



BuildRoot

Making Embedded Linux Easy

What is new?

Peter Korsgaard, Maintainer
ELCE 2013

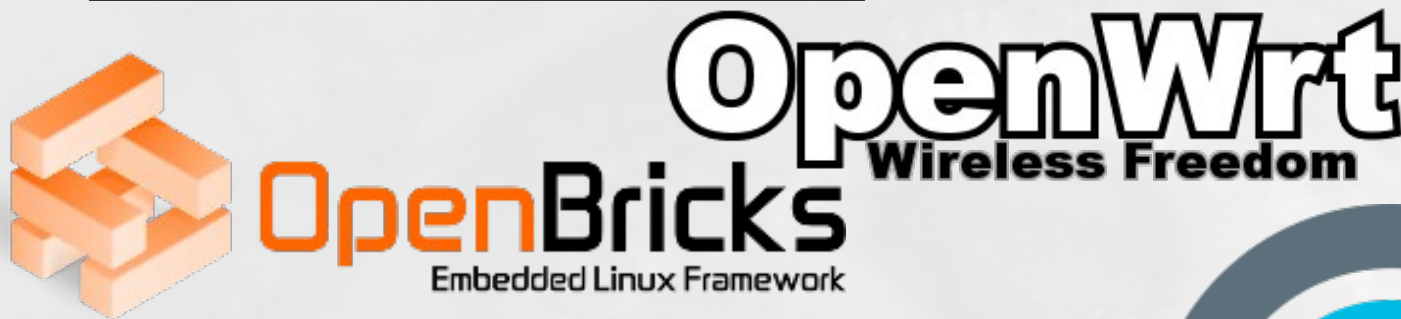
What is it?

- An **Embedded Linux build** system
 - Cross toolchain
 - Bootloader
 - Linux kernel
 - Rootfs
- All software components of an embedded Linux system



BuildRoot
Making Embedded Linux Easy

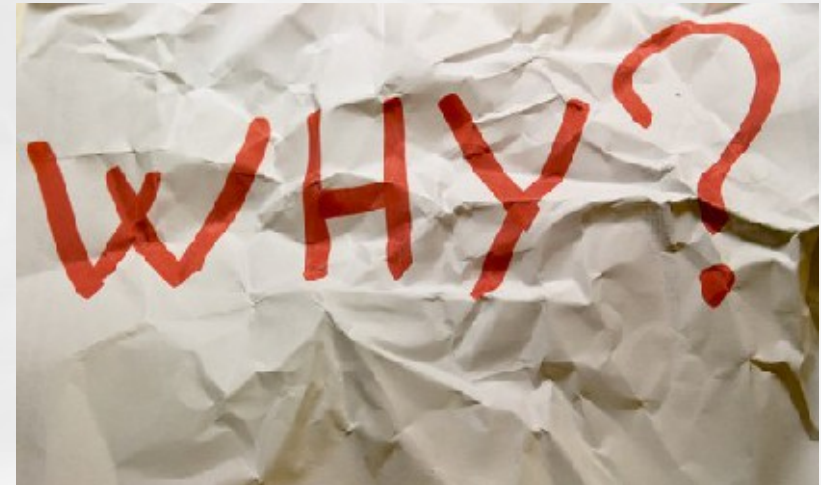
Alternatives



Why Buildroot?

- One of the longest running projects
 - **Started in 2001 as a way to test & demo uClibc**
 - **Mature and well documented**
- Relatively simple

*For me, OE fails the easy to understand, quick to setup test.
I now use buildroot. -- Kevin Hilman, ARM kernel developer.*
- Regular release schedule
 - **Every 3 months + bugfix releases**
- Real community project
 - **No single company steering direction**
 - **Active and friendly community**



