# Advances in OpenBSD packages

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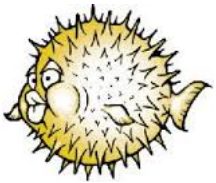


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# HTTPS is a lie

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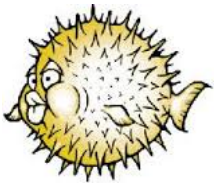


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# Introduction

This talk is actually a two-parter

- Security of https in `pkg_add` (joint LSE / OpenBSD work)
- Security/convenience of building packages (`PORTS_PRIVSEP`)

## Introduction

- `pkg_add` is used to install and update packages.
- currently grabs packages through an external `ftp` command.
- `ftp` handles ftp, http, https.

# The problem

## More precisely

- each transfer is a new `ftp` process
- https is slower than http by about 30%.
- no resumption, because we have no state
- libtls did provide session resumption, but no serialization

## HTTPS

TLS, like most crypto frameworks, uses asymetric crypto for authentification
**That's expensive.**
Session resumption shunts that by starting with a shared secret
With session resumption, you get one less packet on a connection start.
And it's even more useful for slow boxes.

# How to do it

## Strategy

- libtls must have serialisation for session info
- `ftp` must support this as an option
- `pkg_add` has to pass the option (and create the file)
- `pkg_add` must connect to the same server each time

## Same server ?

We now use cdn mirrors, (mostly thanks to Job Snyder) so the first connection starts with a redirect.
Solution: `pkg_add` parses redirection messages, so that **all** connections within a run end up on the same box.

## the tls part

Not my work, mostly Joel Sing, Bob Beck, Ted Unangt, Theo de Raadt
Ended up working with a temporary file: `ftp -S session=/dev/fd/n`.

## the `pkg_add` part

Ended up retooling temporary file creation so I could get pure fd (and unlink the file) pass the fd to `ftp`.

# Didn't work at first

## No such file

Turns out perl does something really smart, see $SYSTEM_FD_MAX. Everything above it is marked close-on-exec.
That's actually what we want.
Just turn it off manually WHEN we want the fd.

# The code

```
sub setup_session
{
        my $self = shift;
        $self->{count} = 0;
        local ($>, $));
        my ($uid, $gid, $user) = $self->fetch_id;
        if (defined $uid) {
                $> = $uid;
                $) = "$gid $gid";
        }
        my ($fh, undef) = OpenBSD::Temp::fh_file("session",
                sub { unlink(shift); });
        if (!defined $fh) {
                $self->{state}->fatal("Can't write session into tmp directory");
        }
        $self->{fh} = $fh; # XXX store the full fh and not the fileno
}
sub ftp_cmd
{
        my $self = shift;
        return $self->SUPER::ftp_cmd." -S session=/dev/fd/".fileno($self->{fh});
}
sub drop_privileges_and_setup_env
{
        my $self = shift;
        $self->SUPER::drop_privileges_and_setup_env;
        # reset the CLOEXEC flag on that one
        fcntl($self->{fh}, F_SETFD, 0);
}
```

# Results

Most mirrors support session resumption.
A few do weird things, the Brazilian mirror for instance
Some (ftp.fr) had to get session resumption
Some don't really support session resumption, `mirror.vdms.io` for instance.

Note that you can debug this with `https://www.ssllabs.com/`

| | |
|---|---|
| **Secure Renegotiation** | **Supported** |
| **Secure Client-Initiated Renegotiation** | No |
| **Insecure Client-Initiated Renegotiation** | No |
| **BEAST attack** | Not mitigated server-side (more info) TLS 1.0: 0xc013 |
| **POODLE (SSLv3)** | No, SSL 3 not supported (more info) |
| **POODLE (TLS)** | No (more info) |
| **Downgrade attack prevention** | **Yes, TLS_FALLBACK_SCSV supported** (more info) |
| **SSL/TLS compression** | No |
| **RC4** | No |
| **Heartbeat (extension)** | No |
| **Heartbleed (vulnerability)** | No (more info) |
| **Ticketbleed (vulnerability)** | No (more info) |
| **OpenSSL CCS vuln. (CVE-2014-0224)** | No (more info) |
| **OpenSSL Padding Oracle vuln. (CVE-2016-2107)** | No (more info) |
| **ROBOT (vulnerability)** | No (more info) |
| **Forward Secrecy** | With modern browsers (more info) |
| **ALPN** | Yes h2 http/1.1 |
| **NPN** | Yes h2 http/1.1 http/1.0 |
| **Session resumption (caching)** | **No (IDs assigned but not accepted)** |

# session tickets ?

## RFC 5077

- server won't/can't cache session information
- so it sends it to the client
- signed/encrypted by the server for validity
- on resumption, client sends the ticket
- server decodes it and says okay

# Bad speed-up

## Still slow

HTTPS with session resumption is faster than without
but still way slower than http.
Went from 30% slower to 25% slower.

