

# GNU Mes – Full Source Bootstrap

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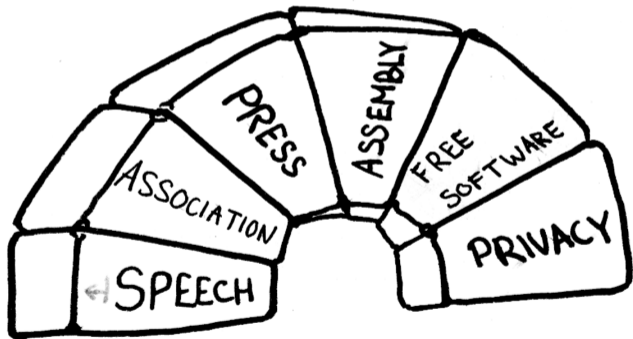
FOSDEM'21

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# Outline

- 1 Introduction
- 2 Reproducibility
- 3 Bootstrappability
- 4 Freedom
- 5 Thanks

# Full Source Bootstrap: Why?



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## GNU Mes

- A Scheme interpreter written in ~5,000LOC of simple C.
- A C compiler written in Scheme.
- Built on LISP: eval/apply, the [Maxwell Equations of Software](#).



# The Holy Grail: Stage0's hex0 => Mes

*The holy grail of bootstrappability will be connecting mes to hex0.  
– Carl Dong, Chaincode Labs*

# Full Source Bootstrap: WE DID IT!!!



## GNU Mes

- A Scheme interpreter written in ~5,000LOC of simple C, or M2.
- A C compiler written in Scheme.
- Built on LISP: eval/apply, the [Maxwell Equations of Software](#).





# Ken Thompson

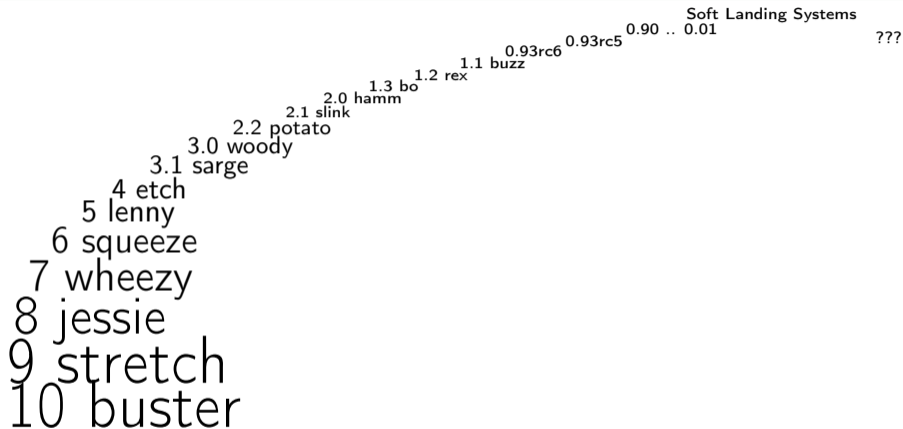
*TURING AWARD LECTURE*

## **Reflections on Trusting Trust**

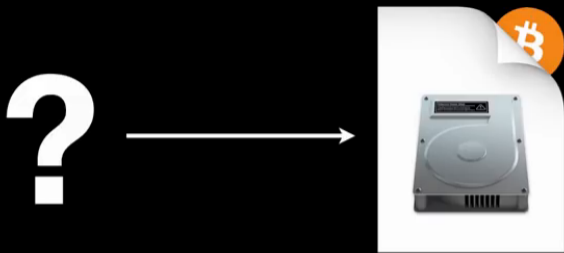
*To what extent should one trust a statement that a program is free of Trojan horses? Perhaps it is more important to trust the people who wrote the software.*



# Journey to the Source?

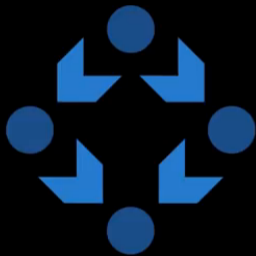


*As time goes on we will expire the binary packages for old releases. Currently we have binaries for squeeze, lenny, etch, sarge, woody, potato, slink, hamm and bo available, and only source code for the other releases. – [www.debian.org/distrib/archive](http://www.debian.org/distrib/archive)*



