

Stretching out for trustworthy reproducible builds

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What?



What are reproducible builds?

“reproducible builds”
enable anyone to reproduce
identical binary packages
from a given source

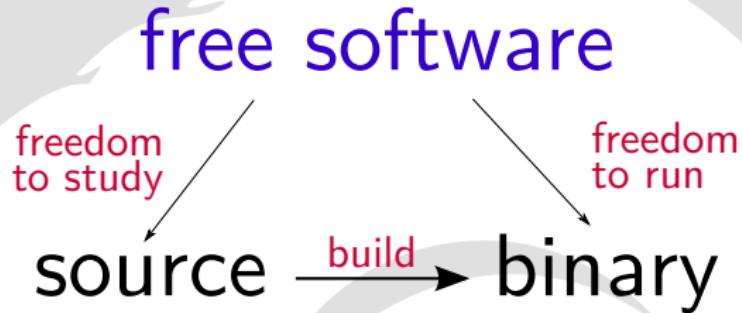


“I want to believe”

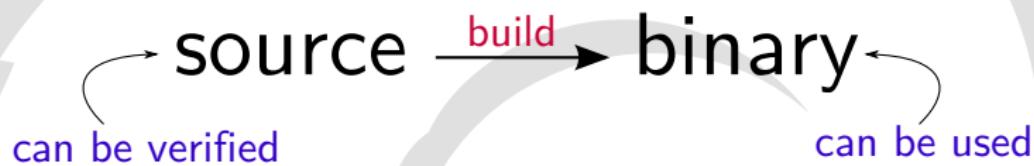
source →
^{build} binary



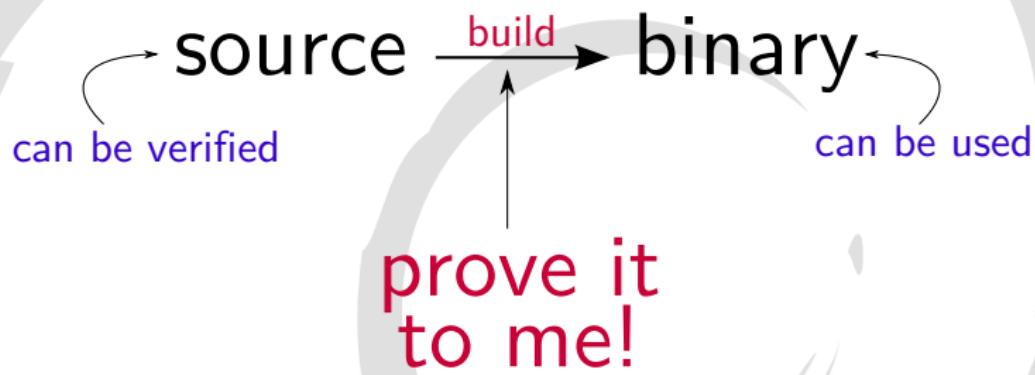
“I want to believe”



“I want to believe”



“I want to believe”





Why?



Why?

Reproducible builds allow for **independent verifications** that a binary matches what the source intended to produce.

... and other nice things.



But I'm the developer!

"I know what's in the binary because I compiled it myself!"

"I'm an upstanding, careful, and responsible individual!"

"Why should I have to worry about hypothetical risks about the contents of my binaries?"



But the build machines are secure

- How can you be sure?

Unpleasant thoughts

- We think of software development as a fundamentally benign activity.
 - ▶ “*I'm not that interesting.*”
- Users can be targeted through developers
- Known successful attacks against infrastructure used by Linux (2003), FreeBSD (2013)



Strong motivations

- Compromise one computer to get:
 - ▶ Hundreds of millions of other computers?
 - ▶ Every bank account in the world?
 - ▶ Every Windows computer in the world?
 - ▶ Every Linux server in the world?
- Compromise one computer is worth:
 - ▶ \$100k USD? (Market price of remote 0day)
 - ▶ \$100M USD? (Censorship budget of Iran per year)
 - ▶ \$4B USD? (Bitcoin market cap)



How small can a backdoor be?

OpenSSH 3.0.2 (CVE-2002-0083) – exploitable security bug (privilege escalation: user can get root)

```
{  
    Channel *c;  
-   if (id < 0 || id > channels_alloc) {  
+   if (id < 0 || id >= channels_alloc) {  
        log("channel_lookup: %d: bad id", id);  
        return;  
    }
```



Result of fixing the bug (asm)

```
cmpl $0x0,0x8(%ebp)
js 16
mov 0x4,%eax
cmp %eax,0x8(%ebp)
jle 30
mov 0x8(%ebp),%eax
mov %eax,0x4(%esp)
movl $0x4c,(%esp)
call 25
```

```
cmpl $0x0,0x8(%ebp)
js 16
mov 0x4,%eax
cmp %eax,0x8(%ebp)
jl 30
mov 0x8(%ebp),%eax
mov %eax,0x4(%esp)
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js 16
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cmp %eax,0x8(%ebp)
jl 30
mov 0x8(%ebp),%eax
mov %eax,0x4(%esp)
movl $0x4c,(%esp)
call 25
```

Resulting difference in the binary

What's the difference between `if (a > b)`
and `if (a >= b)` in x86 assembly?

assembly:	JLE	JL
opcode:	0x7E	0x7C
binary:	01111110	01111100

A single bit!

Other corresponding opcode pairs also differ by just a single bit (JGE=0x7D, JG=0x7F)



Result of fixing the bug (hex)

Vulnerable	Fixed
55 89 e5 83 ec	55 89 e5 83 ec
28 83 7d 08 00	28 83 7d 08 00
78 0a a1 04 00	78 0a a1 04 00
00 00 39 45 08	00 00 39 45 08
7e 1a 8b 45 08	7c 1a 8b 45 08
89 44 24 04 c7	89 44 24 04 c7
04 24 4c 00 00	04 24 4c 00 00
00 e8 fc ff ff	00 e8 fc ff ff
ff b8 00 00 00	ff b8 00 00 00
00 eb 35	00 eb 35

Overall file size: approx. 500 kB

Result of fixing the bug (hex)

Vulnerable	Fixed
55 89 e5 83 ec	55 89 e5 83 ec
28 83 7d 08 00	28 83 7d 08 00
78 0a a1 04 00	78 0a a1 04 00
00 00 39 45 08	00 00 39 45 08
7e 1a 8b 45 08	7c 1a 8b 45 08
89 44 24 04 c7	89 44 24 04 c7
04 24 4c 00 00	04 24 4c 00 00
00 e8 fc ff ff	00 e8 fc ff ff
ff b8 00 00 00	ff b8 00 00 00
00 eb 35	00 eb 35

Overall file size: approx. 500 kB

How did this start?

The screenshot shows a web browser window with the URL <https://blog.torproject.org/blog/deterministic-builds-part-one-cyberwar-and-global-compromise>. The page header features the Tor logo and navigation links for HOME, ARCHIVES, and ABOUT TOR. The main content is titled "Deterministic Builds Part One: Cyberwar and Global Compromise". It includes a timestamp ("Posted August 20th, 2013 by mikeperry in"), tags ("cyberpeace, dangerous toys, decentralization, deterministic builds, github, lack of foresight, National Insecurity Agency, security"), and a summary of the author's work on a new build system for the Tor Browser Bundle. Below the summary, there are sections for "Upcoming events" (listing FOSDEM, Tor's Winter 2014 Developers Meeting, and Roger at Financial Crypto 2014) and a "Search" bar.

https://blog.torproject.org/blog/deterministic-builds-part-one-cyberwar-and-global-compromise

Tor

HOME ARCHIVES ABOUT TOR

Deterministic Builds Part One: Cyberwar and Global Compromise

View Edit

Posted August 20th, 2013 by mikeperry in [cyberpeace](#), [dangerous toys](#), [decentralization](#), [deterministic builds](#), [github](#), [lack of foresight](#), [National Insecurity Agency](#), [security](#)

I've spent the past few months developing a new build system for the [3.0 series](#) of the Tor Browser Bundle that produces what are called "deterministic builds" -- packages which are byte-for-byte identical no matter who actually builds them, or what hardware they use. This effort was extraordinarily involved, consuming all of my development time for over two months (including several nights and weekends), babysitting builds and fixing differences and issues that arose.

When describing my recent efforts to others, by far the two most common questions I've heard are "Why did you do that?" and "How did you do that?". I've decided to answer each question at length in a separate blog post. This blog post attempts to answer the first question: "Why would anyone want a deterministic build process?"

The short answer is: to protect against targeted attacks. Current popular software development practices simply cannot survive targeted attacks of the scale and scope that we are seeing today. In fact, I believe we're just about to witness the first examples of large scale "watering hole" attacks. This would be malware that attacks the software development and build processes themselves to distribute copies of itself to tens or even hundreds of millions of machines in a single, officially signed, instantaneous update. Deterministic, distributed builds are perhaps the only way we can reliably prevent these types of targeted attacks in the face of the endless stockpiling of weaponized exploits and other "cyberweapons".

Add a New Blog Post
Manage Blog
Admin Comments
Manage Users
Add an Event
Manage Events
Manage Forums

Search

Search

Upcoming events

- [Tor @ FOSDEM, Brussels](#)
(14 days on Feb 1)
- [Tor's Winter 2014 Developers Meeting, Reykjavik, Iceland](#)
(30 days on Feb 17)
- [Roger @ Financial Crypto 2014 Bar Harbor](#)

Bitcoin's motivation

- Malicious modifications to binaries could result in irrevocable unwanted transfers of bitcoins
- Individual developers could be blamed for such modifications
- Users might not believe that a developer's machine was hacked
- Reproducible builds therefore protect developers



Nothing new though

From: Martin Uecker <muecker@gmx.de>

Cc: debian-devel@lists.debian.org

Date: Sun, 23 Sep 2007 23:32:59 +0200

I think it would be really cool if the Debian policy required that packages could be rebuild bit-identical from source. At the moment, it is impossible to independently verify the integrity of binary packages.

