Bootstrapping the Debian and Ubuntu ARM64 Ports

Wookey

Linaro

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Who am I

- Free Software developer since 1990
- Unix sysadmin since 1996
- Arm Linux developer since 1999
- Debian developer since 2000
- Ubuntu development since 2010

Some things I had something to do with:
Survex, PsiLinux, ArmLinux book, Emdebian, bootfloppies, Therion, apt-cross, dpkg-cross, Debian cross-toolchains, OpenEmbedded, Netbook Project, LART, YAFFS, Balloonboard, xdeb, Multiarch, sbuild

- Currently an ARM secondee to Linaro

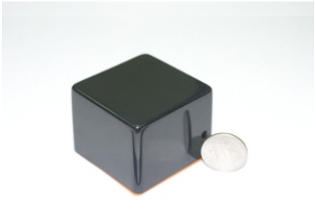
Outline

Outline

ARM desktops and servers

Acorn Risc PC (1994)

Rebel Netwinder (2000)


Solidrun Cubox (2012)

Dell/Calxeda server (2012)

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ARM laptops

Psion Netbook Pro (2003)

Toshiba AC100 (2010)

Genesi Smartbook (2010)

Samsung Chromebook (now)

Debian ports

Name	Bits	ABI	ISA	Released
arm	32	OABI	v3	2000:Potato (Discontinued 2011)
armeb	32	OABI	v3	2006:unofficial big endian
armel	32	EABI	v4t/v5	2009:Lenny, Ubuntu 9.05
armhf	32	EABI	v7	2012:Wheezy, Ubuntu 12.04
arm64	64	v8	v8	2013

Nomenclature

Simple version

arm64,aarch64,ARMv8 are all the same thing

More details:

arm64	Debian and Ubuntu architecture name
aarch64	ARM 64-bit execution mode
aarch64-linux-gnu	GNU triplet name
ARMv8	ARM CPU architecture name
A64	64 bit instruction set
A32	32 bit ARMv8 instruction set
aarch32	ARM 32-bit execution mode

Bootstrapping

20 Debian ports in 20 years

i386, 68000, Alpha, Sparc, PowerPC, ARM, IA64, PA-RISC, MIPS (Big endian), MIPS (little endian), S/390, AMD64, FreeBSD-i386, FreeBSD-amd64, armel, armhf, sh4, s390x, PowerPC64, Hurd-i386

Bootstrapping

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Bootstrapping is normal, not exceptional
A 'Universal OS' should be able to bootstrap itself

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The Bootstrap Problem

- Build-dependency loops

The Bootstrap Problem

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A more detailed look

The Bootstrap Problem

- Build-dependency loops
- Natively built
- Maximally configured
- Much worse for binary distros than source-based
- Lack of flexibility is in packaging

Outline

Bootstrap solutions

Traditionally

- Cheat and use something else
- Bodgery and Hackery
- No hardware yet - models are really slow

'Universal OS' solution

- Cross Building
- Build profiles
  - `Build-Depends: debhelper, byacc | bison, comerr-dev, docbook-to-man, libldap2-dev <!stage1>, libncurses5-dev`

Debian cross-build methods

Old dpkg-cross style

- Special tools for cross-dependencies: apt-cross, xapt, xdeb
- -cross packages created with dpkg-cross
- Libraries and headers in /usr/<triplet>

New Multiarch style

- Apt does cross-dependencies
- Standard library and headers paths
- Normal host architecture packages used

Multiarch

- Install libraries side-by side: i386/amd64, arm/arm64, amd64/arm64
  - /usr/lib/libfoo (amd64)→/usr/lib/x86_64-linux-gnu/libfoo
  - /usr/lib/libfoo (armel)→/usr/lib/arm-linux-gnueabi/libfoo
  - /usr/lib/libfoo (arm64)→/usr/lib/aarch64-linux-gnu/libfoo
- Packages arch-qualified: libfoo:arm64, wine:i386
- Packages marked Multi-Arch: Same, Foreign, Allowed
- Canonical file locations: Runtime is the same as build-time.
- Run foreign binaries in-place (natively or with qemu)
- 32/64 special casing goes away (/lib64, /emul/ia32-linux)
- Build/host version lockstep

Usage example

```
dpkg --add-architecture i386
apt-get install skype:i386
```

Outline

ARM internal Bootstrap

- Ubuntu Maverick
- Using xdeb, with staging support
- Equivs to fake toolchain dependencies
- Manual build order

So it's all done already?

ARM is an IP Company

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Now I can be rude about ARM legal

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Now I can be rude about ARM legal

- Paranoid about patent grants in FLOSS licences
- No cross-fixes, bootstrapping or arm64 support upstreamed
- Engineers disillusioned

So it's all done already?