KISS

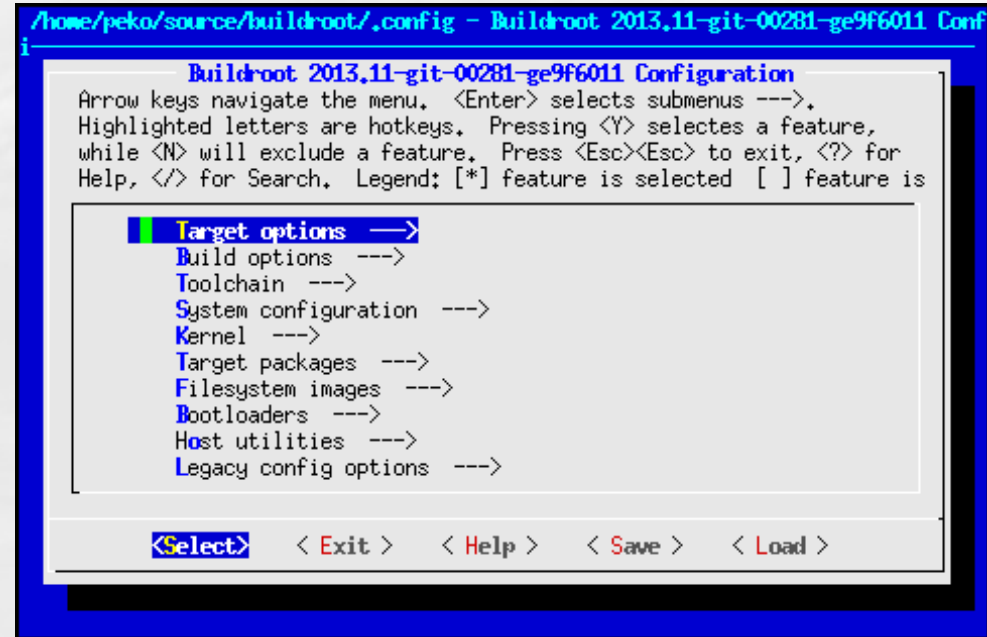
- Lots of tradeoffs
 - **Features vs simplicity**
 - **How can it be generalized?**
- Rootfs image, no binary packages!



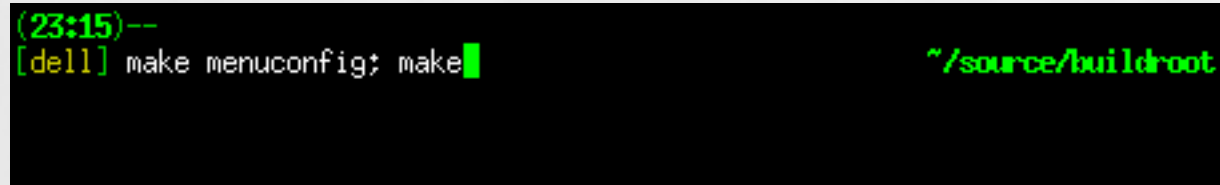
How does it work?

