Private Site

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1. Home

1.1. Welcome to Dr. Bengt Mårtensson's private homepage

Hi! Welcome to my private site. This site is a "private site" in the sense of containing all stuff that do not fit on my consulting site (in German only), which describes the professional side of me, as a freelancing engineer.

NEW! Now with a section on Home automation and remote control!

1.2. Some personal stuff

1.2.1. Over me

I was born Lund, Sweden, and grew up in the south of Sweden. I studied at the University (Mathematics) and the Institute of Technology (Electrical Engineering) in Lund and got my masters degree ("Civilingeniörsexamen") in Electrical Engineering in 1982. The year 1983-1984 I spent as a student at Harvard University, while I, as cross registering student, also took courses at the Massachusetts Institute of Technology. In 1986 I got my Ph.D. ("Teknisk Doktor", "Doctor of Philosophy in Engineering") from the Department of Automatic Control (PhD advisor: Prof. K. J. Åström, co-supervised by Prof. Christopher I. Byrnes, who I met during my Harvard period) also in Lund. (Photo taken after the doctoral promotion, 1986.) In 1987, I spent 5 months as postdoctoral fellow at the Department of Electrical Engineering at the University of Waterloo, with Prof. M. Vidyasagar.

In 1987 I moved to Bremen, Germany, to work with the Institute for Dynamical Systems at the University of Bremen. 1998 I moved to Munich, where I am presently living. I have been working for/with, among others, science + computing, BMW, and Askon Consulting. Presently, I work as a free-lancing engineering consultant, with this home site.

1.3. Impressum

This web site uses a strict separation between content and style. The content of the site is mainly written using the Apache Document XML-Format version 2.0 which is a simple (sometimes too simple :-) format to describe e.g. web content (but not its style). The content is processed with the Apache Forrest framework (which can be described as a stripped-down, offline Apache Cocoon, adapted to WEB publishing), to generate W3C valid 4.01 (transitional) HTML, as well as PDF files.

The section on the Einstein puzzles uses a few XML files using the, by me designed, einsteinpuzzle.dtd, for example the puzzle file `einstein.xml`. These files are not only used to automatically generate C++-files to solve the corresponding puzzle, but are also,

through a custom XSLT-stylesheet, integrated into Forrest, so that the XML puzzle files generate a HTML-file (like `einstein.html`) (and, through Forrest, a PDF file), optimized for human reading.

The photo gallery was generated from one single XML File, again with a custom DTD. A Metamorphosis script generates all the needed XML-files (using the Apache Document DTD), showing the photos. To determine the needed files, a Metamorphosis script generates a dependency file, which is included by a Makefile, that thus determines the files needed. Image transformations are also made by make, using the freeware Imagemagick program `convert`.

XML Files were edited with GNU Emacs, which, after 20 years of usage, still remains my preferred authoring environment! (I am even mentioned in the Acknowledgments!). Operating platform was GNU/Linux (SuSE Linux 9.2 – 10.0), using the Gnome desktop.

This site is not "optimized" for a particular browser, but based on vendor neutral standards from the World Wide Web Consortium. All HTML on the site is expected to be valid HTML 4.01 transitional, using CSS and Javascript (nothing dramatic happens without Javascript, though). Anyhow, for technical, political, and security reasons, I recommend the Firefox browser. Still, this site is not "best viewed with Firefox"...

No products from Redmond have been used in the production of this site.

This sites uses SI units and -prefixes, except, in a few cases when natural, the IEC 60027-2 binary prefixes are used, with names clearly different from SI-prefixes. (See this article.)

1.4. Site Linkmap Table of Contents

This is a map of the complete site and its structure.

- MyProj _____ *site*
  - Home _____ *home*
    - Index _____ *index* : Homepage
    - Personal _____ *personal* : Over me
    - Impressum _____ *impressum* : Over the site
    - Sitemap _____ *linkmap* : Site Linkmap
    - Legal _____ *legal* : Legal blurb
  - Barf's dBox Page _____ *dbox*
    - Main _____ *index* : Barf's dBox page
    - Patches _____ *patches* : Barf's patch page
    - GPL+Tuxbox (Deutsch) _____ *gpl_tuxbox* : GPL

und das Tuxbox-Projekt

- newmake _____ *flash-yadds-newmake* : Building Flash Images and YADDs with newmake
- newmake (Deutsch) _____ *flash-yadds-newmake-de* : Flashimages und YADDs mit newmake
- Newmake architecture _____ *newmake-architecture* : The architecture of newmake
- The dBox automounter _____ *automount* : Setting up and using the automounter
- Online image updates _____ *update* : Setting up online updates for Neutrino
- Analog & Digital Outputs _____ *io* : Analog and digital outputs from the dBox
- Hardware modifications _____ *hwmodding* : Hardware modification
- Photogallery Modding _____ *hw-photogallery* : Improved AV-Switching
- Linux server setup _____ *server* : Setting up a Linux/Unix Server for the dBox
- Noninteractive Flashing _____ *dboxflasher* : Non-interactive Flashing using dboxflasher
- The dBox IR Keyboard _____ *keyboard* : Things to do with the dBox IR Keyboard
- FAQ _____ *faq* : Frequently asked questions (for the dBox page)

- Home Theatre _____ *hometheatre*
  - Main _____ *index* : My Hometheatre Page
  - Mk1 _____ *mk1* : My Hometheatre Mk 1
  - Mk2 _____ *mk2* : My Hometheatre Mk 2
  - Mk3 _____ *mk3* : My Hometheatre Mk 3
  - Mk4 _____ *mk4* : My Hometheatre Mk 4
  - Mk5 _____ *mk5* : My Hometheatre Mk 5 (present)
  - High Definition _____ *HD* : High Definition Video

