You think you're not a target?
A tale of 3 developers…

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SCALE 16X
Pasadena, CA
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My name is…

Debian Project Leader

Free software developer for 10+ years

Freelance software developer

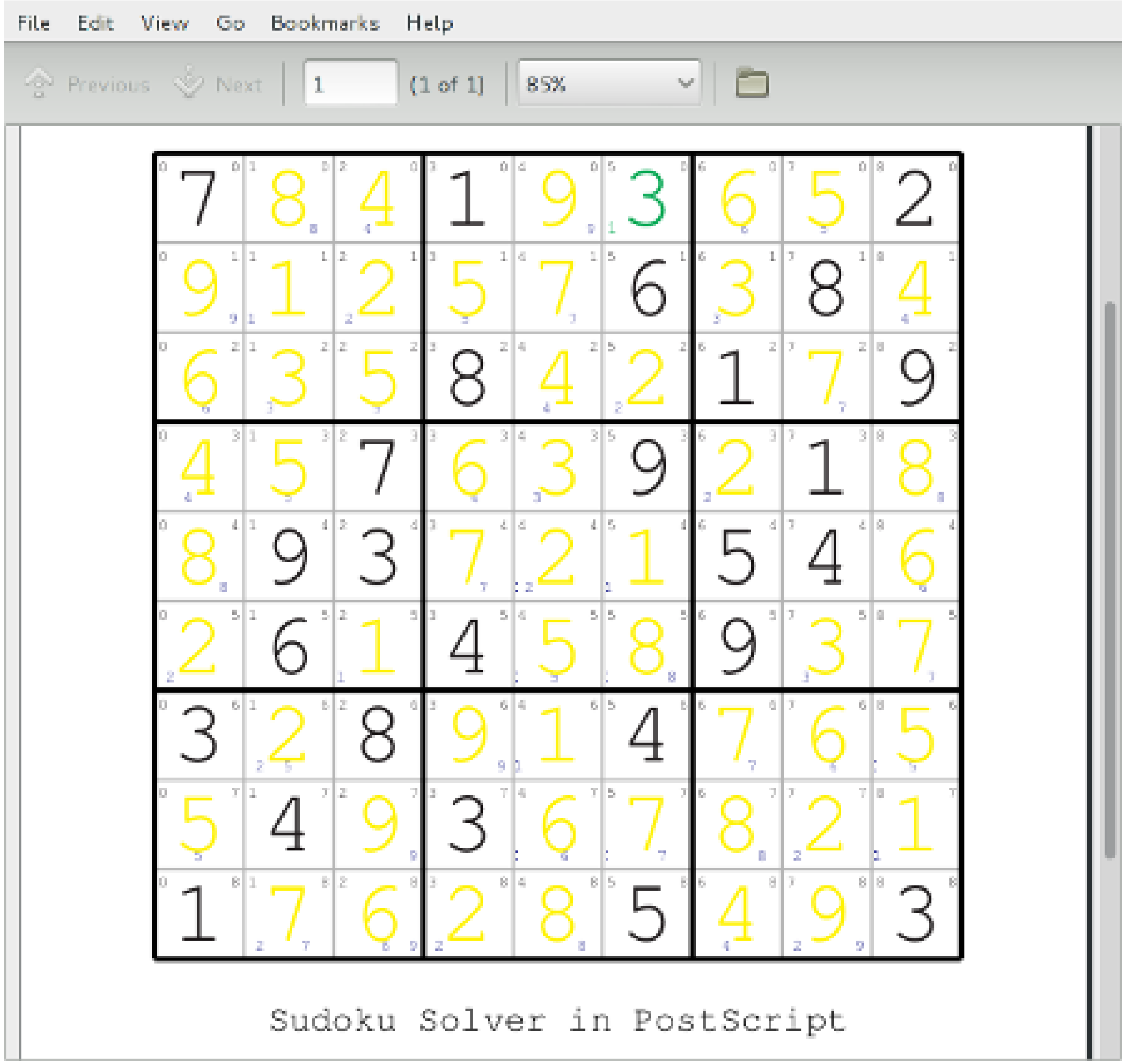
```
< zed0> can you get cp to give a progress bar like wget?
```