- **Kconfig** based interactive configuration tool

- From the Linux kernel
- Tree structure
- Dependencies, conflicts
- Help



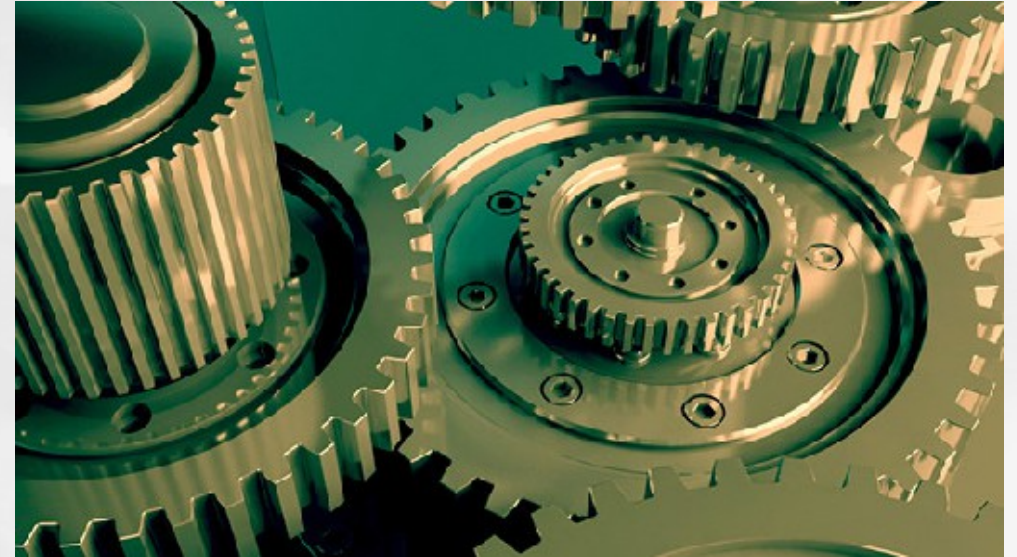
- **Make** based build system



- Both **familiar** technologies to developers

Packages

- Buildroot is structured around **packages**
 - **Each with a number of steps**
 - Download, Extract, Patch, Configure, Build, Install
- A build executes all **enabled** packages
 - **With the chosen options**
 - **In the correct order**
- **Meta** build system
 - **Source code is downloaded**
 - **Build system is driven by Buildroot**



Anatomy of a package

- Config.in with options
 - In the kconfig language

```
config BR2_PACKAGE_GZIP
```

```
    bool "gzip"
```

```
    depends on BR2_USE_WCHAR
```

```
    help
```

```
        Standard GNU compressor. Provides things like gzip,  
        gunzip, gzcat, etc...
```

```
        http://www.gnu.org/software/gzip/gzip.html
```

```
comment "gzip requires a toolchain with WCHAR support"
```

```
    depends on !BR2_USE_WCHAR
```


Anatomy of a package

- Package.mk with build steps
 - **Sensible defaults for packages using autotools or cmake**

```
GZIP_VERSION = 1.6  
GZIP_SOURCE = gzip-$(GZIP_VERSION).tar.xz  
GZIP_SITE = $(BR2_GNU_MIRROR)/gzip  
  
$(eval $(autotools-package))
```

Anatomy of a package

- Finally include it in package/Config.in under the right sub option

menu “Compressors and decompressors”

..

include “package/gzip/Config.in”

```
/home/peko/source/buildroot/.config - Buildroot 2013.11-git-00589-gf0801fa Conf
i
Compressors and decompressors
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> selects a feature,
while <N> will exclude a feature. Press <Esc><Esc> to exit, <?> for
Help, </> for Search. Legend: [*] feature is selected [ ] feature is
[ ] bzip2
[*] gzip
[ ] infozip
+ (+)
<Select> <Exit> <Help> <Save> <Load>
```

Source code

- Git managed similar to Linux kernel, only maintainer has commit access
- Patches gets posted and reviewed on mailing list
 - **200-300 patches gets integrated each month**
- Patch queue managed in Patchwork