    - Multichannel, DVD Audio _____ *DVD_Audio* : Multichannel music and DVD Audio
    - AV Control 5 _____ *avcontrol* : AV Control 5 modification
    - AV Control 5 Pictures _____ *avcontrol_pics* : AV Control 5 modification pictures
    - Shelf _____ *shelf* : Multimedia shelf
    - General Photos _____ *general_photogallery* : The general photo gallery
- Home Autom. & Remote Control _____ *harc* : Home Automation and Remote Control
    - main _____ *index* : Home automation & Remote Control
    - Project HARC _____ *project_harc* : Project HARC
    - Pronto _____ *pronto* : Pronto modification
    - Blind motors _____ *blinds* : Blinds
- Software _____ *software*
    - main _____ *index* : My software page
    - Gnans _____ *gnans* : Simulation software
    - Einstein Puzzle _____ *puzzle* : So-called Einstein's Puzzle
- Misc. _____ *misc*
    - Index _____ *index* :
    - Kilobyte _____ *kilobyte* : 1000 or 1024?
    - Modal Popups _____ *modal* : Modal popups are evil!
- All _____ *all*
    - Whole Site HTML _____ *whole_site_html*
    - Whole Site PDF _____ *whole_site_pdf*

1.5. Legal

1.5.1. Legal Blurb

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2. Barf's dBox Page

2.1. Barf's dBox page

2.1.1. Legal

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I, as well as the Tuxbox project, do not condone illegally accessing Pay-Tv. Using information or downloads from this page for this, or other illegal purposes, is strictly prohibited.

2.1.2. General

One of my interests is Tuxbox project. It aims for a free, Linux based operating system for the digital TV-Receiver known as the dBox2. See the project's home page. I am active in the Tuxbox forum using the nickname "Barf".

This is a fun project. It is both technologically and socially very interesting. There has *never* been an official release, and there are also no release-schedule. The project in its current stadium is explicitly aimed at experienced Linux users/programmers. However, there are often unofficial images released. Through these, the project has had a considerable impact, far outside of the programmer community. "Linux on the dBox" has established itself — amazing for a project with no releases! Unfortunately, it has also proved to be a powerful platform for implementing illegal pay-tv decoding, something that is a severe concern for the project. There are also, in particular in the forum, a large number of unexperienced users, who often, sometimes in obnoxious tone, complain over missing support, unfixed bugs, lack of Unix capacities in Windows, etc. (Calling the password file `\etc\passwd`, routinely killing processes with `kill -9`, making files executable with `chmod 777`,...) Official documentation, both user documentation and API documentation, is largely missing. As often the case in situations like this, this breeds

the HOWTO-tradition: Documents written by authors who, often, have a very incomplete understanding of the problem, describing (at best) a cookbook method for reaching a particular goal, without any attempts of understanding. (Occasionally, also valuable documents by knowledgeable persons are called "HOWTO"s.)

As a supporter and contributer of free software, nowadays sometimes called open source, for example in the sense of the Free Software Foundation, I am concerned about the relative emphasis on tools for non-free operating systems (in particular for those from a certain Redmond based firm), as well as binary-only releases. The best example of this is the Windows boot manager, a very useful and capable tool, that is almost indispensable in the initial phase.

As I said, an interesting project...

2.1.3. Articles and Tutorials

- Über GPL und das Tuxbox Projekt. ("On GPL and the Tuxbox project"). An article on GPL and the Tuxbox/dbox community. Only in German language, no English version planned.
- Building images and Yadds with newmake (beginner(?) to advanced). Also available in German.
- The newmake architecture (advanced)
- Setting up and using the automounter
- Setting up an online image- and update server for Neutrino
- Analog and Digital Video- and Audio-outputs on the dBox with Neutrino (intermediate to advanced)
- Improved AV-Switching. Obsolete; content merged into the previous entry.
- Some Hardware Modifications of the Nokia dBox
- Photogallery Modding
- Setting up a Unix/Linux dBox server (beginner to intermediate)
- Noninteractive flashing with Unix/Linux and dboxflasher (beginner to advanced)
- The dBox IR-Keyboard

2.1.4. Barf's Patches

I have written a number of patches, that for one reason or another, are not checked in into CVS. They are presented on the patch page, sometimes together with binaries.

2.1.5. FAQ (for this page)

FAQ

2.1.6. Feedback

Suggestions, criticism, etc are welcome, either directly to me or in the forum.

2.2. Barf's patch page

2.2.1. Revision history

Date	Description
...	...
2006-06-05	Following patches are now checked-in or obsolete: Online updates, infobar, avsstuff, discrete on/off for Neutrino, saa7126, mcrec, IMDB, LIRC-Patch. Link to the ghosting patch added. Updated camd.c.diff-errormessage. Misc. small improvements.

2.2.2. Barf's Patches

Name/Link	Date	Description	Forum thread(s)	Status
kabr	2006-03-29	A translation layer for remotes and keyboards. See the article.	Volle Unterstützung der Dbox2 Tastatur	Works, but needs some testing.
Found in CVS, partially in branch newmake. Ghosting patch.	2006-05-15	The well known Unix/Linux automounter taken to Tuxbox by yours truly. See Thread. Requires newmake. See the article.	Automount / autofs	Working.
controldc.cpp, Makefile.am.contro	2006-01-15	An interactive command line tool for sending messages to controld. For experimenting and debugging controld, as well as allowing switching video format etc without bypassing controld. See code. Put C++-program in directory `...apps/tuxbox`	controldc: Kommandozeilenpr zum Plappern mit controld	Just works. No big deal. Not really polished.

