

# Stretching out for trustworthy reproducible builds

Holger Levsen  
holger@debian.org





# What?



# What are reproducible builds?

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

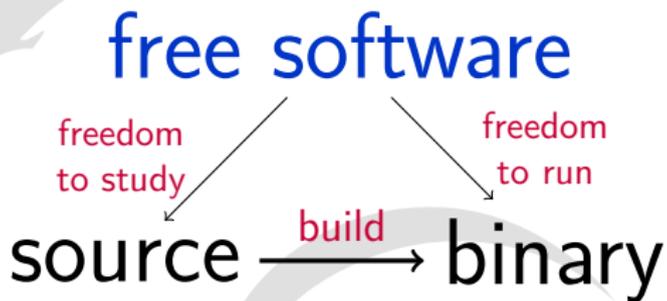


“I want to believe”

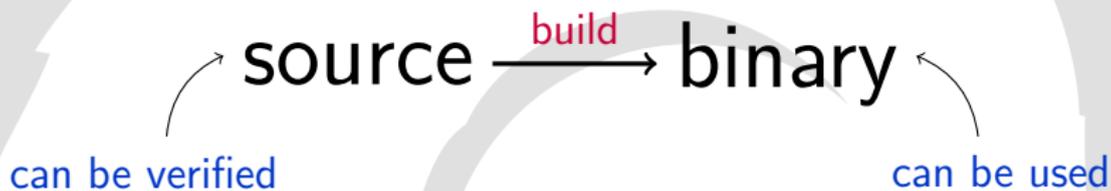
source  $\xrightarrow{\text{build}}$  binary



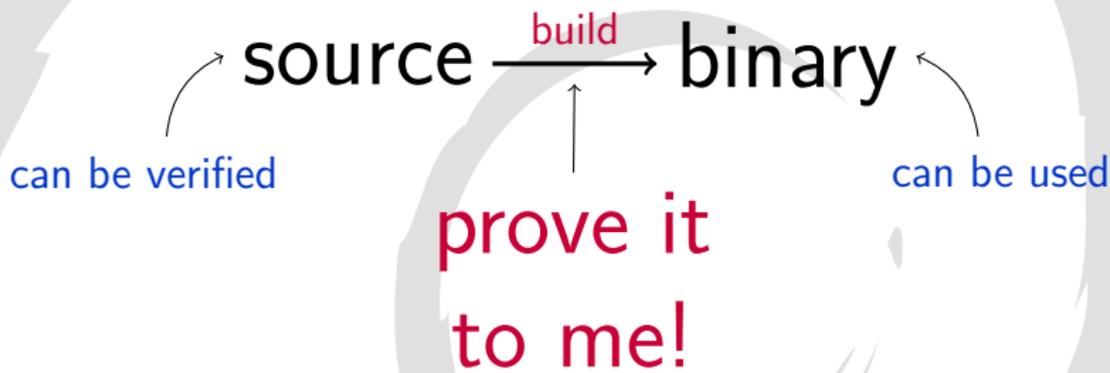
“I want to believe”

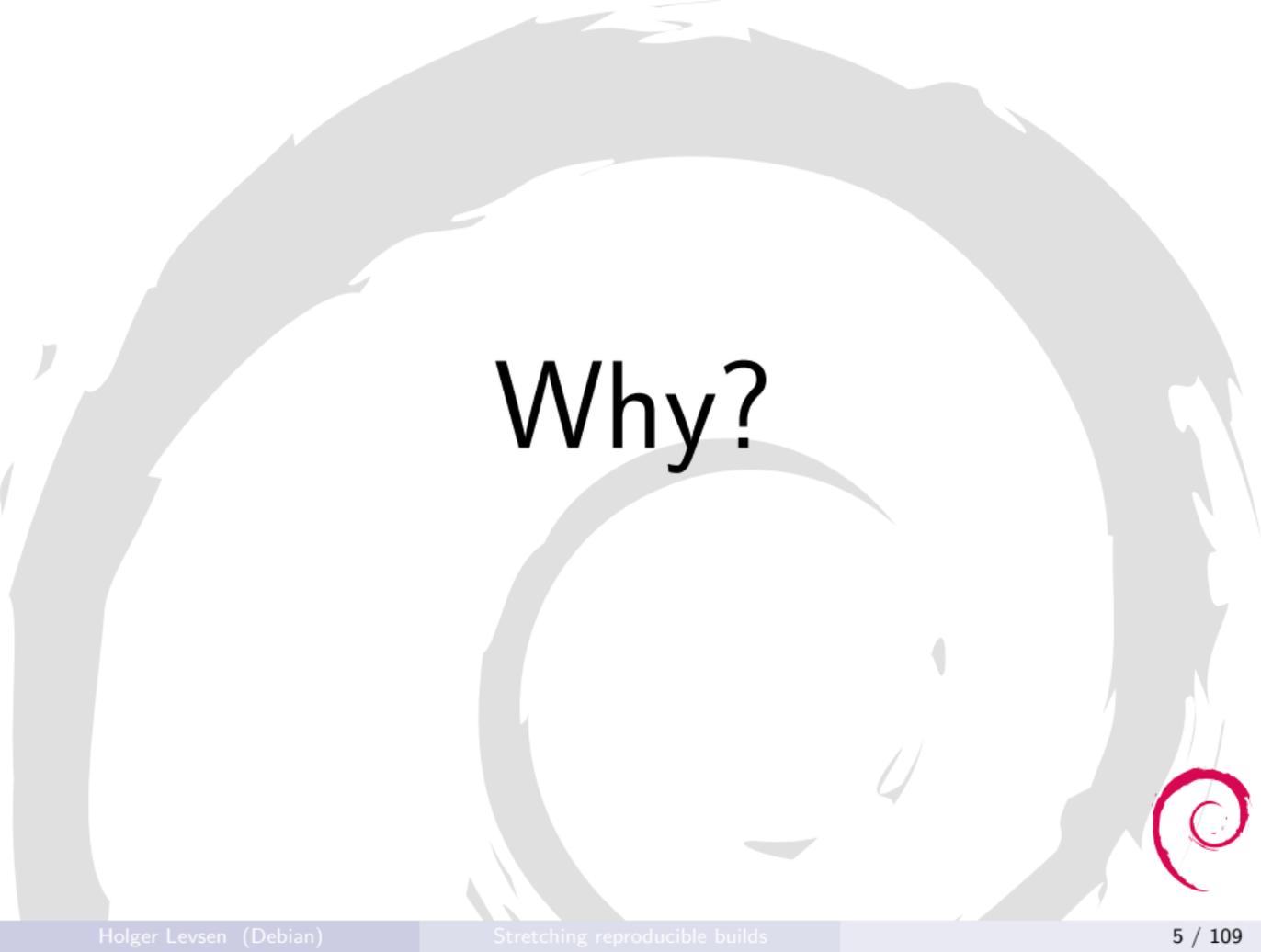


# “I want to believe”



# “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
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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

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

Fixed

```
55 89 e5 83 ec
28 83 7d 08 00
78 0a a1 04 00
00 00 39 45 08
7c 1a 8b 45 08
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04 24 4c 00 00
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# Result of fixing the bug (hex)

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04 24 4c 00 00
00 e8 fc ff ff
ff b8 00 00 00
00 eb 35
```



# How did this start?



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

Startpage



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](#), [ghia](#), [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