# Bitcoin Build System Security

Carl Dong, Chaincode Labs



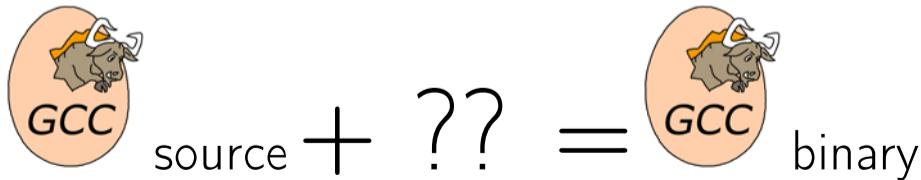
**Reproducible  
Builds**

# What is a Bootstrap?

Impossible task: pull yourself up on your boot straps



Software: to create your first: kernel, shell, C compiler, ...



## How to Bootstrap: An Old Recipe...



*Recipe for yoghurt: Add yoghurt to milk – Anonymous*

# How to Bootstrap: Create your second GCC

Traditional recipe: like yoghurt



... and done!



VELO  
Pure-F  
diam

*Halfvolle melk  
Lekken en gez*

HALFVOLLE MELK IS VAN NA  
AAN CALCIUM EN EIWIT. CAL  
VAN BELANG VOOR HET BE  
STERKE BOTTEN MET BE







**We're Reproducible!**



**We're Reproducible!**



**We're Reproducibly Malicious**

Reproducibility **is not enough**

Reproducibility  
Clean source code **is not enough**



**Guix**

Pronounced *Geeks*





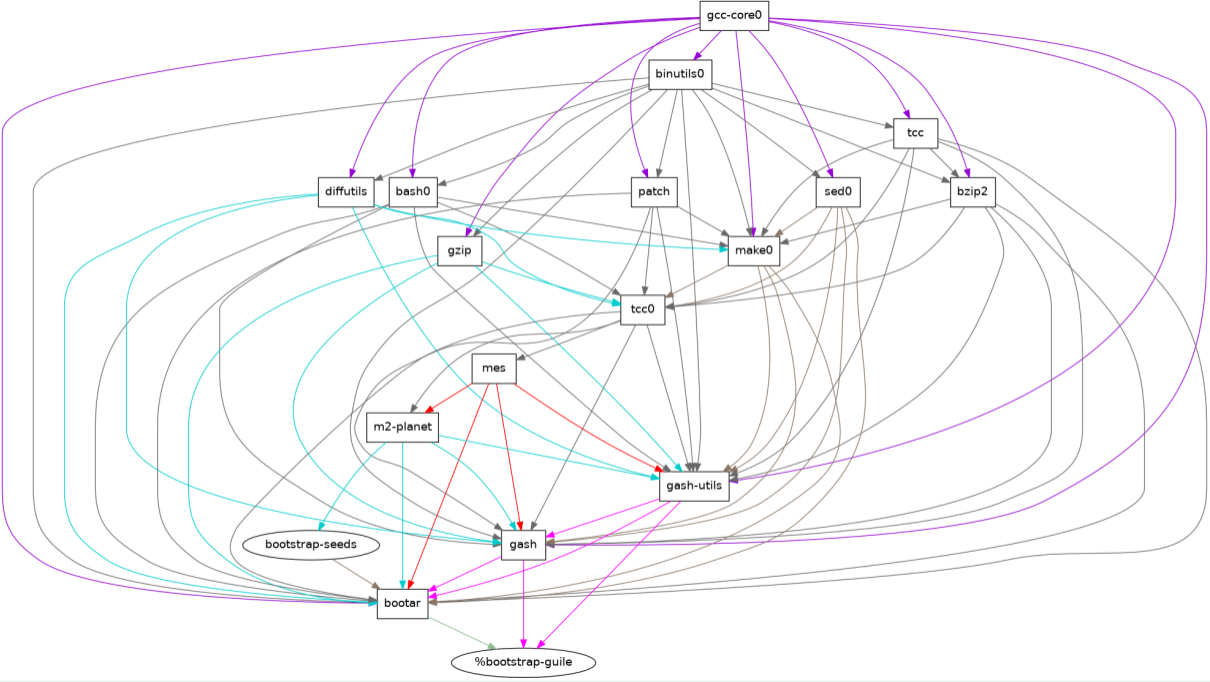
# WE DID IT! We did what?