`dclient`,

		and patch the Makefile.am there.		
In CVS, branch newmake.		The newmake rewrite of the Tuxbox build system. See this article, as well as the architecture article.	Flashtargets in Makefile umgeschrieben (concepts); @BARF wegen deinen neuen Rules ;-) (support); Bugreports zu "new flashrules barf" (bugs); new flashrules barf beispiel (advocacy).	Stable. Checked in in the branch "newmake".
zapit audio patch	2005-10-23	For Neutrino. Using this patch, Tuxbox will, for each channel, remember the last selected AudioPID (that characterizes an audio channel) and save it, also between reboots. When returning to the channel, it will attempt to use the previously selected audio channel, if still available. Patch is against version 1.375 of zapit.cpp.	Forum thread, see also this thread, and this.	Stable, widely tested, works perfectly. For "religous" reasons (see the referenced threads), will not to be committed. The patch is very popular with image providers.
neutrino.cpp.diff	2005-04-02	Optional SCART-Mode by startup for Neutrino. Active-going pin-8 on the VCR-SCART wakes the dBox from standby. It would be logical and useful, that	Forum Thread.	Not 100% reliable. Neutrino may go to an undefined state as Pin-8 goes low again.

		the Tuxbox enters Scart-mode directly, if pin8 is active when booting (like BetaNova).		
camd.c.patch-error	2006-06-05	Error message for not subscribed channels. Sometimes when switching to a (sub-)channel, the screen simply stays black, without no user message at all. This patch to camd.c, generates a (unfortunately not localized) error message for the case of the channel not being subscribed to/the sub channel not being available. Not really Neutrino-dependen but rather dependent of the Neutrino NHTTPD-API.	Yes.	Works, but is a very ugly hack.
camd.c.patch		De-deactivating. This de-deactivates certain capacities in `camd.c`.	Yes.	works
channellist.cpp, channellist.h, and neutrino.cpp		Improved handling of hidden bouquets. Using the WEB-Interface (or by editing bouquets.xml manually), bouquets can be marked as "hidden". These	Forum thread.	Unfortunately, something with this patch triggers a bug/problem somewhere. When zapping down, and jumping over a hidden bouquet, something regarding the

		should be "hidden" from the zapping user. Unfortunately, by zapping, next-channel and previous-channel enters the hidden bouquets. Furthermore, you can select them by entering the channel number. These patches to stop this erroneous behavior.		avia-decoding may go into a silly state. Don't apply, unless you want to find the problem!)
Fix to menue.cpp.		The menus of Neutrino has a fairly stupid time-out behavior: when a menu times out, control is returned to its precessor, instead of closing a possible menu hierarchy.	yes	Works, at least most of the time.

2.2.3. Checked-in Patches

Name/Link	Date	Description	Forum thread(s)	Status
Checked in to CVS.	2006-02-21	Modernization of Neutrino's online update facilities. See the article.	Modernisierung der Neutrino onlineupdatefunktio	Checked in, here (among others).
infobar.cpp.diff	2006-01-22	With this patch, the infobar does not time out in radio mode. See Thread.	bitte kein OSD timeout im Radio Modus (Neutrino)	This checkin implements a separate time-out for the infobar in radio mode; setting this to 0 achieves the desired effect.
avsstuff	2006-01-05	Improved Audio/Video Switching with Neutrino. See its	Konfiguration Videoausgänge, Terminatorbug	Commited here.

		own page.		

- It is common to manually add entries (services) to /var/tuxbox/config/zapit/services.xml, for example to be able to make timer recordings of subchannels. See this thread. The problem is, that the next channel scan destroys the manually added information. Thread. This patch for getservices.cpp and introduces another services-files, called `myservices.xml` and `antiservices.xml`. They should have the same semantic and syntax as the `services.xml`-file. All manual additions should be made to this `myservices.xml`, which will never be overwritten by the system. Entries made to `antiservices.xml` will be removed from the services list, for channels that you (or other users of the dBox) will never want to access or even see in the channel listings.
- Recently, a timeout was added to the LCD-display. Thread. Enclosed patch for neutrino.cpp turns on the LCD-display when Home is pressed.
- The present CVS-Neutrino does not object to being shutdown in the middle of a recoding, thus (possibly accidentally) ruining a recording. Here is the fix, as a patch to neutrino.cpp. Thread.

2.2.4. Obsolete Patches

Name/Link	Date	Description	Forum thread(s)	Status
saa7126_core.c		Once, if the Tuxbox is set to generate S-Video (also known as Y/C, and, incorrectly, S-VHS) on the TV-Scart, the VCR-Scart delivers only a black-and-white (technically VBS) signal as "composite" (CVBS) output. This patch, solved the problem (but not without a price...).	this, this, and this. this thread.	Obsoleted by avsstuff.
mcrec patch		mcrec is a nice tool for the digital streaming of the radio channels of Music Choice. This patch makes it more usable by	Forum thread.	Probably just as obsolete as mcrec.

