The U-boot bootloader

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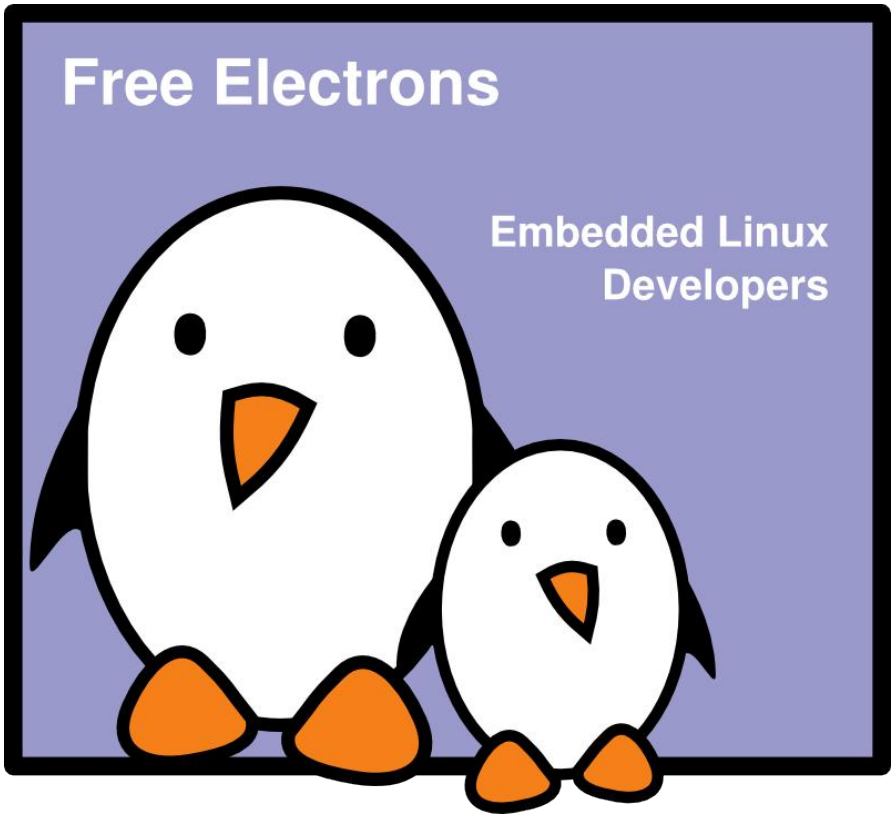
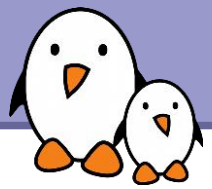


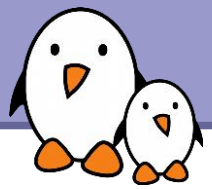
Latest update: Jan 19, 2011,
Document sources, updates and translations:
http://free-electrons.com/docs/u-boot
Corrections, suggestions, contributions and translations are welcome!



U-Boot

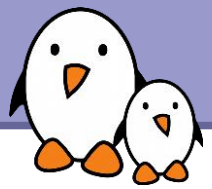
U-Boot is a typical free software project

- Freely available at http://www.denx.de/wiki/U-Boot
- Documentation available at http://www.denx.de/wiki/U-Boot/Documentation
- The latest development source code is available in a Git repository: http://git.denx.de/cgi-bin/gitweb.cgi?p=u-boot.git;a=summary
- Development and discussions happen around an open mailing-list http://lists.denx.de/pipermail/u-boot/
- Since the end of 2008, it follows a fixed-interval release schedule. Every two months, a new version is released. Versions are named YYYY.MM.



Compiling U-Boot (1)

- Get the source code from the website, and uncompress it
- The `include/configs/` directory contains one configuration file for each supported board
  - It defines the CPU type, the peripherals and their configuration, the memory mapping, the U-Boot features that should be compiled in, etc.
  - It is a simple .h file that sets pre-processor constants. See the `README` file for the documentation of these constants.
- Assuming that your board is already supported by U-Boot, there should be one file corresponding to your board, for example `include/configs/omap2420h4.h`.