## Adapt Mes and Mes C Library for M2-Planet

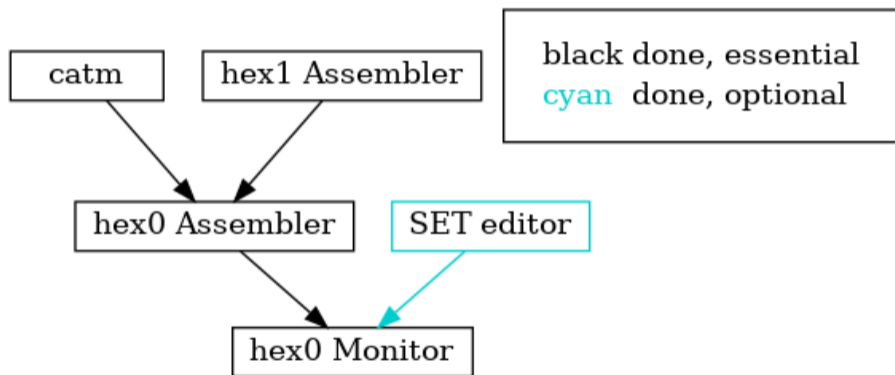
- `#define FOO => ...; #if BAR => ...; CAR (x) => x->car`
- remove global and static array data
- `foo.bar => foo->bar`
- rewrite pointer arithmetic
- rewrite garbage collector
- mature M2-Planet
- ...

## Integrate Full Source Bootstrap

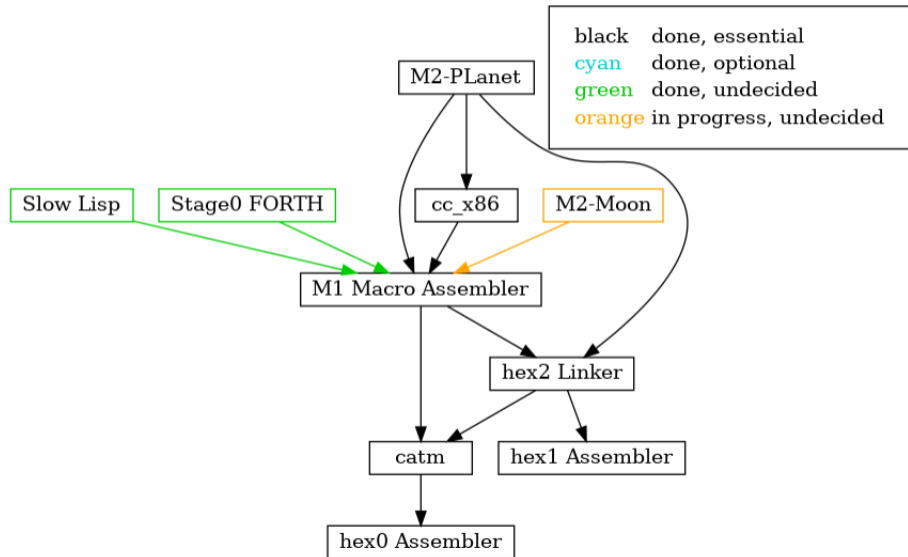
- package M2-Planet
- remove (dependency on) bootstrap seeds
- ...