		implementing options for hierarchical storage, XML-File generation, and filename uglification. Note: the patch is against version 0.17, not against 0.18 which is the current version in the Tuxbox CVS repository.		
Patch to global.css and epg.html.		This little hack integrates IMDB (Internet Movie DataBase) support into the Neutrino Web server. With this patch applied, every film info page gets an additional link entitled "Suche IMDB", which, when pressed, issues a reasonably intelligently chosen search command to the IMDB. Simple, but useful. To use this patch, it is not necessary to patch the source tree, or rebuild the image: Just put patched versions of `global.css` and `epg.html` in `/var/httpd_pri`	Forum thread.	Works fine, however not with the new web interface by yjogol. Loses on titles like "German Title (English Title)".
LIRC-Patch for controld.cpp		LIRC-Support for 16:9/4:3 automatic format adjustment. The Tuxbox software	-	Works. Updated 2005-08-23 (performance improvement). Included in the

		supports automatic aspect ratio switching both through SCART-Pin 8 and WSS on line 23. Unfortunately, there are situations when both these methods are not enough, see my setup. For example, my projector (Panasonic PT-AE500) when connected by YUV-signals does not evaluate WSS, and does not use Pin8. Therefore, the possibility of sending LIRC-commands when switching between 16:9 and 4:3 is desirable. This patch extends the LIRC-capacities of Neutrino, in that, when switching to 16:9 (4:3) format, the LIRC-File `16:9.lirc` (`4:3.lirc`), if present, is executed as a LIRC-file. (Yes, I know, some operating systems have problems with file names containing colons. On Tuxbox, and other sane operating systems, this is not an issue.)		avsstuff patch (thus obsolete).

This patch to rcinput.cpp makes Bottom-right an OFF-button, and this patch to neutrino.cpp does the rest.	2005-06-25	Discrete on/off for Neutrino. It is a pain in the a* that todays consumer electronics often do not come with separate on- and off-buttons, but with only a toggle-button. Of course, a human being can tell what state a device is in (on or off for example), but for the purpose of home automation, it is desirable to send signals, for example from your remote control, to turn the thing OFF (or on), regardless of its present state. The dBox with Betanova OR Tuxbox software is just as silly, at least without this patch. There is also a "Discrete-Standby"-implemented. Note that "Bottom Left" and "Bottom Right"-buttons are required. For those whose remote controls do not contain these, but instead own a Philips Pronto, the forum participant "move" posted the Pronto codes in the same thread.	Forum thread.	Works with no problems. Largely obsoleted by the kabr-patch above.

- Imagekit from 2003-12-15. Integrates the creation of dBox images, jffs2only or mixed (cramfs + jffs2) into the configure /make-process. Comes with documentation in a

tar.gz archive. See thread. Obsoleted by newmake.
- Original version of the ImageKit. Obsoleted by newer version.
- Remember AudioPIDs For Neutrino. Using this patch, Tuxbox will, for each channel, remember the last selected AudioPID (that characterizes an audio channel) and save it, also between reboots. When returning to the channel, it will attempt to use the previously selected audio channel, if still available. Forum thread. Obsoleted by the zapit patch described above.
- Select start channel. For Neutrino. Not everyone likes to be reminded in the morning of what they viewed late last evening ;-). This patch implements two option flags for zapit: with -a, the starting channel is take from the file /var/tuxbox/config/zapit/start_channel.conf (if it exists). If using the -r option, zapit will never attempt to write its configuration file to non-volatile memory. Forum thread. (Despite being patches to the same file, this and the previous patch can be applied independently of one another, or both.) Obsoleted by the zapit patch described above.
- 16:9 mode for an application designed for 4:3 looks extremely ugly. Presently, Neutrino contains several such situations. It would be quite hard to fix the distorted menus, but some cases are easy to fix. This patch to neutrino.cc forces 4:3 in radio mode, and this patch to mp3player.cpp forces the mp3-player to use 4:3. This patch to scan.cpp fixes channel searching. Note that the patch make sense only for users using automatic pin-8 video format. Forum thread. (Obsoleted by newer official versions.)

2.2.5. Barf's Binaries

Here we provide some binaries for the user who can not compile the sources themselves.

Name	Date	Description
kermit	2006-01-05	The classical communication/file transfer program, compiled for the dBox. Home Page here.
zapit	Version 1.388; 2006-06-05.	with the audio-patch above applied.

2.3. Über GPL und das Tuxbox Projekt.

2.3.1. Zusammenfassung

In diesem Artikel wird etwas Hintergundinformation zu der Lizenz für die Software des Tuxbox Projekts, die GPL (General Public License) präsentiert. Dies ist als Formalisierung der Idee von Software Sharing zu verstehen. Es wird auf das Tuxboxprojekt und seine drei "offizielle Images", eingegangen, sowie der Kampf gegen das Schwarzsehen. Es wird gezeigt, dass diese Verhältniss an starken Wiedersprüchen leidet.

Ich möchte mich hier bei den Forumsbenutzern dietmarw und Feynman für Feedback auf eine frühere Version dieses Artikels bedanken.

2.3.2. Distanzierung

Ich distanziere mich ausdrücklich vom empfangen und entschlüsseln von verschlüsselten Fernseh- und Radioprogrammen, für die keine gültige Lizenz vorliegt ("Schwarzsehen"). Dies ist sowohl strafbar, als auch ein moralisch verwerfliches Vergehen/Verbrechen. Dass ich im Folgende einige Versuche, das Schwarzsehen zu bekämpfen kritisiere, darf in **keinster Weise** als Unterstützung oder Verharmlosung vom Schwarzsehen verstanden werden.