# 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 independly verify the integricity of binary packages.*

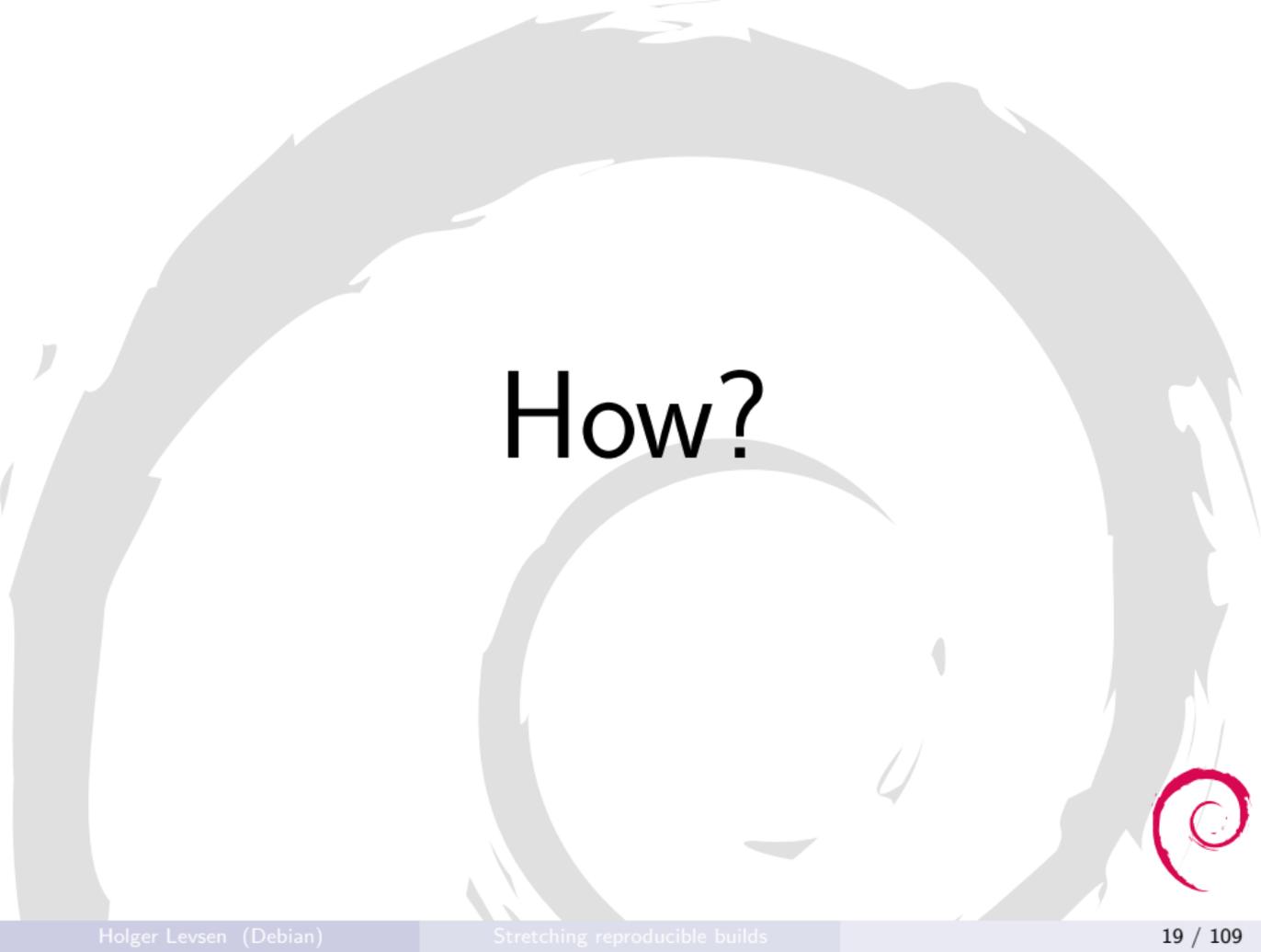
<https://lists.debian.org/debian-devel/2007/09/msg00746.html>