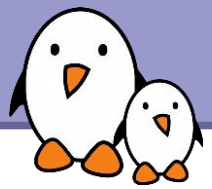
Compiling U-Boot (2)

- U-Boot must be configured before being compiled
  - `make BOARDNAME_config`
  - Where `BOARDNAME` is the name of the configuration file in `include/configs/`, without the `.h`
- Make sure that the cross-compiler is available in `PATH`

```
export PATH=/usr/local/uclibc-0.9.29-2/arm/bin/:$PATH
```

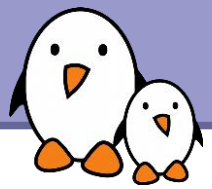
- Compile U-Boot, by specifying the cross-compiler prefix. Example, if your cross-compiler executable is `arm-linux-gcc`:

```
make CROSS_COMPILE=arm-linux-
```



Installing U-Boot

- U-Boot must usually be installed in flash memory to be executed by the hardware. Depending on the hardware, the installation of U-Boot is done in a different way:
  - The board provides some kind of specific boot monitor, which allows to flash the second stage bootloader. In this case, refer to the board documentation and tools
  - U-Boot is already installed, and can be used to flash a new version of U-Boot. However, be careful: if the new version of U-Boot doesn't work, the board is unusable
  - The board provides a JTAG interface, which allows to write to the flash memory remotely, without any system running on the board. It also allows to rescue a board if the bootloader doesn't work.

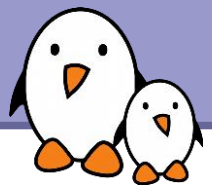


U-boot prompt

- Connect the target to the host through a serial console
- Power-up the board. On the serial console, you will see something like:

```
U-Boot 1.1.2 (Aug  3 2004 - 17:31:20)
RAM Configuration:
Bank #0: 00000000  8 MB
Flash:  2 MB
In:    serial
Out:   serial
Err:   serial
u-boot #
```

- The U-Boot shell offers a set of commands. We will study the most important ones, see the documentation for a complete reference or the `help` command.



Information commands

Flash information

```
U-Boot> flinfo
DataFlash:AT45DB021
Nb pages:   1024
Page Size:    264
Size=  270336 bytes
Logical address: 0xC0000000
Area 0: C0000000 to C0001FFF (RO) Bootstrap
Area 1: C0002000 to C0003FFF      Environment
Area 2: C0004000 to C0041FFF (RO) U-Boot
```

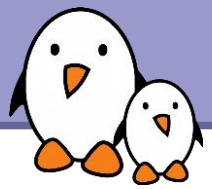
NAND flash information

```
U-Boot> nand info
Device 0: NAND 256MiB 3,3V 8-bit, sector size 128 KiB
```

U-Boot information

```
U-Boot> version
U-Boot 2009.08 (Nov 15 2009 - 14:48:35)
```

Can vary from one board to the other
(according to the U-Boot compile configuration)



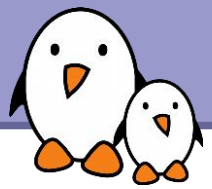
Environment variables (1)

- U-Boot can be configured through environment variables, which affect the behavior of the different commands.
- See the documentation for the complete list of environment variables.
- The `printenv` command also to display all variables or one :

```
u-boot # printenv
baudrate=19200
ethaddr=00:40:95:36:35:33
netmask=255.255.255.0
ipaddr=10.0.0.11
serverip=10.0.0.1
stdin=serial
stdout=serial
stderr=serial

u-boot # printenv serverip
serverip=10.0.0.2
```

Network configuration



Environment variables (2)

- The value of the environment variables can be changed using the `setenv` command :

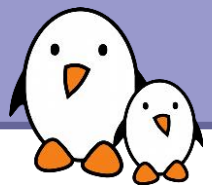
```
u-boot # setenv serverip 10.0.0.2
```

