The Scratchbox development environment

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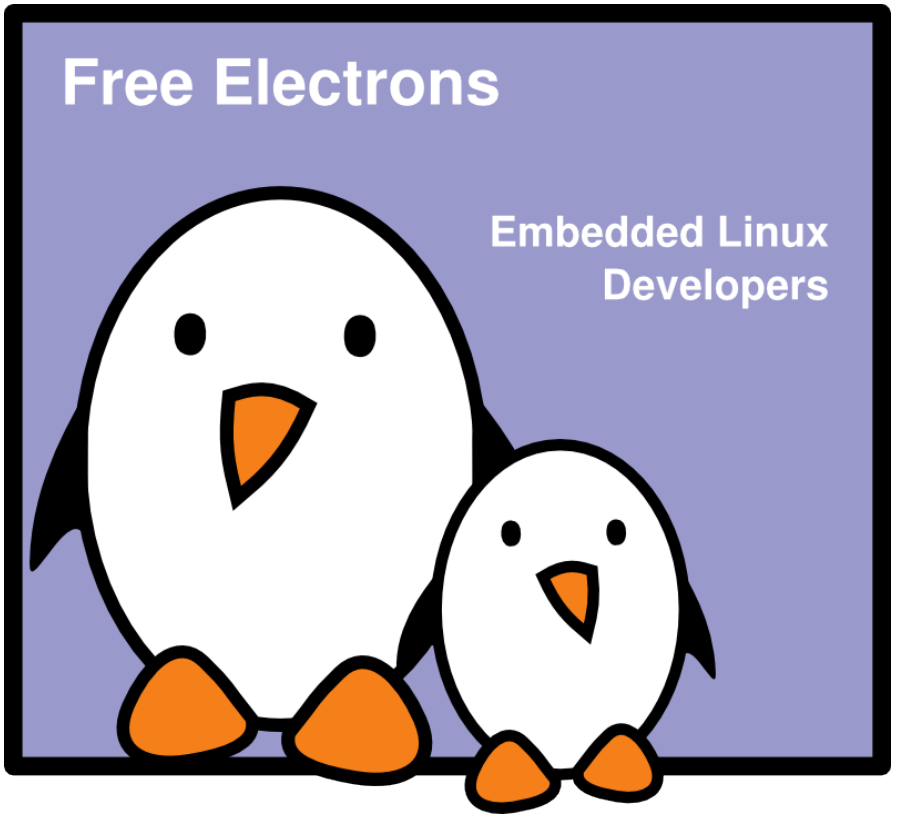

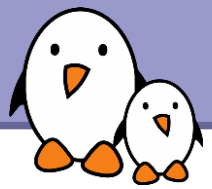

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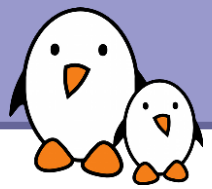
Document sources, updates and translations:
http://free-electrons.com/docs/scratchbox

Corrections, suggestions, contributions and translations are welcome!

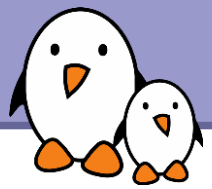
Latest update: Sep 15, 2009



Scratchbox

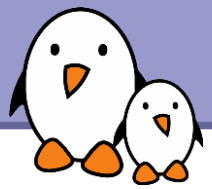
http://www.scratchbox.org

- Cross-compiling toolkit designed to make embedded Linux application development faster and easier.
- Provide a sandbox environment that emulates some characteristics of the target system
  - Dependencies are not mixed with host system's libraries
  - Transparent cross-compiling, making building tools believe they are doing a native compile job : no tweaking to support cross-compiling, and fast compiling on a cheap `x86` box.
- Supported architectures : `arm` and `x86`.
  Experimental support for `cris`, `mips` and `ppc`.



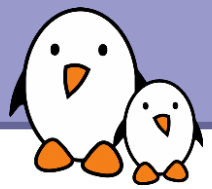
History

- Research started in 2002
- First public release in 2003
- Scratchbox 1.0 in February 2005, « Apophis »
  - Still maintained, with regular updates to various components from 2005 to 2008.
- Scratchbox 2.0
  - In development : version 1.99.0.23 released in February 2008.
- Developed by Movial, sponsored by Nokia.
- Used for the Maemo environment of the Nokia Internet tablets.



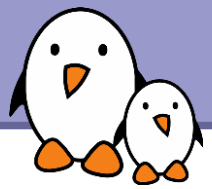
Features

- Chrooted environment
  - Running on the host, but only target files are visible.
- Transparent cross-compiling
- Transparent execution, either through Qemu or remote execution using `sbrsh`.
- Comes with ready-made cross-compiling toolchains and tools to build Debian packages.
- Supports both uClibc and glibc.
- Provides basic root filesystems.