# 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 to achieve reproducibility?

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





# How to

## Record the build environment



# .buildinfo files

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: ttorcon
Binary: python-ttorcon
Architecture: all
Version: 0.11.0-1
Build-Path: /usr/src/debian/ttorcon-0.11.0-1
Checksums-Sha256:
  a26549d9...7b 125910 python-ttorcon_0.11.0-1_all.deb
  28f6bcbe...69 2039 ttorcon_0.11.0-1.dsc
Build-Environment:
  base-files (= 8),
  base-passwd (= 3.5.37),
  bash (= 4.3-11+b1),
  ...
```





# How to Reproduce the build environment



- snapshot.debian.org archives every state of the Debian archive.
- 2015-05-25: 29 terabytes of data in 17 million files.

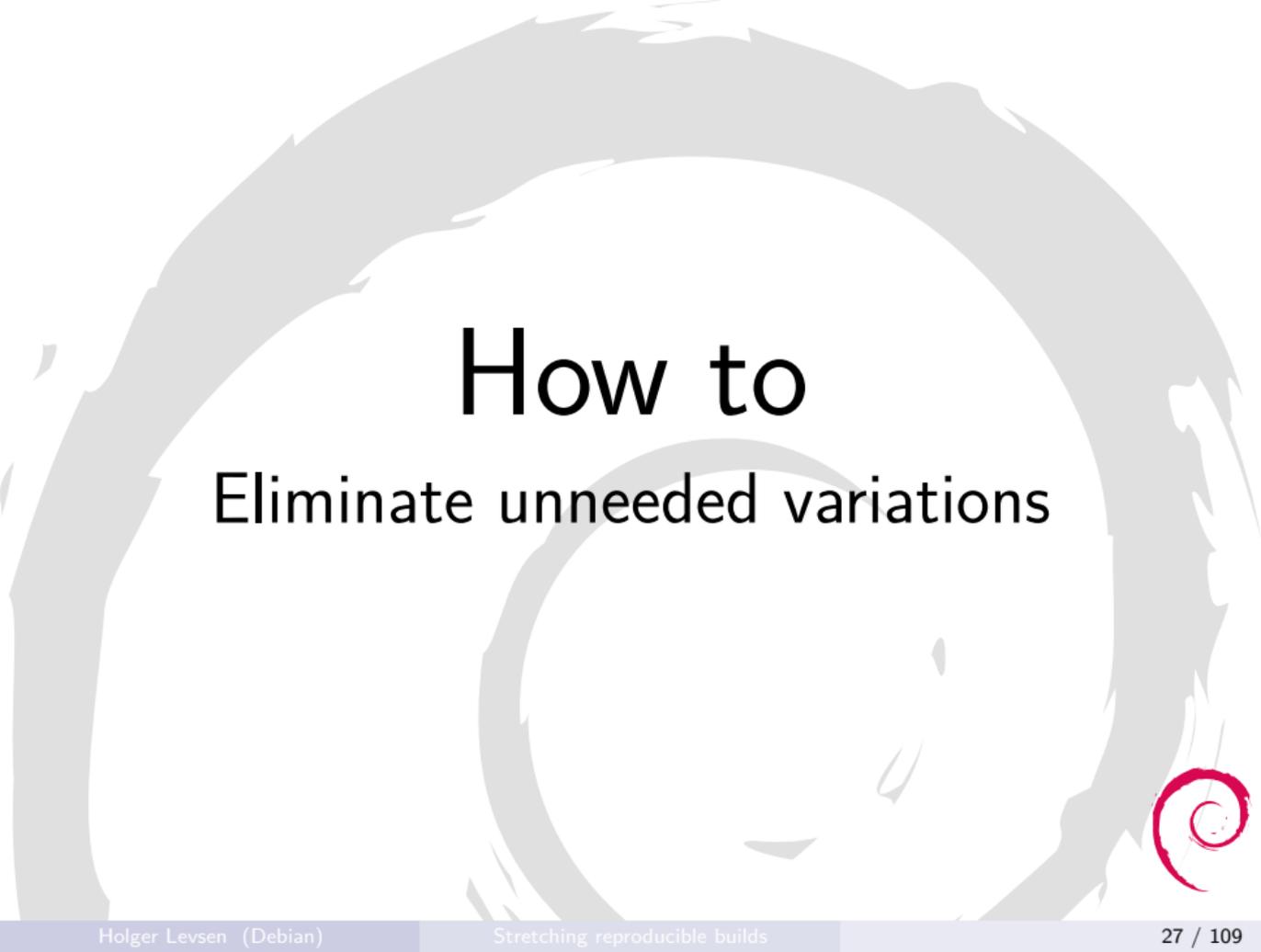


# srebuild

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

Status: proof-of-concept in #774415





# How to 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 handles:
  - ▶ ar archives (.a)
  - ▶ gzip
  - ▶ Java jar
  - ▶ Javadoc HTML
  - ▶ ZIP archives
- Written in Perl (like dpkg-dev)

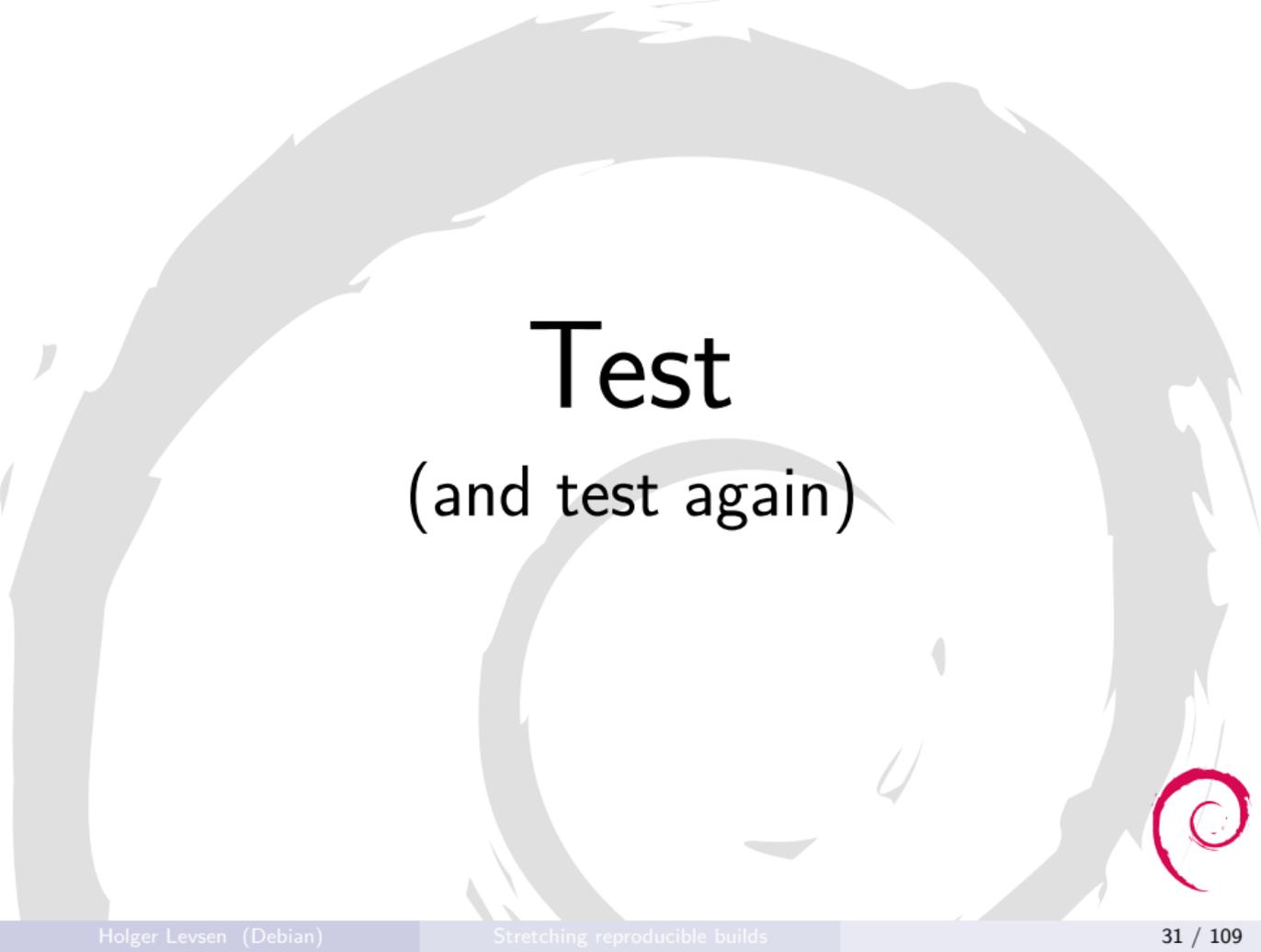


# Investigating packages

debbindiff :

- Two files → HTML and/or plain text output showing the differences
- Works with many file types, eg .changes, .deb, .rpm, iso9660, squashfs images, directories, ...
- 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

- 27 jobs defined in 370 LOC of YAML
  - ▶ 8 build jobs, rescheduled every 2 minutes
  - ▶ Job for auto-scheduling via a SQLite database
  - ▶ 5 jobs to recreate pbuilder base.tgz for sid, testing and experimental and debbindiff schroots (just sid and testing)
  - ▶ job to update notes and issues from Git
  - ▶ JSON output
  - ▶ a maintenance job and one to report problems in the results
  - ▶ remaining jobs mostly to create HTML and graphs
- 11 Shell scripts with 2766 LOC
  - ▶ including one to be manually run (on alioth) by team members to independently schedule packages
- 11 Python3 scripts with 3123 LOC
- constantly updated “static” webpages



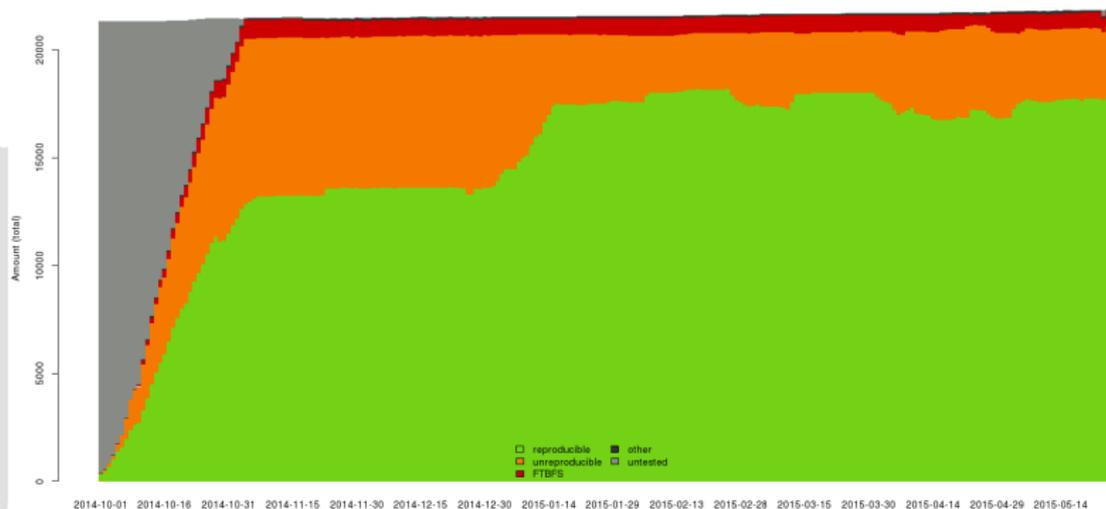
# reproducible.debian.net: today

- driven by jenkins.debian.net
  - ▶ announced 2014-09-26
- virtual hardware sponsored by profitbricks.com - constantly increasing ;-) Thanks for the support!
  - ▶ migration to a even more distributed system has just begun, incl. to jenkins.debian.org and using a 2nd build host
- tests packages in main on amd64 in experimental, unstable and testing
  - ▶ scheduler reschedules unstable twice as testing at te moment - but we can change this anytime easily
  - ▶ frequent IRC notifications, optionally targeted on demand
- all code and configuration in `jenkins.debian.net.git`



# reproducible.debian.net overall stats

Reproducibility status for packages in 'unstable'



# For those in the back

# 81.5%

More than 17,800 source packages!



# For those in the back

# 81.5%

More than 17,800 source packages!  
(in our test environment!)



# reproducible.debian.net: variations

The second build differs by:

- time
- timezone
- file ordering
- CPU ordering and availability
- hostname, domainname
- username
- umask
- LANG and LC\_ALL
- kernel version (using `linux64 --uname-2.6`)
- `DEB_BUILD_OPTIONS="parallel=22"`



# What is not varied (yet)

- day/month/year
- /proc/cpuinfo
- rebuilds on different filesystems (currently tmpfs only)
- *more?*



# 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 reproducibly!](#)

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 unreproducible packages](#)

[stats](#)

[package sets stats](#)

 3058 (14.1%) packages which failed to build reproducibly: [java-xmlbuilder](#) [gfpoken](#) [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
2	2
3	3
4	4
5	5
6	6
7	7
8	8

**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](#) [build \(4MB\)](#) [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
-----BEGIN PGP SIGNED MESSAGE-----
```