2.3.3. Die "Hacker's Ethics"

Es ist sowohl nützlich als auch interessant etwas über die Hintergründe der GPL zu wissen. Dies ist von Stephen Levy in dem Buch "Hackers: Heroes of the computer revolution" sowohl sehr gut als auch sehr lesenswert beschreiben. (Das Buch ist z.B von Amazon erhältlich; leider keine deutsche Übersetzung verfügbar. Das englischsprachige Wikipedia hat einen sehr guten Artikel über das Buch.) Levy beschreibt dadrin u.a. die "hackers ethics", die sich in folgende Punkten zusammenfassen lässt:

1. Information soll frei sein. Sie darf nicht verborgen werden, oder geheimgehalten.
2. Programmierer/hackers tauschen Information zwischen sich aus. Das Verbergen von Information ist unkooperativ, sowohl gegen andere Hackers, als auch gegen die Menschlichkeit.
3. Quellcode für Programme ist in diesem Sinn nichts anderes als "Information".
4. Jede Art von "Gefängniss" für Informationen stellt eine Herausforderung zum Knacken dar.

Bekanntestes Sprachrohr ist Richard Stallman, der, um diese Ideen zu verteideigen und weitmögligst zu verbreiten, die Free Software Foundation (FSF) und das GNU Projekt gegründet hat.

Das Prinzip vom "Sharen" von Software und dessen Quellcode ist vom Prinzip der Freiheit (und die langfristige Gewährleistung der Freiheit) der Information abgeleitet.

2.3.4. GPL: Ein Hackers Ehrencodex in juristischer Spache

Die einfachste Möglichkeit ein selbstgeschriebenes Programm zu sharen, ist das Verzichten auf alle Rechte und Einschränkungen für das Programm: die Veröffentlichung als "public domain". Dies heisst, dass jeder sich davon bedienen kann (gut), vielleicht abgeleitete und verbesserte Versionen erstellen kann (auch gut), und vielleicht sie unter weniger freie Voraussetzungen andere zu Verfügung stellen kann (weniger gut). Es war Stallmans Wunsch, dass freie Software frei bleiben sollte, in dem Sinn, dass auch abgeleitete Werke zu Benutzung und Weiterverarbeitung der Öffentlichkeit zu Verfügung stehen. Deswegen hat er einige Regeln formuliert, die dem Empfänger einige Dinge

verbieten, Dinge die die abgeleitete Werke unfrei machen würden.

Diese Regeln wurden in der "General Public License" zusammengefasst. Streng genommen ist sie nicht anderes als eine Formalisierung und Präzisierung von dem Prinzip (und Hackers Ehrencodex): "Freie Information (Software) soll frei bleiben".

Hier ist, informell ausgedruckt, die Grundidee in GPL: "Diese Software ist frei (nicht mit kostenlos zu verwechseln). Du darfst sie für alle Zwecke benutzen. Du darfst sie ausserdem weitergeben und für unterschiedliche Zwecke weiterentwickelt, und die modifizierte Versionen weitergeben. Was du nicht machen darfst, ist die Freiheit der Empfänger einzuschränken, in dem du die abgeleitete Software mit restriktiveren Bedingungen versiehst."

Die GPL formuliert dazu einige präzise Anweisungen, wie z.B. Anforderungen wie "Quellcode zur Verfügung zu stellen" zu verstehen sind.

Ein in diesem Sinn freies Programm darf für jeden zweck ("for any purpose") benutzt werden, gut oder böse.

Zu den Quellen eines Programmes zählen auch "Buildscripte", die zum Erstellen der Software erforderlich sind (es sei denn, das sie ganz trivial sind).

Der genaue Text für GPL Version 2 befindet sich hier. Neulich ist eine Version 3 erschienen, die aber sich nicht in dem Sinn von Version 2 unterscheidet. Eine deutsche Übersetzung der Version 2 befindet sich hier. Nur die englische Version ist aber verbindlich. Auch lesenswert ist die FSF FAQ zum GPL (nur in englischer Sprache).

Die GPL ist neulich von Landgericht München I für juristich verbindlich befunden.

Niemand kann zum "Sharen" gezwungen werden. So kann jemanden, der alle Rechte für ein Programm besitzen, frei wählen zwischen, u.a. keine Veröffentlichung, eine restriktive Lizenzierung gegen Lizenzgebühr, Veröffentlichung nur in Binärform, Public Domain (in Quell- oder Binärform), oder eine Veröffentlichung unter eine Lizenz wie GPL oder Ähnliches (siehe diese Liste über verbreitete Lizenzen für freie Software). Für abgeleitete Werke gelten aber andere Regeln, z.B. besitzt der "letzte Author" nicht die Rechte (mit Ausnahme des Public-Domain-Softwares), und kann, sowohl formell als auch moralisch, nicht frei über die Bedingungen für eine Veröffentlichung bestimmen.

Die GPL wurde in der 80-er Jahren formuliert. Während dieser Zeit war z.B. das selbständige Kompilieren von Programmen eine Selbstverständlichkeit. Nicht alle könnte selbständig ein Programm schreiben, aber man könnte mindestens C-Quellen von Usenet Newsgruppen wie z.B. comp.sources.unix runterladen und mit dem Compiler übersetzen. Das Konzept von Software ohne Quellcode, oder Betriebssysteme ohne einen C-compiler war einfach fremd. Hacker (hier benutze ich das Wort als in Levys buch) haben haubtsächich Programme für UNIX-Plattformen (vorzugsweise BSD) geschrieben, selten für andere Plattformen wie VMS, Amiga, Atari, Macintosh, C-64. Die Microsoft Betriebssysteme MS-DOS und Windows galten als das uncoolste überhaupt.