ARM is an IP Company

Now I can be rude about ARM legal

- Paranoid about patent grants in FLOSS licences
- No cross-fixes, bootstrapping or arm64 support upstreamed
- Engineers disillusioned
- All has to be done again

```
+export DEB_BUILD_GNU_TYPE ?= $(shell dpkg-architecture -qDEB_BUILD_GNU_TYP
+
+ifeq ($(DEB_BUILD_GNU_TYPE), $(DEB_HOST_GNU_TYPE))
+  confflags += --build $(DEB_HOST_GNU_TYPE)
+  CROSS=""
+else
+  confflags += --build $(DEB_BUILD_GNU_TYPE) --host $(DEB_HOST_GNU_TYPE)
+  CROSS=$(DEB_HOST_GNU_TYPE)-
+endif
```

On the one hand great early community engagement

On the other complete failure to give back

Illustrates Linaro/corporate culture clash

Outline

Debian/Ubuntu Bootstrap Overview

Overview

- Ubuntu Quantal-based (and Debian Wheezy)
- All done in public from start - Upstreaming as we go along
- Multiarch building and cross-dependencies
- Standard tools: Sbuild, reprepro, apt, dpkg-cross
- Modified dpkg: build-profile support
- cross-build-essential

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Debian/Ubuntu Bootstrap Process

1. Prepare repository
2. Add new arch support to dpkg-architecture
3. Set up build chroot
4. Toolchain bootstrap
5. Fix support packages: dpkg-cross, cross-build-essential, autoconf
6. Build stuff. . .

How many packages do we need?

	Debian Sid	Ubuntu Precise
`base system`	62	94
`plus build-essential`	73	138
the above plus dependencies	106	140
number of source packages	55	75

Toolchain Bootstrap

'3-stage' bootstrap

1	Linux	linux-libc-dev headers
2	GCC stage1	Bare C-compiler
3	eglibc stage1	Minimal libc
4	GCC stage2	C-compiler against eglibc
5	eglibc stage2	Full libc build (without libselinux)
6	GCC stage3	All compilers

Automated by arm64-cross-toolchain-base

Toolchain Bootstrap

Bootstrap fun

- Need to build -source packages
  - linux-source
  - binutils-source
  - eglibc-source
  - gcc-4.7-source
- Kernel is 3.5, arm64 support is 3.7
- Quantal has eglibc 2.15, aarch64 support is glibc 2.16
- Package only builds with gcc-4.6, aarch64 support only for gcc-4.7
- Complicated packaging for Debian+Ubuntu, 12 architectures, Linux+BSD

Set up a chroot

`http://wiki.linaro.org/Platform/DevPlatform/CrossCompile/arm64bootstrap`

Create chroot

```
apt-get install sbuild
sudo sbuild-createchroot
  --make-sbuild-tarball=/srv/chroots/quantal-cross-arm64.tgz quantal
  /srv/chroots/quantal http://archive.ubuntu.com/ubuntu/
```

Build flags

```
STRIP CFLAGS -fstack-protector
APPEND LDFLAGS -L/usr/lib/aarch64-linux-gnu
               -L/lib/aarch64-linux-gnu -L/usr/lib
               -Wl,-rpath-link=/usr/lib/aarch64-linux-gnu:
               /lib/aarch64-linux-gnu:/usr/lib
```

Apt preferences

```
Package:  *
Pin:  release n=quantal-bootstrap
Pin-Priority:  1001
```

Building Packages

Getting Build-Deps and building is simple

Manually

```
apt-get install crossbuild-essential-arm64
apt-get build-dep -aarm64 acl
apt-get source acl
cd acl-2.2.51
dpkg-buildpackage -aarm64
```

Using sbuild

```
sbuild -c quantal-bootstrap -d quantal
  --host=arm64 acl_2.2.51
```

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Dependency analysis

Dependency analysis

```
dose-debbuildcheck --deb-native-arch=amd64
--deb-foreign-archs=arm64 --deb-host-arch=arm64 <packages
files> <source file> -f -e -s --checkonly <package>
```

Output

```
      package: src:dpkg
      version: 1.16.7ubuntu3profile1
      architecture: any,all
      essential: false
      unsat-dependency: arm64:liblzma-dev
```

Outline

Current status

- Nearly all Ubuntu so far
- Cross toolchain available to install
- Cross-support packages available
- Perl and python multiarched
- Arch all packages are easy
- 25 source Packages built
- Maybe 100 to go for base image
- No real testing beyond compiler yet

TODO: update perl cross-build

Getting involved

This is an open effort - help is welcome.

Just trying arm64

OE-based image `http://www.linaro.org/engineering/armv8`

Helping with the bootstrap

Set up build environment

`wiki.linaro.org/Platform/DevPlatform/CrossCompile/arm64bootstrap`

- Fix cross-build failures
- Fix cyclic dependency problems

`http://wiki.debian.org/DebianBootstrap`

Resources

- `http://wiki.debian.org/Arm64Port`
- `http://people.debian.org/~wookey/bootstrap.html`

Thanks

Wookey
wookey@wookware.org
http://wookware.org

http://wiki.debian.org/Arm64Port

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