## It's all about the Pentium^ WRTT

- TCP handshake: 3 packets
- TLS handshake: an extra 4 packets
- (with session resumption: 6 packets)

# Less RTT

## At the TCP level

There's an extension that allows sessions to start quickly
Needs some kind of cookie to prevent some DOSing.

## At the TLS level

People are working on TLS 1.3
(yeah, I know it was approved. Let's wait for a few CVE first, then we can use it)
The handshakes are coalesced, less packets
There's an experimental mode called 0-RTT resumption
(Send encrypted info directly along with the ticket)

# Why HTTPS - crypto 101 still

## Security considerations

- integrity: we have it through **signatures**
- authentication: likewise
- confidentiality: do we care

# About signatures

## Paranoid signatures

### Every package is signed externally (in the gzip header)

```
<gzip header>
Untrusted comment: verify with openbsd-63-pkg.pub
RWT58k1AWz/zZG4PGHFXsGGANXma1ETfAIX26os0A2RD6A6Bs38CWFzpE16jOO+VsZRCsUGGP85WVXUfhfcti6AZVNAiiyOzOQc=
date=2018-03-11T14:53:47Z
key=/etc/signify/openbsd-63-pkg.sec
algorithm=SHA512/256
blocksize=65536

b0896fec0204c2f9291410c032e503ac6da41c9be49537c0688190fd781c292d
2427dd3653ed775f372dd71a882edf14e88d36bc547bb1590de1e75e806e2c5e
aaab821c30bc49cab2aa8e00283c2d83c256476a5ea7d9d0bca2189f11e578f4
2bcb382177ff53383d660511bfc21add474f33868b9a8607775be0b011447311
2b066b4c73de1e2bc17d2b6c36a53c26e4b9529cbbf0e62c25ec26fc847288cf
ba3fa754009fe9184a94975d6d7b937fc0cd0e70f77817add2dbc5f310473b64
4d71debbf9107c72e573816c671b14914c4ed40963b8509d954e5a9c7ad84fb4
83b7ebf1d0b3bab34c03eeec925f61f1bc6f90ca65d9b50684bc69451bc8938b
fc182b6f1bbf5f2b1ef3624103f712dbcb72cbdd37c0482c9d918a170672c14e
37c8c986f4e6761f528b7705984f947f2d15d048ac7a21f723fc01aa985d652e
aaa580a9fd1c6931eae3a9572ac3fb234e92fdaba42b2fb2d25b9f779d244b43
517a7236e5d5b424fd34445b644b5e03f710c233a721eca7f8c0f66aff4a6c67
<actual gzip contents>
```

# Out-of-date mirrors

## controls

- `pkg_add` displays the ts of the quirks (exception) package
- (get quirks thru https explicitly)
- (add expiration timestamps for quirks so that `pkg_add` complains)
- the quirks package contains a cve list of packages that **MUST** be updated.
- people don't remember that list

# My other persona

## Epita LSE

In my lab, I work with people on automatic data analysis

- malware classification
- network traffic analysis

So using sophisticated stats techniques to recognize stuff

(they call it Machine Learning these days, but it's just large stats cooking... mostly)

https is a lie

## Encryption does not change packet size

- So I can decode actual GET url lengths
- And `pkg_add` has a predictable order: get stuff in alphabetic order, minus dependencies.
- the only saving grace is the signify block size.

# Hacking things

- do a few `pkg_add` ourselves to see the workflow
- always gets the list, then quirks
- then packages in alphabetical order, with dependencies inserted
- ... so you retrieve package names lengths
- ... and match it with the mirrors
- ... just need a bit of exploration, but it is 100% accurate.

# Confidentiality 2

## https is a lie

- I can get around url GET lengths
- X-OpenBSD-Padding: A.....A (normal distribution)
- harder to work around package sizes

# Road map

Using http 1.1 (persistent connection) with byte-ranges is the way to go.

