELEASE
```

As an example, take the patch for `named(8)`. Read the advisory, and grab the necessary file from FreeBSD Security Advisories. More information on interpreting the advisory, can be found in the FreeBSD Handbook.

In the security brief, this advisory is called `SA-09:12.bind`. After downloading the file, it is required
to rename the file to an appropriate patch level. It is suggested to keep this consistent with official FreeBSD patch levels, but its name may be freely chosen. For this build, let us follow the currently established practice of FreeBSD and call this p7. Rename the file:

```
% cd /usr/local/freebsd-update-server/patches/7.1-RELEASE/; mv bind.patch 7-SA-09:12.bind
```

When running a patch level build, it is assumed that previous patches are in place. When a patch build is run, it will run all patches contained in the patch directory.

There can be custom patches added to any build. Use the number zero, or any other number.

It is up to the administrator of the FreeBSD Update Server to take appropriate measures to verify the authenticity of every patch.

At this point, a diff is ready to be built. The software checks first to see if a scripts/init.sh has been run on the respective release prior to running the diff build.

```
# cd /usr/local/freebsd-update-server
# sh scripts/diff.sh amd64 7.1-RELEASE 7
```

What follows is a sample of a differential build run.

```
# sh -e scripts/diff.sh amd64 7.1-RELEASE 7
Wed Aug 26 17:10:25 UTC 2009 Building world for FreeBSD/amd64 7.1-RELEASE-p7
Wed Aug 26 18:05:11 UTC 2009 Distributing world for FreeBSD/amd64 7.1-RELEASE-p7
Wed Aug 26 18:06:16 UTC 2009 Building and distributing kernels for FreeBSD/amd64 7.1-RELEASE-p7
Wed Aug 26 18:17:50 UTC 2009 Constructing world components for FreeBSD/amd64 7.1-RELEASE-p7
Wed Aug 26 18:18:02 UTC 2009 Distributing source for FreeBSD/amd64 7.1-RELEASE-p7
Wed Aug 26 11:19:23 PDT 2009 Moving components into staging area for FreeBSD/amd64 7.1-RELEASE-p7
Wed Aug 26 11:19:42 PDT 2009 Indexing world0 for FreeBSD/amd64 7.1-RELEASE-p7
Thu Sep 30 18:23:29 UTC 2010 Building world for FreeBSD/amd64 7.1-RELEASE-p7
Thu Sep 30 19:18:15 UTC 2010 Distributing world for FreeBSD/amd64 7.1-RELEASE-p7
Thu Sep 30 19:19:18 UTC 2010 Building and distributing kernels for FreeBSD/amd64 7.1-RELEASE-p7
Thu Sep 30 19:30:52 UTC 2010 Constructing world components for FreeBSD/amd64 7.1-RELEASE-p7
Thu Sep 30 19:31:03 UTC 2010 Distributing source for FreeBSD/amd64 7.1-RELEASE-p7
Thu Sep 30 12:32:25 PDT 2010 Moving components into staging area for FreeBSD/amd64 7.1-RELEASE-p7
```
Files found which include build stamps:
kernel|generic|/GENERIC/hptrr.ko
kernel|generic|/GENERIC/kernel
world|base|/boot/loader
world|base|/boot/pxeboot
world|base|/etc/mail/freebsd.cf
world|base|/etc/mail/freebsd.submit.cf
world|base|/etc/mail/sendmail.cf
world|base|/etc/mail/submit.cf
world|base|/lib/libcrypto.so.5
world|base|/usr/bin/ntpq
world|base|/usr/include/osreldate.h
world|base|/usr/lib/libalias.a
world|base|/usr/lib/libalias_cuseeme.a
world|base|/usr/lib/libalias_dummy.a
world|base|/usr/lib/libalias_ftp.a

Values of build stamps, excluding library archive headers:
v1.2 (Aug 26 2009 18:11:44)
@()FreeBSD 7.1-RELEASE-p7 0: Wed Aug 26 18:11:50 UTC 2009
FreeBSD 7.1-RELEASE-p7 0: Wed Aug 26 18:11:50 UTC 2009
    root@server.myhost.com:/usr/obj/usr/src/sys/Generic
7.1-RELEASE-p7
Wed Aug 26 17:29:15 UTC 2009

built by root@server.myhost.com on Wed Aug 26 17:49:58 UTC 2009
built by root@server.myhost.com on Wed Aug 26 17:49:58 UTC 2009
built by root@server.myhost.com on Wed Aug 26 17:49:58 UTC 2009
built by root@server.myhost.com on Wed Aug 26 17:49:58 UTC 2009

ntpq 4.2.4p5-a Wed Aug 26 17:29:42 UTC 2009 (1)
* Copyright (c) 1992-2009 The FreeBSD Project.

Wed Aug 26 17:20:39 UTC 2009
Wed Aug 26 17:29:30 UTC 2009
Aug 26 2009
Updates are printed, and approval is requested.

New updates:
- kernel|generic|/GENERIC/kernel.symbols|f|0|0|0555|0|7c8dc176763f96ced0a57fc04e7c1b8d793f27e006dd13e0b499e1474ac47e10|
- kernel|generic|/GENERIC/kernel|f|0|0|0555|0|33197e8cf15bbbac263d17f39c153c9d489348c2c534f7ca1120a1183dec67b1|
- kernel|generic|/d|0|0|0755|0||
- src|base|/d|0|0|0755|0||
- src|bin|/d|0|0|0755|0||
- src|cddl|/d|0|0|0755|0||
- src|contrib|/contrib/bind9/bin/named/update.c|f|0|10000|0644|0|4d434abf0983df9bc47435670d307fa882ef4b348ed8ca90928d250f42ea0757|
- src|contrib|/contrib/bind9/lib/dns/openssldsalink.c|f|0|10000|0644|0|c6805c39f3da2a06dd3f163f26c31a4a692d4c9a2d929c0acc88d736324f550|
- src|contrib|/contrib/bind9/lib/dns/opensslrsa_link.c|f|0|10000|0644|0|fa0f7417ee9da42cc80fd96ad24e7a34125e05b5ae075bd6e3238f1c022a712|

FreeBSD/amd64 7.1-RELEASE update build complete. Please review the list of build stamps printed above and the list of updated files to confirm that they look sensible, then run