Patchwork Bulldozer development

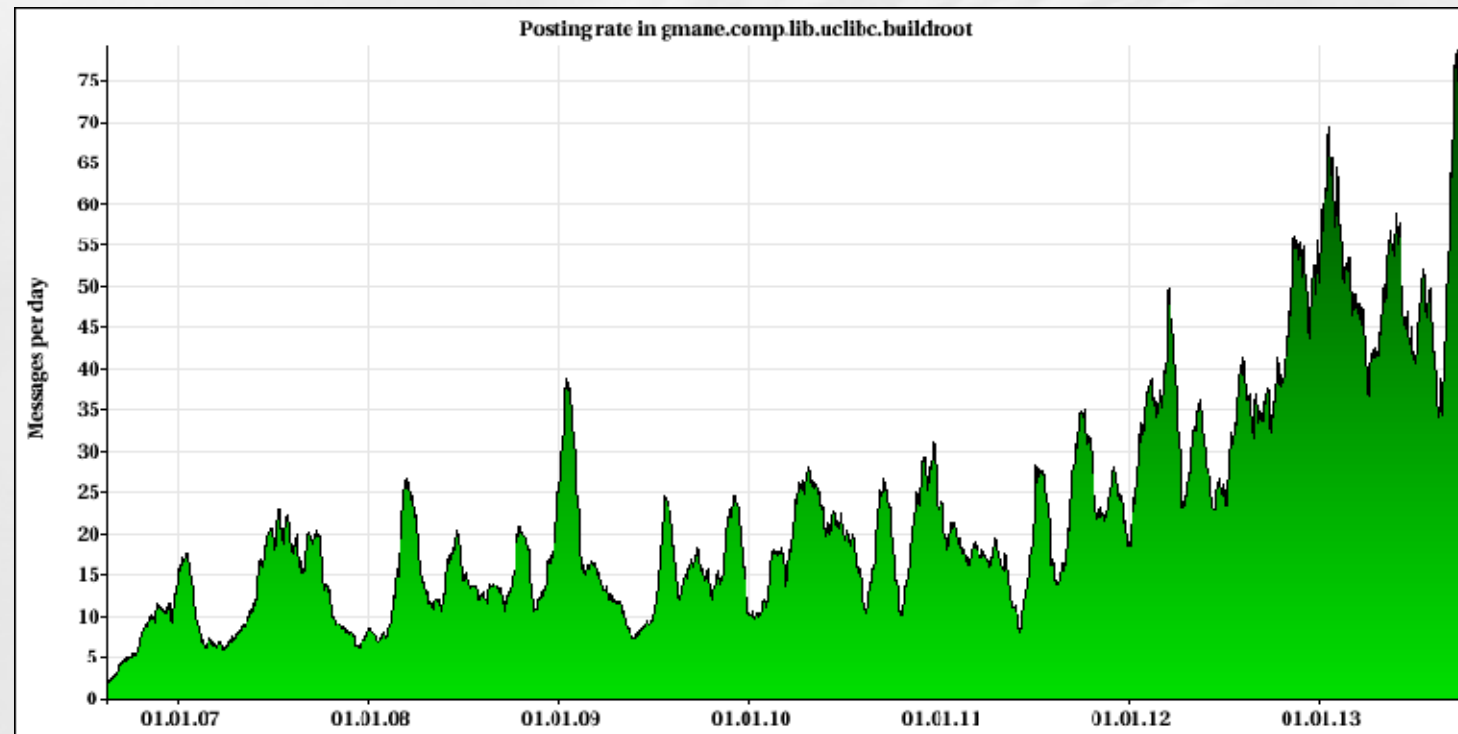
Project | all issues | patches | and scripts | other projects

Incoming patches

Filter: Status = Action Required	Action: No		Date	Submitter	Delegate	Status
<input type="checkbox"/> Patch						
<input type="checkbox"/> [v2,2/2] Align -			2013-09-24	Thierry Beldie		New
<input type="checkbox"/> [v2,1/2] Added ass=2 support			2013-09-24	harry holtz		New
<input type="checkbox"/> [PATCH v2 1/4] core: introduce the DR2_EXTERNAL variable			2013-09-24	Thomas Petazzoni		New
<input type="checkbox"/> core: introduce the RPR2_EXTERNAL variable (assata patchelf fix manual build)			2013-09-23	Serguei Merline		New
<input type="checkbox"/> [v2,1/1] openpowerlink: new package			2013-09-23	Romain Haour		New
<input type="checkbox"/> [Patches]D: package@v2: reflect the dependency for something use max as TARGET_OS			2013-09-23	Axel Lr		New
<input type="checkbox"/> [v2] xscrtensaver: new package			2013-09-23	Emor Dawson		New
<input type="checkbox"/> xapp.xscrtensaver: new package			2013-09-22	Emor Dawson		New
<input type="checkbox"/> [v2,v2/2] manual generation: rename manual-ext into manual-req			2013-09-21	Thomas De Schampheleire		New
<input type="checkbox"/> [v2,v2/2] manual generation: check dependencies first			2013-09-21	Thomas De Schampheleire		New
<input type="checkbox"/> [v2,1/1] Openpowerlink: new package			2013-09-21	Romain Haour		New
<input type="checkbox"/> [v2,1/1] Openpowerlink: new package			2013-09-21	Romain Haour		New
<input type="checkbox"/> [v2,1/1] cyrex: new package			2013-09-20	Hart Weber		New
<input type="checkbox"/> [v2,3/6] onflow: new package			2013-09-20	g.r.s.bihan.gow@free.fr		New
<input type="checkbox"/> [v2,5/6] packages: update dependency on udev			2013-09-20	g.r.s.bihan.gow@free.fr		New
<input type="checkbox"/> [v2,4/6] sys: bundle set command firmware search path			2013-09-20	g.r.s.bihan.gow@free.fr		New
<input type="checkbox"/> [v2,2/6] systemd: bump to v205.			2013-09-20	g.r.s.bihan.gow@free.fr		New
<input type="checkbox"/> [v2,2/6] libcap: remove old SysV symlink and use autostdlib			2013-09-20	g.r.s.bihan.gow@free.fr		New