Seitdem hat sich vieles geändert... Das Wort Hacker hat leider in der moderne Nachrichtensprache die ursprüngliche Bedeutung verloren, und wird eher im Sinn von Computerkriminalität benutzt.

2.3.5. Das Hackerprojekt "Tuxbox"

In Jahr 2000 wurde ein interessantes Hackerprojekt gestartet: das Tuxbox projekt. Der PayTV-Sender Premiere hat, um das digitale Bezahlfernsehen zu stimulieren, sehr intressante high-end Hardware (mit dem Standards von etwa Jahr 2000) stark subventieniert auf den deutschen Markt veräussert (die dBox2). Das darin enthaltene Betriebssystem, Betanova, war, wie wir alle wissen, überhaubt nicht in der Lage das Potential der Hardware und der digitale Fernsehsendungen auszuloten. Die Hackerseele stellt sich dabei die Frage, wie die Hardware "befreit" werden kann.

Die ursprunglich entwickelte Software wurde dabei (mit Ausnahme von `mkflfs`, siehe unten) unter die GPL gestellt.

Eine intressente Beschreibung nicht nur von konkrete Tatsachen, sonder auch wie ein Hardwarehacker "tickt", befindet sich in dem Buch von Andrew "bunnie" Huang, "Hacking the X-Box", das sich mit dem X-Box von Microsoft befasst. (Leider ist das Buch nicht in Deutsch erhältlig.)

Auch wenn es (mit aller Wahrscheinlichkeit) niemals die Bestrebung der ursprünglichen Entwickler war, hat es sich gezeigt, dass die dBox2/Tuxbox-Kombination von relativ flexibler und leistungsfähiger Hardware, zusammen mit der offenen Natur der Software eine sehr attraktive Sammlung von Tools für das Entwickeln von Schwarzseherprogramme darstellte.

(Offiziell) aus diesem Grund hat sich das Tuxboxprojekt für ein Open-Source Projekt etwas merkwürdig verhalten. Eine wichtige Komponente (mkflfs) wurden nicht veröffentlicht, sondern geheimgehalten. Auch wenn die meisten anderen Teile im Quellcodeverwaltungssystem CVS veröffentlicht wurden, war es nicht möglich ausschliesslich mit veröffentichen Code ein vollständiges Image zu erstellen und zu flashen. "Offizielle" Flashimages wurden von AlexW zur Verfügung gestellt. Erst später, u.a wegen der nicht veröffentlichte Tools, war es möglich ohne umfassende Einarbeitung ein Image zu erstellen.

Die offizielle Motivierung für die, in dieser Art, teilweise nicht freie Software war, dass man somit das erstellen von Schwarzseherimages auf Basis der Tuxboxsoftware verhindern wollte. Es hat sich gezeigt, dass dies nicht erfolgreich war. Das geheimhalten von `mkflfs` hat nichts gebracht: Es hat einfach gereicht, die passende Version (für 1 bzw. 2 Flashchips) von einem AlexW-Image in Binärform zu extrahieren und unverändert wiederzuverwenden, genau so wie die Anleitung zu Erstellen von "sauberen" Images das Verfahren beschrieben hat.

Zum Flashen, und für einige andere Operationen auf der dBox war es nahezu notwendig,

ein nur für Windows verfügbares programm mit geheimem Quellcode zu verwenden: der Bootmanager. (Laut Gerücht sind die Quellen nicht nur niemals veröffentlicht worden, sondern sogar in einem Plattencrash verlorengegangen :-). Ein moderneres ähnliches Programm ist Alexander Hallenbergs ("Gurgel") Flashassistent, auch mit unveröffentlichtem Quellcode.

Wesentlich für den Erfolg des Projekts war das "reverse Engineering" von Teilen der ursprünglichen Software. Insbesondere wird aus der (als legal erworbene, z.B. bei Kauf der Hardware) Software einige Binärdateien, die Firmware für einige custom Chips (AViA und CAM-modul) extrahiert, und in der neuen Software benutzt. Diese Firmware ist nur in vorhandene, verschlüsselte Form enthältlig. Eine decompilierung oder Analyse ist (meines Wissens nach) niemals publiziert worden. Es wird angenommen, das sobald die Originalsoftware legal erworben ist, und die Firmware nicht zu Weiterverbreitung angeboten werden, alle gesetzlichen Anforderungen erfüllt sind, und, implizit, dass das Verfahren juristisch unproblematisch ist. (Siehe z.B. Tuxbox Wiki.)

Unter anderem aus diesen Grunden ist das Tuxbox-Projekt (leider) mehr verbunden mit bereitstellen von Flashimages, als mit dem eigentlichen Kern: die Quellen im CVS.

Seit ein Paar Jahren existiert eine große Anzahlt von unterschiedlichen Tuxbox-basierenden Images. Fast alle sind für Schwarzsehen ausgelegt, auch wenn man oft das eigentliche "Scharfmachen" (installation von besondere Softwarekomponente, z.B. sogenannte Emulatoren ("Emus"), die eine lizenzierte Entschlüsslung emuliert, und installation von Entschlüsselungsschlüsseln ("Keys")) dem Benutzer überläßt. Fast alle diese Images verletzen die GPL in dem Sinn dass sie:

1. Quellcode für Erweiterungen, sowie ggf. Buildscripte etc. nicht den Benutzern zu Verfügung stellen, und/oder
2. Die Images werden anderen Regeln für Weiterverbreitung und Modifikation unterlegt als GPL.

