Linux on TI OMAP™ processors

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Two technical solutions

You are free to choose between 2 paths

▶ Commercial solution
Sources, tools and support from MontaVista Software.

▶ Community solution
Sources, tools and support from the Linux developer and user community.

Whatever the way, the advantages are the same: your embedded system is fully based on Free Software, royalty-free and you are fully in control.

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Commercial solution

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Montavista

http://www.mvista.com/

The market leader

- Employs some of the most active kernel hackers, in particular on the `arm` platform

- All kernel development shared with the community kernel core and drivers (Linux 2.6 example: preemption option, many drivers...)

- Graphical development tools are proprietary

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MontaVista Linux OMAP support

Follow the MontaVista Software for OMAP Processors
link on http://linux.omap.com

- ▶ Full solution supporting major OMAP platforms and boards:
  kernel (with optimizations and advanced features), toolchains, root
  filesystems, proprietary graphical development and profiling tools.

- ▶ Commitment for long-term technical support and updates.

- ▶ Great for companies without sufficient in-house Linux expertise,
  focusing on the added value of their system.
  Good for embedded systems with long life on the market.

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MontaVista Linux supported boards

Found on http://mvista.com/boards.php (Apr 2007)

Texas Instruments	OMAP1510 Innovator Development Kit	ARM	ARM925	CEE 3.0
Texas Instruments	OMAP1510/5910 Innovator Development Kit	ARM	OMAP5910 (ARM925EJ-S)	PRO 3.1
Texas Instruments	OMAP1610 GSM/GPRS SDP	ARM	ARM926EJS	CEE 3.1
Texas Instruments	OMAP1611 GSM/GPRS SDP	ARM	ARM926EJS	CEE 3.1
Texas Instruments	OMAP1710 H3	ARM	ARM926EJS	Mobilinux 4.0
Texas Instruments	OMAP2420 GSM/GPRS SDP	ARM	ARM1136	CEE 3.1
Texas Instruments	OMAP2430	arm	2430	CEE 3.1
Texas Instruments	OMAP2430	arm	OMAP2430	Mobilinux 4.1
Texas Instruments	OMAP5912 OSK Software Development Board	ARM	OMAP5912 (ARM926EJ-S)	PRO 4.0
Texas Instruments	OMAP5912 OSK Software Development Board	ARM	OMAP5912 (ARM926EJ-S)	PRO 3.1
Texas Instruments	OMAP730 GSM/GPRS SDP	ARM	ARM926EJS	CEE 3.1

CEE: Consumer Electronics Edition
Targets consumer electronics devices

PRO: Professional Edition
Real-time, multi-process, many applications.

Mobilinux: targets mobile devices
Power management, hard real-time performance, fast start-up, and small footprint.

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Community solutions

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OMAP Linux community

http://linux.omap.com
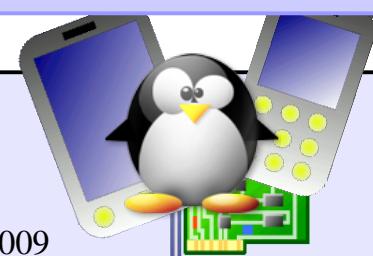
▶ The main welcome page for Linux developers on OMAP
Mailing lists, sample code, documentation, and other resources.

▶ OMAP Linux community downloads
http://linux.omap.com/pub/

```
bootloader/        U-boot binaries and sources (board specific)
documentation/     Misc documentation
filesystem/        Ramdisks and root filesystems (shared by all boards)
kernel/            Kernel images and config files (board specific), sources
patches/           Available kernel source patches (including unofficial ones)
toolchain/         arm-linux toolchain (generic)
xloader/           Used to boot from Nand flash
```

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Useful mailing lists

▶ **Linux ARM** mailing lists
Should be used whenever the topic is not OMAP specific
http://lists.infradead.org/mailman/listinfo/linux-arm-kernel:
Linux kernel and drivers
http://lists.infradead.org/mailman/listinfo/linux-arm:
Linux userspace libraries and tools
http://lists.infradead.org/mailman/listinfo/linux-arm-toolchain:
Using or building cross-compiling toolchains

▶ **linux.omap.com** mailing lists
http://linux.omap.com/mailman/listinfo
Linux-omap-open-source: Linux OMAP community mailing list.

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Configuring and compiling the kernel

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Getting kernel sources for OMAP (1)

Mainstream Linux kernel releases
ftp://ftp.kernel.org/pub/linux/kernel/v2.6/

▶ Supported OMAP cores (Linux 2.6.15 status)
730, 1510, 16XX, 5912, 24XX

▶ Supported boards (Linux 2.6.15 status)
Innovator, H2, H3, H4, OSK and other OMAP based devices

See `arch/arm/mach-omap*/Kconfig` for details.