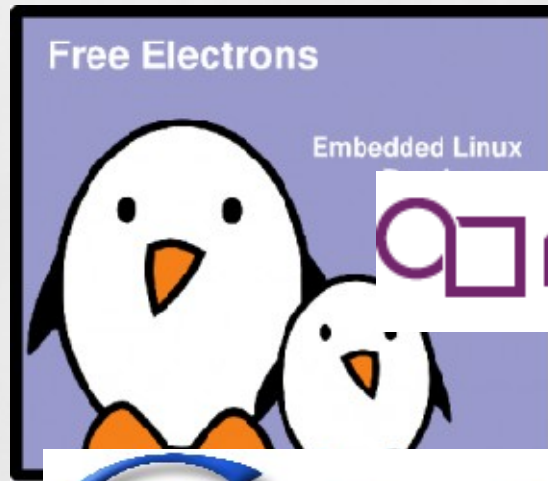
Mailing List

- User support and development
- 1000+ subscribers, ~2000 mails / month



Developer Days

- 2x / Year
 - Around FOSDEM and Embedded Linux Conference Europe
- Sponsored by companies using Buildroot
 - Thanks!



Companies using Buildroot

- Use in products
 - Barco
 - Google (fiber)
 - Rockwell Collins
- Use as SDK
 - Atmel
 - Imagination Technologies
 - Synopsys
 - Tensilica

.. And a bunch of others that don't tell us about it

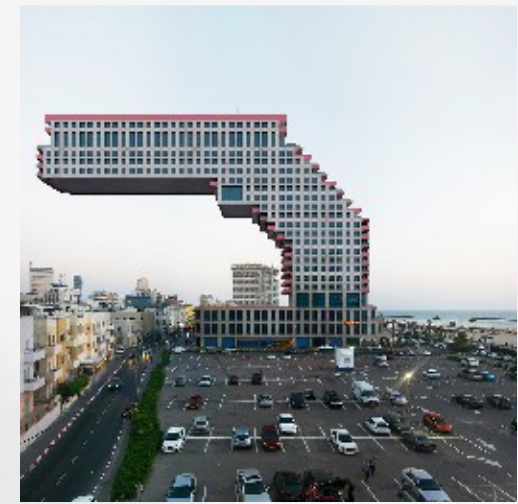


What is new?



Architecture Support

- New Architectures
 - **Blackfin, Aarch64, ARC, Microblaze, Nios II, Xtensa**
 - **Bfin/ARC/Xtensa contributed by Analog/Synopsys/Tensilica**
- Improved variant support
 - **ARM soft/hard/hardfp, NEON, VFP variants**
- Improved NOMMU support
 - **Package annotation**
 - **FLAT/FDPIC selection**