# Experimental “reproducible” toolchain

- Test and refine changes to tools used by build systems
- Currently 11 source packages modified - compared to unstable:
  - ▶ `dpkg`, `debhelper`, `cdb`s, `docbook-to-man`, `fontforge`, `ghostscript`, `gtk-doc`, `libxslt`, `python-support`, `sphinx` & `wheel`
- Most patches already submitted to the BTS
- `git://git.debian.org/reproducible/$pkg.git`  
in branch `pu/reproducible_builds`
- repositories overview on `r.d.n`

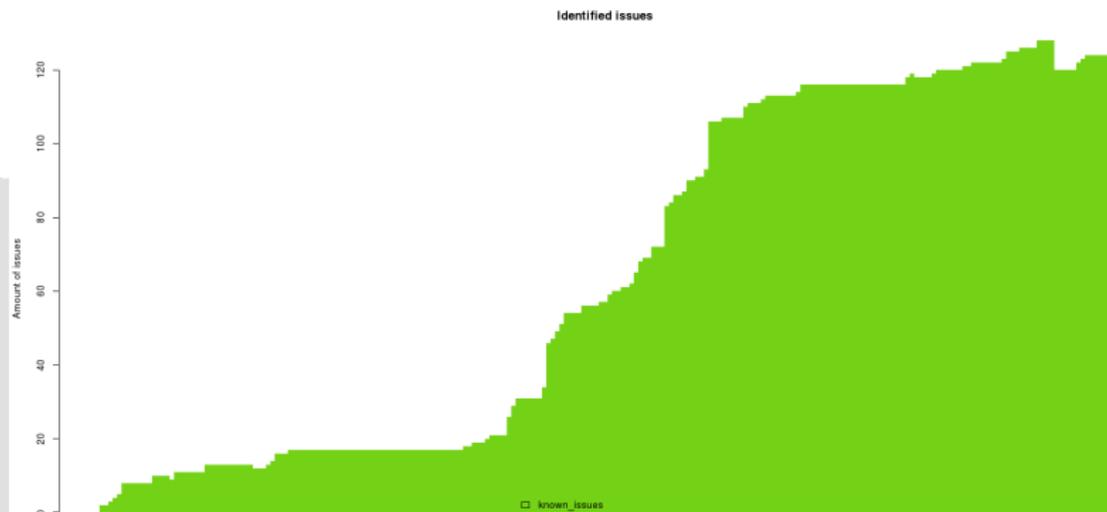


# Investigated packages

Packages which have notes



# Identified issues

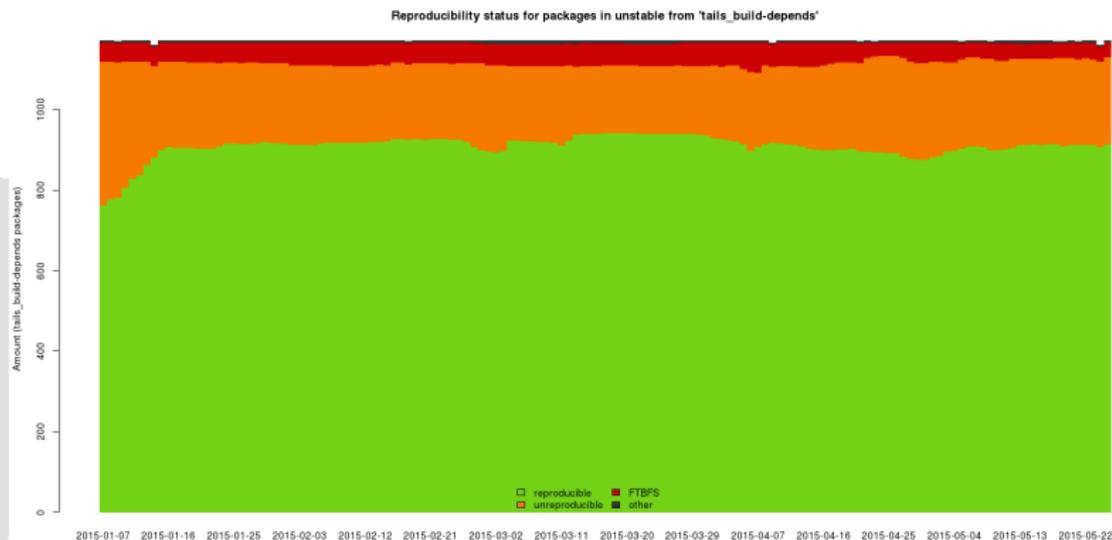


# reproducible.debian.net: package sets

- currently 25 package sets:
  - ▶ Essential:yes, Required:yes, build-essential and their build dependencies
  - ▶ 1337 most frequently installed packages (popcon)
  - ▶ “key packages” (from UDD)
  - ▶ All Packages installed on all debian.org machines
  - ▶ All Packages which had a security fix (DSA) published
  - ▶ All (GNOME|KDE|XFCE) packages and their build dependencies
  - ▶ All packages in Tails and their build dependencies
  - ▶ All packages in Grml and their build dependencies
  - ▶ All packages maintained by pkg-perl-maintainers, pkg-java-maintainers, pkg-haskell-maintainers, pkg-ruby-extras-maintainers, pkg-golang-maintainers, debian-ocaml, debian-boot



# r.d.n package sets: tails\_build-depends



# reproducible.debian.net: more goodies

- [https://reproducible.debian.net/\\$PACKAGE](https://reproducible.debian.net/$PACKAGE)
- List of unreproducible packages per maintainer
- List of packages without any identified issue
- Reproducibility status displayed in:
  - ▶ [tracker.debian.org](https://tracker.debian.org)
  - ▶ Debian Developer's Package Overview, eg. <https://qa.debian.org/developer.php?login=holger>
  - ▶ Debian Maintainer Dashbord, eg <https://udd.debian.org/dmd/?email=holger%40debian>