<https://lists.debian.org/debian-devel/2007/09/msg00746.html>



Wouldn't it be cool?

- Debian is the largest collection of free software
- More than 21,000 source packages
- “Our priorities are our **users** and **free software**”





How?

How?

- Record the build environment
- Reproduce the build environment
- Eliminate unneeded variations



How: Record the build environment



*.buildinfo

New control file *.buildinfo which records:

- Versions of build dependencies
 - ▶ ... and their dependencies
- Checksum of the source package.
- Checksums of the binary packages.



Example *.buildinfo

```
Format: 1.9
Build-Architecture: amd64
Source: txtorcon
Binary: python-txtorcon
Architecture: all
Version: 0.11.0-1
Build-Path: /usr/src/debian/txtorcon-0.11.0-1
Checksums-Sha256:
    a26549d9...7b 125910 python-txtorcon_0.11.0-1_all.deb
    28f6bcbe...69 2039 txtorcon_0.11.0-1.dsc
Build-Environment:
    base-files (= 8),
    base-passwd (= 3.5.37),
    bash (= 4.3-11+b1),
...
...
```



How: Reproduce the build environment

snapshot.debian.org

- snapshot.debian.org archives every state of the Debian archive.
- 2015-01-29: 28 terabytes of data in almost 17 million files.



srebuild

- Thin wrapper around sbuild
- Find the right archive snapshot
- Install packages listed in the *.buildinfo file
- Start the build

Status: work in progress



How: Eliminate unneeded variations

General approach

- Gitian (Bitcoin, Tor Browser):
 - ▶ Use a VM: same kernel, same user, same build path
 - ▶ libfaketime
- Debian:
 - ▶ Fix the tools
 - ▶ Fix the build systems
 - ▶ Work-arounds as last resort



strip-nondeterminism

- Normalize various file formats
- Currently handle:
 - ▶ ar archives (.a)
 - ▶ gzip
 - ▶ Java jar
 - ▶ Javadoc HTML
 - ▶ ZIP archives
- Written in Perl (like dpkg-dev)

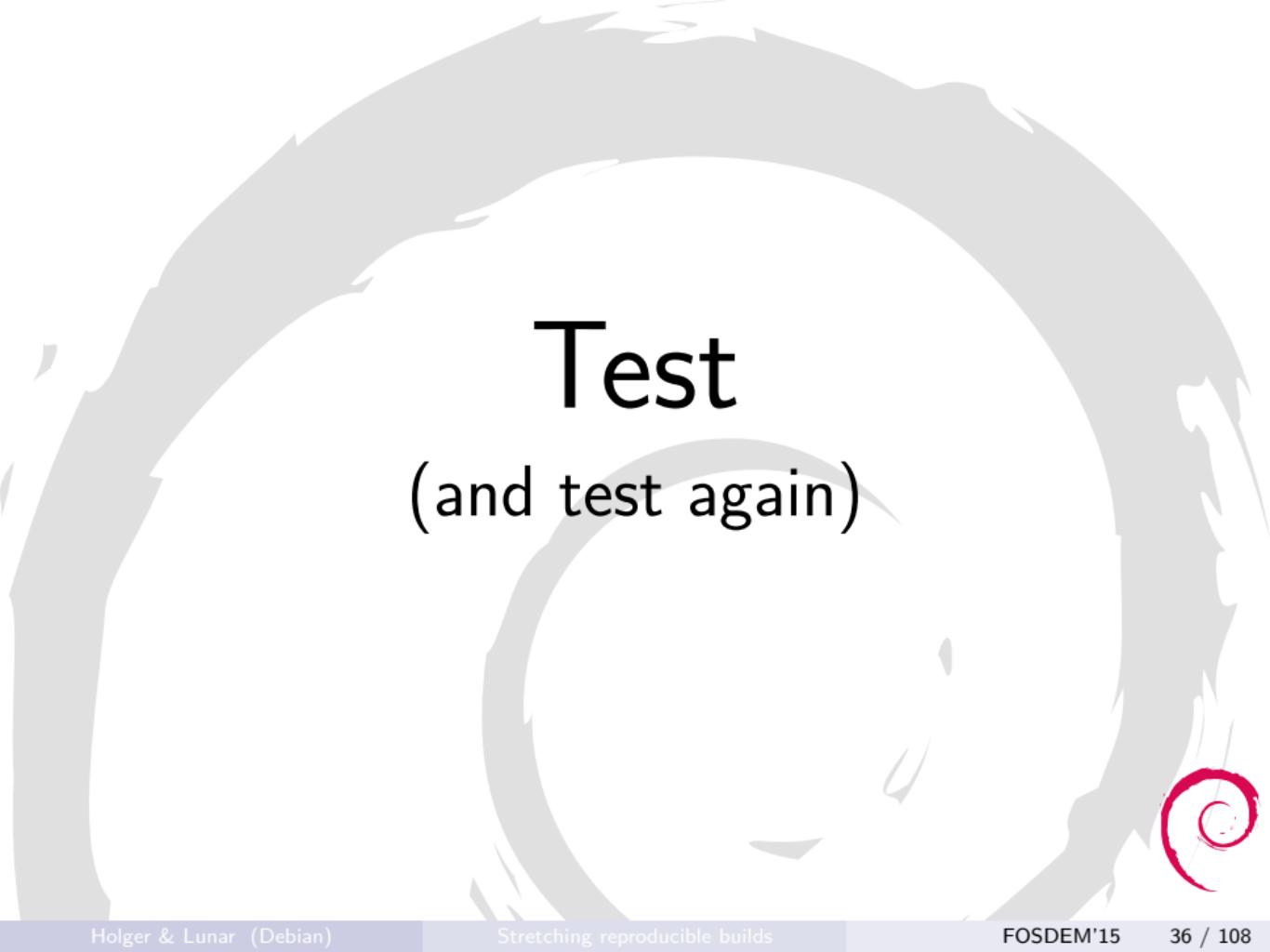


Investigating packages

debbindiff :

- Two files → HTML
- Recursively unpack archives
- Seeks human readability:
 - ▶ uncompress PDF
 - ▶ disassemble binaries,
 - ▶ unpack Gettext files,
 - ▶ ... *easy to extend to new file formats*
- Falls back to binary comparison





Test (and test again)



reproducible.debian.net: idea

- Build the package
- Rebuild the package
- Compare the results

Initially a 10 lines shell script...



reproducible.debian.net: today

- Driven by jenkins.debian.net
 - ▶ announced 2014-09-26
- 14 jobs defined in 263 LOC of YAML
 - ▶ 3 build jobs, rescheduled every 2 minutes
 - ▶ Job for auto-scheduling
 - ▶ Jobs to recreate pbuilder base.tgz and debbindiff schroot
 - ▶ Job to update notes and issues from Git
 - ▶ JSON output
 - ▶ Remaining jobs mostly to create HTML and graphs
- 13 Shell scripts with 2049 LOC
- 4 Python scripts with 948 LOC



reproducible.debian.net: variations

The second build is different in:

- time
- file ordering
- CPU ordering and availability
- hostname
- user & group
- locale



reproducible.debian.net: more goodies

- [https://reproducible.debian.net/\\$PACKAGE](https://reproducible.debian.net/$PACKAGE)
- Reproducibility status in tracker.debian.org
- Package sets:
 - ▶ Essential: yes, build-essential
 - ▶ 1337 most frequently installed packages (popcon)
 - ▶ Packages installed on Debian machines
 - ▶ All packages in Tails and their build dependencies
 - ▶ All packages in Grml and their build dependencies
- List of unreproducible packages per maintainer



reproducible.debian.net: not reproducible

Overview of packages which failed to build reproducibly

21557 packages have been attempted to be build so far, that's 100.0% of 21557 source packages in Debian sid currently.
Out of these, 17632 packages (81.7%) [could be built reproducible!](#)

Have a look at:

-
-
-
-
-
-
- [issues](#)
- [packages with notes](#)
- [currently scheduled](#)

[packages tested in the last 24h](#) [packages tested in the last 48h](#) [all tested packages \(sorted alphabetically\)](#)

[maintainers of unreplicable packages](#) [stats](#) [package sets stats](#)

3058 (14.1%) packages which failed to build reproducibly: [java-xmlbuilder](#) [gfspoken](#) [freehep](#) [graphicsio-tests](#) [munge-maven-plugin](#) [maven](#) [nvidia-settings](#) [camping](#) [libmodule-build-perl](#) [octave-secsld](#) [alienblaster](#) [primrose](#) [gpgme1.0](#) [webassets](#) [vmm](#) [ubuntu-packaging-guide](#) [txtorcon](#) [tsung](#) [taurus](#) [statsmodels](#) [spykeviewer](#) [skimage](#) [shinken](#) [sardana](#) [salt](#) [rdflib](#) [quodlibet](#) [qiime](#) [pythondialog](#) [python-tidylib](#) [python-shapely](#) [python-sfml](#) [python-secretstorage](#) [python-repoze.who](#) [python-reconfigure](#) [python-qt4](#) [python-pyaudio](#) [python-mzml](#) [python-fitbit](#) [python-expyriment](#) [python-django-mptt](#) [python-cogent](#) [pytables](#) [pyqt5](#) [pyotherside](#) [pyopencl](#) [pymvpa2](#) [pymvpa](#) [pycurl](#) [pycairo](#) [py-postgresql](#) [py3cairo](#) [psi4](#) [powerline](#) [plainbox](#) [phatch](#) [php-guzzle](#) [pebl](#) [paramiko](#) [owncloud-doc](#) [owncloud-client](#) [opencolorio](#)

reproducible.debian.net: package

gdb 7.7.1+dfsg-5  at 2015-01-24 15:50 UTC: notes debbindiff buildinfo rbuild (4MB) PTS BTS sources debian/rules

reproducible builds

Version annotated: 7.7.1+dfsg-5

Identified issues:

Identifier:	timestamps_in_jar
URL	https://wiki.debian.org/ReproducibleBuilds/TimestampsInJarFiles
Description	jar (Java Archive) file stores mtimes. Most often of files generated during the build.
Identifier:	timestamps_in_dvi_generated_by_latex
URL	https://wiki.debian.org/ReproducibleBuilds/TimestampsInDviGeneratedByLaTeX
Description	The creation date of the DVI file is the current time.