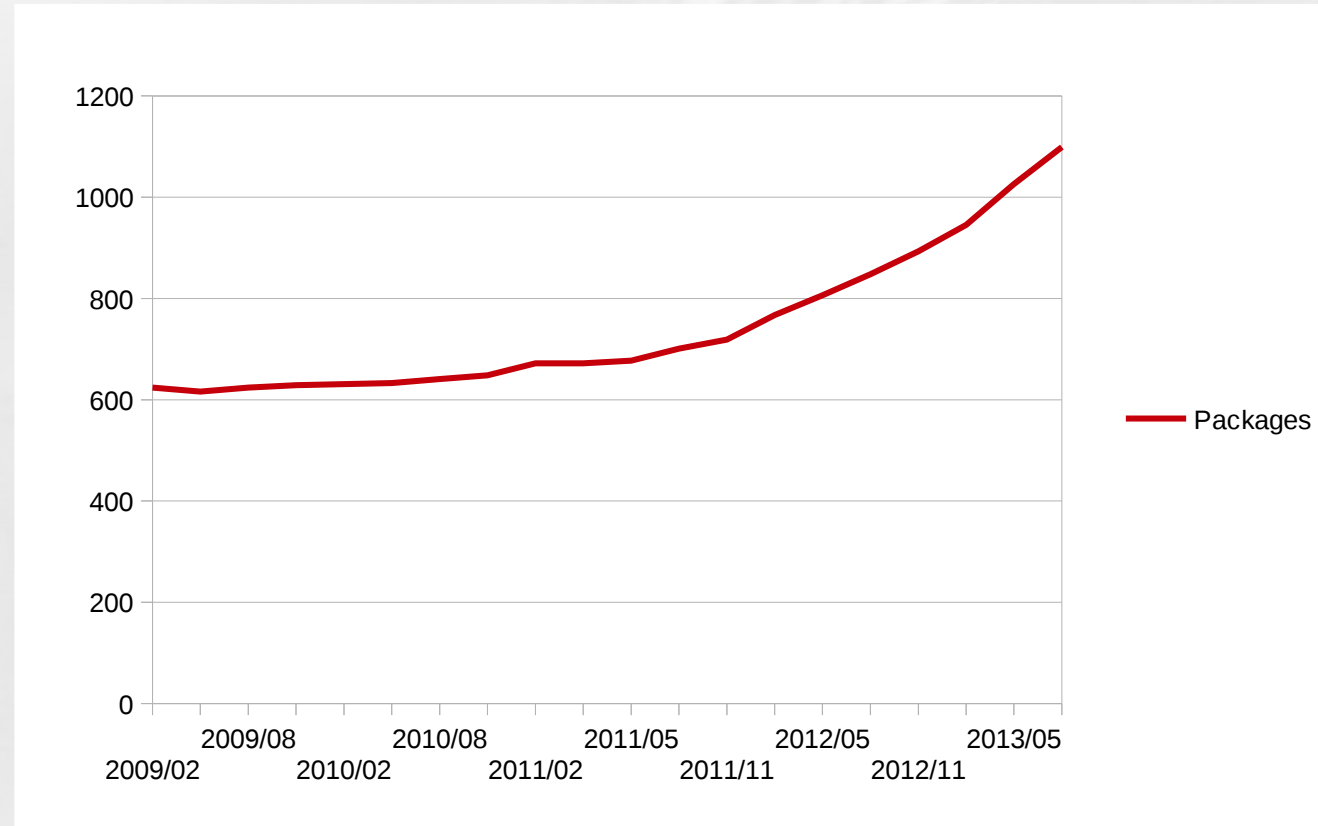
Toolchains

- C library options for internal toolchain
 - **EGlibc, Glibc, uClibc**
- External toolchain support
 - **Preconfigs for CodeBench, Linaro**