```
sh -e approve.sh amd64 7.1-RELEASE
```
to sign the build.

Follow the same process as noted before for approving a build:

```
# sh -e scripts/approve.sh amd64 7.1-RELEASE
Wed Aug 26 12:50:06 PDT 2009 Signing build for FreeBSD/amd64 7.1-RELEASE
Wed Aug 26 12:50:06 PDT 2009 Copying files to patch source directories for FreeBSD/amd64 7.1-RELEASE
Wed Aug 26 12:50:06 PDT 2009 Copying files to upload staging area for FreeBSD/amd64 7.1-RELEASE
Wed Aug 26 12:50:07 PDT 2009 Updating databases for FreeBSD/amd64 7.1-RELEASE
Wed Aug 26 12:50:07 PDT 2009 Cleaning staging area for FreeBSD/amd64 7.1-RELEASE

The FreeBSD/amd64 7.1-RELEASE update build has been signed and is ready to be uploaded. Remember to run

```
sh -e umountkey.sh
```
to unmount the decrypted key once you have finished signing all
After approving the build, upload the software:

```bash
# cd /usr/local/freebsd-update-server
# sh scripts/upload.sh amd64 7.1-RELEASE
```

For reference, the entire run of `diff.sh` is attached.

### 7. Tips

- If a custom release is built using the native `make release` procedure, `freebsd-update-server` code will work from your release. As an example, a release without ports or documentation can be built by clearing functionality pertaining to documentation subroutines `findextradocs()`, `addextradocs()`, and altering the download location in `fetchiso()`, respectively, in scripts/build.subr. As a last step, change the `sha256(1)` hash in `build.conf` under your respective release and architecture and you are ready to build off your custom release.

```bash
# Compare ${WORKDIR}/release and ${WORKDIR}/${1}, identify which parts
# of the world/doc subcomponent are missing from the latter, and
# build a tarball out of them.
findextradocs() {
}
# Add extra docs to ${WORKDIR}/${1}
addextradocs() {
}
```

- Adding `-j NUMBER` flags to `buildworld` and `obj` targets in the scripts/build.subr script may speed up processing depending on the hardware used, however it is not necessary. Using these flags in other targets is not recommended, as it may cause the build to become unreliable.

```bash
# Build the world
log "Building world"
cd /usr/src &&
make -j 2 ${COMPATFLAGS} buildworld 2>&1
# Distribute the world
log "Distributing world"
make -j 2 obj &&
make ${COMPATFLAGS} release.1 release.2 2>&1
```

- Create an appropriate DNS SRV record for the update server, and put others behind it with variable weights. Using this facility will provide update mirrors, however this tip is not necessary unless you wish to provide a redundant service.
IN SRV 0 1 80 host2.myserver.com.
IN SRV 0 0 80 host3.myserver.com.