Die meisten Imagebauer legen großer Wert darauf, ihre Images mit individuellen Verbesserungen zu versehen. Dies betrifft natürlich die Schwarzseherfähigkeiten, aber auch andere Eigenschaften wie GUI-Menus, Plugins, Logos etc. Die "Verbesserungen" diesbezüglich sind in fast allen Fälle ziemlich überflächlich, und tragen nur selten zu wirklichen Funktionalitätsverbesserungen oder -Erweiterungen bei. Auch zu den Modifikationen, die nicht mit Schwarzsehen verknüpft sind, wird Quellcode geheim gehalten. Dies gilt auch für verwendete Buildscripte etc. In einem Fall wird eine Weiterdistribution untersagt (sowohl von unmodifizierte, als auch für modifizierte Images), sogar Anleitungen zu Modifikation (egal für welche Zweck) werden verboten!, angeblich um die Benutzung für Schwarzsehen zu verhindern...

Es ist verständlich, dass die Imagebauer in gewissem Sinn markieren wollen, was sie erschaffen haben — trotzdem ist es ja eine kreative Tat. Durch 1. oder 2. oben macht man aber dadurch freie Software unfrei, indem man weiteres "Sharing" (sowohl von eigene Beiträge als auch von den "99%" der Programmcodes, der unverändert durchgereicht wird) untersagt. Traurig ist, dass das Sharen von Software keinen Stellenwert hat; man ist

sogar stolz über geheim gehaltene ("non-public") Teile. (Vielleich hat man Angst, dass eine Veröffentlichung schlechten Programmierstil, oder "geklaute" Teile verraten würde?)

Formell sagt man, dass 1. und 2. oben die GPL verletzt. Wie oben beschrieben, sehe ich dies nicht als ein Verletzung irgenwelcher langweiligen und uncoolen Bestimmungen, sondern als ein *unkooperatives Verhalten*: Es werden Programme, frei im Sinn der GPL zu Verfügung gestellt, und man bedankt den Autoren und der Welt damit, dass man abgeleitete Werke unfrei macht. Es ist auch eine zweifelhaftes Verständniss von "intellektuellem Eigentum" (sowohl in formellem als auch in moralischem Sinn). Den ursprunglichen Authoren und Copyrightinhabern verneint man ihre Rechte indem man ihre Lizenzbestimmungen ignoriert. Selbst fordert man aber, dass der Rest der Welt die eigenen Bestimmungen (die sich oft die ursprungliche wiedersprechen) unbedingt respektiert.

2.3.6. Das Tuxbox Forum

Für das Tuxbox-projekt, wie vom Forum und Wiki definiert, gelten folgende Regeln (in meiner Formulierung):

1. Schwarzsehen wird nicht toleriert, auch nicht Diskussion darüber. Die Foren, die sich mit Schwarzsehen befassen, oder dulden, werden (in Anlehnung an Star Wars) "die dunkle Seite" genannt.
2. Die Images von dietmarw, YADI und Jack the Grabber ("JtG") gelten als die drei "offiziellen Images" des Tuxbox-projekts.
3. Alles andere als die drei "offizielle Images", und natürlich selbstgebautes, also auch "illegale Images" wo das "Schaftmachen" (in Sinn von oben) nicht stattgefunden hat, gelten als illegal.
4. Support für "illegale Images" werden verweigert, weil sie illegal sind, und weil sie (nicht a priori, aber in allen bekannten Fällen) "GPL verletzen".
5. Die "offiziellen Images" unterstützen out-of-the-box nicht den Empgang von Premiere, auch nicht mit gültiger Lizenz und Smartcard. Der Grund ist dass die AGB von Premiere den Empfang mit nicht authorisierter Hard- oder Software untersagt. In diesem Fall wird das "Scharfmachen" dem Benutzer überlassen: Entweder durch Austausch von einem enthaltenen Programm durch ein anderes, in Internet erhältliches, oder eine triviale Sourcecodemodifikation wird die Software in der Lage sein Premiere, mit einem gültigen Smartcard, zu empfangen.
6. Die oben genannten Firmwarefiles (ucodes) dürfen nicht verbreitet werden. Die "offiziellen Images" werden ohne sie zur Verfügung gestellt. Das Extrahieren und das von Betanova unabhängige Benutzen wird als unproblemstisch angesehen, solange sie aus dem original legalen Betanovaimage des Benutzers gewonnen wurden.

Im Tuxboxforum haben sich besondere Sitten entwickelt. Ablehnung vom offensichtlich illegalem Schwarzsehen, und man "hat" GPL. Man supportet "die drei offiziellen Images". Support für andere (ausser selbstgebastelte, ohne Schwartseherzusätze) wird verweigert, nicht nur aus gesetzliche Gründen, sondern (völlig konsequent und richtig)

weil sich die Images "der dunklen Seite" sich auf, (zumindest im Detail) in geheimen Art und Weise modifizierte Quellen, und deswegen korrekte Antworten nicht möglich seien. Dabei geht man sehr "pragmatisch" mit den Mangel von Quellen zu dem JtG-Image um (siehe unten).

Das Verständniss von GPL scheint auch sehr "pragmatisch" zu sein. GPL wird als eine Sammlung feine, aber schwierig zu verstehende Regeln zu sein. Z.B. wurde einmal die Frage, falls das Bereitstellen der Quellen einer Modifikation durch Bereitschaft, auf Anfrage die Quellen zu mailen, abgedeckt ist, als "Auslegungsinterpretation" (fehlerhaft) eingestuft. Die Grundcharakter, GPL als Inkarnation der Idee der Sharing von Software wird nicht verstanden.