Comments:
Capture build time and hostname in
/usr/share/doc/gdb/check.log.gz



reproducible.debian.net: package

gdb 7.7.1+dfsg-5  at 2015-01-24 15:50 UTC: notes debbindiff buildinfo rbuild (4MB) PTS BTS sources debian/rules reproducible builds

```
/srv/reproducible-results/tmp.7nCU6iQ1Qp/b1/gdb_7.7.1+dfsg-5_amd64.changes vs.  
/srv/reproducible-results/tmp.7nCU6iQ1Qp/b2/gdb_7.7.1+dfsg-5_amd64.changes  
List of files does not match
```

1 2 b50f3b2295bb9326dc9f0aca00fe62f9 23964520 devel optional 3 1938d3870b5e8630678a197371895db9 2290974 devel optional 4 68dd51ae5e93497a222899a7394db8b33 1921986 devel optional 5 ef05db34e2230f40a29456844c7f6be 2778614 devel optional 6 467e677816443aa17f76a332c3059bd7 243784 devel optional 7 19d1d1454ad62a1872683b174b4dbd28 18135504 debug extra optional 8 33b38adcb35ff40eff6404a6a64ebc6b5 8691 devel optional gd	1 2 dfe3b37639e8666ce714849e41218bf0 23963628 devel optional 3 05ade3469adba2eb21bfe65f25d9f1c9 2290898-devel optional 4 2be2566270f0b1175a9730bf400eeecd 1921982-devel optional 5 ef05db34e2230f40a29456844c7f6be 2778614-devel optional 6 467e677816443aa17f76a332c3059bd7 243784-devel optional 7 19d1d1454ad62a1872683b174b4dbd28 18135504-debug extra optional 8 51ef6cf7f7302ea4e27fcf02632fc99f 8691-devel optional gd
--	--

gdb-minimal_7.7.1+dfsg-5_amd64.deb

control.tar.gz

reproducible.debian.net: package

```
gdb 7.7.1+dfsg-5  at 2015-01-24 15:50 UTC: notes debbindiff buildinfo rbuild (4MB) PTS BTS sources debian/rules reproducible builds

Starting to build gdb on 2015-01-24 15:50
The jenkins build log is/was available at https://jenkins.debian.net/job/reproducible\_builder\_alpha/26194/console
Reading package lists...
Building dependency tree...
Reading state information...
NOTICE: 'gdb' packaging is maintained in the 'Git' version control system at:
git://anonscm.debian.org/pkg-gdb/gdb.git
Need to get 17.7 MB of source archives.
Get:1 http://ftp.de.debian.org/debian/ sid/main gdb 7.7.1+dfsg-5 (dsc) [2783 B]
Get:2 http://ftp.de.debian.org/debian/ sid/main gdb 7.7.1+dfsg-5 (tar) [17.7 MB]
Get:3 http://ftp.de.debian.org/debian/ sid/main gdb 7.7.1+dfsg-5 (diff) [71.0 kB]
Fetched 17.7 MB in 0s (21.5 MB/s)
Download complete and in download only mode
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA512

Format: 3.0 (quilt)
Source: gdb
Binary: gdb, gdb-minimal, gdb64, gdb-multiarch, gdbserver, gdb-source, gdb-dbg
Architecture: any all
-----
```

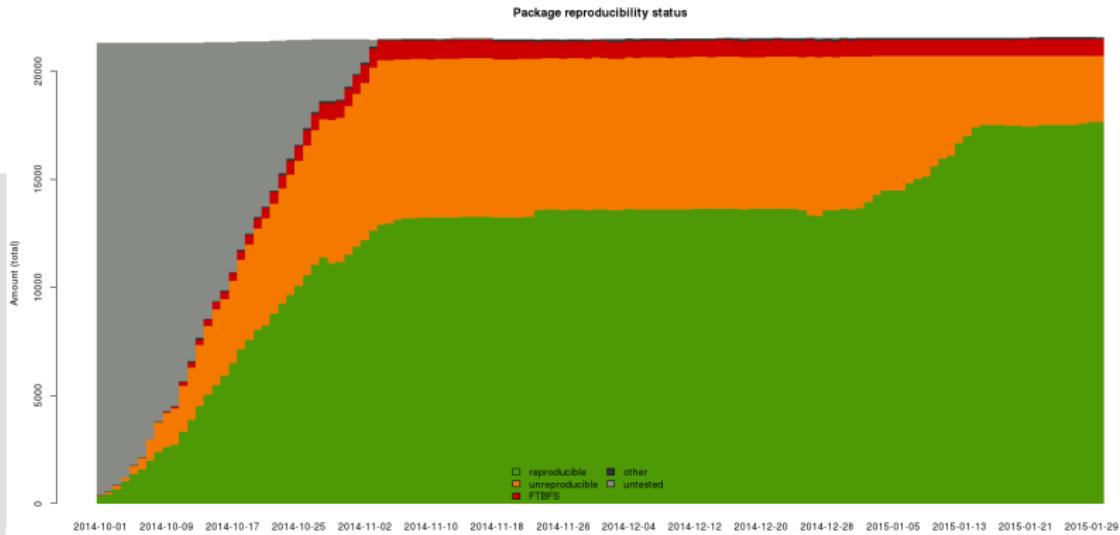


Experimental “reproducible” toolchain

- Test and refine changes to tools used by build systems
- Currently 20 source packages
- Examples : `dpkg`, `debsign`, `cdbs`, `libxslt`,
`r-base`, `gtk-doc`, `fontforge`, ...
- Most patches already submitted
- `git://git.debian.org/reproducible/$pkg.git`
in branch `pu/reproducible_builds`



reproducible.debian.net overall stats



For those in the back

81.7%

More than 17,600 source packages!



For those in the back

81.7%

More than 17,600 source packages!
(in our test environment!)

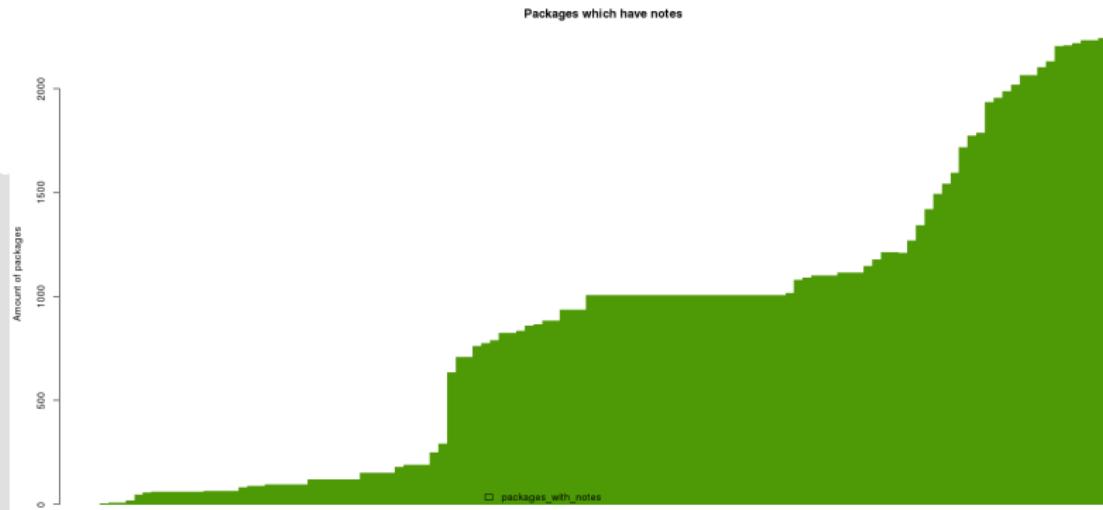


What is not tested (yet)

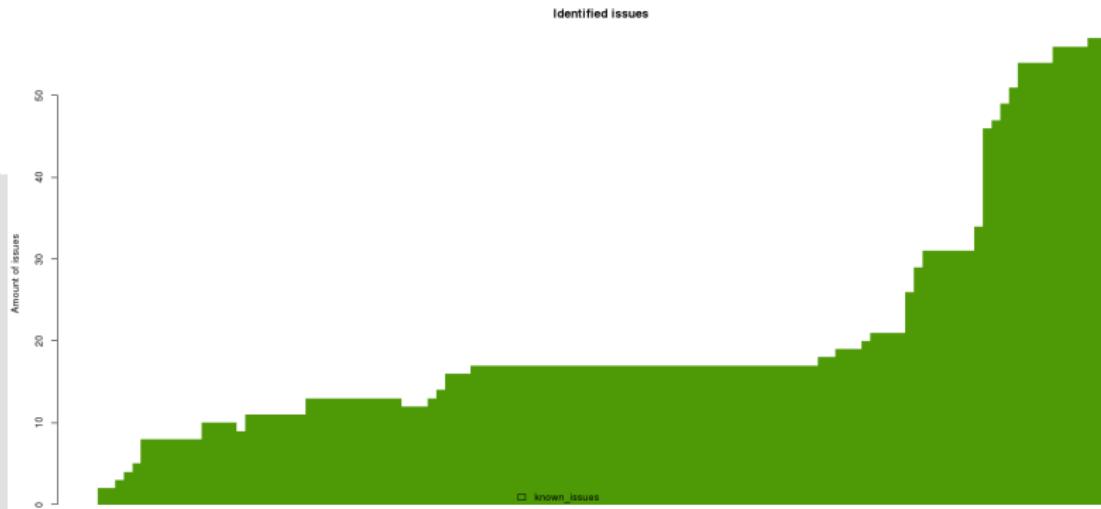
- uname output
- Day/month/year
- /proc/cpuinfo
- *More?*



Investigated packages



Identified issues



Findings



Identified issues

- Timestamps (recording current time)
- File order
- (Pseudo-)randomness:
 - ▶ Temporary file paths
 - ▶ UUID
 - ▶ Protection against complexity attacks



Identified issues (cont.)