# 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



## Identified issues (cont.)

# 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_newtyp.o	234	16296	Jan	2	06:22	2015	fld_newtyp.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

a 2f20 2020 2020 2020 !<arch>./	a 2f20 2020 2020 2020 !<arch>./
0 3134 3231 3837 3334 14218734	0 3134 3231 3837 3334 14218734
<b>0 2020 3020 2020 2020 06 0 0</b>	<b>0 2020 3020 2020 2020 51 0 0</b>
0 3239 3634 2020 2020 0 2964	0 3239 3634 2020 2020 0 2964
a 0000 0bd8 0000 0bd8 .....	a 0000 0bd8 0000 0bd8 .....
0 0000 0bd8 0000 0bd8 .....	0 0000 0bd8 0000 0bd8 .....
0 0000 0bd8 0000 0bd8 .....	0 0000 0bd8 0000 0bd8 .....
0 0000 0bd8 0000 0bd8 .....	0 0000 0bd8 0000 0bd8 .....
0 0000 0bd8 0000 0bd8 .....	0 0000 0bd8 0000 0bd8 .....
0bd8 0000 0bd8 0000 0bd8 0000 0bd8 .....	0bd8 0000 0bd8 0000 0bd8 0000 0bd8 .....
5 6e67 6433 0074 656e engd2.tengd3.ten	5 6e67 6433 0074 656e engd2.tengd3.ten
7 6435 0074 656e 6764 gd4.tengd5.tengd	7 6435 0074 656e 6764 gd4.tengd5.tengd
7 0074 656e 6764 3800 6.tengd7.tengd8.	7 0074 656e 6764 3800 6.tengd7.tengd8.
4 656e 6764 3130 0074 tengd9.tengd10.t	4 656e 6764 3130 0074 tengd9.tengd10.t
0 756e 696e 756d 2e6f engd11..uninum.o	0 756e 696e 756d 2e6f engd11..uninum.o
0 3134 3231 3837 3334 / 14218734	0 3134 3231 3837 3334 / 14218734
<b>0 2020 3132 3334 2020 05 1234 1234</b>	<b>0 2020 3132 3334 2020 50 1234 1234</b>
0 3336 3636 3038 2020 100644 366608	0 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 21:03:28 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 PyQt4
```

```
#
```

```
# WARNING! All changes made in this file
```

```
from PyQt4 import QtCore
```

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

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

```
# Resource object code
```

```
#
```

```
# Created: Thu Jan 1 01:17:12 2015
```

```
# by: The Resource Compiler for PyQt4
```

```
#
```

```
# 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 FO	64f 5231 0000 733c 4245 414d 4174 6f6d Fi
68 0264 0006 6f75 7464 summaryh.d..outd	968 0264 0006 6f75 7464 summaryh.d..outd
69 6e68 0264 0001 696b irk..ebin.h.d..lik	269 6e68 0264 0001 696b irk..ebin.h.d..lik
61 6262 6572 642d 6465 .../ejabberd-de	a61 6262 6572 642d 6465 .../ejabberd-de
64 656a 6802 6400 0776 v/includejh.d..v	564 656a 6802 6400 0776 v/includejh.d..v
00 0535 2e30 2e32 6802 ersionk..5.0.2h.	b00 0535 2e30 2e32 6802 ersionk..5.0.2h.
68 0662 0000 07de 610c d..timeh.b....a.	568 0662 0000 07de 610c d..timeh.b....a.
<b>26 6802 6400 0673 6f75 a.a.a.a&amp;h.d..sou</b>	<b>120 6802 6400 0673 6f75 a.a.a.a h.d..sou</b>
74 6d70 2f62 7569 6c64 rcek.Q/tmp/build	f74 6d70 2f62 7569 6c64 rcek.Q/tmp/build
65 7264 2d63 6f6e 7472 d/ejabberd-contr	265 7264 2d63 6f6e 7472 d/ejabberd-contr
31 342e 3039 2e32 322f ib-0.2014.09.22/	031 342e 3039 2e32 322f ib-0.2014.09.22/
69 6e5f 6578 7472 612f mod_admin_extra/	d69 6e5f 6578 7472 612f mod_admin_extra/
5f 6164 6d69 6e5f 6578 src/mod_admin_ex	45f 6164 6d69 6e5f 6578 src/mod_admin_ex
6a 4162 7374 0000 0000 tra.erljAbst....	c6a 4162 7374 0000 0000 tra.erljAbst....
9 6e65 0000 037c 0000 0000 0000 0000 Lin	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...
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000 .....
) 0000 0000 8000 0000 .....	) 0000 0000 8000 0000 .....
d 21b8 014c cd21 5468 .....!.L.!Th	d 21b8 014c cd21 5468 .....!.L.!Th
? 616d 2063 616e 6e6f is program canno	? 616d 2063 616e 6e6f is program canno
e 2069 6e20 444f 5320 t be run in DOS	e 2069 6e20 444f 5320 t be run in DOS
a 2400 0000 0000 0000 mode....\$......	a 2400 0000 0000 0000 mode....\$......
) <b>5df1 9154 0000 0000 PE..L...].T....</b>	) <b>9ef1 9154 0000 0000 PE..L...].T....</b>
l 0b01 0800 00a2 0000 .....!......	l 0b01 0800 00a2 0000 .....!......
) 6ec1 0000 0020 0000 .....n.....	) 6ec1 0000 0020 0000 .....n.....
) 0020 0000 0002 0000 .....@.....	) 0020 0000 0002 0000 .....@.....
) 0400 0000 0000 0000 .....	) 0400 0000 0000 0000 .....
) <b>30fb 0000 0300 4085 .....0.....e.</b>	) <b>3552 0100 0300 4085 .....5R.....e.</b>
) 0000 1000 0010 0000 .....	) 0000 1000 0010 0000 .....
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000 .....
) 00e0 0000 6003 0000 ...K.....	) 00e0 0000 6003 0000 ...K.....
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000 .....
) 0000 0000 0000 0000 .....	) 0000 0000 0000 0000 .....



# Timestamps in Java jar

data.tar

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

metadata

l.1-SNAPSHOT.jar	l.1-SNAPSHOT.jar
1568 bytes, number of entries: 45	1568 bytes, number of entries: 45
inx 0 bx stor 15-Jan-07 20:23 META	inx 0 bx stor 15-Jan-07 20:25 META
inx 259 b- defN 15-Jan-07 20:23 META	inx 259 b- defN 15-Jan-07 20:25 META
inx 0 b- stor 15-Jan-07 20:23 org/	inx 0 b- stor 15-Jan-07 20:25 org/
inx 0 b- stor 15-Jan-07 20:23 org/	inx 0 b- stor 15-Jan-07 20:25 org/
inx 0 b- stor 15-Jan-07 20:23 org/	inx 0 b- stor 15-Jan-07 20:25 org/
inx 0 b- stor 15-Jan-07 20:23 org/	inx 0 b- stor 15-Jan-07 20:25 org/
inx 0 b- stor 15-Jan-07 20:23 org/	inx 0 b- stor 15-Jan-07 20:25 org/
inx 0 b- stor 15-Jan-07 20:23 org/	inx 0 b- stor 15-Jan-07 20:25 org/
inx 585 b- defN 15-Jan-07 20:23 org/	inx 585 b- defN 15-Jan-07 20:25 org/
inx 5744 b- defN 15-Jan-07 20:23 org/	inx 5744 b- defN 15-Jan-07 20:25 org/
inx 320 b- defN 15-Jan-07 20:23 org/	inx 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-----usr/bin/env python-----
29 VFSL=valueFromFrameOrSearchList         ameOrSearchList
30 VFSL=valueFromSearchList                rchList
31 VFN=valueForName
32 currentTime=time.time                   time
33 __CHEETAH_version__ = '2.4.4'           __ = '2.4.4'
34 __CHEETAH_versionTuple__ = (2, 4, 4,   Tuple__ = (2, 4, 4, 'development', 0)
35 __CHEETAH_genTime__ = 1421397870.77925 __ = 1421397902.668939
36 __CHEETAH_genTimestamp__ = 'Fri Jan 16 stamp__ = 'Fri Jan 16 08:45:02 2015'
37 __CHEETAH_src__ = 'dsc.tmpl'            'dsc.tmpl'
38 __CHEETAH_srcLastModified__ = 'Fri Feb Modified__ = 'Fri Feb 25 06:40:15 2011'
39 __CHEETAH_docstring__ = 'Autogeneratedg__ = 'Autogenerated by Cheetah: The Pyth
40
41 if __CHEETAH_versionTuple__ < RequiredionTuple__ < RequiredCheetahVersionTuple:
42     raise AssertionError(                onError(
43 +--127 lines: 'This template was compo is 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.htb**