Damn right you can.

```
#!/bin/sh
cp_p()
{
   strace -q -ewrite cp -- "${1}" "${2}" 2>&1 \
      | awk '{
        count += $NF
            if (count % 10 == 0) {
               percent = count / total_size * 100
               printf "%3d%% [", percent
               for (i=0;i<=percent;i++)
                  printf "="
               printf ">"
               for (i=percent;i<100;i++)
                  printf " "
               printf "]\r"
            }
         }
         END { print "" }' total_size=$(stat -c '%s' "${1}") count=0
}
```

In action:

```
% cp_p /mnt/raid/pub/iso/debian/debian-2.2r4potato-i386-netinst.iso /dev/null
76% [===========================================>                   ]
```

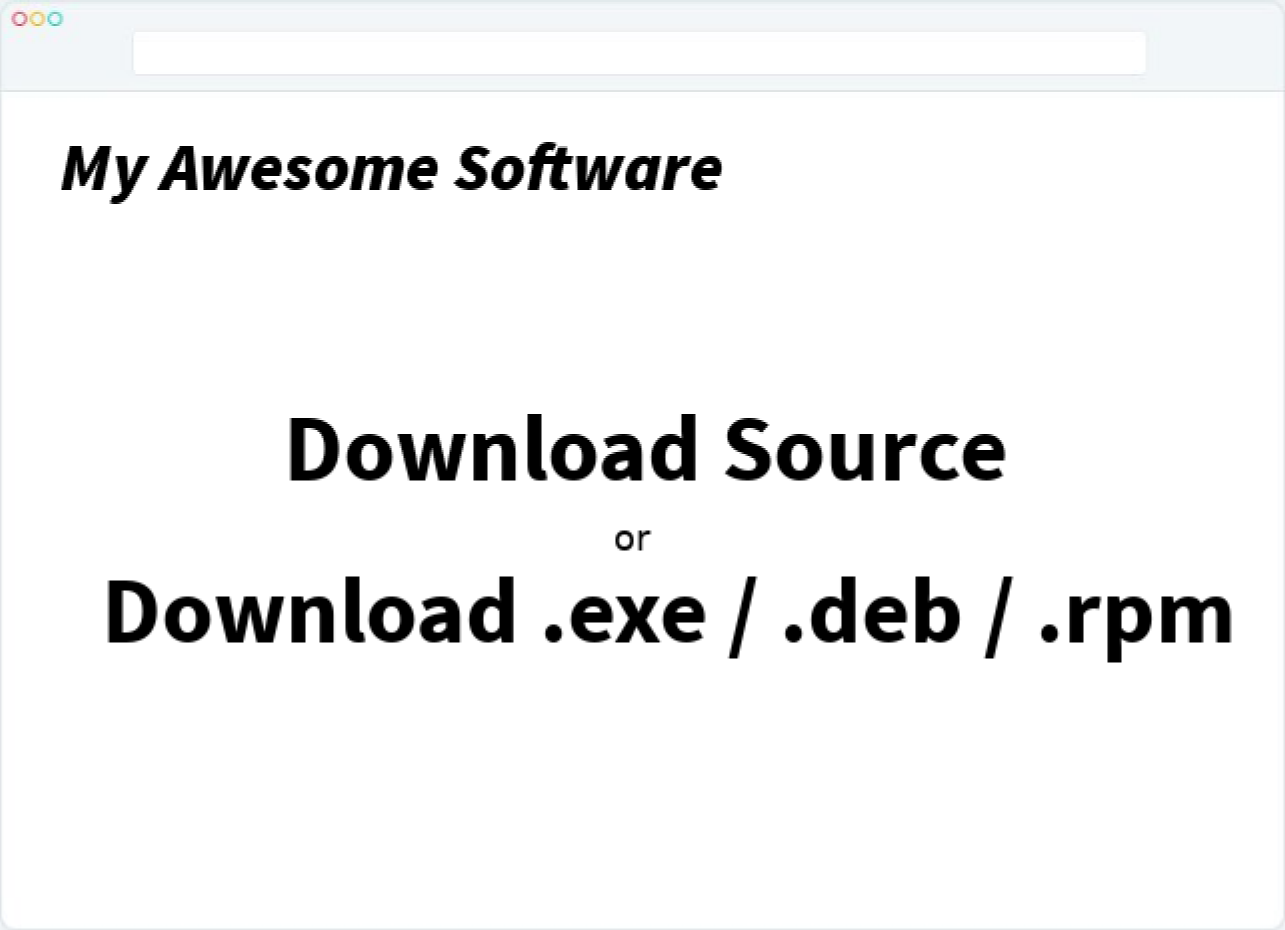


7	8	4	1	9	3	6	5	2
9	1	2	5	7	6	3	8	4
6	3	5	8	4	2	1	7	9
4	5	7	6	3	9	2	1	8
8	9	3	7	2	1	5	4	6
2	6	1	4	5	8	9	3	7
3	2	8	9	1	4	7	6	5
5	4	9	3	6	7	8	2	1
1	7	6	2	8	5	4	9	3