- Environment variable changes can be stored to flash using the `saveenv` command. The location in flash is defined at compile time in the U-Boot configuration file.
- You can even create small scripts stored in environment variables:

```
setenv mmc-boot 'mmc init 0; if fatload mmc 0
80000000 boot.ini; then source; else if
fatload mmc 0 80000000 uImage; then run mmc-
bootargs; bootm; fi; fi'
```

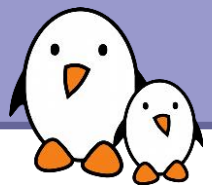
- You can then execute the script:

```
run mmc-boot
```



Transferring files to the target

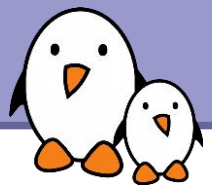
- U-Boot is mostly used to load and boot a kernel image, but it also allows to change the kernel image and the root filesystem stored in flash.
- Files must be exchanged between the target and the development workstation. This is possible :
  - Through the network if the target has an Ethernet connection, and U-Boot contains a driver for the Ethernet chip. If so, the TFTP protocol can be used to exchange files
  - Through the serial line if no Ethernet connection is available.



Configuring and testing tftp

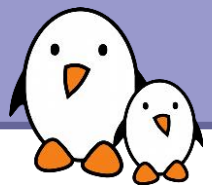
On GNU/Linux systems based on Debian: Ubuntu, Knoppix

- Install the `tftpd-hpa` package (tftp server):
  ```
  apt-get install tftpd-hpa
  ```
- Copy files to the root directory of the tftp server. Example:
  ```
  cp arch/arm/boot/uImage /var/lib/tftpboot
  ```
- To test the server, install a tftp client on your workstation:
  ```
  apt-get install tftp-hpa
  ```
- Use it to download a file (`-4` to force the use of IPv4)
  ```
  tftp -4 localhost
  > get uImage
  ```



U-boot mkimage

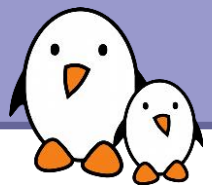
- The kernel image that U-Boot loads and boots must be prepared, so that an U-Boot specific header is added in front of the image
- This is done with a tool that comes in U-Boot, `mkimage`
- Debian / Ubuntu: just install the `uboot-mkimage` package.
- Or, compile it by yourself: simply configure U-Boot for any board of any architecture and compile it. Then install `mkimage`:
  `cp tools/mkimage /usr/local/bin/`
- The special target `uImage` of the kernel Makefile can then be used to generate a kernel image suitable for U-Boot.



Flashing a kernel image

- Compile your kernel and generate the U-Boot header running `make uImage`
- Copy the kernel image to the directory exported by the TFTP server
- On the board, in U-Boot, download the kernel image to memory :
  ```
  u-boot # tftp 8000 uImage
  ```
- Unprotect NOR flash
  ```
  u-boot # protect off 1:0-4
  ```
- Erase NOR flash
  ```
  u-boot # erase 1:0-4
  ```
- Copy to NOR flash (`0x01000000`: first sector)
  ```
  u-boot # cp.b ${fileaddr} 1000000 ${filesize}
  ```
- Restore NOR flash sector protection:
  ```
  u-boot # protect on 1:0-4
  ```

See our practical labs for details handling NAND flash.



boot commands

- Specify kernel boot parameters:

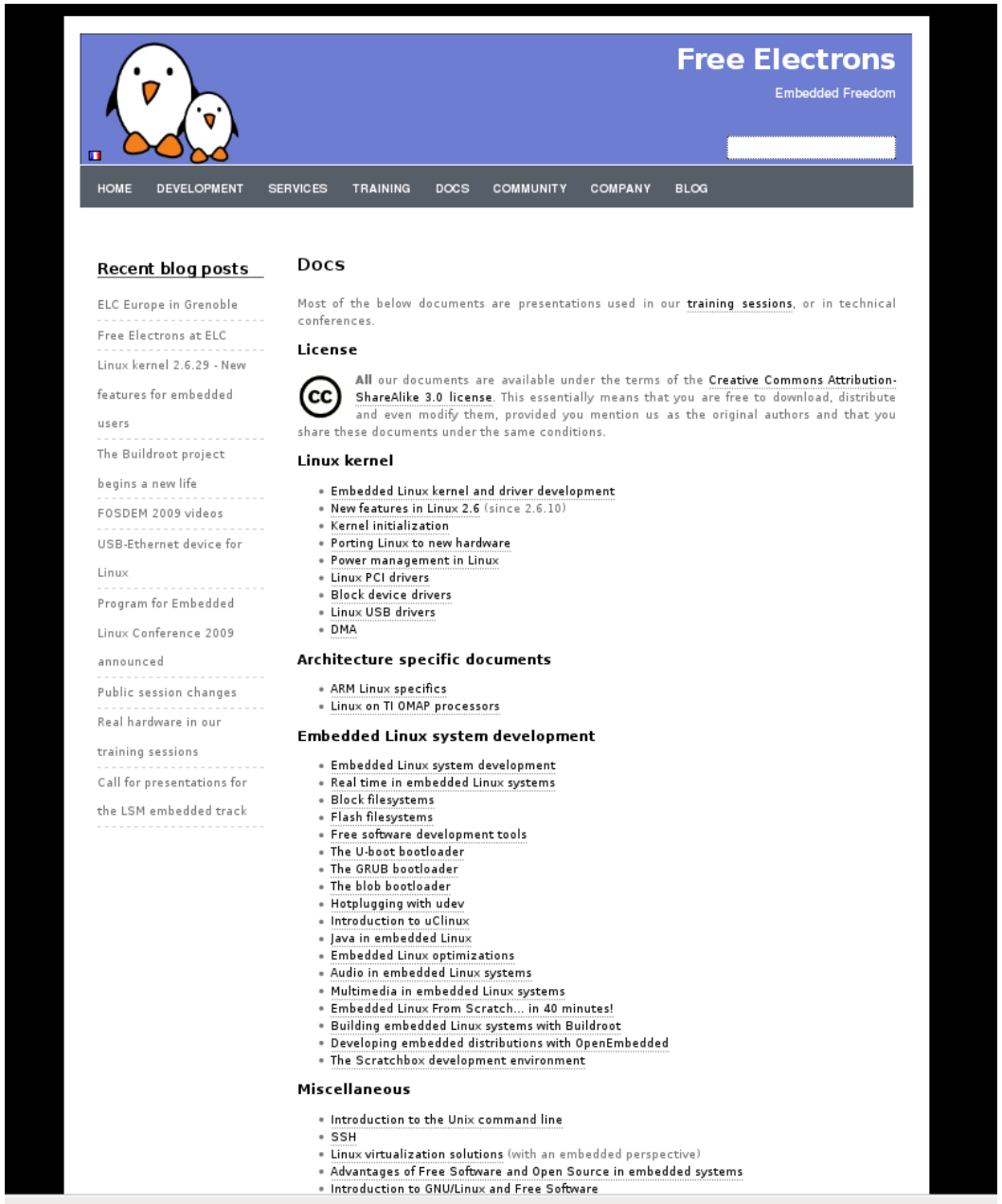
```
u-boot # setenv bootargs mem=64M \
console=ttyS0,115200 init=/sbin/init \
root=/dev/mtdblock0
```

Continues on the same line

- Execute the kernel from a given physical address (RAM or flash):

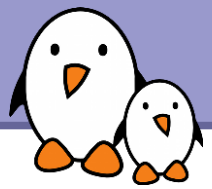
```
bootm 0x01030000
```

Related documents



All our technical presentations on http://free-electrons.com/docs

- Linux kernel
- Device drivers
- Architecture specifics
- Embedded Linux system development



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