PHILIPS

MythTV on Nexperia

Klaas de Waal
Philips Semiconductors
CTO/ST&A
Advanced Systems Labs

• Focussed on Cross Platform Communications
  – Connecting home, mobile and automotive
  – Building the interoperability network on PS platforms
  – Prototyping the “Connected Consumer” on top of the latest Nexperia solutions
  – We will deliver our results incrementally through prototyped systems based on Linux
MythTV on Nexperia

• MythTV
  – What & Why
  – Functionality
  – Features & Functions
  – Components
• Open Source
  – Way of working
  – Why Open Source on Nexperia
• MythTV on Nexperia
  – Architecture
  – Modifications
  – Compilation
  – Toolchain
• Results & Conclusion
MythTV – What & why

• Media Center on LinuxPC

• "MythTV is a GPL licensed suite of programs that allow you to build the mythical home media convergence box on your own using Open Source software and operating systems" (Isaac Richards, 2002)

• Convergence PC and CE worlds
  – TV related info available on the internet
    • Program guide information
    • Internet Movie Database
  – PC hardware suited for A/V applications
    • Large hard disks to store recordings
    • Tuners available in PC’s
MythTV – Functionality

- MediaCenter applications:
  - Personal Video Recorder
    - Hard disk
    - Time shift
  - User interaction via Remote control
  - Networked / distributed application
    - View anywhere in network
  - Photo album

EPG

WWW

Home network
MythTV – Main menu: Focus on PVR
MythTV – Electronic Program Guide

<table>
<thead>
<tr>
<th>Channel</th>
<th>Time</th>
<th>Show</th>
</tr>
</thead>
<tbody>
<tr>
<td>73 TRAV</td>
<td>8:00 pm</td>
<td>Top Ten Predators Up Close (Special)</td>
</tr>
<tr>
<td>3 WKYC</td>
<td>8:30 pm</td>
<td>The West Wing (Drama)</td>
</tr>
<tr>
<td>4 WUAB</td>
<td>9:00 pm</td>
<td>The Twilight Zone (SciFi)</td>
</tr>
<tr>
<td>5 WEWS</td>
<td>9:30 pm</td>
<td>The Bachelor (Reality)</td>
</tr>
<tr>
<td>6 DISN</td>
<td></td>
<td>Rip Girls (Drama)</td>
</tr>
</tbody>
</table>
MythTV – Playback Recordings Menu

Select a recording to view:

- That '70s Show
- The Agency
- All Programs
  - CSI: Miami
  - Frank Herbert's Children of D...
  - Still Standing

The Agency - "Spy Finance"
Airdate: Sat Apr 12, 10:00 pm - 11:00 pm
Channel: 7
Description: Gage and Quinn must deal with an organized crime leader involved with an al-Qaida cell.
MythTV – Features & Functions

- Distributed architecture (Client / Server)
- Supports MPEG2
  - Analog source: tuner / encoder card
  - Digital source: DVB-S or DVB-T
- Use Internet for EPG
- Use DVB program information (EIT) for EPG
- Supports plug-ins, for example:
  - MythGallery photo album
  - MythWeather weather forecast from the Internet
- PC application
- Based on Linux
- Most processing done by the Pentium, but:
  - Support for MPEG2 decode hardware accelerators
  - Can also run on a slow PC
- Source code available
MythTV on Nexperia

- The Advanced Systems Lab has already demonstrated similar functionality on Nexperia
- MythTV is typical for a future CE application the Nexperia home chips are intended for

- My challenge:

  - Either it works
    -> Opportunities…
  - Or not
    -> Feedback results to the business
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Way of working

• Open source
  – MythTV is now an Internet-based collaborative effort
    • Many contribute to the project, based on their need and / or expertise
  – Based on Linux
  – Source code available via dedicated website
  – Lots of re-use:
    • Built "on top of" existing open source packages
  – GPL license
MythTV - Components

MythTV

Qt-E  MySQL

Perl  xmltv  lame

libffmpeg  freetype  gtk+  ...

... and many more ... (pango, netpbm, atk, zlib, glib, gettext, gnupg, pkgconfig, automake, autoconfig, fontconfig, etc.)
Why Open Source on Nexperia

• Very much open source software available

• PS cannot write all possible software themselves
• Even if we could it takes time…..and costs money…

• With open source software we can:
  – Test feasibility of our platforms for these applications
  – Demonstrate product ideas
  – Show to ISV's the capabilities of our platforms

• For products we can:
  – Write the software ourselves
  – Buy software of ISV's
  – Sort out the IPR issues and use open source software
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MythTV – Client/Server or Frontend/Backend?

Server

- Tuners
- PVR
- Internet
- Storage

Client

- GUI
- MPEG2 decode
- TV-output

MythTV Backend

MythTV Frontend
The Nexperia pnx8550

• Is called "Programmable Source Decoder"…
• Designed for Digital TV
  – MIPS for GUI and control
  – Hardware for:
    • MPEG2 decode
    • Image improvement
  – TriMedia’s for:
    • AV streaming
    • Software codecs
    • ….