Sudoku Solver in PostScript

Three developers…

Alice



My Awesome Software

Download Source

or

Download .exe / .deb / .rpm

Bob
AR-15
SAMSUNG
TEKMAT
RAIDMAX

Eve

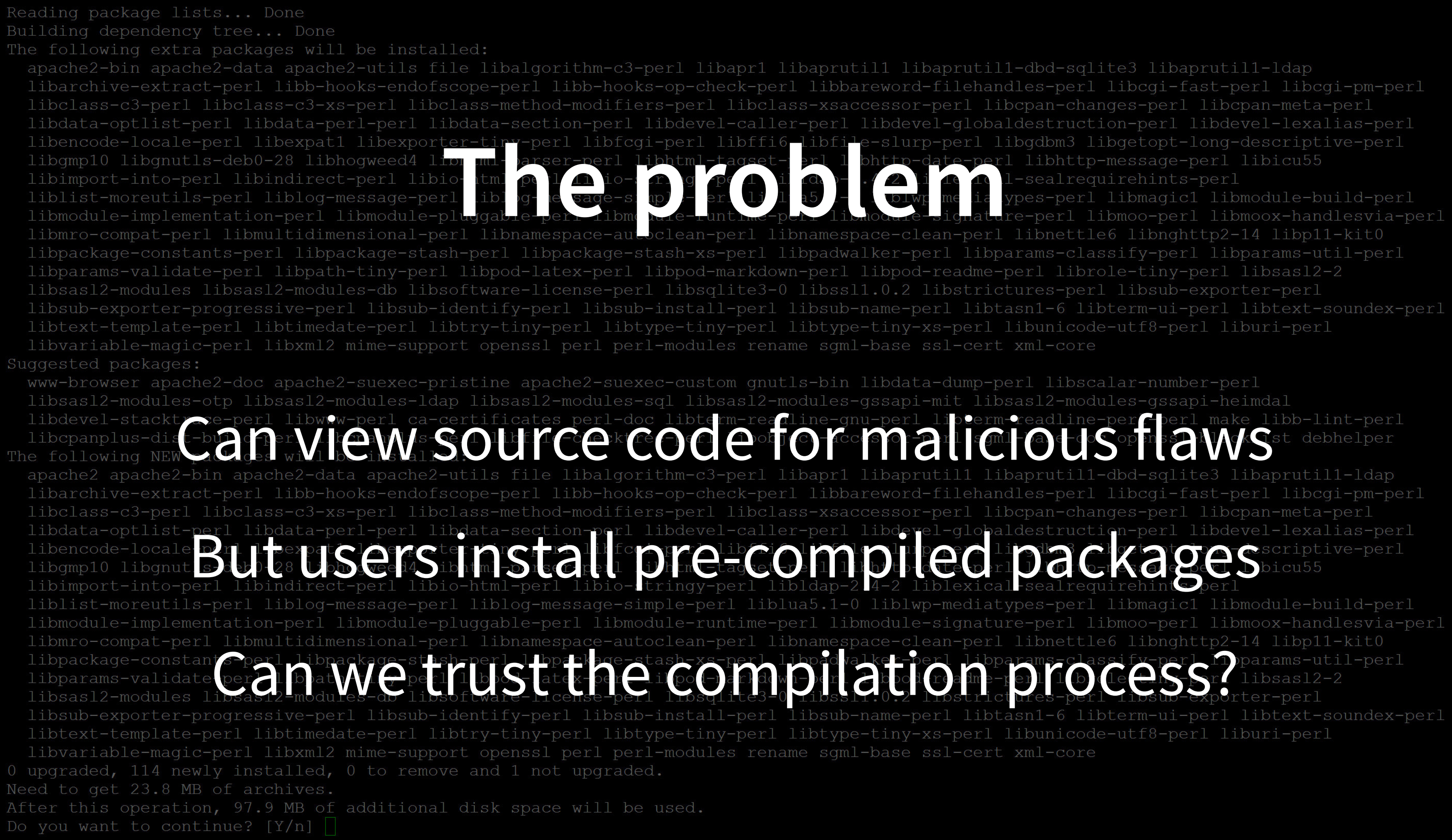
Eve

The problem

Can view source code for malicious flaws

But users install pre-compiled packages

Can we trust the compilation process?



```
Reading package lists... Done
Building dependency tree... Done
The following extra packages will be installed:
  apache2-bin apache2-data apache2-utils file libalgorithm-c3-perl libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap
  libarchive-extract-perl libb-hooks-endofscope-perl libb-hooks-op-check-perl libbareword-filehandles-perl libcgi-fast-perl libcgi-pm-perl
  libclass-c3-perl libclass-c3-xs-perl libclass-method-modifiers-perl libclass-xsaccessor-perl libcpan-changes-perl libcpan-meta-perl
  libdata-optlist-perl libdata-perl-perl libdata-section-perl libdevel-caller-perl libdevel-globaldestruction-perl libdevel-lexalias-perl
  libencode-locale-perl libexpat1 libexporter-tiny-perl libfcgi-perl libffi6 libfile-slurp-perl libgdbm3 libgetopt-long-descriptive-perl
  libgmp10 libgnutls-deb0-28 libhogweed4 libhtml-parser-perl libhtml-tagset-perl libhttp-date-perl libhttp-message-perl libicu55
  libimport-into-perl libindirect-perl libio-html-perl libio-stringy-perl libldap-2.4-2 liblexical-sealrequirehints-perl
  liblist-moreutils-perl liblog-message-perl liblog-message-simple-perl liblua5.1-0 liblwp-mediatypes-perl libmagic1 libmodule-build-perl
  libmodule-implementation-perl libmodule-pluggable-perl libmodule-runtime-perl libmodule-signature-perl libmoo-perl libmoox-handlesvia-perl
  libmro-compat-perl libmultidimensional-perl libnamespace-autoclean-perl libnamespace-clean-perl libnettle6 libnghttp2-14 libp11-kit0
  libpackage-constants-perl libpackage-stash-perl libpackage-stash-xs-perl libpadwalker-perl libparams-classify-perl libparams-util-perl
  libparams-validate-perl libpath-tiny-perl libpod-latex-perl libpod-markdown-perl libpod-readme-perl librole-tiny-perl libsasl2-2
  libsasl2-modules libsasl2-modules-db libsoftware-license-perl libsqlite3-0 libssl1.0.2 libstrictures-perl libsub-exporter-perl
  libsub-exporter-progressive-perl libsub-identify-perl libsub-install-perl libsub-name-perl libtasn1-6 libterm-ui-perl libtext-soundex-perl
  libtext-template-perl libtimedate-perl libtry-tiny-perl libtype-tiny-perl libtype-tiny-xs-perl libunicode-utf8-perl liburi-perl
  libvariable-magic-perl libxml2 mime-support openssl perl perl-modules rename sgml-base ssl-cert xml-core
Suggested packages:
  www-browser apache2-doc apache2-suexec-pristine apache2-suexec-custom gnutls-bin libdata-dump-perl libscalar-number-perl
  libsasl2-modules-otp libsasl2-modules-ldap libsasl2-modules-sql libsasl2-modules-gssapi-mit libsasl2-modules-gssapi-heimdal
  libdevel-stacktrace-perl libwww-perl ca-certificates perl-doc libterm-readline-gnu-perl libterm-readline-perl-perl make libb-lint-perl