**metadata**

```
+--249 lines: Archive:  boa.apphelp.htb-----
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**

64	2015-01-09	22:29:44	CMakeLists.txt	64	2015-01-09	22:32:29	CMakeLists.txt
08	2015-01-09	22:29:44	afinfo.c	08	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
06	2015-01-09	22:29:44	exalpha.c	06	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	1	-rw-r--r--	pbuilder2/pbuilder2
2	-rw-r--r--	pbuilder1/pbuilder1	2	-rw-r--r--	pbuilder2/pbuilder2
3	-rw-r--r--	pbuilder1/pbuilder1	3	-rw-r--r--	pbuilder2/pbuilder2
4	-rw-r--r--	pbuilder1/pbuilder1	4	-rw-r--r--	pbuilder2/pbuilder2
5	-rw-r--r--	pbuilder1/pbuilder1	5	-rw-r--r--	pbuilder2/pbuilder2
6	-rw-r--r--	pbuilder1/pbuilder1	6	-rw-r--r--	pbuilder2/pbuilder2
7	-rw-r--r--	pbuilder1/pbuilder1	7	-rw-r--r--	pbuilder2/pbuilder2
8	-rw-r--r--	pbuilder1/pbuilder1	8	-rw-r--r--	pbuilder2/pbuilder2
9	-rw-r--r--	pbuilder1/pbuilder1	9	-rw-r--r--	pbuilder2/pbuilder2
10	-rw-r--r--	pbuilder1/pbuilder1	10	-rw-r--r--	pbuilder2/pbuilder2
11	-rw-r--r--	pbuilder1/pbuilder1	11	-rw-r--r--	pbuilder2/pbuilder2
12	-rw-r--r--	pbuilder1/pbuilder1	12	-rw-r--r--	pbuilder2/pbuilder2

## Identified issues (cont.)

# Examples

Timestamps in documentation



# Timestamps written by Doxygen

**data.tar.xz**

**data.tar**

**./usr/share/doc/libnfo-doc/html**  
**/dir\_68267d1309a1af8e8297ef4c3efbcdba.html**

<pre>: &lt;!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"&gt;&lt;html&gt;&lt;head&gt;&lt;meta charset="utf-8" /&gt;&lt;title&gt;libnfo documentation&lt;/title&gt;&lt;/head&gt;&lt;body&gt;&lt;div class="memlist"&gt;&lt;div class="memItemLeft" align="right" valign="top"&gt;&lt;small&gt;&lt;span style="float: right; font-weight: bold; color: red;"&gt;Mon Dec 15 2014 04:03:26 for libnfo by &amp;#1</pre>	<pre>: &lt;!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"&gt;&lt;html&gt;&lt;head&gt;&lt;meta charset="utf-8" /&gt;&lt;title&gt;libnfo documentation&lt;/title&gt;&lt;/head&gt;&lt;body&gt;&lt;div class="memlist"&gt;&lt;div class="memItemLeft" align="right" valign="top"&gt;&lt;small&gt;&lt;span style="float: right; font-weight: bold; color: red;"&gt;Mon Dec 15 2014 04:04:03 for libnfo by &amp;#1</pre>
---	---



# 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	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, 01:23
--	--



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

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

# Timestamps written by GNU groff

data.tar.xz

data.tar

./usr/share/doc/corosync/html/confdb\_context\_get.3.html

<pre>&lt;!-- Creator      : groff version 1.22.3 - &lt;!-- CreationDate: Thu Jan  8 04:06:53 20 &lt;!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4 "http://www.w3.org/TR/html4/loose.dtd"&gt; &lt;html&gt; &lt;head&gt; &lt;meta name="generator" content="groff -Tr &lt;meta http-equiv="Content-Type" content=" +-- 95 lines: &lt;meta name="Content-Style"</pre>	<pre>&lt;!-- Creator      : groff version 1.22.3 - &lt;!-- CreationDate: Thu Jan  8 04:09:52 20 &lt;!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4 "http://www.w3.org/TR/html4/loose.dtd"&gt; &lt;html&gt; &lt;head&gt; &lt;meta name="generator" content="groff -Th &lt;meta http-equiv="Content-Type" content=" +-- 95 lines: &lt;meta name="Content-Style"</pre>
---	---

./usr/share/doc/corosync/html/confdb\_context\_set.3.html

<pre>1 &lt;!-- Creator      : groff version 1.22 2 &lt;!-- CreationDate: Thu Jan  8 04:06:53 3 &lt;!DOCTYPE html PUBLIC "-//W3C//DTD HTI</pre>	<pre>1 &lt;!-- Creator      : groff version 1.22 2 &lt;!-- CreationDate: Thu Jan  8 04:09:53 3 &lt;!DOCTYPE html PUBLIC "-//W3C//DTD HTI</pre>
--	--

# 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/
-- 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**

<pre>1 +--301 lines: &lt;!DOCTYPE HTML PUBLIC " 302 &lt;/DL&gt; 303 &lt;/DL&gt; 304 &lt;HR&gt; 305 This document was created by 306 man2html, 307 using the manual pages.&lt;BR&gt; 308 Time: 07:05:10 GMT, January 16, 2015 309 &lt;/BODY&gt; 310 &lt;/HTML&gt;</pre>	<pre>1 +--301 lines: &lt;!DOCTYPE HTML PUBLIC " 302 &lt;/DL&gt; 303 &lt;/DL&gt; 304 &lt;HR&gt; 305 This document was created by 306 man2html, 307 using the manual pages.&lt;BR&gt; 308 Time: 07:06:29 GMT, January 16, 2015 309 &lt;/BODY&gt; 310 &lt;/HTML&gt;</pre>
--	--



# Timestamps in TeX output (.dvi)

data.tar.xz

data.tar

manual.dvi.gz

manual.dvi

b 0000 0000 04b0 1b20 .....;.....	b 0000 0000 04b0 1b20 .....;.....
0 7574 2032 3031 342e TeX output 2014.	0 7574 2032 3031 342e TeX output 2014.
<b>6 3430 8b00 0000 0100 12.11:0640.....</b>	<b>6 3431 8b00 0000 0100 12.11:0641.....</b>
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 .e:	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 .e:

< ||| > < ||| >

## Identified issues (cont.)

# 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 comdate[]="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])
```