• The Question:
  – Can pnx8550 also run "tomorrow's software" i.e. MythTV?
MythTV - Map to Nexperia - backend (server)

**MythTV-backend ("server")**:  
- Needs only "general purpose" computing  
  - To store programs on hard disk  
  - Transmit programs on the network  
- Uses tuners that produce MPEG2:  
  - Analog tuner cards with MPEG2 hardware encoders  
  - DVB-T or DVB-S is already MPEG2  
- MPEG2 section filtering supported in hardware  
- Unused "chip real-estate":  
  - MPEG2 audio/video decoding not used  
  - Image enhancement functions not used  
  - TriMedia's not used

\[ \text{Nexperia pnx8550 not optimal for MythTV-backend} \]
MythTV - Map to Nexperia - frontend (client)

- MythTV-backend ("client"):
  - Requirements similar to Digital TV or STB:
    - Run the Graphical User Interface
    - MPEG2 audio/video decoding
    - Image enhancement
  - Difference is:
    - Ethernet connection instead of a tuner

⇒ Nexperia pnx8550 well suited for MythTV-backend
MythTV on Nexperia – Client / server architecture

Server
- Tuners
- PVR
- Internet
- Storage

Client
- GUI
- MPEG2 decode
- TV-output

MythTV Backend

MythTV Frontend

TCP/IP

PC

Nexperia
MythTV on Nexperia – Modifications

• Modifying MythTV:
  – Problem:
    • MPEG2 audio/video decoding on TriMedia
  – Solution:
    – Philips Research knows a lot about MythTV
    – Use of LinuxPC with TM1300 "Kenobi" card
    – Use of "Luddite" gives identical software development environment
    – Philips Research added "Kenobi" driver to MythTV
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MythTV on Nexperia – Compilation

• Starting conditions:
  – Linux distribution available
  – Typical "embedded" distribution: very limited number of open source packages
  – Cross-compilation development environment

• The work:
  – Compile all required open source packages:
    • MythTV, MySQL, Qt-Embedded, pango, gtk+, lame, netpbm, xmltv, atk, zlib, glib, gettext, gnupg, pkgconfig, automake, autoconfig, freetype, fontconfig, ....
Cross-compilation blues

Problem: open-source software not written for cross-compilation

Example of automatic configuration:
   The “configure” script wants to find out the size of an “int”
   This is done by:
   – Creating small “C” program that prints out the size of an “int”
   – Compiling this program
   – Running this program
   – Use the output of the program in the rest of the script
   This fails horribly!!

Other cross-compilation problems:
   – Use of header files and libraries from your LinuxPC
     • Also Linux, but slightly different…
   – Use of native PC tools (cc, ar, ld, strip etc) instead of the cross-compilation tools
Compilation Overview

- Configure/Make
  - Dependency check
- Pre-process
  - Include files
- Compile
  - Create object file
- Link
  - Combine object files & libraries

Linux on PC: Native compilation on X86PC for X86PC (fast)
Embedded: Cross- compilation on X86PC for MIPS (fast)
Linux on MIPS: Native compilation on MIPS for MIPS (slow)
Compilation with “distcc”

Configure/Make

Pre-process

Compile

Link

MIPS

PC
Compilation for MIPS with “distcc”

Requires:
• Capability to run native compiler on MIPS
• Identical native and cross compilers:
  – compiler version
  – libc version
  – binutils version
  – Generated from the same source

Result:
• Can compile anything on MIPS that compiles on PC
• Without Makefile modifications!
• A bit slower than native on PC
• Much faster than native on MIPS
MythTV on Nexperia – Toolchain Troubles

Problem: using the Qt-Embedded shared library
– All applications linked against the Qt-Embedded shared library do crash with a “segmentation fault”.

Investigation showed:
– Problem is related to number of functions in library
– Problem reproducible with “hello world” application
– Problem depends on version of toolchain used to build the shared library!
– Toolchain is built from packages gcc, libc and binutils
– Toolchain built with binutils-2.14 is OK
– Toolchain built with binutils-2.15 fails
Toolchain Troubles (2)

How to get this fixed: three approaches
1. Do It Yourself:
   • I did try (but it was too difficult for me…)
2. Vendor Support
   • “We do not support the pnx8525, only the pnx8550”
   • “We do not support the pnx8550, not validated yet”
   • “It has to be reproduced on a MIPS Malta 4Kec”
3. Report this to the Open Source
   • http://sourceware.org/bugzilla/show_bug.cgi?id=660
   • Never heard anything….

My workaround:
• One toolchain compiles Qt-Embedded (but not the rest)
• Another toolchain compiles the rest
Toolchain Troubles (3)

Conclusions:

1. Bugs in MIPS toolchains do not get fixed by themselves

2. For problems like this you need either:
   – Support from third parties, or:
   – Build the competence yourself

3. Vendor Support:
   – Get support for the chip you actually use…
Results & Conclusion (1)

MythTV-Frontend (client) runs on Nexperia!!
• Demonstrated at CRE 2005:
  – Live TV (incoming MPEG2 via Ethernet)
  – Play TV from hard disk recording
  – MythTV photo album application
• Can play MPEG2-HD streams
  – From MythTV-backend on PC
  – From MythTV-backend on the same box
• Shown at CES 2006 in the Philips CE “Home Gateway” demo
• Subjective performance:
  – TV and GUI performs OK
  – UI not much slower than with low-end VIA X86
  – Switching from UI to TV takes a long time
Results & Conclusion (2)

• Photo album JPEG decoding very slow on MIPS
  – better in hardware or on TriMedia!
• MythTV-Frontend needs 64MByte main memory
• Linux virtual memory makes it possible to run it:
  – On pnx8550 with only 48 MByte for Linux/MIPS
• Would like to have at least 128MByte for Linux/MIPS
to run MythTV and the MythTV plug-ins
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...yesterday afternoon...