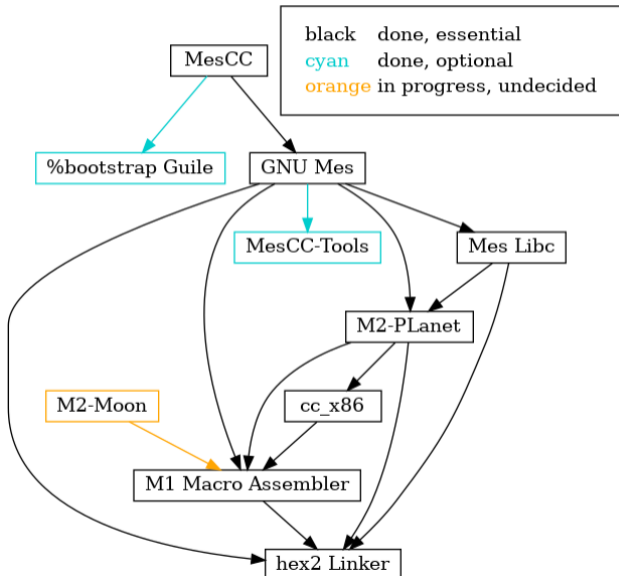
# Full Source Bootstrap: Stage 0



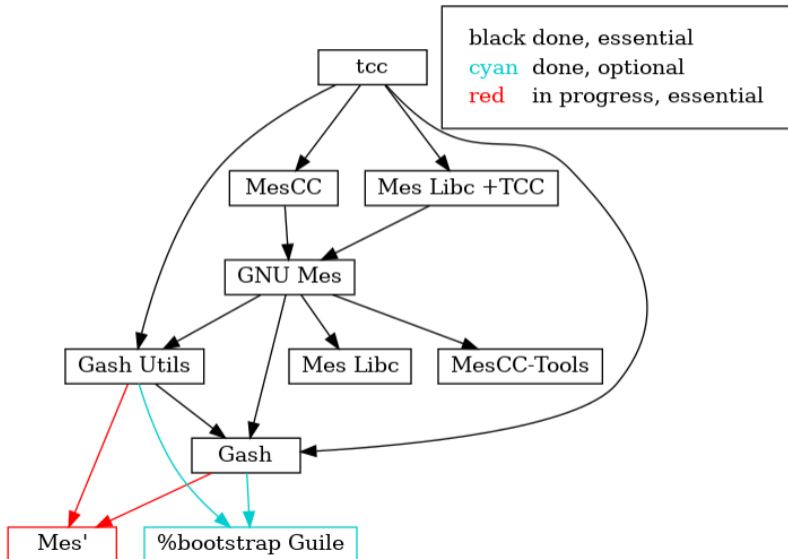
# Full Source Bootstrap: Stage 1



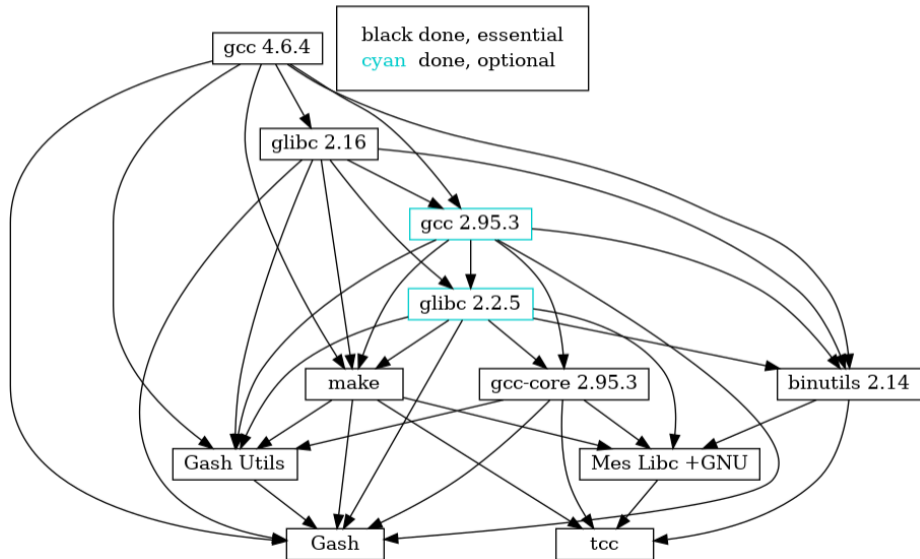
# Full Source Bootstrap: Stage 2



# Full Source Bootstrap: Stage mes



# Full Source Bootstrap: Stage mesboot





# Long path: Full Source Bootstrap

- 500+ MB: no bootstrap
- 252 MB: GNU Guix System v1.0
- 145 MB: Reduced Binary Seed
  - master branch
  - GCC, GLIBC, Binutils
  - + MesCC-Tools, + Mes
- 57 MB: Scheme-only
  - wip-bootstrap branch
  - Awk, Bash, Bzip2, GNU Core Utilities, Grep, Gzip, Make, Patch, Sed, Tar, and XZ.
  - + Gash (source only!)
- 357 bytes: Full Source
  - MesCC-Tools, Mes
  - + Stage0: 357 bytes (x86)





- Source code
- Binary seeds
- Guix System
- Linux
- Guix's Childhurds (Hurd in VM)

# What's Next?

## wip-full-source-bootstrap

- release mes-0.24
- update and merge

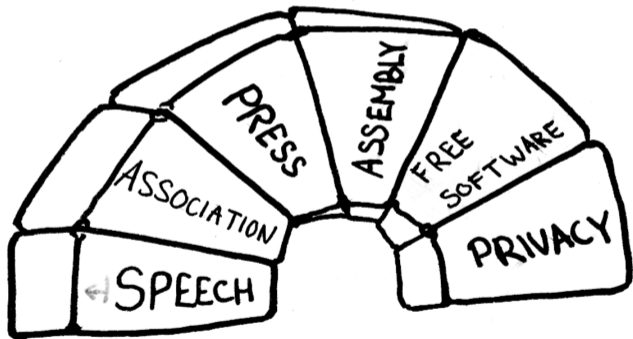
## wip-arm-bootstrap

- finish the bootstrap: currently stuck at glibc-mesboot0 (2.2.5)
- release mes-0.23
- update and merge

## RISC-V

- remove gcc-2.95 from the bootstrap
- port RISC-V extensions to gcc-4.6

# Free Software as a Human Right



(C) 2014 Richard Stallman and others, CC-BY 3.0

## Free Software == Freedom of Computing

- Inspect source => Free Software
- Binary matches source? => Reproducible builds
- Toolchain compromised? => Bootstrappable builds
