The U-boot bootloader

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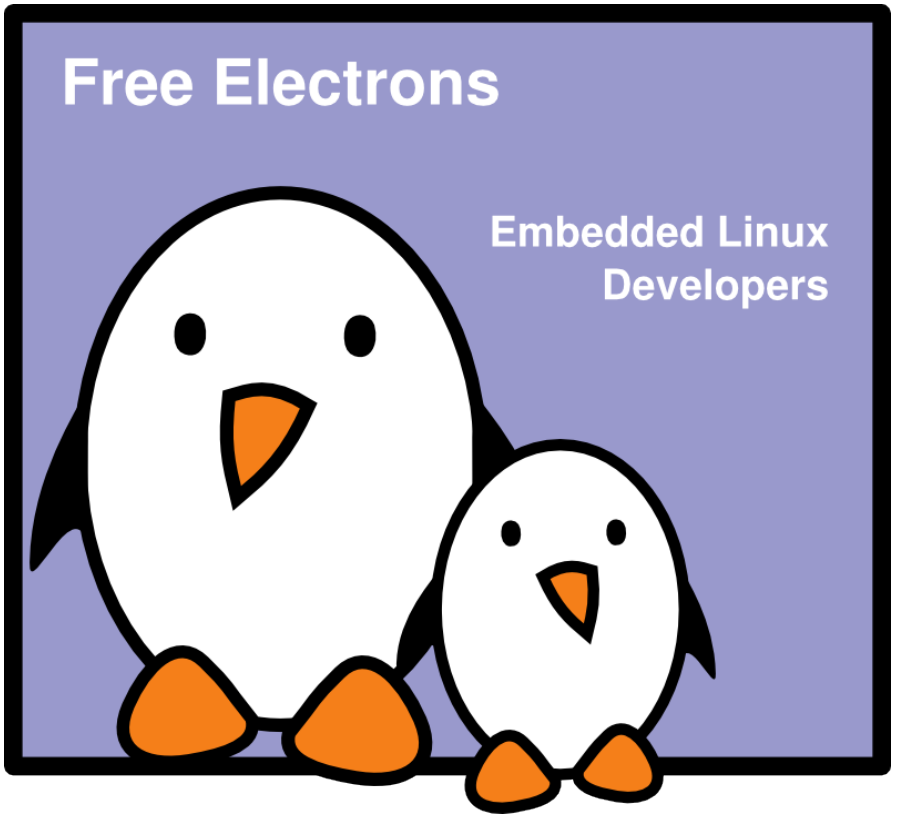

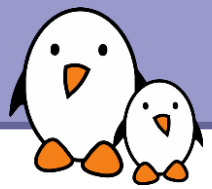

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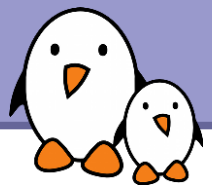
Document sources, updates and translations:
http://free-electrons.com/docs/u-boot

Corrections, suggestions, contributions and translations are welcome!

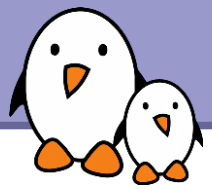
Latest update: Feb 3, 2009



Das U-boot

http://www.denx.de/wiki/UBoot/WebHome

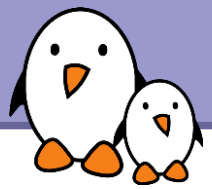
- Das U-Boot: Universal Bootloader from Denx Software
- The most used on `arm`.
- Supports: `arm`, `ppc`, `mips`, `x86`, `m68k`, `nios`...
- See our U-boot presentation for details:
  http://free-electrons.com/docs/u-boot
- Easy to port to new boards.
  See our BSP presentation for porting details:
  http://free-electrons.com/docs/bsp



Postprocessing kernel image for U-boot

The U-boot bootloader needs extra information to be added to the kernel and initrd image files.

