IT'S ALIVE!

Linux on PowerPC Porting Guide

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What it takes to boot Linux

- **Firmware**
  - reset
  - Setup Hardware
  - Load Images

- **Kernel**
  - Start Kernel
  - Probe Drivers
  - Mount Root Filesystem

- Userspace
  - init

- **Kernel**
  - Ramdisk

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**Some Questions**

- Where is the console?
- What drivers need to be probed?
- How is data passed from firmware to the kernel?
What needs to be prepared

- Firmware Image
- Executed on reset
- Kernel Image (uImage for U-Boot)
- Flattened Device Tree Blob (DTB)
- Root Filesystem
  Could be anywhere: NFS, ramdisk, Flash, USB, etc
Toolchain

ELDK
Crosstool-ng
PowerPC distros: Fedora, Debian, etc
Just a few of the options!
Concerning U-Boot

- git://git.denx.de/u-boot
- Files to add/modify
  - Makefile
  - boards/<boardname>/*
  - include/configs/<boardname>.h
- Clone an existing board port
Building U-Boot

```bash
~$ git clone git://git.denx.de/u-boot
~$ cd u-boot
~/u-boot$ [... add your board support! ...]
~/u-boot$ export PATH=/home/opt/eldk-4.1/bin:/home/opt/eldk-4.1/usr/bin:$PATH
~/u-boot$ export CROSS_COMPILE=ppc_4xx-
~/u-boot$ export ARCH=powerpc
~/u-boot$ make clobber
~/u-boot$ make ml507_elc2009_config # <==== Configure for your board
~/u-boot$ make
       [... Make does lots of stuff ...]
~/u-boot$ cp u-boot /path/to/install/directory # ELF image
~/u-boot$ cp u-boot.bin /path/to/install/directory # Binary image
```
Concerning the kernel...

- What files to add/change?

  (Nothing to see here!)

- Instead Flattened Device Tree (fdt) describes hardware.
The OF Device Tree

- Describes the hardware
- Originally from Open Firmware
Building the Kernel and DTB image

```bash
~$ git clone git://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux-2.6.git
~$ cd linux-2.6
~/linux-2.6$ [... add your board support! ...]
~/linux-2.6$ export PATH=/home/opt/eldk-4.1/bin:/home/opt/eldk-4.1/usr/bin:$PATH
~/linux-2.6$ export CROSS_COMPILE=ppc_4xx-
~/linux-2.6$ export ARCH=powerpc
~/linux-2.6$ make mrproper
~/linux-2.6$ make 44x/virtex5_defconfig   # <==== Configure the kernel
~/linux-2.6$ make menuconfig
       [... add/remove features ...]
       [... add "virtex440-ml507-elc2009.dtb" to CONFIG_EXTRA_TARGETS ...]
~/linux-2.6$ make
       [... Make does lots of stuff ...]
~/linux-2.6$ cp arch/powerpc/boot/uImage /path/to/install/directory
~/linux-2.6$ cp arch/powerpc/boot/*/dtb /path/to/install/directory
```
Concerning the root filesystem...

- Options:
  - Roll your own
  - Use a Tool
    - Buildroot, LTIB, PTXdist, Gentoo Embedded, Open Embedded, etc.
  - Use a Distribution:
    - Debian, Ubuntu, Red Hat, etc.
    - MontaVista, ELDK, etc.
Concerning Device Drivers...

- Core devices attached to processor
  - Local bus attached
  - Board description
  - Do I use `platform_bus`? ... Use `of_platform_bus`!
- Does probing work?
  - PCI, USB
    - Existing drivers correctly probed.
- Is probing broken/unreliable/none-existent?
  - MDIO, I2C, SPI
    - Helper functions in `drivers/of/*` to populate bus
Demo time...
Demo time...
Additional Resources:

U-Boot

- http://www.denx.de/wiki/U-Boot
- u-boot@lists.denx.de mailing list

Kernel

- linuxppc-dev@ozlabs.org mailing list

Device Tree

- IEEE1275-1994 (OpenFirmware) Specs
  - http://www.complang.tuwien.ac.at/forth/1275.ps.gz
- linux-2.6/Documentation/powerpc/booting-without-of.txt
  - Also see linux-2.6/Documentation/powerpc/dts-bindings/*
- devicetree-discuss@ozlabs.org mailing list

Root Filesystem

- Thomas Petazzoni’s Buildroot talk, Osaka Room, 4:40 (right now!)
- Klass van Gend’s BitBake talk, Yesterday, watch video online
- Thomas Petazzoni’s Build tools BoF, Osaka Room, Wednesday 1:00
Acknowledgements

• IBM, Xilinx and Freescale who provide cool platforms to hack on
• CELinux Forum for giving me the opportunity to talk
• Far too many Linux developers to mention
Goals:
- Step through the porting process
- Give overview of the structure
- How to find additional information
- Where to get help

This will be a informal talk. Please ask questions, ask for clarification if anything doesn't make sense. I've got lots of technical details that I can talk about, more than enough to fill this hour, so if there is any aspect that you're interested in please let me know.

I'm going to start with a high level overview of the porting process and then drill down into the technical details. I'm also going to show off a 'canned' demo of porting Linux to a new PowerPC platform.
Very flexible
- Linux doesn't care how it is loaded into RAM
- doesn't care about rootfs location
What needs to be prepared

- Firmware Image
  Executed on reset
- Kernel Image
  (uImage for U-Boot)
- Flattened Device Tree Blob
  (DTB)

Root Filesystem
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What I have here is an ML507 board from Xilinx. If you were in Dr. John William's talk yesterday you will already know a little bit about FPGAs.

In this case, I'm not actually interested in demonstrating FPGA technologies, but it happens to be a convenient platform. I've got a sample bitstream on this CF card turns this board into a PowerPC platform with a serial port, an Ethernet port and some other devices.
Demo time...
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