- CPU and memory related:
 - ▶ Code optimizations for current CPU class
 - ▶ Recording of memory addresses
- Build-path
- Others, eg. locale settings



Examples

Timestamps added by build systems



Timestamps in static libraries

data.tar

./usr/lib/libform_g.a

metadata

234 14112 Jan 2 06:04 2015 f_trace.o	234 14112 Jan 2 06:22 2015 f_trace.o
234 14336 Jan 2 06:04 2015 fld_arg.o	234 14336 Jan 2 06:22 2015 fld_arg.o
234 16112 Jan 2 06:04 2015 fld_attr.o	234 16112 Jan 2 06:22 2015 fld_attr.o
234 16368 Jan 2 06:04 2015 fld_current.o	234 16368 Jan 2 06:22 2015 fld_current.o
234 23592 Jan 2 06:04 2015 fld_def.o	234 23592 Jan 2 06:22 2015 fld_def.o
234 14920 Jan 2 06:04 2015 fld_dup.o	234 14920 Jan 2 06:22 2015 fld_dup.o
234 13064 Jan 2 06:04 2015 fld_ftchoice.o	234 13064 Jan 2 06:22 2015 fld_ftchoice.o
234 13992 Jan 2 06:04 2015 fld_ftlink.o	234 13992 Jan 2 06:22 2015 fld_ftlink.o
234 13992 Jan 2 06:04 2015 fld_info.o	234 13992 Jan 2 06:22 2015 fld_info.o
234 13616 Jan 2 06:04 2015 fld_just.o	234 13616 Jan 2 06:22 2015 fld_just.o
234 14688 Jan 2 06:04 2015 fld_link.o	234 14688 Jan 2 06:22 2015 fld_link.o
234 13472 Jan 2 06:04 2015 fld_max.o	234 13472 Jan 2 06:22 2015 fld_max.o
234 13208 Jan 2 06:04 2015 fld_move.o	234 13208 Jan 2 06:22 2015 fld_move.o
234 16296 Jan 2 06:04 2015 fld_newftyp.o	234 16296 Jan 2 06:22 2015 fld_newftyp.o
234 16232 Jan 2 06:04 2015 fld_opts.o	234 16232 Jan 2 06:22 2015 fld_opts.o
234 14312 Jan 2 06:04 2015 fld_pad.o	234 14312 Jan 2 06:22 2015 fld_pad.o
234 13616 Jan 2 06:04 2015 fld_page.o	234 13616 Jan 2 06:22 2015 fld_page.o
234 13504 Jan 2 06:04 2015 fld_stat.o	234 13504 Jan 2 06:22 2015 fld_stat.o
234 14912 Jan 2 06:04 2015 fld_type.o	234 14912 Jan 2 06:22 2015 fld_type.o
234 13488 Jan 2 06:04 2015 fld_user.o	234 13488 Jan 2 06:22 2015 fld_user.o

Timestamps in static libraries (cont.)

data.tar

./usr/lib/libuninum.a

No differences found inside, yet data differs

2f20 2020 2020 2020 !<arch>./	2f20 2020 2020 2020 !<arch>./
3134 3231 3837 3334 14218734	3134 3231 3837 3334 14218734
2020 3020 2020 2020 06 0 0	2020 3020 2020 2020 51 0 0
3239 3634 2020 2020 0 2964	3239 3634 2020 2020 0 2964
0000 0bd8 0000 0bd8	0000 0bd8 0000 0bd8
0000 0bd8 0000 0bd8	0000 0bd8 0000 0bd8
0000 0bd8 0000 0bd8	0000 0bd8 0000 0bd8
0000 0bd8 0000 0bd8	0000 0bd8 0000 0bd8
0000 0bd8 0000 0bd8	0000 0bd8 0000 0bd8
0000 0bd8 0000 0bd8	0000 0bd8 0000 0bd8
0bd8 0000 0bd8 0000 0bd8 0000 0bd8	0bd8 0000 0bd8 0000 0bd8 0000 0bd8
6e67 6433 0074 656e engd2.tengd3.ten	6e67 6433 0074 656e engd2.tengd3.ten
6435 0074 656e 6764 gd4.tengd5.tengd	6435 0074 656e 6764 gd4.tengd5.tengd
0074 656e 6764 3800 6.tengd7.tengd8.	0074 656e 6764 3800 6.tengd7.tengd8.
656e 6764 3130 0074 tengd9.tengd10.t	656e 6764 3130 0074 tengd9.tengd10.t
756e 696e 756d 2e6f engd11..uninum.o	756e 696e 756d 2e6f engd11..uninum.o
3134 3231 3837 3334 / 14218734	3134 3231 3837 3334 / 14218734
2020 3132 3334 2020 05 1234 1234	2020 3132 3334 2020 50 1234 1234
3336 3636 3038 2020 100644 366608	3336 3636 3038 2020 100644 366608

Timestamps written by Maven

data.tar.xz

data.tar

annotation-indexer.jar

META-INF/maven/org.jenkins-ci/annotation-indexer/pom.properties

```
1 #Generated by Maven
2 #Tue Dec 16 21:03:56 UTC 2014
3 version=1.9
4 groupId=org.jenkins-ci
5 artifactId=annotation-indexer
```

```
1 #Generated by Maven
2 #Tue Dec 16 21:06:28 UTC 2014
3 version=1.9
4 groupId=org.jenkins-ci
5 artifactId=annotation-indexer
```

Timestamps written by PyQt4

data.tar.xz

data.tar

./usr/lib/armory/qrc_img_resources.py

```
# -*- coding: utf-8 -*-

# Resource object code
#
# Created: Thu Jan 1 01:13:33 2015
#       by: The Resource Compiler for PyQt
#
# WARNING! All changes made in this file

from PyQt4 import QtCore

---87477 lines: qt_resource_data = "\---
```

Timestamps written by Erlang compiler

data.tar.xz

data.tar

./usr/lib/x86_64-linux-gnu/ejabberd/ebin/mod_admin_extra.beam

```
4f 5231 0000 733c 4245 414d 4174 6f6d F0  
68 0264 0006 6f75 7464 summaryh.d..outd  
69 6e68 0264 0001 696b irk..ebinh.d..ik  
61 6262 6572 642d 6465 ..../ejabberd-de  
64 656a 6802 6400 0776 v/includejh.d..v  
00 0535 2e30 2e32 6802 ersionk..5.0.2h.  
68 0662 0000 07de 610c d..timeh.b....a.  
26 6802 6400 0673 6f75 a.a.a.a&h.d..sou  
74 6d70 2f62 7569 6c64 rcek.Q/tmp/build  
65 7264 2d63 6f6e 7472 d/ejabberd-contr  
31 342e 3039 2e32 322f ib-0.2014.09.22/  
69 6e5f 6578 7472 612f mod_admin_extra/  
5f 6164 6d69 6e5f 6578 src/mod_admin_ex  
6a 4162 7374 0000 0000 tra.erljAbst....  
9 6e65 0000 037c 0000 0000 0000 0000 Lin
```

< ⌂ >

```
64f 5231 0000 733c 4245 414d 4174 6f6d F0  
968 0264 0006 6f75 7464 summaryh.d..outd  
269 6e68 0264 0001 696b irk..ebinh.d..ik  
a61 6262 6572 642d 6465 ..../ejabberd-de  
564 656a 6802 6400 0776 v/includejh.d..v  
b00 0535 2e30 2e32 6802 ersionk..5.0.2h.  
568 0662 0000 07de 610c d..timeh.b....a.  
120 6802 6400 0673 6f75 a.a.a.a h.d..sou  
f74 6d70 2f62 7569 6c64 rcek.Q/tmp/build  
265 7264 2d63 6f6e 7472 d/ejabberd-contr  
031 342e 3039 2e32 322f ib-0.2014.09.22/  
d69 6e5f 6578 7472 612f mod_admin_extra/  
45f 6164 6d69 6e5f 6578 src/mod_admin_ex  
c6a 4162 7374 0000 0000 tra.erljAbst....  
69 6e65 0000 037c 0000 0000 0000 0000 Lin
```

< ⌂ >

Timestamps in PE binaries

Windows, UEFI, Mono...