Lots of new packages

- 30% more packages since last year

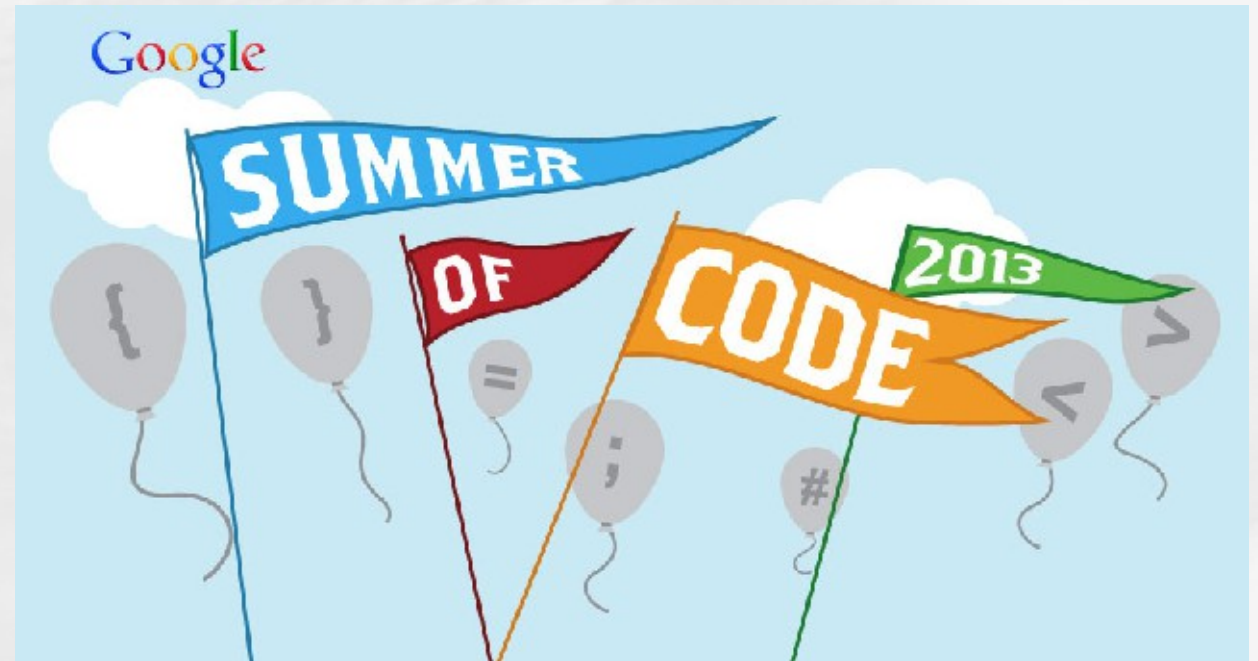


Packages

- Multimedia
 - **Gstreamer 1.2, Wayland, EFL, Qt5, Pulseaudio, Opus, Linphone, tvheadend ..**
- Scripting
 - **Python3, nodejs, ..**
- System
 - **Flashbench, systemd, ..**
- Development
 - **Perf, lttng, trace-cmd, wireshark, ..**

Google Summer of Code

- Improved support for multimedia features of popular ARM SoCs
 - **Spenser Gilliland** with **Thomas Petazzoni** as mentor
- GPU drivers
 - **PowerVR** on TI
 - **Mali** on Allwinner
 - **Vivante** on i.MX
 - **RPi**
- Video acceleration
 - **CedarX** on Allwinner
 - **VPU** on i.MX
 - **Gst-omx** on RPi



Quality assurance



- Development cycle splitup
 - 2 months of feature development
 - 1 month of stabilization
 - Bugfix release if critical issues are found post release
- Continuous regression tests
 - Randpackageconfig
 - 4 servers 24/7

Date	Status	Commit	Submitter	Arch	Failure reason	Data
2013-08-23 16:19:05	OK	a9558e02	Thomas Petazzoni (Free Electrons build server)	mips64	none	dr. and log. config. defconfig
2013-08-23 16:31:17	OK	a9558e02	Thomas Petazzoni (Free Electrons build server)	x86_64	none	dr. and log. config. defconfig
2013-08-23 16:07:12	NOX	a9558e02	Thomas Petazzoni (Free Electrons build server)	arm	civetweb-1.3	dr. and log. config. defconfig
2013-08-23 14:51:58	OK	a9558e02	Peter Korsgaard (pc210)	i686	none	dr. and log. config. defconfig
2013-08-23 14:42:07	OK	a9558e02	Thomas Petazzoni (Free Electrons build server)	mipsel	none	dr. and log. config. defconfig
2013-08-23 14:15:10	OK	a9558e02	Thomas Petazzoni (Free Electrons build server)	arm	none	dr. and log. config. defconfig
2013-08-23 14:11:18	NOX	a9558e02	Thomas Petazzoni (Free Electrons build server)	xtensa	lmod 15	dr. and log. config. defconfig
			Thomas			dr. and