## Identified issues (cont.)

# 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/utills.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.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/utills.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
28 /usr/share/babiloo/qt/historyListModel.py
29 /usr/share/babiloo/qt/main.py
30 +-- 4 lines: /usr/share/babiloo/qt/about.py
34 /usr/share/babiloo/qt/onlineDictionary.py
35 /usr/share/babiloo/qt/definitionView.py
36 /usr/share/babiloo/qt/SplashScreen.py
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
```



## Identified issues (cont.)

# 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'
9     ],
10    'inc' => '-pthread -I/usr/inc
11    'libs' => '-lgtkspell -lgtk-;
12    'typemaps' => [
13 ++ 30 lines: 'gtkspell.typemap'-----
```

```
1 package GtkSpell::Install::Files;
2
3 $self = {
4     'deps' => [
5         'Pango',
6         'Cairo',
7         'Gtk2',
8         'Glib'
9     ],
10    'inc' => '-pthread -I/usr/inc
11    'libs' => '-lgtkspell -lgtk-;
12    'typemaps' => [
13 ++ 30 lines: 'gtkspell.typemap'-----
```



# 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 4c1c	4f67 6753 0002 0000 0000 0000 0000 b2dd
2106 0000 0000 693d d98c 011e 0176 6f72	920e 0000 0000 b90a bf35 011e 0176 6f72
6269 7300 0000 0001 112b 0000 0000 0000	6269 7300 0000 0001 112b 0000 0000 0000
4871 0000 0000 0000 9901 4f67 6753 0000	4871 0000 0000 0000 9901 4f67 6753 0000
0000 0000 0000 0000 4c1c 2106 0100 0000	0000 0000 0000 0000 b2dd 920e 0100 0000
7c12 0a7e 0b3f ffff ffff ffff ffb5	9927 b7d1 0b3f ffff ffff ffff ffb5
0376 6f72 6269 732f 0000 0058 6970 682e	0376 6f72 6269 732f 0000 0058 6970 682e
4f72 6720 6c69 6256 6f72 6269 7320 4920	4f72 6720 6c69 6256 6f72 6269 7320 4920
3230 3134 3031 3232 2028 5475 7270 616b	3230 3134 3031 3232 2028 5475 7270 616b
c3a4 72c3 a46a 6969 6e29 0000 0000 0105	c3a4 72c3 a46a 6969 6e29 0000 0000 0105
766f 7262 6973 1242 4356 0100 0001 000c	766f 7262 6973 1242 4356 0100 0001 000c
5214 2125 1953 4a63 0895 5252 2905 1d63	5214 2125 1953 4a63 0895 5252 2905 1d63
lines: 00000c0: 505b 471d 63d4 3946 2164 10	lines: 00000c0: 505b 471d 63d4 3946 2164 10
9452 4a29 a594 524a 29a5 0000 8003 0700	9452 4a29 a594 524a 29a5 0000 8003 0700
8000 23e8 24a3 ca22 6c34 e1c2 0310 0000	8000 23e8 24a3 ca22 6c34 e1c2 0310 0000
0002 0002 4c00 8101 8282 5108 0284 1108	0002 0002 4c00 8101 8282 5108 0284 1108
0000 0000 0008 00f8 0000 480a 8088 8868	0000 0000 0008 00f8 0000 480a 8088 8868
e60c 0e10 1214 1618 1a1c 1e20 2224 0000	e60c 0e10 1214 1618 1a1c 1e20 2224 0000
0000 0000 0000 0000 0000 044f 6767 5300	0000 0000 0000 0000 0000 044f 6767 5300
04af 1200 0000 0000 004c 1c21 0602 0000	04af 1200 0000 0000 00b2 dd92 0e02 0000
0086 dc69 8014 5e40 3b47 4c37 3a49 3f42	0026 c74f de14 5e40 3b47 4c37 3a49 3f42



