OpenEZX, how to free Motorola Linux Smartphones

Stefan Schmidt
stefan@datenfreihafen.org

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Outline

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Summarize

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stefan@
datenfreihafen.
org

Introduction

- ▶ Motorola sells Linux smartphones in Asia for quite some time
- ▶ They start selling the A780 in Europe end of 2005. Unfortunately they stopped it again in 2006
- ▶ October 2005 Harald Welte started the OpenEZX project
- ▶ The reason for calling the project OpenEZX is the internal Motorola name EZX. No idea what it stands for. If somebody knows, tell me. :-)
- ▶ Currently there are more then 10 different EZX devices
- ▶ The main work is still done on the old A780/E680

Pictures

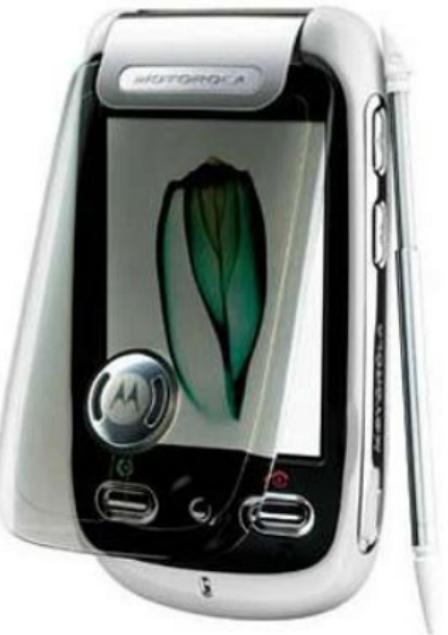Figure: E680

Figure: A780

Pictures

Figure: ROKR E2

Figure: A1200

Core components

- ▶ Quad Band GSM
- ▶ GPRS, sometimes EDGE but no UMTS
- ▶ Intel Xscale (PXA271) for the application CPU
- ▶ GSM/Baseband CPU Neptun LTE
- ▶ MicroSD or SD card slot
- ▶ Bluetooth
- ▶ 320x240 LCD with touchscreen
- ▶ Camera
- ▶ FM-Radio (E680, ROKR E2)
- ▶ GPS (European A780)
- ▶ Wlan (A910)
- ▶ Enhanced Mini USB

Enhanced Mini USB (EMU)

▶ Mini USB plug
▶ The EMU can be changed between different modes:
  ▶ USB device port
  ▶ USB host port
  ▶ Serial port
  ▶ Stereo audio signal
  ▶ 500mA charger
  ▶ Carkit

Motorola and the GPL

- ▶ No GPL license or source in the shipping box
- ▶ The guys from motorolafans requested the first kernel code
- ▶ Bootloader code followed
- ▶ http://opensource.motorola.com/ was started as a place to store the code
- ▶ For A1200, ROKR E2 and A910 they started releases for more than one firmware release
- ▶ Still buggy kernel trees

Motorola and the community

- ▶ Only contact about getting GPL compliant
- ▶ No contact to developers or engineers
- ▶ No submission of patches
- ▶ No documentation
- ▶ No SDK for native Linux applications
- ▶ It's a pity. :-(
- ▶ Anyone at Motorola interested in community efforts should drop me a line

Free software

- ▶ 2.4.20 based kernel with many modifications from Montavista and Motorola
    - ▶ EZX ARM subarchitecture
    - ▶ Touchscreen
    - ▶ Button
    - ▶ Backlight
    - ▶ SD / MMC / Transflash
    - ▶ mux_cli
    - ▶ GPRS
    - ▶ Bootloader
    - ▶ gcc and glibc
    - ▶ Userspace tools like modutils and findutils
- ▶ Glibc system including a samba server instead of uclibc and busybox

Closed software

- ▶ The GUI is based on Qt Embedded. Motorola added own EZX libraries
- ▶ PDA, PIM and dialer functions
- ▶ Opera webbrowser
- ▶ Real media player
- ▶ CoPilot navigation software
- ▶ Java VM