data.tar.xz

data.tar

./usr/lib/mono-cecil/Mono.Cecil.Mdb.dll

9000 0300 0000 0400 0000 ffff 0000 MZ...	9000 0300 0000 0400 0000 ffff 0000 MZ...
0 0000 0000 0000 0000	0 0000 0000 0000 0000
0 0000 0000 8000 0000	0 0000 0000 8000 0000
1 21b8 014c cd21 5468 ..!..L.!Th	1 21b8 014c cd21 5468 ..!..L.!Th
2 616d 2063 616e 6e6f is program canno	2 616d 2063 616e 6e6f is program canno
3 2069 6e20 444f 5320 t be run in DOS	3 2069 6e20 444f 5320 t be run in DOS
4 2400 0000 0000 0000 mode....\$.....	4 2400 0000 0000 0000 mode....\$.....
5 5df1 9154 0000 0000 PE..L...].T...	5 9ef1 9154 0000 0000 PE..L...].T...
6 0b01 0800 00a2 0000 ..!.....	6 0b01 0800 00a2 0000 ..!.....
7 9ec1 0000 0020 0000 ..n.....	7 9ec1 0000 0020 0000 ..n.....
8 0020 0000 0002 0000 ..@.....	8 0020 0000 0002 0000 ..@.....
9 0400 0000 0000 0000	9 0400 0000 0000 0000
10 30fb 0000 0300 4085@.	10 3552 0100 0300 40855R..@.
11 0 0000 1000 0010 0000	11 0 0000 1000 0010 0000
12 0 0000 0000 0000	12 0 0000 0000 0000
13 0 00e0 0000 6003 0000 ..K.....	13 0 00e0 0000 6003 0000 ..K.....
14 0 0000 0000 0000	14 0 0000 0000 0000
15 0 0000 0000 0000	15 0 0000 0000 0000

Timestamps in Java jar

data.tar

```
./usr/share/java/flute-1.1-SNAPSHOT.jar
```

metadata

	1.1-SNAPSHOT.jar	1.1-SNAPSHOT.jar
	1568 bytes, number of entries: 45	1568 bytes, number of entries: 45
!nx	0 bx stor 15-Jan-07 20:23 META	0 bx stor 15-Jan-07 20:25 META
!nx	259 b- defN 15-Jan-07 20:23 META	259 b- defN 15-Jan-07 20:25 META
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	0 b- stor 15-Jan-07 20:23 org/unx	0 b- stor 15-Jan-07 20:25 org/
!nx	585 b- defN 15-Jan-07 20:23 org/unx	585 b- defN 15-Jan-07 20:25 org/
!nx	5744 b- defN 15-Jan-07 20:23 org/unx	5744 b- defN 15-Jan-07 20:25 org/
!nx	320 b- defN 15-Jan-07 20:23 org/unx	320 b- defN 15-Jan-07 20:25 org/

They are ZIP archives, really.

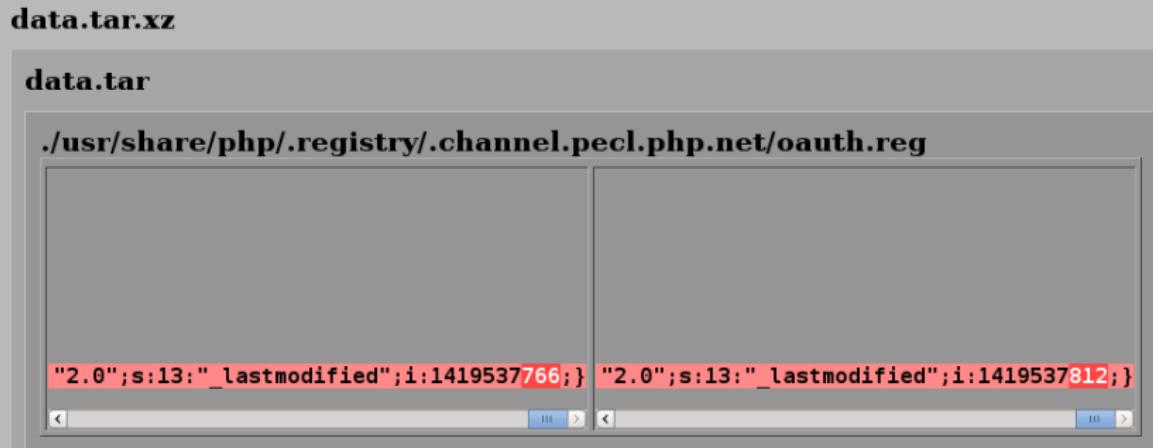
Timestamps in PHP registry

data.tar.xz

data.tar

./usr/share/php/.registry/.channel.pecl.php.net/oauth.reg

```
"2.0";s:13:"_lastmodified";i:1419537766;} "2.0";s:13:"_lastmodified";i:1419537812;}
```



Timestamps by a template engine

data.tar

./usr/lib/python2.7/dist-packages/spectacle/dsc/_init__.py

```
1 +-- 28 lines: #!/usr/bin/env python-----  
29 VFFSL=valueFromFrameOrSearchList  
30 VFSL=valueFromSearchList  
31 VFN=valueForName  
32 currentTime=time.time  
33 __CHEETAH_version__ = '2.4.4'  
34 __CHEETAH_versionTuple__ = (2, 4, 4,  
35 __CHEETAH_genTime__ = 1421397870.77925  
36 __CHEETAH_genTimestamp__ = 'Fri Jan 16 08:45:02 2015'  
37 __CHEETAH_src__ = 'dsc.tmpl'  
38 __CHEETAH_srcLastModified__ = 'Fri Feb 25 06:40:15 2011'  
39 __CHEETAH_docstring__ = 'Autogenerated by Cheetah: The Python  
40  
41 if __CHEETAH_versionTuple__ < RequiredVersionTuple__ < RequiredCheetahVersionTuple:  
42     raise AssertionError(  
43 +--127 lines: 'This template was compiled with Cheetah vers
```



Identified issues (cont.)

Examples

Archives



Timestamps in gzip headers

data.tar.xz

data.tar

./usr/share/ispell/brasileiro.mwl.gz

metadata

1 gzip compressed data, was "br.ispell",	last modified: Sat Jan 3 22:47:40 2015
--	--

...<< >>...	...<< >>...
-------------	-------------

Timestamps in ZIP archives

data.tar.xz

data.tar

./usr/share/boa-constructor/Docs/boa.apphelp.htm

metadata

```
--249 lines: Archive: boa.apphelp.htm-----  
minimum file system compatibility required: MS-DOS, OS/2 or NT FAT  
minimum software version required to extract: 2.0  
compression method: deflated  
compression sub-type (deflation): normal  
file security status: not encrypted  
extended local header: no  
file last modified on (DOS date/time): 2015 Jan 16 09:55:52  
file last modified on (UT extra field modtime): 2015 Jan 16 09:55:52 local  
file last modified on (UT extra field modtime): 2015 Jan 16 09:55:52 UTC  
32-bit CRC value (hex): 5bb8662c  
compressed size: 1660 bytes  
uncompressed size: 5682 bytes  
length of filename: 19 characters  
length of extra field: 24 bytes  
length of file comment: 0 characters
```

Timestamps in tarballs

data.tar.xz

data.tar

./usr/share/doc/allegro4-doc/examples/source.tar.gz

source.tar

metadata

54 2015-01-09 22:29:44 CMakeLists.txt	54 2015-01-09 22:32:29 CMakeLists.txt
98 2015-01-09 22:29:44 afinfo.c	98 2015-01-09 22:32:29 afinfo.c
19 2015-01-09 22:29:44 akaitest.c	19 2015-01-09 22:32:29 akaitest.c
32 2015-01-09 22:29:44 allegro.pcx	32 2015-01-09 22:32:29 allegro.pcx
70 2015-01-09 22:29:44 digitest.c	70 2015-01-09 22:32:29 digitest.c
10 2015-01-09 22:29:44 ex12bit.c	10 2015-01-09 22:32:29 ex12bit.c
46 2015-01-09 22:29:44 ex3buf.c	46 2015-01-09 22:32:29 ex3buf.c
57 2015-01-09 22:29:44 ex3d.c	57 2015-01-09 22:32:29 ex3d.c
34 2015-01-09 22:29:44 exaccel.c	34 2015-01-09 22:32:29 exaccel.c
96 2015-01-09 22:29:44 exalpha.c	96 2015-01-09 22:32:29 exalpha.c
62 2015-01-09 22:29:44 example.dat	62 2015-01-09 22:32:29 example.dat
65 2015-01-09 22:29:44 example.h	65 2015-01-09 22:32:29 example.h
30 2015-01-09 22:29:44 examples.txt	30 2015-01-09 22:32:29 examples.txt

Users and groups in tarballs

data.tar.xz

data.tar

./usr/share/doc/raster3d/diffs.tar.gz

diffs.tar

metadata

```
1 -rw-r--r-- pbuilder1/pbuilder1
2 -rw-r--r-- pbuilder1/pbuilder1
3 -rw-r--r-- pbuilder1/pbuilder1
4 -rw-r--r-- pbuilder1/pbuilder1
5 -rw-r--r-- pbuilder1/pbuilder1
6 -rw-r--r-- pbuilder1/pbuilder1
7 -rw-r--r-- pbuilder1/pbuilder1
8 -rw-r--r-- pbuilder1/pbuilder1
9 -rw-r--r-- pbuilder1/pbuilder1
10 -rw-r--r-- pbuilder1/pbuilder1
11 -rw-r--r-- pbuilder1/pbuilder1
12 -rw-r--r-- pbuilder1/pbuilder1
```

```
1 -rw-r--r-- pbuilder2/pbuilder2
2 -rw-r--r-- pbuilder2/pbuilder2
3 -rw-r--r-- pbuilder2/pbuilder2
4 -rw-r--r-- pbuilder2/pbuilder2
5 -rw-r--r-- pbuilder2/pbuilder2
6 -rw-r--r-- pbuilder2/pbuilder2
7 -rw-r--r-- pbuilder2/pbuilder2
8 -rw-r--r-- pbuilder2/pbuilder2
9 -rw-r--r-- pbuilder2/pbuilder2
10 -rw-r--r-- pbuilder2/pbuilder2
11 -rw-r--r-- pbuilder2/pbuilder2
12 -rw-r--r-- pbuilder2/pbuilder2
```