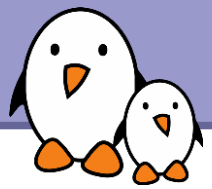
- `mkimage` postprocessing utility provided in U-boot sources
- Kernel image postprocessing:
  `make uImage`



Postprocessing initrd image for U-boot

```
mkimage
  -n initrd \                    Name
  -A arm \                       Architecture
  -O linux \                     Operating System
  -T ramdisk \                   Type
  -C gzip \                      Compression
  -d rd-ext2.gz \                Input file
  uInitrd                        Output file
```

Note: this applies to initramfs images in the same way. Bootloaders don't see the difference between initrds and initramfs.



Compiling Das U-boot

- Get the U-boot sources from http://www.denx.de/wiki/UBoot
- In the U-boot source directory:
  Find the name of the config file for your board in `include/configs`
  (for example: `omap1710h3.h`)
- Configure U-boot:
  `make omap1710h3_config` (`.h` replaced by `_config`)
- If needed, change the cross-compiler prefix in `Makefile`:

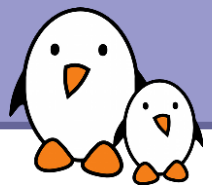
```
ifeq ($(ARCH),arm)
CROSS_COMPILE = arm-linux-
endif
```

- Specify the path to your cross-compiler. For example:

```
export PATH=/usr/local/uclibc-0.9.28-2/arm/bin:$PATH
```

- Compile:

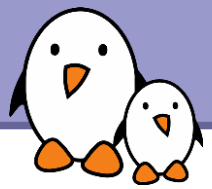
```
make
```



Compiling U-boot mkimage

If you just need `mkimage`
and U-boot is already installed on your board:

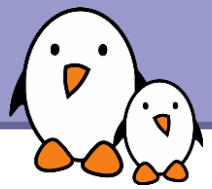
- `mkimage` is completely architecture and board independent.
- Configure U-boot sources for any board on any architecture (see previous slide).
- Compile:
  `make` (or `make -k` if you have minor failures)
- Install `mkimage`:
  `cp tools/mkimage /usr/local/bin/`



Configuring tftp (1)

Often in development: downloading a kernel image from the network. Instructions for xinetd based systems (Fedora Core, Red Hat...)

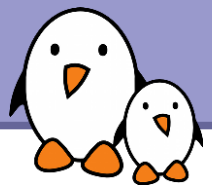
- Install the `tftp-server` package if needed
- Remove `disable = yes` in `/etc/xinetd.d/tftp`
- Copy your image files to the `/tftpboot/` directory (or to the location specified in `/etc/xinetd.d/tftp`)
- You may have to disable SELinux in `/etc/selinux/config`
- Restart xinetd:
  `/etc/init.d/xinetd restart`



Configuring tftp (2)

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

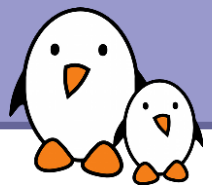
- Install the `tftpd-hpa` package if needed
- Set `RUN_DAEMON="yes"`
  in `/etc/default/tftpd-hpa`
- Copy your images to `/var/lib/tftpboot`
- `/etc/hosts.allow`:
  Replace `ALL : ALL@ALL : DENY` by `ALL : ALL@ALL : ALLOW`
- `/etc/hosts.deny`:
  Comment out `ALL: PARANOID`
- Restart the server:
  `/etc/init.d/tftpd-hpa restart`



U-boot prompt

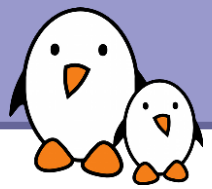
- Connect the target to the host through a serial console
- Power-up the board.
  On the serial console, you will see something like:

```
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 #
```



Board information

```
u-boot # bdinfo
DRAM bank = 0x00000000
-> start = 0x00000000
-> size = 0x00800000
ethaddr = 00:40:95:36:35:33
ip_addr = 10.0.0.11
baudrate = 19200 bps
```



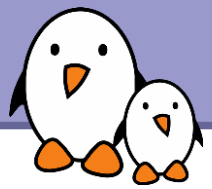
Environment variables (1)

```
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 # setenv serverip 10.0.0.2

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

Network settings for TFTP and NFS



Environment variables (2)

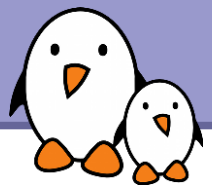
- Environment variable changes can be stored to flash using the `saveenv` command.
- You can even create small shell scripts stored in environment variables:

```
setenv myscript 'tftp 0x21400000 uImage ;
bootm 0x21400000'
```

- You can then execute the script:

```
run myscript
```

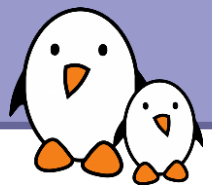
- More elaborate scripting is available with script files, to be processed with `mkimage`.



Network commands

```
u-boot # tftp 8000 u-boot.bin
From server 10.0.0.1; our IP address is
10.0.0.11
Filename 'u-boot.bin'.
Load address: 0x8000
Loading: ####################
done
Bytes transferred = 95032 (17338 hex)
```

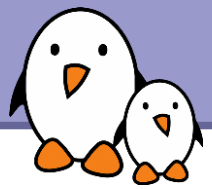
The address and size of the downloaded file are stored in the `fileaddr` and `filesize` environment variables.



Flash commands (1)

```
u-boot # flinfo
Bank # 1: AMD Am29LV160DB 16KB,2x8KB,32KB,31x64KB
Size: 2048 KB in 35 Sectors
Sector Start Addresses:
S00 @ 0x01000000 ! S01 @ 0x01004000 !
S02 @ 0x01006000 ! S03 @ 0x01008000 !
S04 @ 0x01010000 ! S05 @ 0x01020000 !
S06 @ 0x01030000 S07 @ 0x01040000
...
S32 @ 0x011D0000 S33 @ 0x011E0000
S34 @ 0x011F0000
```

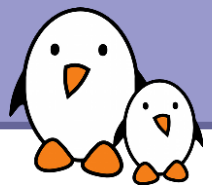
Protected sectors



Flash commands (2)

```
u-boot # protect off 1:0-4
Un-Protect Flash Sectors 0-4 in Bank # 1

u-boot # erase 1:0-4
Erase Flash Sectors 0-4 in Bank # 1
Erasing Sector 0 @ 0x01000000 ... done
Erasing Sector 1 @ 0x01004000 ... done
Erasing Sector 2 @ 0x01006000 ... done
Erasing Sector 3 @ 0x01008000 ... done
Erasing Sector 4 @ 0x01010000 ... done
```



Flash commands (3)

Storing a file in flash

- Downloading from the network:

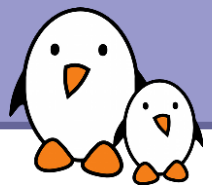
```
u-boot # tftp 8000 u-boot.bin
```

- Copy to flash (`0x01000000`: first sector)

```
u-boot # cp.b ${fileaddr} 1000000 ${filesize}
Copy to Flash... ............... done
```

- Restore flash sector protection:

```
u-boot # protect on 1:0-4
Protect Flash Sectors 0-5 in Bank # 1
```



boot commands

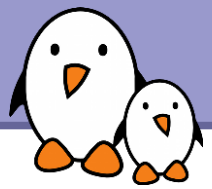
- Specify kernel boot parameters:

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

Continues on the same line

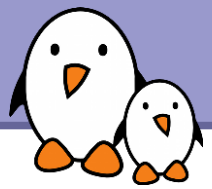
- Execute the kernel from a given physical address (RAM or flash):

```
bootm 0x01030000
```



Useful links

- U-boot home page:
  http://www.denx.de/wiki/UBoot/WebHome
- Very nice overview about U-boot
  (which helped to create this section):
  http://linuxdevices.com/articles/AT5085702347.html
- The U-boot manual:
  http://www.denx.de/wiki/view/DULG/UBoot



Related documents

All the technical presentations and training materials created and used by Free Electrons, available under a free documentation license (more than 1500 pages!).

http://free-electrons.com/training

- Introduction to Unix and GNU/Linux
- Embedded Linux kernel and driver development
- Free Software tools for embedded Linux systems
- Audio in embedded Linux systems
- Multimedia in embedded Linux systems

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- Advantages of Free Software in embedded systems
- Embedded Linux optimizations
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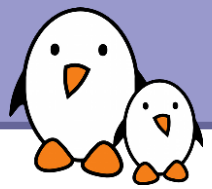
- How to port Linux on a new PDA



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