**but**

- this only solves the connection packets
- byte-range are helped by signatures (we only need 64K blocks)
- encryption still doesn't protect lengths
- we would need to enqueue several requests so that the size is unpredictable

# More details

There are two modes

- initial installation
- update

# On initial installation

- we still need byte-ranges (dependencies)
- so more or less grab 64K
- ... then the rest
- we've got the sizes from the list
- stutter a bit, pad stuff with redundant 64K

# Details

- so the sizes are all 64K
- ... but for the last one, we get it as two requests
- ... so randomly do other requests in two parts

# Details 2

- Signatures have a header
- ... that header is longer for larger packages
- ... so we need to fuzz the sizes as well
- ... basically random sizes 8K-16K
- ... so we don't even have to grab the last one twice
- ... this will work for updates as well

# Brittle

Relies on two requests being queued and satisfied as one stream

## Better approach

- randomly split each package in packets of reasonable size
- make sure the last packet is large enough
- (smallest package is 550 bytes)
- so basically, you pre-compute a split of the package in packets around 8K long (that can occasionally go down to 500 bytes and up to 16K).
- you make darn sure the last packet is big enough. If it's not, you enlarge other packets randomly
- ... I haven't looked at timing yet, but this should be darn unpredictable

# Not deployed yet

## Details details...

- somewhat complicated (though less than the first version)
- will reuse the "distant" protocol that we use for scp
- needs to handle timeouts manually, because HTTP 1.1 tends to drop you for no reason

# Ports privsep

## dpb state

dpb is fully privilege separated, several identities

- starts as root
- fetches as _pfetch
- builds as _pbuild
- ports tree belongs to user

The problem is when you try to play with it manually (as always with privsep). You end up doing everything as root, because it's a nightmare otherwise.

## Introducing PORTS_PRIVSEP

The idea is to use doas to change identity on the fly.
and add calls to `bsd.port.mk`

# Why doas

- Basically the security model is still that you have to become root to run `pkg_add` anyway.
- So then you add doas invocations to switch to `_pbuild` or `_pfetch`.
- Once you moved to `_pbuild` or `_pfetch`, you can't go back, so this gives you security.
- Oh, and `_pfetch` has network access, but `_pbuild` doesn't.

```
_PFETCH = ${SUDO} -u ${FETCH_USER}
_PBUILD = ${SUDO} -u ${BUILD_USER}
_MK_READABLE = ${_PBUILD} chmod a+rX
_PMAKE = cd ${.CURDIR} && PKGPATH=${PKGPATH} exec ${_PBUILD} ${MAKE}
_PREDIR = |${_PBUILD} tee >/dev/null
# Some operations will need sudo in privsep mode
_PSUDO = ${SUDO}
_UPDATE_PLIST_SETUP=FAKE_TREE_OWNER=${BUILD_USER} \
        PORTS_TREE_OWNER=$$(id -un) ${SUDO}
_INSTALL_CACHE_REPO = ${SUDO} install -d -o ${FETCH_USER} -g $$(id -g ${FETC
```

# feedback

Basic introduction was surprisingly easy, but there were a lot of details to fix.
Because it can't be recursive: if you switch to `_pbuild`, you can no longer use doas.
So you have to be very sure of each operation.
(thanks to Solene, Jeremy, Klemens...)

## The fine print

- Slightly less secure than `dpb`, because you trust the infrastructure.
- Requires doas setup (so setuid binaries) within the ports tree.
- Long term solution should be to start as root and drop privs always.
- There are just way more places to tweak
- And then you run large Makefiles as root...
- That's what base does (apart from the large Makefiles part)

Base uses su.
We will use `chroot -u user / cmd`
... because it can be prefixed to a command without needing any more tweaks.
Bonus: a second chroot mode, where the ports tree is NOT chroot'd but anything running in it is.

- We are trying to limit stuff, basically have doas only run `pkg_add` and delete.
- but doas sucks, because you can't restrict it to "perl somescript args".
- And we have scripts in the ports tree that are run through perl.
- because not guaranteed execute bit.

- Special treatment for `update_plist` and `update_patches`.
- They are run as root and switch to user and `_pbuild` as needed.
- Because the whole build tree might not be readable.
- Move them to base ?
- Paranoia...

# Integration with other tools

- People running `dpb` in a chroot will use `proroot`.
- `proroot` sets up everything by default
- for manual interaction, you mostly need two scripts/aliases
  - one to chroot
  - another one to edit files prior to edit patches.
- but with `PORTS_PRIVSEP` set, you can do everything properly.

# Success! and then

Turns out people like having `PORTS_PRIVSEP`
Even when not in a `proot` with `dpb`
So they started setting things up manually
We will have a `fix-permissions` target.
Maybe even run automatically if the checks don't work ?

# Conclusion

HTTPS: the same deductive approach can be used for any public web site.
Do some web-crawling + predictive model.
I'd be very interested to know how other package systems fare.
For instance, news sites: article length + assets