- Hardware trustable? => DDC, free hardware

## Moving target: Are we losing GCC?

June 12, 2014

GCC 4.7.4, the final "bootstrappable", already a **huge** download

August 3rd, 2016

GCC 4.9.4 released, as of 4.8 requires C++03 to bootstrap

May 18, 2020

GCC moved away from C++03 and now needs to C++11 to bootstrap

# Contemplate: What is happening?

*It just doesn't **feel** right*  
*– Vagrant Cascadian, Debian developer*



*Vulnerability to a **trusting trust attack** is a symptom of an unauditible or missing bootstrap story. – janneke*

## Choices: More control, or less control?

raise bootstrappable awareness

to take back control over our computing, or

keep doing what we're doing

and watch the erosion of our computing freedoms.

# Thanks

- Carl Dong
- Danny Milosavljevic
- David Terry
- Jeremiah Orians
- Ludovic Courtès
- Matt Wette
- Pjotr Prins
- Rutger van Beusekom
- Timothy Sample
- Vagrant Cascadian

# Want to join?

## You can help

- raise awareness
- make core GNU packages bootstrappable again
- GCC (c++!), GNU Libc (python?!)
- reduced bootstrap NixOS, Debian
- port MesCC to the Hurd, FreeBSD
- retweet/toot @janneke\_gnu janneke@octodon.social

## Connect

- irc freenode.net #bootstrappable #guix
- mail bug-mes@gnu.org guix-devel@gnu.org
- git <https://git.savannah.gnu.org/git/mes.git>
- web [bootstrappable.org](http://bootstrappable.org)