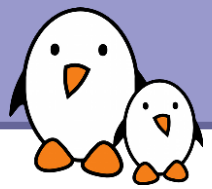
Installing Scratchbox

- On Debian/Ubuntu, add the Scratchbox repository to the package sources:
  `deb http://scratchbox.org/debian/ apophis main`
- On other distributions, download binary tarballs from
  http://scratchbox.org/download/files/sbox-releases/apophis/tarball/
- Install the following packages
  - `scratchbox-core`
  - `scratchbox-libs`
  - A toolchain package, for example
    `scratchbox-toolchain-arm-gcc4.1-uclibc20061004`
  - CPU transparency development kit
    `scratchbox-devkit-cputransp`



Configuring Scratchbox

- Scratchbox is installed in `/scratchbox`
- Add your account to the Scratchbox system
  `sudo /scratchbox/sbin/sbox_adduser <user>`
- This will
  - Add your user to the `sbox` group
  - Create files and directories inside the Scratchbox system for your user
- Need to log out and log in again for the group change to take effect
- Login using `/scratchbox/login`
- Scratchbox says « No current target »



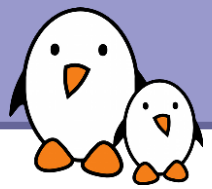
Configuring a target

- Two configuration tools
  - `sb-conf`, command line
  - `sb-menu`, semi-graphical curses interface
- Using sb-conf

```
sb-conf setup armdemo
  --compiler=arm-gcc4.1-uclibc20061004
  --devkits=cputransp
  --cputransp=/scratchbox/devkits/cputransp/bin/
          qemu-arm-0.8.2-sb2
```

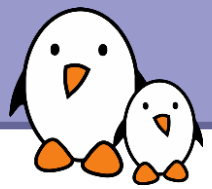
- Select the new target

```
sb-conf select armdemo
```



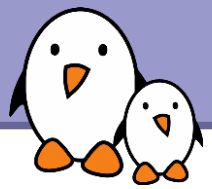
Exploring the target

- The prompt is now
  `[sbox-armdemo: ~] >`
- Inside the `armdemo` target, in your home directory
- Your target root filesystem is stored in `/targets/armdemo`
  - A set of symbolic links from `/` allows to think that you are actually running on the target
  - Some host tools, provided by Scratchbox, are still available
- The target root filesystem is empty. Let's ask to fill it with the C library, headers and basic /etc files
  `sb-conf install armdemo -c -e`
- Can also be done with `sb-menu`



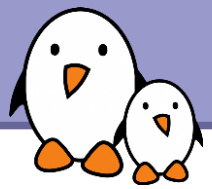
Using Scratchbox

- Test a simple program provided by Scratchbox
- Extract
```
tar xfz /scratchbox/packages/hello-world.tar.gz
```
- Configure and compile
```
cd hello-world
./autogen.sh
make
```
- Check that the program is compiled for ARM
```
file hello
hello: ELF 32 bit LSB executable, ARM [...]
```
- Run it: `./hello`



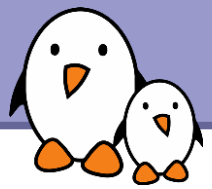
Using Scratchbox (2)

- Possible to cross-compile and install libraries in a transparent way
  - `./configure`
  - `make`
  - `make install`
- And then, to cross-compile programs using these libraries.
- Cross-compiling is a lot easier.



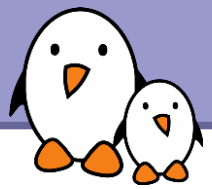
How Scratchbox works (1)

- The user is chrooted into `/scratchbox/users/<user>/`
- This directory looks like a regular root filesystem
  - Most directories are symbolic links to `target/links/<dir>`
  - These are again symbolic links to `target/<target>/<dir>`
  - They are switched when changing the target
  - The home directory in `/scratchbox/users/<user>/home/` is not target-specific
- Various host directories are remounted inside the target using the `--bind` option of `mount`: `/scratchbox, /tmp, /proc, /dev/, /dev/pts, /dev/shm, /sys`



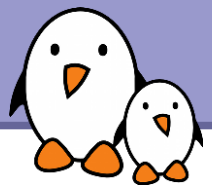
How Scratchbox works (2)

- Target root filesystem is stored in `/scratchbox/users/thomas/targets/<target>`
- Contains the filesystem hierarchy that should be used on the embedded devices
- Configuration file stored in `/scratchbox/users/thomas/targets/<target>.config`
  - Defines the architecture, CPU transparency method, cross-compiler, compiler and linker options, host compiler, host compiler options...
  - Many other variables can be defined to configure the target



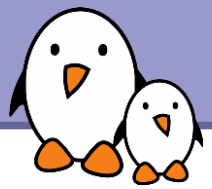
How Scratchbox works (3)

- Toolchain binaries are executed through a wrapper
- The `gcc` binary is a symlink to `sb_gcc_wrapper`, which runs the correct compiler depending on the target configuration.
- Build systems think that they are building natively.
- Outside of Scratchbox, the toolchain can be used in a normal way (`ARCH-linux-gcc`, etc.)



How Scratchbox works (4)

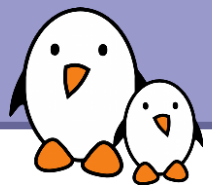
- Host tools take precedence over target binaries
- Host tools are hardwired to use libraries in `/scratchbox/host_shared/`
- `PATH` is set so that host binaries are used in preference over target binaries, but it is not enough for absolute paths.
- Scratchbox uses a technique called *binary redirection.*
- Using `LD_PRELOAD`, some libc functions are overriden
  - `exec()` and friends
  - `uname()` so that the target architecture is correctly returned.
  - etc.