Examples

Timestamps in documentation



Timestamps written by Doxygen

data.tar.xz

data.tar

**./usr/share/doc/libnfo-doc/html
/dir_68267d1309a1af8e8297ef4c3efbcdः.html**

```
: <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML  
emitem:info_8h"><td class="memItemLeft" align="right" style="vertical-align: top;">  
separator:><td class="memSeparator" colspan="2"><br>
```

```
ontents -->  
oter part -->  
oter"/><address class="footer"><small>  
Mon Dec 15 2014 04:03:26 for libnfo by &#10;  
footer" src="doxygen.png" alt="doxygen"/>  
  
ress>
```

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML  
emitem:info_8h"><td class="memItemLeft" align="right" style="vertical-align: top;">  
separator:><td class="memSeparator" colspan="2"><br>
```

```
ntents -->  
oter part -->  
oter"/><address class="footer"><small>  
Mon Dec 15 2014 04:04:03 for libnfo by &#10;  
ooter" src="doxygen.png" alt="doxygen"/>  
  
ress>
```



Timestamps written by docbook-to-man

data.tar.xz

data.tar

ace_netsvcs.1.gz

ace_netsvcs.1

ETSVCS" "1" ----- ETSVCS" "1" -----

vc.conf, /usr/share/doc/ace-netsvcs/ACE-rvc.conf, /usr/share/doc/ace-netsvcs/ACE-r

dt@cs.wustl.edu>

docbook-to-man, Thu 25 Dec 2014, 01:10

dt@cs.wustl.edu>

docbook-to-man, Thu 25 Dec 2014, 01:23



Timestamps written by Ghostscript

data.tar.xz

data.tar

./usr/share/doc/c++-annotations/cplusplus.pdf

pdftk cplusplus.pdf output - uncompress

```
d='W5M0MpCehiHzreSzNTczkc9d' ?>
a' x:xmptk='XMP toolkit 2.9.1-13, fram
3.org/1999/02/22-rdf-syntax-ns#' xmlns:
er>dvips + GPL Ghostscript 9.06</pdf:Pr :2b7e66bf-d448-11ef-0000-a06d27758a43'
Date>2015-01-14T20:23:14Z</xmp:ModifyDa :2b7e66bf-d448-11ef-0000-a06d27758a43'
:29Z</xmp:CreateDate>
rref package</xmp:CreatorTool></rdf:Des
DocumentID='uuid:b743c33d-d447-11ef-000 :2b7e66bf-d448-11ef-0000-a06d27758a43'
t='application/pdf'><dc:title><rdf:Alt :2b7e66bf-d448-11ef-0000-a06d27758a43'
```

Timestamps written by Ghostscript (cont.)

431320 9159 0 obj	431320 9159 0 obj
431321 <<	431321 <<
431322 /ModDate (D:20150114202314Z00'00	431322 /ModDate (D:20150114202629Z00'00
431323 /Subject ()	431323 /Subject ()
431324 /CreationDate (D:20150114202314Z	431324 /CreationDate (D:20150114202629Z
431325 /Author ()	431325 /Author ()
431326 /Title ()	431326 /Title ()
431327 /Keywords ()	431327 /Keywords ()
431328 /Creator (LaTeX with hyperref pa	431328 /Creator (LaTeX with hyperref pa
431329 /Producer (dvips + GPL Ghostscri	431329 /Producer (dvips + GPL Ghostscri
431330 >>	431330 >>
431331 +-+9160 lines: endobj xref-----	431331 +-+9160 lines: endobj xref-----
440491 0027736476 00000 n	440491 0027736476 00000 n
440492 0027841270 00000 n	440492 0027841270 00000 n
440493 trailer	440493 trailer
440494	440494
440495 <<	440495 <<
440496 /Info 9159 0 R	440496 /Info 9159 0 R
440497 /ID [<ece9748e11c19361dc941039bb	440497 /ID [<54f331d30af99447035b87a9bb
440498 /Root 1 0 R	440498 /Root 1 0 R
440499 /Size 9160	440499 /Size 9160
440500 >>	440500 >>

Timestamps written by GNU groff

data.tar.xz

data.tar

./usr/share/doc/corosync/html/confdb_context_get.3.html

```
<!-- Creator      : groff version 1.22.3 -  
<!-- CreationDate: Thu Jan  8 04:06:53 20  
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4  
"http://www.w3.org/TR/html4/loose.dtd">  
<html>  
<head>  
<meta name="generator" content="groff -T  
<meta http-equiv="Content-Type" content="  
++ 95 lines: <meta name="Content-Style"
```

```
<!-- Creator      : groff version 1.22.3 -  
<!-- CreationDate: Thu Jan  8 04:09:52 20  
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4  
"http://www.w3.org/TR/html4/loose.dtd">  
<html>  
<head>  
<meta name="generator" content="groff -Th  
<meta http-equiv="Content-Type" content="  
++ 95 lines: <meta name="Content-Style"
```

./usr/share/doc/corosync/html/confdb_context_set.3.html

```
1 <!-- Creator      : groff version 1.22  
2 <!-- CreationDate: Thu Jan  8 04:06:53  
3 <!DOCTYPE html PUBLIC "-//W3C//DTD HT
```

```
1 <!-- Creator      : groff version 1.22  
2 <!-- CreationDate: Thu Jan  8 04:09:5:  
3 <!DOCTYPE html PUBLIC "-//W3C//DTD HT
```

Timestamps written by Javadoc

data.tar.xz

data.tar

./usr/share/doc/libconstantine-java-doc/javadoc/allclasses-frame.html

```
DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/strict.dtd"
-- NewPage -->
<html lang="en">
<head>
-- Generated by javadoc (version 1.7.0_65) on Wed Jan 07 12:39:34 UTC 2015 -->
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
<title>All Classes</title>
<meta name="date" content="2015-01-07">
<link rel="stylesheet" type="text/css" href="stylesheet.css" title="Style">
</head>
<body>
147 lines: <h1 class="bar">All Classes</h1>-----
```



Timestamps written by man2html

data.tar.xz

data.tar

./usr/share/doc/privoxy/man-page/privoxy-man-page.html

```
1 +- 301 lines: <!DOCTYPE HTML PUBLIC "-//I...>
302 </DL>
303 </DL>
304 <HR>
305 This document was created by
306 man2html,
307 using the manual pages.<BR>
308 Time: 07:05:10 GMT, January 16, 2015
309 </BODY>
310 </HTML>
```

```
1 +- 301 lines: <!DOCTYPE HTML PUBLIC "-//I...>
302 </DL>
303 </DL>
304 <HR>
305 This document was created by
306 man2html,
307 using the manual pages.<BR>
308 Time: 07:06:29 GMT, January 16, 2015
309 </BODY>
310 </HTML>
```

Timestamps in TeX output (.dvi)

data.tar.xz

data.tar

manual.dvi.gz

manual.dvi

```
b 0000 0000 04b0 1b20 .....;.....
0 7574 2032 3031 342e TeX output 2014.
6 3430 8b00 0000 0100 12.11:0640.....
0 0000 0000 0000 .....
0 0000 0000 0000 .....
d 9ff2 0000 8ea0 0218 .....
b 8d91 63ba d4f3 327c .s.....{..c...2|
0 0800 0000 0463 6d72 {Y.....cmr
0 7490 871c 7970 9078 8.Go....t...yp.x
5 7365 7474 696e 6793 7573 696e 6793 .es
```

```
b 0000 0000 04b0 1b20 .....;.....
0 7574 2032 3031 342e TeX output 2014.
6 3431 8b00 0000 0100 12.11:0641.....
0 0000 0000 0000 0000 .....
0 0000 0000 0000 0000 .....
d 9ff2 0000 8ea0 0218 .....
b 8d91 63ba d4f3 327c .s.....{..c...2|
0 0800 0000 0463 6d72 {Y.....cmr
0 7490 871c 7970 9078 8.Go....t...yp.x
5 7365 7474 696e 6793 7573 696e 6793 .es
```



Examples

“Compiled at/on/by”



Build time via C preprocessor macros

```
80     {"to",1,NULL,'t'},  
81     {0,0,0,0}  
82 };  
83  
84 #define MSGSIZE 512  
85 #define INPUT_TEXT_SIZE_INIT 32  
86  
87 char *pgname ="numconv";  
88 char compdate[]="Compiled " __DATE__ " " __TIME__ ;  
89  
90 void ShowNumberSystems(int which) {
```

package info (click to toggle)

libuninum 2.7-1.1

- links: [PTS](#)
- area: main
- in suites: jessie, sid, wheezy
- size: 1,972 kB
- SLOC: ansic: 9,968; sh: 8,715; tcl: 553; makefile: 78

Build time via C preprocessor macros

```
190 z_version(void)
191 {
192     printf("Zorp %s (%s)\n"
193         "Revision: %s\n"
194         "Compile-Date: %s %s\n"
195         "Config-Date: %s\n"
196         "Trace: %s\n"
197         "Debug: %s\n"
198         "IPOptions: %s\n"
199         "%s\n"
200         ,
201         BROCHURE_VERSION, VERSION,
202         ZORP_SOURCE_REVISION,
203         __DATE__, __TIME__,
204         ZORP_CONFIG_DATE,
205         ON_OFF_STR(ENABLE_TRACE),
206         ON_OFF_STR(ENABLE_DEBUG),
207         ON_OFF_STR(ENABLE_IPOPTIONS),
```

package info (click to toggle)

zorp 3.9.5-4

- links: [PTS](#)
- area: main
- in suites: jessie, sid, wheezy
- size: 5,412 kB
- ctags: 5,387

Build time recorded via Makefile