  libcpanplus-dist-build-perl libcpanplus-perl libfile-checktree-perl libobject-accessor-perl sgml-base-doc opensp [illegible] debhelper
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils file libalgorithm-c3-perl libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap
  libarchive-extract-perl libb-hooks-endofscope-perl libb-hooks-op-check-perl libbareword-filehandles-perl libcgi-fast-perl libcgi-pm-perl
  libclass-c3-perl libclass-c3-xs-perl libclass-method-modifiers-perl libclass-xsaccessor-perl libcpan-changes-perl libcpan-meta-perl
  libdata-optlist-perl libdata-perl-perl libdata-section-perl libdevel-caller-perl libdevel-globaldestruction-perl libdevel-lexalias-perl
  libencode-locale-perl libexpat1 libexporter-tiny-perl libfcgi-perl libffi6 libfile-slurp-perl libgdbm3 libgetopt-long-descriptive-perl
  libgmp10 libgnutls-deb0-28 libhogweed4 libhtml-parser-perl libhtml-tagset-perl libhttp-date-perl libhttp-message-perl libicu55
  libimport-into-perl libindirect-perl libio-html-perl libio-stringy-perl libldap-2.4-2 liblexical-sealrequirehints-perl
  liblist-moreutils-perl liblog-message-perl liblog-message-simple-perl liblua5.1-0 liblwp-mediatypes-perl libmagic1 libmodule-build-perl
  libmodule-implementation-perl libmodule-pluggable-perl libmodule-runtime-perl libmodule-signature-perl libmoo-perl libmoox-handlesvia-perl
  libmro-compat-perl libmultidimensional-perl libnamespace-autoclean-perl libnamespace-clean-perl libnettle6 libnghttp2-14 libp11-kit0
  libpackage-constants-perl libpackage-stash-perl libpackage-stash-xs-perl libpadwalker-perl libparams-classify-perl libparams-util-perl
  libparams-validate-perl libpath-tiny-perl libpod-latex-perl libpod-markdown-perl libpod-readme-perl librole-tiny-perl libsasl2-2
  libsasl2-modules libsasl2-modules-db libsoftware-license-perl libsqlite3-0 libssl1.0.2 libstrictures-perl libsub-exporter-perl
  libsub-exporter-progressive-perl libsub-identify-perl libsub-install-perl libsub-name-perl libtasn1-6 libterm-ui-perl libtext-soundex-perl
  libtext-template-perl libtimedate-perl libtry-tiny-perl libtype-tiny-perl libtype-tiny-xs-perl libunicode-utf8-perl liburi-perl
  libvariable-magic-perl libxml2 mime-support openssl perl perl-modules rename sgml-base ssl-cert xml-core
0 upgraded, 114 newly installed, 0 to remove and 1 not upgraded.
Need to get 23.8 MB of archives.
After this operation, 97.9 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

The solution?

Health

NHS cyber-attack: Amber Rudd says lessons must be learnt

35 minutes ago | Health

Top S

NHS 'm

The NHS
systems
attack, th

35 min

Watson
defeat'

8 hour

Tory pl
past

30 min

Attacker must infect everybody simultaneously

How does this help?

Alice: Blackmail will be discovered

Bob: Tampered servers will be discovered

Carol: Tampered laptop will be discovered

Removes incentive to attack in the first place

“Reproducible” builds allows verification that no flaws have been introduced during the compilation process

"Builds with the same dependencies"... ✖

"Reliable" builds... ✖

Identical build results