License compliance support



- Buildroot itself is **GPLv2+**, many packages also copyleft
- Packages are annotated with their license

```
GZIP_LICENSE = GPLv3+  
GZIP_LICENSE_FILES = COPYING
```

- **make legal-info** generates
 - A manifest listing enabled packages, their version and license info
 - A copy of the license files
 - A copy of the source code tarballs
 - Buildroot configuration
- Notice that this is **to support** legal compliance, further work may be needed
 - Proprietary application linking to GPL libraries
 - License conflicts (E.G. OpenSSL vs GPL)

Eclipse CDT Plugin



C Project

Create C project of selected type

Project name:

☒ Use default location

Location:

Choose file system:

Project type:

- Executable
- Shared Library
- Static Library
- Makefile project
- GNU Autotools
 - Empty Project**
 - Hello World ANSI C Autotools Project
 - Autotools Shared Library Project

Toolchains:

- Autotools Buildroot ARM (/home/melanie/buildroot/buildroot/**
- GNU Autotools Toolchain

☒ Show project types and toolchains only if they are supported on the platform

Defconfigs

- Preconfigured setups for popular boards
 - Cubieboard, beaglebone, nitrogen6x, rpi, sheevaplug, wandboard, ..
 - A bunch of QEMU variants



System users

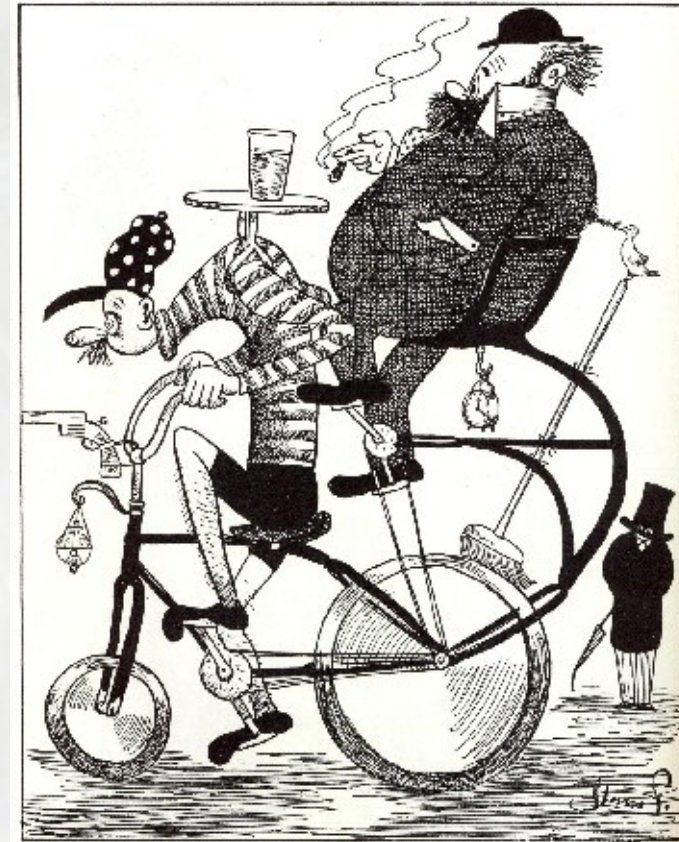
got root?

- Packages can now add system users:

```
# user uid group gid pass homedir shell groups comment
define TVHEADEND_USERS
tvheadend -1 tvheadend -1 * /home/tvheadend – video TVHeadend
endif
```


Customization

- System configuration menu in menuconfig
 - **Hostname, banner, password, init system, getty, ..**
- Rootfs overlays
 - **For adding extra files**
- Hook scripts to tweak
 - **Post-build (after all rootfs packages have been built)**
 - **Post-image (after Buildroot is done)**
- Custom packages



Upcoming work

- Package overlays (external packages)
- SELinux support
- Updated systemd/udev
- ... + What else gets submitted

Questions?



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<http://buildroot.org>