```
149 genversion.$(OBJEXT): $(genversion_SOURCES) genversion.h  
150  
151 genversion.h: $(top_builddir)/config.status  
152     -rm -f $@ $@.new  
153     echo '#define CC "$(CC)"' > $@.new  
154     echo '#define BUILT_DATE "'`date`"' >> $@.new  
155     echo '#define BUILT_MACH "$(target)"' >> $@.new  
156     mv $@.new $@  
157  
158 version.c: genversion$(EXEEXT)  
159     -rm -f version.c  
160     ./genversion$(EXEEXT) > version.c  
161  
162 BUILT_SOURCES += genversion.h version.c
```

package info (click to toggle)

amanda 1:3.3.6-4

- links: [PTS](#), [VCS](#)
- area: main
- in suites: jessie, sid
- size: 25,248 kB
- ctags: 28,823
- SLOC: ansic: 225,464; perl:

Hostname recorded via ./configure

```
364     VERSION="$VERSION ($svn$SVN_REV)"  
365 fi  
366 fi  
367 HOSTNAME=`hostname`  
368 DATE=`date +"%d.%m.%Y %H:%M:%S %Z"  
369  
370 cat > version.h <<EOF  
371 /*  
372 * anytun version info  
373 *  
374 * this file was created automatically  
375 * do not edit this file directly  
376 * use ./configure instead  
377 */  
378  
379 #ifndef ANYTUN_version_h_INCLUDED  
380 #define ANYTUN_version_h_INCLUDED  
381  
382 #define VERSION_STRING_0 " version $VERSION"  
383 #define VERSION STRING 1 "built on $HOSTNAME, $DATE"
```

package info (click to toggle)

anytun 0.3.5-1

- links: [PTS](#), [VCS](#)
- area: main
- in suites: jessie, sid
- size: 1,424 kB
- ctags: 1,339
- SLOC: cpp: 9,126; sh: 618;
- makefile: 367

Build time recorded via ./configure

```
364     VERSION="$VERSION ($svn$SVN_REV)"  
365 fi  
366 fi  
367 HOSTNAME=`hostname`  
368 DATE=`date + "%d.%m.%Y %H:%M:%S %Z"`  
369  
370 cat > version.h <<EOF  
371 /*  
372 * anytun version info  
373 *  
374 * this file was created automatically  
375 * do not edit this file directly  
376 * use ./configure instead  
377 */  
378  
379 #ifndef ANYTUN_version_h_INCLUDED  
380 #define ANYTUN_version_h_INCLUDED  
381  
382 #define VERSION_STRING_0 " version $VERSION"  
383 #define VERSION STRING 1 "built on $HOSTNAME, $DATE"
```

package info (click to toggle)

anytun 0.3.5-1

- links: [PTS](#), [VCS](#)
- area: main
- in suites: jessie, sid
- size: 1,424 kB
- ctags: 1,339
- SLOC: cpp: 9,126; sh: 618;
- makefile: 367

m4 macros for autoconf (build time)

```
75 AC_FLDIGI_SH_DQ([echo $ac_configure_args])
76 AC_DEFINE_UNQUOTED([BUILD_CONFIGURE_ARGS], [$ac_sh_dq], [Configure arguments])
77
78 AC_FLDIGI_SH_DQ([date])
79 AC_DEFINE_UNQUOTED([BUILD_DATE], [$ac_sh_dq], [Build date])
80
81 AC_FLDIGI_SH_DQ([whoami])
82 AC_DEFINE_UNQUOTED([BUILD_USER], [$ac_sh_dq], [Build user])
83
84 AC_FLDIGI_SH_DQ([hostname])
85 AC_DEFINE_UNQUOTED([BUILD_HOST], [$ac_sh_dq], [Build host])
86
87 AC_FLDIGI_SH_DQ([${CXX} -v 2>&1 | tail -1])
88 AC_DEFINE_UNQUOTED([BUILD_COMPILER], [$ac_sh_dq], [Compiler])
```



m4 macros for autoconf (username)

```
75 AC_FLDIGI_SH_DQ([echo $ac_configure_args])
76 AC_DEFINE_UNQUOTED([BUILD_CONFIGURE_ARGS], [$ac_sh_dq], [Configure arguments])
77
78 AC_FLDIGI_SH_DQ([date])
79 AC_DEFINE_UNQUOTED([BUILD_DATE], [$ac_sh_dq], [Build date])
80
81 AC_FLDIGI_SH_DQ([whoami])
82 AC_DEFINE_UNQUOTED([BUILD_USER], [$ac_sh_dq], [Build user])
83
84 AC_FLDIGI_SH_DQ([hostname])
85 AC_DEFINE_UNQUOTED([BUILD_HOST], [$ac_sh_dq], [Build host])
86
87 AC_FLDIGI_SH_DQ([${CXX} -v 2>&1 | tail -1])
88 AC_DEFINE_UNQUOTED([BUILD_COMPILER], [$ac_sh_dq], [Compiler])
```



m4 macros for autoconf (hostname)

```
75 AC_FLDIGI_SH_DQ([echo $ac_configure_args])
76 AC_DEFINE_UNQUOTED([BUILD_CONFIGURE_ARGS], [$ac_sh_dq], [Configure arguments])
77
78 AC_FLDIGI_SH_DQ([date])
79 AC_DEFINE_UNQUOTED([BUILD_DATE], [$ac_sh_dq], [Build date])
80
81 AC_FLDIGI_SH_DQ([whoami])
82 AC_DEFINE_UNQUOTED([BUILD_USER], [$ac_sh_dq], [Build user])
83
84 AC_FLDIGI_SH_DQ([hostname])
85 AC_DEFINE_UNQUOTED([BUILD_HOST], [$ac_sh_dq], [Build host])
86
87 AC_FLDIGI_SH_DQ([${CXX} -v 2>&1 | tail -1])
88 AC_DEFINE_UNQUOTED([BUILD_COMPILER], [$ac_sh_dq], [Compiler])
```



Examples

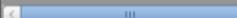
File ordering



File ordering in python-support files

./usr/share/python-support/babiloo.private

```
1 +-+ 16 lines: /usr/share/babiloo/run.py  
17 /usr/share/babiloo/core/modules/utils.py  
18 /usr/share/babiloo/core/modules/__init__.py  
19 /usr/share/babiloo/core/modules/compress.py  
20 /usr/share/babiloo/core/net/xmlrpc.py  
21 /usr/share/babiloo/core/net/__init__.py  
22 /usr/share/babiloo/core/net/downloader.py  
-----  
23 /usr/share/babiloo/qt/settings.py  
24 /usr/share/babiloo/qt/gui_widgets.py  
25 /usr/share/babiloo/qt/dictfilemanager.py  
26 /usr/share/babiloo/qt/contentSearchModel.py  
27 /usr/share/babiloo/qt/historylistmodel.py  
28 /usr/share/babiloo/qt/main.py  
29 +-+ 4 lines: /usr/share/babiloo/qt/about_ui.py  
33 /usr/share/babiloo/qt/onlineDictionary.py  
34 /usr/share/babiloo/qt/definitionView.py  
35 /usr/share/babiloo/qt/SplashScreen.py  
36 /usr/share/babiloo/qt/__init__.py  
37 /usr/share/babiloo/qt/Qt2Po.py  
38 /usr/share/babiloo/qt/images_rc.py  
39 /usr/share/babiloo/qt/about_ui.py  
40 /usr/share/babiloo/qt/settings_ui.py  
41 /usr/share/babiloo/qt/chooseLanguage_ui.py  
42 /usr/share/babiloo/qt/main_ui.py  
-----  
1 +-+ 16 lines: /usr/share/babiloo/run.py  
17 /usr/share/babiloo/core/modules/utils.py  
18 /usr/share/babiloo/core/modules/__init__.py  
19 /usr/share/babiloo/core/modules/compress.py  
20 /usr/share/babiloo/core/net/xmlrpc.py  
21 /usr/share/babiloo/core/net/__init__.py  
22 /usr/share/babiloo/core/net/downloader.py  
23 /usr/share/babiloo/qt/main_ui.py  
24 /usr/share/babiloo/qt/settings.py  
25 /usr/share/babiloo/qt/gui_widgets.py  
26 /usr/share/babiloo/qt/dictfilemanager.py  
27 /usr/share/babiloo/qt/contentSearchModel.py  
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30 +-+ 4 lines: /usr/share/babiloo/qt/about_ui.py  
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37 /usr/share/babiloo/qt/__init__.py  
38 /usr/share/babiloo/qt/Qt2Po.py  
39 /usr/share/babiloo/qt/images_rc.py  
-----  
40 /usr/share/babiloo/qt/settings_ui.py  
41 /usr/share/babiloo/qt/chooseLanguage_ui.py  
42 /usr/share/babiloo/qt/about_ui.py
```



Examples

Randomness



Random Perl hash order

See *Algorithmic complexity attacks* in perlsec(1).

data.tar.xz

data.tar

./usr/lib/x86_64-linux-gnu/perl5/5.20/Gtk2/Spell/Install/Files.pm