```
# sha1sum ./my-binary
```

```
Alice    7a482b984883990bd4ab2ac5985630886cc252c

Bob      7a482b984883990bd4ab2ac5985630886cc252c

Carol    d0f65b7de7a49e818b8095538d3a0f783cc9c27
```

Wait, software isn't reproducible already?

Timestamps

Timezones & locales

Dictionary/hash/database ordering

Build paths

Users, groups, `umask`, environment variables

Build parallelism

Non-deterministic file ordering

Technical advantages

Easier to test changes — minimal diffs

Detect corrupted build environments

Cache ratio — save time, money & CO_2

Finds bugs!

Predictable OpenID secret

```
# Build.PL
$build->config_data(OpenIDConsumerSecret=>int(1e15*rand()));
```

```
# /usr/share/perl5/GBrowse/ConfigData.pm
{
 'OpenIDConsumerSecret' => '639098210478536',
 'cgibin' => '/usr/lib/cgi-bin/gbrowse',
 'conf' => '/etc/gbrowse',
 [..]
},
```

Every installation shares the same secret!

`bugs.debian.org/833885`

Random characters in manpages

```
-This manual page documents the usageoof WikipediaFS.
+This manual page documents the usage of WikipediaFS.
```

```
memcpy(&buf[1], &buf[2], strlen(buf)-1);
```

```
memcpy(3): The memory areas must not overlap
```

" n\\011" → "\111" → maps to capital "I"