OpenEZX goals

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org

- ▶ The goal is a complete free software stack on the application CPU
- ▶ Linux kernel with complete hardware support
- ▶ Cellphone suited GUI
- ▶ Firmware updates
- ▶ Documentation of the hardware

Exploring the system

- ▶ The default firmware ships with a undocumented usbnet mode
- ▶ It allows a telnet root login without password
- ▶ Helps a lot to understand the system
- ▶ Much bloat in applications, database, etc.
- ▶ Even a samba server is running

First own code

- For fast development cycle an easy kernel test method is needed
- Bootloader based on Blob (GPL)
- After some hassle code is available
- With this code as reference Harald Welte wrote boot_usb
- Load zImage from host over usb into phone RAM and execute it
- Unfortunately phone stays in flash mode and no interaction with BP is possible

First own kernel

- ▶ The released kernel code needed some fixes
- ▶ After the 2.4 kernel was running Harald started porting it over to 2.6
- ▶ The core platform is mostly ported
- ▶ Many chips can be used with the already in-tree kernel driver
- ▶ The mux_cli driver gives us a harder fight

2.6 mux_cli driver

- ▶ 3GPP TS07.10 standard for multiplexing channels over a serial link
- ▶ Used for communication with baseband CPU
- ▶ Without this driver no phone functionality is available
- ▶ Only useable with a flashed kernel
- ▶ Phone turns off after 60 seconds with a non working mux_cli driver
- ▶ Hard to debug

Passthrough mode

- ▶ Long test cycles for small changes
- ▶ Luckily Motorola seems to had the same problem :)
- ▶ It is possible to set the mobile into a passthrough mode from the bootloader
- ▶ GPIO pins get rerouted from EMU directly to baseband CPU
- ▶ With a x86 version of the mux_cli driver we got fast test cycles

60 seconds problem

- ▶ After a lot hacking we found out that even userspace is involved here
- ▶ After loading the driver and opening the devices sending a special AT command is needed to turn off the BP watchdog
- ▶ Due to slower 2.6 kernel bootup these tasks are even more time critical

Voice call and audio handling

- ▶ Audio handling on EZX mobiles is pretty complicated
- ▶ You have to route audio between many different codecs, chips and applications:
    - ▶ Baseband CPU
    - ▶ Bluetooth headset
    - ▶ Cable headset
    - ▶ Earphone speaker
    - ▶ Other speaker
    - ▶ Microphone
- ▶ On long term we would like to use the ASoC infrastructure for it
- ▶ For voice calls we will try a simple audio routing driver first

OpenEZX status

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- ▶ Port the architecture and driver from 2.4.20 to 2.6
- ▶ Biggest items left:
    - ▶ ASoC driver
    - ▶ Better handling of the BP (reset)
    - ▶ Power-management
    - ▶ Camera driver
    - ▶ Support newer phones
    - ▶ Many many fixes all over the place
    - ▶ Start submitting upstream
- ▶ We where already able to send a SMS with a 2.6 kernel and free software only

Future plans

- ▶ OpenEZX should focus on kernel level
- ▶ Porting drivers and adding support for more phones
- ▶ Support for ROKR E2 and A1200 is on its way
- ▶ Submit code for review and mainline inclusion
- ▶ On top of our hardware support we need a free mobile phone framework

OpenMoko

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datenfreihafen.
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- http://www.openmoko.org/
- FIC sponsored free mobile phone software stack
- Already tied up with OpenEZX as they share two core developer
- Bottom-up and community driven in the near future
- They also work on a clean TS07.10 kernel infrastructure with EZX phones in mind

GPE Phone

- http://gpephone.linuxtogo.org/
- Implementation of Linux Phone Standards Forum (LiPS) standards
- No reallife hardware support right now.
- Work on A780 and A1200 is in progress
- Needs to be evaluated

Summarize

- ▶ Still much work to be done, but we expect something useable at the end of the year
- ▶ http://www.openezx.org/
- ▶ Some parts of this slides base on slides from Harald Welte. Thank you.
- ▶ You can find the slides later on http://www.datenfreihafen.org/paper.html