```
1 package GtkSpell::Install::Files;
2
3 $self = {
4     'deps' => [
5         'Cairo',
6         'Pango',
7         'Gtk2',
8         'Glib'
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1267 $self = {
1268     'deps' => [
1269        
```

Random serial numbers in Ogg streams

data.tar.xz

data.tar

./usr/share/games/kiki-the-nano-bot/sound/atom_digest.ogg

4f67 6753 0002 0000 0000 0000 0000 0000 4clc 2106 0000 0000 693d d98c 011e 0176 6f72	6269 7300 0000 0001 112b 0000 0000 0000 4871 0000 0000 0000 9901 4f67 6753 0000 0000 0000 0000 0000 4clc 2106 0100 0000 7c12 0a7e 0b3f ffff ffff ffff ffb5
0376 6f72 6269 732f 0000 0058 6970 682e 4f72 6720 6c69 6256 6f72 6269 7320 4920 3230 3134 3031 3232 2028 5475 7270 616b c3a4 72c3 a46a 6969 6e29 0000 0000 0105 766f 7262 6973 1242 4356 0100 0001 000c 5214 2125 1953 4a63 0895 5252 2905 1d63 ines: 00000c0: 505b 471d 63d4 3946 2164 10 9452 4a29 a594 524a 29a5 0000 8003 0700 8000 23e8 24a3 ca22 6c34 e1c2 0310 0000 0002 0002 4c00 8101 8282 5108 0284 1108 0000 0000 0008 00f8 0000 480a 8088 8868 e60c 0e10 1214 1618 1a1c 1e20 2224 0000 0000 0000 0000 0000 044f 6767 5300 04af 1200 0000 0000 004c 1c21 0602 0000 0086 dc69 8014 5e40 3b47 4c37 3a49 3f42	

4f67 6753 0002 0000 0000 0000 0000 0000 b2dd 920e 0000 0000 b90a bf35 011e 0176 6f72	6269 7300 0000 0001 112b 0000 0000 0000 4871 0000 0000 0000 9901 4f67 6753 0000 0000 0000 0000 0000 b2dd 920e 0100 0000 9927 b7d1 0b3f ffff ffff ffff ffff ffb5
0376 6f72 6269 732f 0000 0058 6970 682e 4f72 6720 6c69 6256 6f72 6269 7320 4920 3230 3134 3031 3232 2028 5475 7270 616b c3a4 72c3 a46a 6969 6e29 0000 0000 0105 766f 7262 6973 1242 4356 0100 0001 000c 5214 2125 1953 4a63 0895 5252 2905 1d63 ines: 00000c0: 505b 471d 63d4 3946 2164 10 9452 4a29 a594 524a 29a5 0000 8003 0700 8000 23e8 24a3 ca22 6c34 e1c2 0310 0000 0002 0002 4c00 8101 8282 5108 0284 1108 0000 0000 0008 00f8 0000 480a 8088 8868 e60c 0e10 1214 1618 1a1c 1e20 2224 0000 0000 0000 0000 0000 044f 6767 5300 04af 1200 0000 0000 00b2 dd92 0e02 0000 0026 c74f de14 5e40 3b47 4c37 3a49 3f42	

Examples

Even more timestamps!



Timestamps in PNG

Even images!

data.tar.xz

data.tar

./usr/share/icons/hicolor/128x128/apps/hedgewars.png

sng

```
1 ---104 lines: #SNG: from stdin-----
105      ( 64,141,230)      # rgb = (0x40,
106  }
107 bKGD {index: 12}
108 tRNS {
109  0}
110 tIME {
111  # 31 Dec 2014 05:46:02 GMT
112  year: 2014
113  month: 12
114  day: 31
115  hour: 5
116  minute: 46
117  second: 2
118 }
119 tEXt {
120  keyword: "date:create";
121  text: "2014-12-31T05:46:00+00:00"
122 }
```

```
1 ---104 lines: #SNG: from stdin-----
105      ( 64,141,230)      # rgb = (0x40,
106  }
107 bKGD {index: 12}
108 tRNS {
109  0}
110 tIME {
111  # 31 Dec 2014 05:52:27 GMT
112  year: 2014
113  month: 12
114  day: 31
115  hour: 5
116  minute: 52
117  second: 27
118 }
119 tEXt {
120  keyword: "date:create";
121  text: "2014-12-31T05:52:25+00:00"
122 }
```

Timestamps in TrueType font files

And fonts!

```
by FontForge 14:57 31-July-2012  
Font created: Sun Feb 27 14:37:21 2011  
Font modified: Fri Jan 2 00:02:36 2015
```

```
le (at 102048)  
Version=1  
fontRevision=2.32999  
checksumAdj=cc520daa  
magicNumber=5f0f3cf5 (0x5f0f3cf5, diff=0  
flags=1f baseline_at_0 lsb_at_0 instrs_d  
unitsPerEm=2048  
create[0]=0  
create[1]=c9901221  
File created: Sun Feb 27 14:37:21 2011  
modtime[0]=0  
modtime[1]=d0cb909c  
File modified: Fri Jan 2 00:02:36 2015
```

```
by FontForge 14:57 31-July-2012  
Font created: Sun Feb 27 14:37:21 2011  
Font modified: Fri Jan 2 00:06:50 2015
```

```
le (at 102048)  
Version=1  
fontRevision=2.32999  
checksumAdj=cc5209b2  
magicNumber=5f0f3cf5 (0x5f0f3cf5, diff=0  
flags=1f baseline_at_0 lsb_at_0 instrs_d  
unitsPerEm=2048  
create[0]=0  
create[1]=c9901221  
File created: Sun Feb 27 14:37:21 2011  
modtime[0]=0  
modtime[1]=d0cb919a  
File modified: Fri Jan 2 00:06:50 2015
```



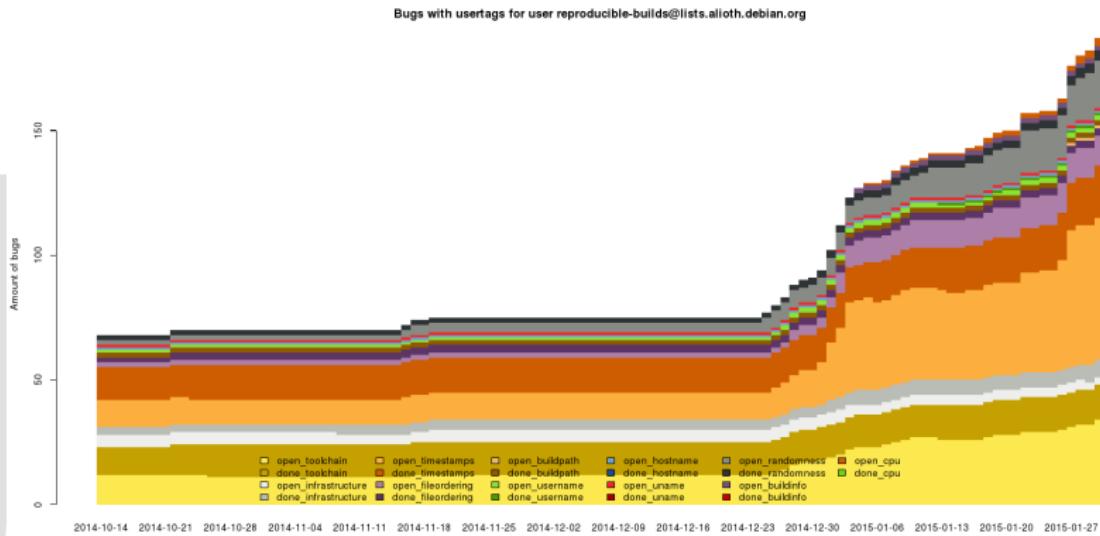
Please help!

Please help!

- Do not record time, username, hostname, kernel version...
 - ▶ ... or make it optional.
- Sort file paths.
- Sort dictionary keys.
- Merge our patches!



Bugs filed



Help Debian?

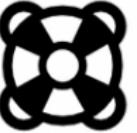
WIKI Login

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debian / Wiki / ReproducibleBuilds

It should be possible to reproduce, byte for byte, every build of every package in Debian.

[About](#) [Make a package
reproducible](#) [How to help](#) [Experimental
toolchain](#)

[Project history](#) [Alioth project](#) [Bug reports](#) [Continuous
integration](#)

Help Debian?

- Inventory issues
- Make packages build reproducibly
- Fix known common issues:
 - ▶ Get reproducible PE binaries;
 - ▶ Random filenames with GCC;
 - ▶ ...
- Hack Debian archive infrastructure
 - ▶ Store and distribute *.buildinfo files (#763822)
 - ▶ ...
- Hack tools to display local packages reproducibility status



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Guillem Jover	Paul Wise	Ximin Luo

Stay in touch

- Subscribe to the ReproducibleBuilds wiki pages.
- Mailing lists:
 - ▶ reproducible-builds@lists.alioth.debian.org
 - ▶ reproducible-commits@lists.alioth.debian.org
- Join #debian-reproducible on irc.oftc.net



Other distributions

- Fedora
<http://securityblog.redhat.com/2013/09/18/reproducible-builds-for-fedora/>
- OpenSUSE build-compare
<https://build.opensuse.org/package/show/openSUSE:Factory/build-compare>
- NixOS
<http://lists.science.uu.nl/pipermail/nix-dev/2013-June/011357.html>



Reproducible Fedora?

- No known activity after the initial blog post.
- Fedora is leading developments for key components.
- Can we help **reproducible Fedora**?



SLES? OpenBSD? Firefox? LibreOffice?

- We hope **reproducible builds** will become the norm.
- Our documentation should be helpful to others.
- Come talk to us!



Future

- Ready for the next Debian release (*stretch*)
- Reproducible installation media
- Reproducible live images (pure Debian, Grml, Tails)
- Reproducible cross-platform builds (“rebootstrap”)
- Binary transparency logs: public log of all software releases



Thanks

- Mike Perry and Seth Schoen for their 31C3 talk
- Profitbricks for sponsoring jenkins.debian.net
- Globalsign for sponsoring X.509 certificates
- Designers of Tango icons
- Everyone who helped!



Questions? Comments?



<https://wiki.debian.org/ReproducibleBuilds>
<https://reproducible.debian.net/>
#debian-reproducible on OFTC

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