## Identified issues (cont.)

# 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
```





You think those were  
enough issues?



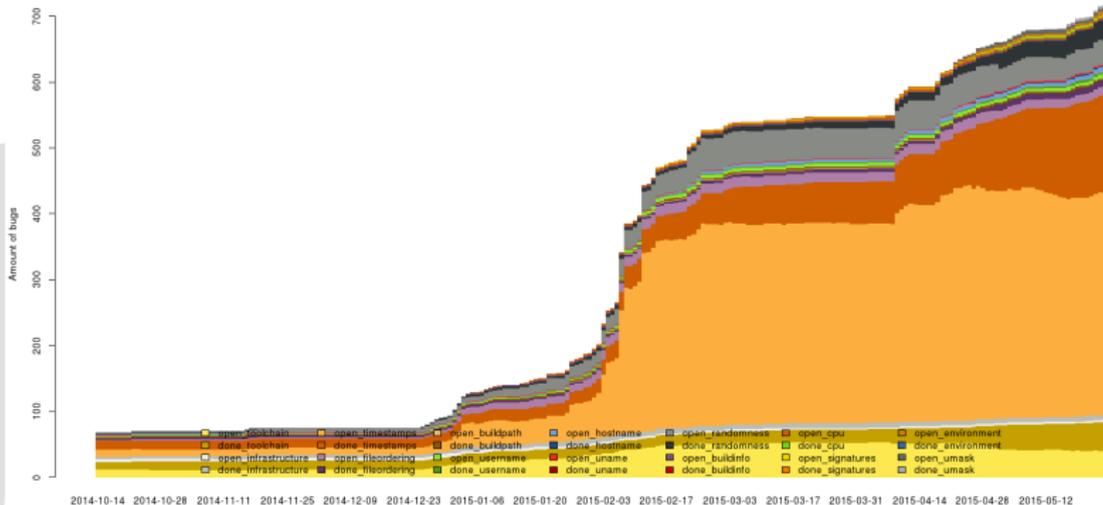
# 66 new issues in the last 4 months found

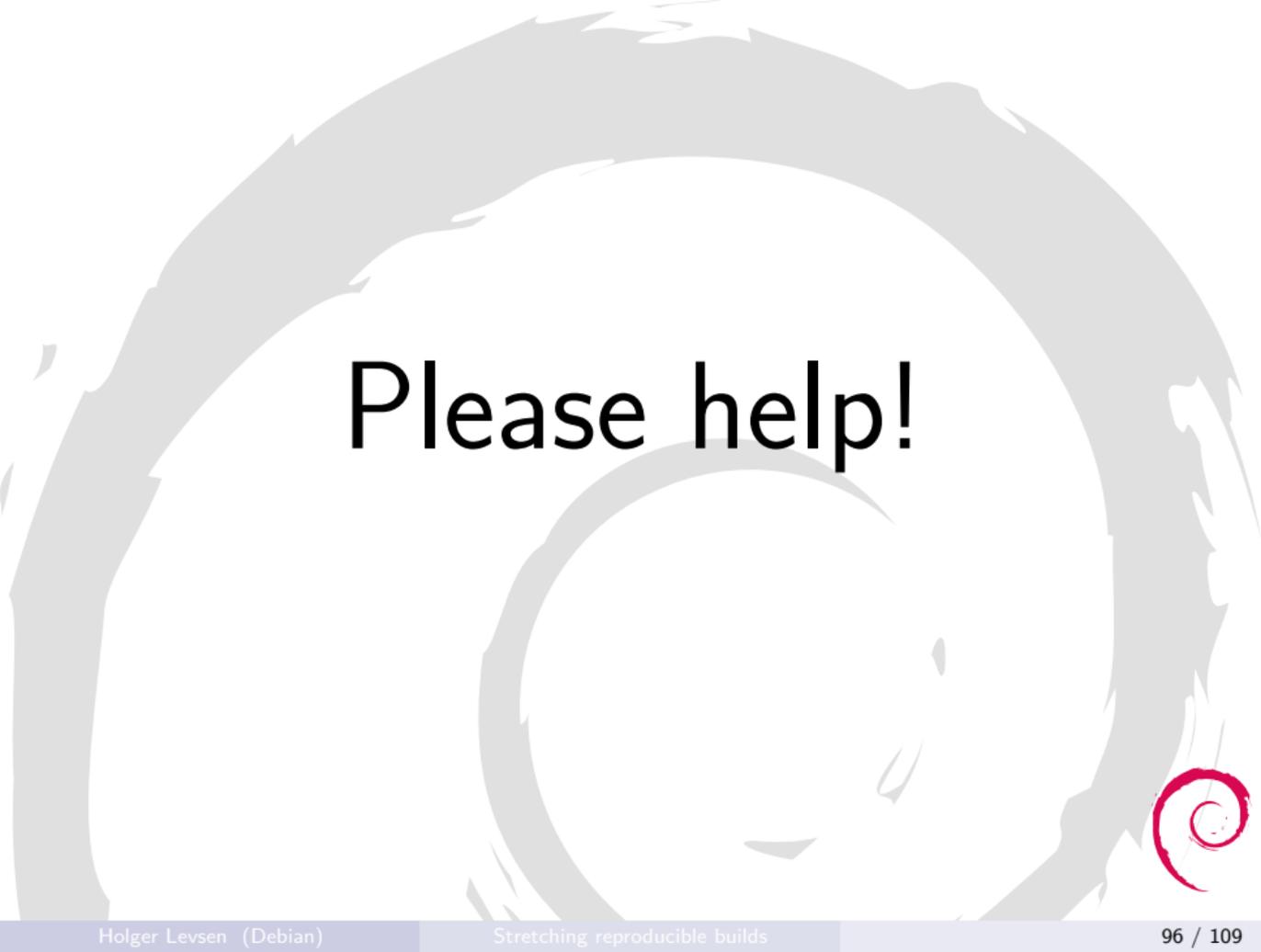
- The slides have not been updated for the 66 new issues identified since January 31 2015 for 124 in total today.
  - ▶ timezone issues
  - ▶ umask issues
  - ▶ several other issues with smaller impact...
- Today there are 3468 packages with notes, compared to 2243 “back then”.



# Bugs filed

Usertags on bugs for user reproducible-builds@lists.alioth.debian.org





# Please help!

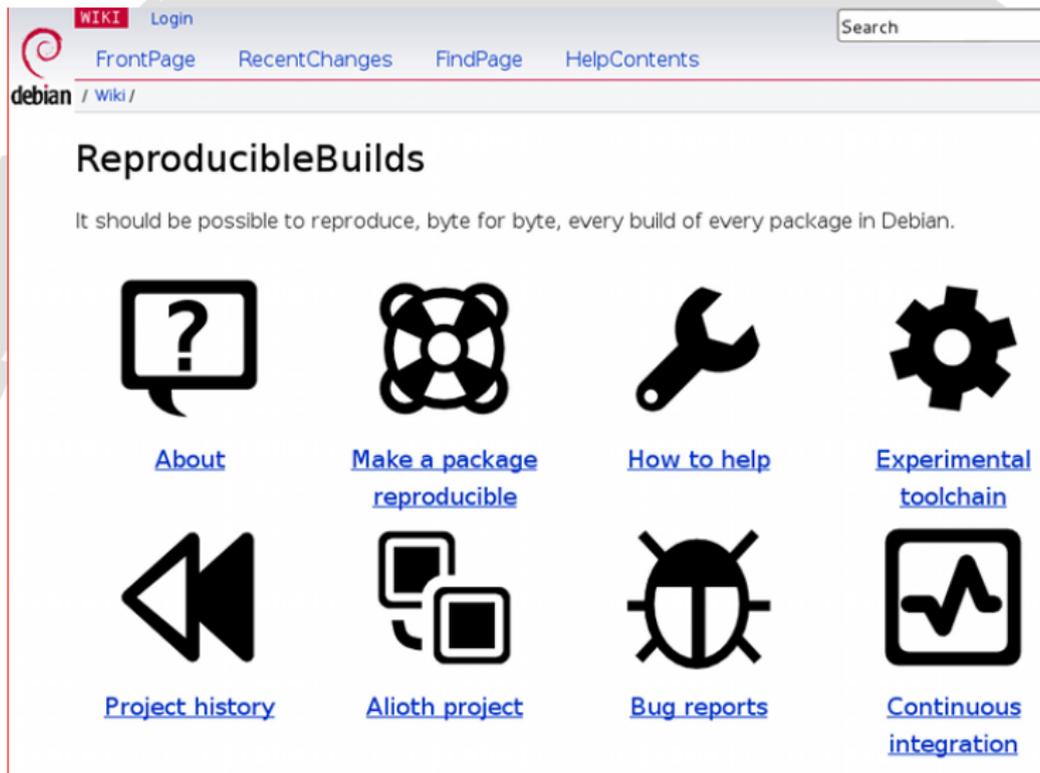


# Please help!

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



# How to help Debian?



The screenshot shows the Debian Wiki page for 'ReproducibleBuilds'. At the top, there is a navigation bar with 'WIKI' in a red box, 'Login', and a search box. Below the navigation bar are links for 'FrontPage', 'RecentChanges', 'FindPage', and 'HelpContents'. The page title is 'ReproducibleBuilds'. Below the title is a paragraph: 'It should be possible to reproduce, byte for byte, every build of every package in Debian.' Below this paragraph are eight icons arranged in a 2x4 grid, each with a corresponding link below it:

-  [About](#)
-  [Make a package reproducible](#)
-  [How to help](#)
-  [Experimental toolchain](#)
-  [Project history](#)
-  [Alioth project](#)
-  [Bug reports](#)
-  [Continuous integration](#)

# How to help Debian?

- Inventory issues and analyse them
- 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)
    - ★ our patch dpkg also ain't in the BTS yet
  - ▶ reproducibly should be mandated in debian-policy...
- Hack tools to display local packages reproducibility status
- We need a logo too :)
- ...



# Contributors

akira  
Andrew Ayer  
Asheesh Laroia  
Chris Lamb (lamby)  
Christoph Berg  
Chris West  
Daniel Kahn Gillmor  
David Suarez  
Drew Fisher  
Eduard Sanou (dhole)  
Guillem Jover

Hans-Christoph Steiner  
Helmut Grohne  
Holger Levsen  
Jelmer Vernooij  
josch  
Juan Picca  
Lunar  
Mattia Rizzolo  
Nicolas Boulenguez  
Niels Thykier  
Niko Tyni

Paul Wise  
Peter De Wachter  
Philip Rinn  
Reiner Herrmann  
Stefano Rivera  
Stéphane Glondu  
Steven Chamberlain  
Tom Fitzhenry  
Tomasz Buchert  
Wookey  
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`
  - ▶ regular team meetings planned, first scheduled for 2015-06-03 19:00 UTC
- Weekly reports



# 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>
- FreeBSD: <https://wiki.freebsd.org/ReproducibleBuilds> and <https://wiki.freebsd.org/PortsReproducibleBuilds>
- OpenWRT: <http://thread.gmane.org/gmane.comp.embedded.openwrt.devel/31080>

# Reproducible Fedora?

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

fedora 



# You're involved in Fedora? FreeBSD? OpenWRT?

- Please talk to me.
- I'd be glad to help set up some continuous testing, but it will need constant maintainers. Could this be you?



# 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



# Reminder

- This is just “research” at the moment. Debian ain't reproducible at all currently.
- However, we know now it is “theoretically possible”. And we do have received lots of support. Personally I hope for much progress at and after DebConf15 in August 2015 in Heidelberg.



# 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!



# Thanks

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- Globalsign for sponsoring X.509 certificates
- Designers of Tango icons
- Everyone who helped!



Very many thanks to: **Lunar**



# Questions? Comments?



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

Holger B8BF 5413 7B09 D35C F026 FE9D 091A B856 069A AA1C