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Getting kernel sources for OMAP (2)

OMAP Linux community kernel releases

▶ Official source for the latest kernel patches:
http://www.muru.com/linux/omap/

▶ Caution: http://linux.omap.com/pub/kernel/ no longer updated.
Better use the above or use mainstream sources!

```
System.map                            16-Dec-2004 15:29   603K
config                                16-Dec-2004 15:29    20K
source/                               16-Dec-2004 19:31     -
uImage-2.6.9                          16-Dec-2004 13:40   1.1M
updated_code_for_USB_DMA_4_14_05.zip  15-Apr-2005 12:26    60K
vmlinux                               16-Dec-2004 15:29    19M
```

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OMAP Linux development tree (1)

OMAP Linux kernel sources now managed with git

▶ See http://free-electrons.com/training/drivers for details about installing git and accessing git trees

▶ Get a copy of the OMAP Linux git tree:

```
cg-clone rsync://source.mvista.com/git/linux-omap-2.6.git
cg-clone rsync://source.mvista.com/git/linux-omap-2.6.git
```
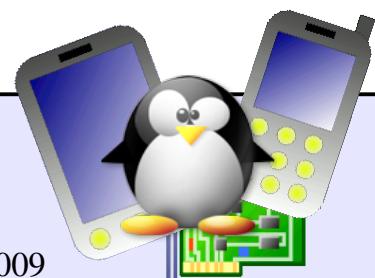
You can also read:

http://muru.com/linux/omap/README_OMAP_GIT

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OMAP Linux development tree (2)

▶ Viewing individual files in the development tree:
http://source.mvista.com/git/gitweb.cgi?p=linux-omap-2.6.git;a=tree

▶ Viewing the latest changes:
http://source.mvista.com/git/gitweb.cgi?p=linux-omap-2.6.git;a=log

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Cross-compiling toolchain

▶ Most people use regular `arm` toolchains

▶ See our http://free-electrons.com/training/devtools document for details about ready-to-use toolchains or how to build your own.

▶ Before compiling, you have to add the toolchain binary directory to your `PATH` environment variable.

▶ Example:
`export PATH=/usr/local/uclic-0.9.28/arm/bin:$PATH`

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Makefile setup

▶ You must set the `arm` architecture and the cross compiler prefix in the `Makefile` file before configuring and compiling the kernel.

▶ Example:
```
ARCH                ?= arm
CROSS_COMPILE    ?= arm-linux-
```

▶ See http://free-electrons.com/training/drivers for full details about configuring, compiling and booting the Linux kernel.

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Configuring and compiling the kernel

▶ First, check for a default config file for your board in
`arch/arm/configs/`
Example: `omap_h4_2420_defconfig`

▶ Configure your kernel with it:
`make omap_h4_2420_defconfig`

▶ Add your own settings:
`make xconfig` or `make menuconfig`

▶ Compile your kernel:
`make`

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Booting the kernel with das U-boot

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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`

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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
```

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Compiling U-boot mkimage

If you don't have `mkimage` yet

▶ Get the U-boot sources from
http://linux.omap.com/pub/bootloader/h3/source/u-boot.tar.gz

▶ In the U-boot source directory:
Find the name of the config file for your board in
`include/configs` (for example: `omap1710h3.h`)
`make omap1710h3_config` (`.h` replaced by `_config`)
`make` (or `make -k` if you have minor failures)
`cp tools/mkimage /usr/local/bin/`

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Configuring tftp (1)

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`

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On systems like Debian (or Knoppix) GNU/Linux

▶ 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`

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DSP software

Needed to take full advantage of the DSP side of the OMAP processors!

▶ TI Linux DSP tools
Proprietary tools licensed to Spectrum Digital OSK5912 customers
Should also be found on http://www.dspvillage.com/

▶ http://dspgateway.sourceforge.net
Linux driver and DSP side libraries. Also include demos!
100% Free Software released by Nokia!
Supported Linux versions: 2.6 (most recent) and 2.4 (only old releases)
Supported processors: OMAP1510/1610 and their derivative devices
(including 1611/1612, 1710, 5910, 5912 etc.)

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OMAP Starter Kit (OSK) resources

▶ OMAP5912 Starter Kit reference - Can be purchased for $295!
http://free-electrons.com/redirect/osk5912.html

▶ OSK for Dummies - Useful howto, guidelines, resources and links
http://oskfordummies.hp.infoseek.co.jp/

▶ OSK page at CE Linux Forum - Useful resources, links and downloads
http://tree.celinuxforum.org/CelfPubWiki/OSK

▶ OMAP development tools - Useful resources and links
http://omap.spectrumdigital.com/osk5912/

Some resources can be useful for other OMAP platforms!

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Useful links

▶ Devices running Linux on OMAP
http://www.muru.com/linux/omap/devices/

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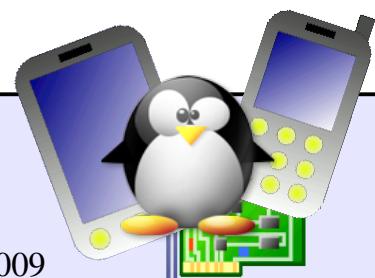
Training labs

Training labs are also available from the same location:
http://free-electrons.com/articles/omap

They are based on OMAP2420 H4 boards, but should also be useful to people with other OMAP development boards.

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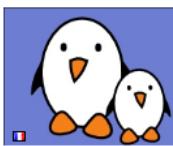
Thanks

▶ To the OpenOffice.org project, for their presentation and word processor tools which satisfied all my needs.

▶ To the Handhelds.org community, for giving me so much help and so many opportunities to help.

▶ To the members of the whole Free Software and Open Source community, for sharing the best of themselves: their work, their knowledge, their friendship.

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

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Linux kernel

Linux device drivers
Board support code
Mainstreaming kernel code
Kernel debugging

Embedded Linux Training

All materials released with a free license!

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Lightweight tools for embedded systems
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