```
- memcpy(&buf[1], &buf[2], strlen(buf)-1);
+ memmove(&buf[1], &buf[2], strlen(buf)-1);
```

bugs.debian.org/842635

Fails to build 0.46% of the time

```
x = f(u('abc'), 16)
y = f(u('abc'), 16)
self.assertEqual(sorted(set(x)), [u('a'), u('b'), u('c')])
```

```
AssertionError: Lists differ: [u'a', u'b'] != [u'a', u'b', u'c']
```

$$({}_3C_2)^*(2/3)^{16} - ({}_3C_1)^*(1/3)^{16} =\sim 0.46\%$$

bugs.debian.org/844233

Debian & reproducible builds

Test framework

Time & date

Hostname & domain name

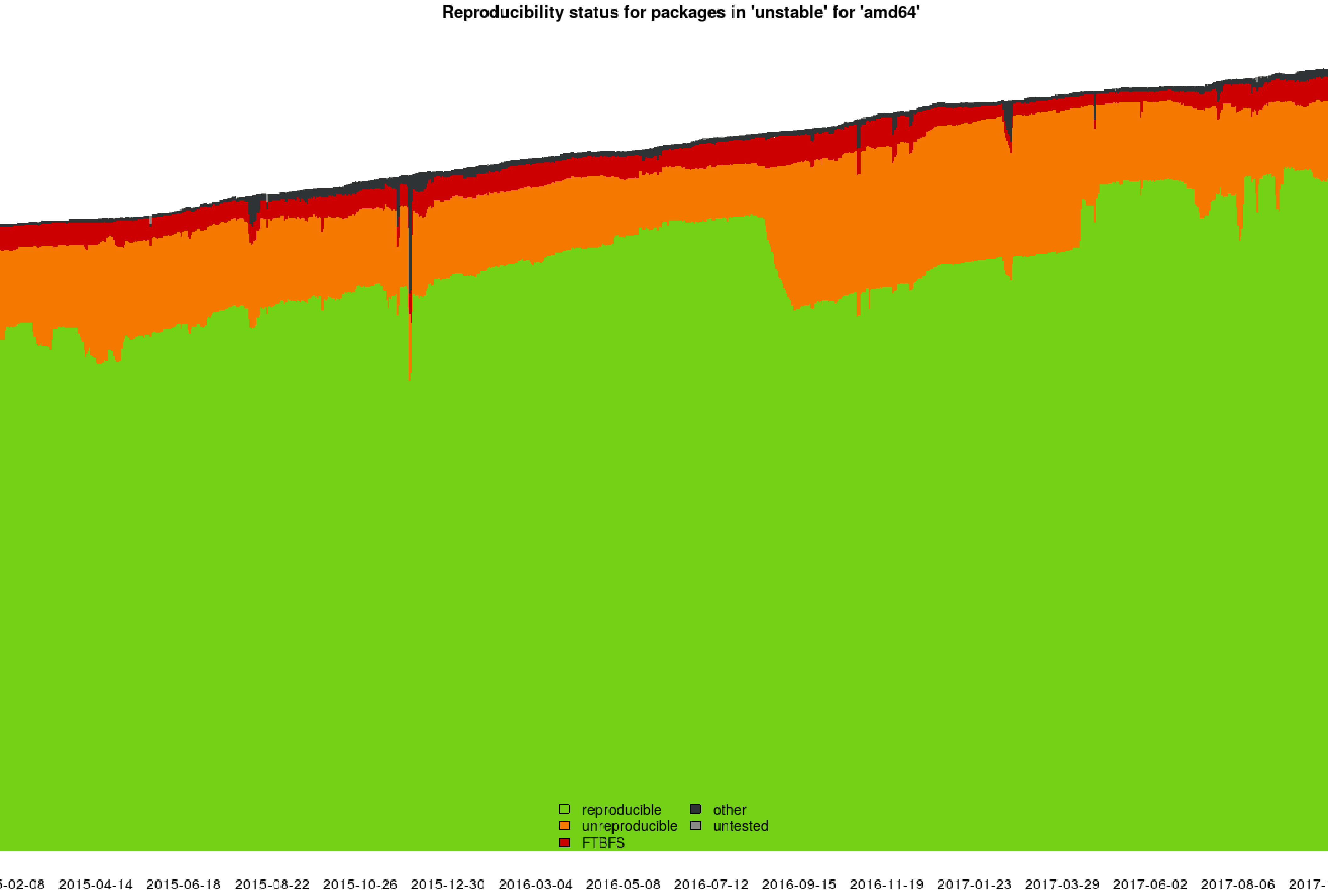
Filesystem (`disorderfs`)

Timezone & locale

`uid` & `gid`

Kernel & CPU type