How Scratchbox works (5)

CPU transparency

- Execute target binaries transparently on the host
- Uses the kernel `binfmt_misc` facility to run an interpreter when a target binary is run.
  - See `/proc/sys/fs/binfmt_misc/` for its configuration.
- The interpreter can then
  - Use qemu user emulation to run the binary
  - Use `sbrsh` to execute the binary directly on the target device using a network connection.

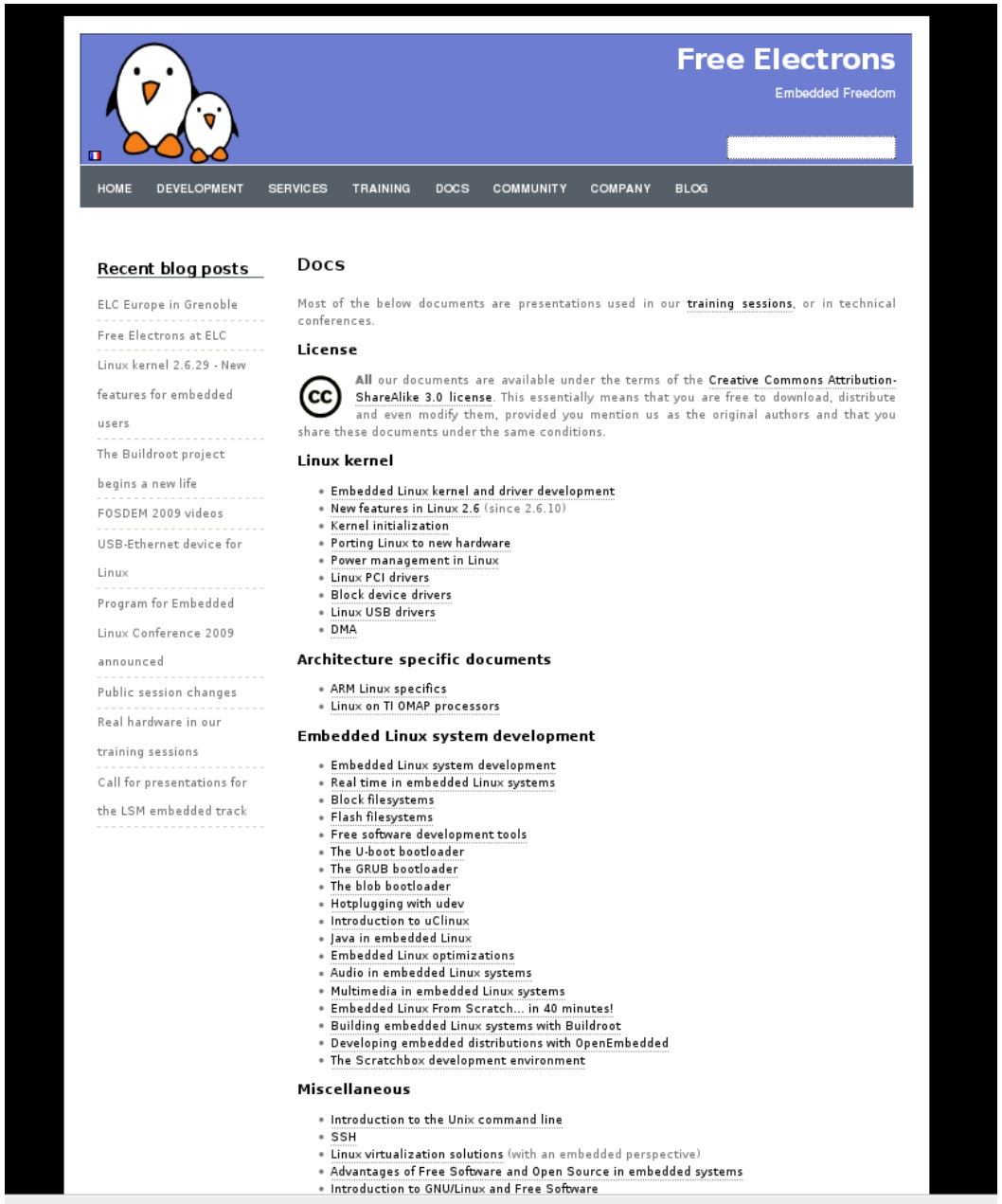


References

- Scratchbox
  http://www.scratchbox.org
- Scratchbox: Cross-compiling a Linux distribution
  http://www.embedded-kernel-track.org/2005/scratchbox-fosdem20

  FOSDEM 2005, Brussels
- Bringing Cross-Compiling to Debian
  http://nchipin.kos.to/debconf-sbox2.pdf
  Debconf 6, Mexico.

Related documents



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- Linux kernel
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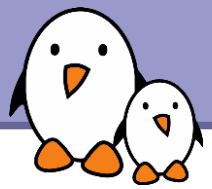

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