First rebuild in 2013	24% packages reproducible
March 2018	93% packages reproducible


Reproducibility status for packages in 'unstable' for 'amd64'
□ reproducible
🟧 unreproducible
🟥 FTBFS
■ other
■ untested
5-02-08
2015-04-14
2015-06-18
2015-08-22
2015-10-26
2015-12-30
2016-03-04
2016-05-08
2016-07-12
2016-09-15
2016-11-19
2017-01-23
2017-03-29
2017-06-02
2017-08-06
2017-1

isdebianreproducibleyet.com

Beyond Debian…

coreboot, Fedora, LEDE, OpenWRT, NetBSD, FreeBSD, Archlinux, Qubes, F-Droid, NixOS, Guix, etc.

Other projects now using Debian's testing framework

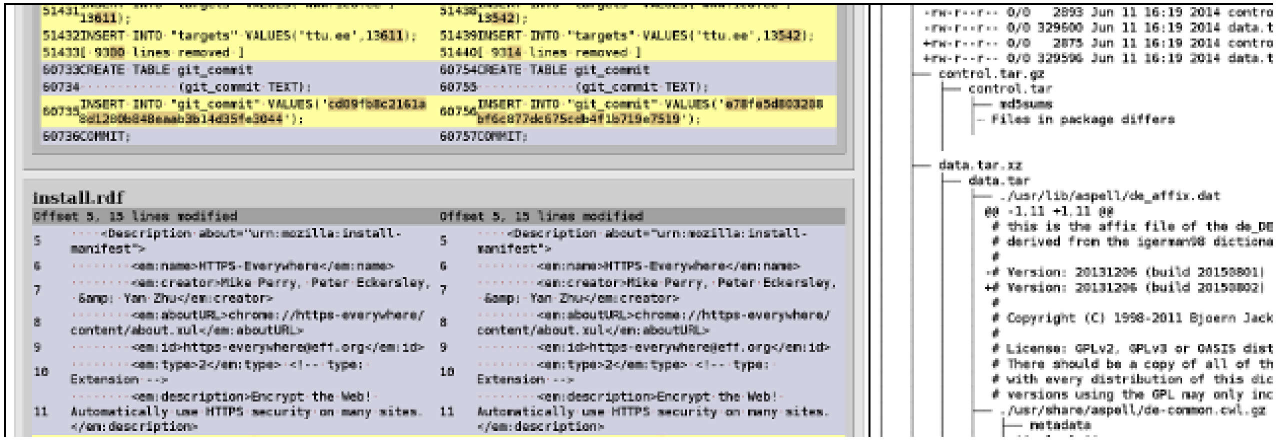
Reproducible Builds summits (Athens, Berlin)

```
# diff -urNad file1 file2
--- file1  2017-06-18 12:37:03.179186661 +0800
+++ file2  2017-06-18 12:37:04.811193648 +0800
@@ -1 +1 @@
-This is the first file.
+This is the second file.
```

diffoscope

in-depth comparison of files, archives, and directories

> *diffoscope* will try to get to the bottom of what makes files or directories different. It will recursively unpack archives of many kinds and transform various binary formats into more human readable form to compare them. It can compare two tarballs, ISO images, or PDF just as easily.



```
51431                                              51438
     13611);                                            13542);
51432INSERT INTO "targets" VALUES('ttu.ee',13611); 51439INSERT INTO "targets" VALUES('ttu.ee',13542);
51433[ 9300 lines removed ]                         51440[ 9314 lines removed ]
60733CREATE TABLE git_commit                       60754CREATE TABLE git_commit
60734             (git_commit TEXT);               60755             (git_commit TEXT);
60735INSERT INTO "git_commit" VALUES('cd09fb8c2161a 60756INSERT INTO "git_commit" VALUES('e78fe5d803208
     8d1200b848eaab3b14d35fe3044');                     bf6c877de675ceb4f1b719e7519');
60736COMMIT;                                        60757COMMIT;
```

install.rdf

```
Offset 5, 15 lines modified                        Offset 5, 15 lines modified
5     <Description about="urn:mozilla:install-     5     <Description about="urn:mozilla:install-
 manifest">                                         manifest">
6         <em:name>HTTPS-Everywhere</em:name>      6         <em:name>HTTPS-Everywhere</em:name>
7         <em:creator>Mike Perry, Peter Eckersley, 7         <em:creator>Mike Perry, Peter Eckersley,
 &amp; Yan Zhu</em:creator>                         &amp; Yan Zhu</em:creator>
8         <em:aboutURL>chrome://https-everywhere/  8         <em:aboutURL>chrome://https-everywhere/
 content/about.xul</em:aboutURL>                    content/about.xul</em:aboutURL>
9         <em:id>https-everywhere@eff.org</em:id>  9         <em:id>https-everywhere@eff.org</em:id>
10        <em:type>2</em:type> <!-- type:          10        <em:type>2</em:type> <!-- type:
 Extension -->                                      Extension -->
          <em:description>Encrypt the Web!                   <em:description>Encrypt the Web!
11 Automatically use HTTPS security on many sites. 11 Automatically use HTTPS security on many sites.
 </em:description>                                  </em:description>
```

```
-rw-r--r-- 0/0   2893 Jun 11 16:19 2014 contro
-rw-r--r-- 0/0 329600 Jun 11 16:19 2014 data.t
+rw-r--r-- 0/0   2875 Jun 11 16:19 2014 contro
+rw-r--r-- 0/0 329596 Jun 11 16:19 2014 data.t
── control.tar.gz
  ├── control.tar
  │ ├── md5sums
  │ - Files in package differs

── data.tar.xz
  ├── data.tar
  │ ├── ./usr/lib/aspell/de_affix.dat
  │ @@ -1,11 +1,11 @@
  │  # this is the affix file of the de_DE
  │  # derived from the igerman98 dictiona
  │  #
  │ -# Version: 20131206 (build 20150801)
  │ +# Version: 20131206 (build 20150802)
  │  #
  │  # Copyright (C) 1998-2011 Bjoern Jack
  │  #
  │  # License: GPLv2, GPLv3 or OASIS dist
  │  # There should be a copy of all of th
  │  # with every distribution of this dic
  │  # versions using the GPL may only inc
  │ ── ./usr/share/aspell/de-common.cwl.gz
  │   ├── metadata
```

https://diffoscope.org/

```
├── aspell-de_20131206-5_all.deb
│   ├── metadata
│   │  rw-r--r-- 0/0      4 Jun 11 16:19 2014 debian-binary
│   │ -rw-r--r-- 0/0   2893 Jun 11 16:19 2014 control.tar.gz
│   │ -rw-r--r-- 0/0 329600 Jun 11 16:19 2014 data.tar.xz
│   │ +rw-r--r-- 0/0   2875 Jun 11 16:19 2014 control.tar.gz
│   │ +rw-r--r-- 0/0 329596 Jun 11 16:19 2014 data.tar.xz
│   ├── control.tar.gz
│   │   ├── control.tar
│   │   │   ├── md5sums
│   │   │   │┄ Files in package differ
│   ├── data.tar.xz
│   │   ├── data.tar
│   │   │   ├── ./usr/lib/aspell/de_affix.dat
│   │   │   │  #
│   │   │   │ -# Version: 20131206 (build 20150801)
│   │   │   │ +# Version: 20131206 (build 20150802)
│   │   │   │  #
│   │   │   ├── ./usr/share/aspell/de-common.cwl.gz
│   │   │   │   ├── metadata
│   │   │   │   │ -gzip compressed data, last modified: Sat Aug  1 18:21
│   │   │   │   │ +gzip compressed data, last modified: Sat Aug  1 18:24
```

try.diffoscope.org

Future work

Source code remains vulnerable

Communicating concept to end-users?

Mandating Debian packages be reproducible?

Get involved!

Fix:	Bugs and toolchain issues!
Follow:	**@ReproBuilds** on Twitter
Join:	`#reproducible-builds` `irc.oftc.net`
Visit:	`reproducible-builds.org`

Thank you!

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