Viele Teilnehmer des Tux-Forums betätigen sich auch, mit den gleichen Nicknames, in Foren der dunklen Seite. Dabei sind sie fast ohne Ausnahme sich der unterschiedlichen Regeln und Sitten der Foren bewusst.

Die naive Idee, dass man das Böse (hier: das Schwarzsehen) durch Verbote (Einschränkungen der Freiheit der Software) bekämpft, ist sehr verbreitet (siehe z.B. die (teilweise recht amüsante) Diskussion über den Einsatz von Filesysteme mit effizientere Kompression). Es ist dabei mehr als unwahrscheinlich, dass irgendwelche Teilnehmer der dunkeln Seite sich von irgendetwas "bösem" durch ein Verbot (oder durch binary-only Programme) aufhälten lassen.

2.3.7. Zu den drei "offiziellen Images"

2.3.7.1. Die dietmarw-Images

Die dietmarw-Images werden nach Änderungen im CVS jede Nacht automatisch gebaut und zum Download zur Verfügung gestellt. Sie sind aus den tagesaktuellen Quellen, mit im CVS verfügbaren Werkzeugen gebaut.

2.3.7.2. YADI-images

Als die AlexW-Images eingestellt wurde, gab es keine automatische und reproduzierbare Art, Images zum Tuxboxprojekt zu bauen. Das Zeil des YADI-Projekts war, (und ist noch laut YADI Homepage): *"Yadi versucht den Prozess der Imageerstellung basierend auf dem GNU DBox2 Software Projekt, durch diverse Scripte und Patche zu vereinfachen bzw. zu automatisieren. Zusätzlich gibt es hier fertige Images im SquashFS und JFFS2 Format"*. Werkzeuge (shellskripte) wurde geschrieben, um ein Image automatisch und reproduzierbar zu erstellen. Die so erstellte Werkzeuge ("das YADI-Skript") waren aber in keinste Weise ein Entwurf für ein richtiges Buildsystem für die Tuxbox, sondern eher als eine laienhaftige Sammlung von Shellskripte zu sehen. In 2004 könnte trotzdem das YADI-Skript ein benutzbares Image erstellen. Es wurde auch unterhalten. Eher als "Nebenprodukt" wurde das so erstellte Image zur Verfügung gestellt: das YADI-Image. Seitdem, scheint es, haben ursprüngliche Mitglieder das Projekts verlassen, und es scheint

so, dass "YADI" nur noch aus ein bis zwei Personen besteht. Seit geraumer Zeit wird das YADI-skript nicht mehr gepflegt, und kann auch nicht mehr ein Image erzeugen. Die ursprüngliche Zielsetzung ist also inzwischen nicht mehr existent und statt dessen wird gelegentlich ein "YADI-Image" ins Netz gestellt.

2.3.7.3. "Jack the Grabber"-Images

Ursprunglich als Image optimiert um zusammen mit dem Closed-Source Programm Jack the Grabber zu funktionieren, wurde das sogenannte "Jack The Grabber"-Image (JtG) veröffentlicht. Bei JtG scheint man nicht viel vom Sharing der Software zu halten. (Siehe Haftungsausschluss und Nutzungsbedingungen, siehe auch Regeln für den JtG-Image Bereich.) Das Image verletzt die GPL in mehrfacher Weise: Es sind einige Modifikationen dadrin enthalten, z.B. an Neutrino, wobei die Quellen nicht zur Verfügung gestellt werden. (Wobei die Modifikationen oft früher oder später in irgendeiner Form ins CVS einfliessen.) Die Verpflichtigung, das abgeleitete Werk gleich frei wie die Quellen zu Verfügung zu stellen wird völlig ignoriert: Laut JtGs Bestimmungen darf das Image nicht weiterverbreitet werden, ein Recht zu Weiterentwicklung (egal für welche Zweck) wird dem Benutzer verneint, und sogar das Veröffentlichung von Anleitungen zu Modifikation (egal zu welchen Zweck) ist untersagt! Das Letzte ist nicht nur eine Verletzung der Softwarelizenzen sondern auch ein Versuch, die Recht der freien Meinungausserungen einzuschränken. (Nicht einmal Microsoft traut sich sowas zu...) Werkzeuge ("Buildskripte") zu Erstellen des Images werden nicht Veröffentlicht. (Ich habe ganz klare Indizien, dass der Imagebauer das Imagebauen als wohlgehütetes Geheimniss halten möchte.)

2.4. Building Flash Images and YADDs with newmake

2.4.1. Revision history

Date	Description
2006-02-14	Initial version.
2006-03-02	Updated script fragments to take into account that customization scripts are now called as `./$@-local.sh` (previously `sh $@-local.sh`), making `$0` different.
2006-03-19	Minor changes. Added section on root partition size.
2006-04-15	Mention custiomizationsdir. Added paragraph on "script" as "misnormer". Added comment on bad magic bytes. Added link to the architecture document.
2006-04-17	Rewrote Cleaning targets (to reflect changes). Updated URL to the GNU Make manual.

2006-07-19	Minor spellfixes, reference to the German Version.

2.4.2. Introduction

Eine deutsche Version dieses Dokuments ist hier verfügbar.

This document covers newmake from the user's perspective, and covers image and yadd builds, and elementary customization. The architecture of newmake is described in another document.

2.4.2.1. Some history

A few years ago, image creation for the Tuxbox software was a black art. The Makefile support was quite incomplete, in particular for other images than cramfs-images. Not only were the CVS tools bad or incomplete, worse, some parts were deliberately kept secret, namely the tool, now known as `mkflfs`, available in the CVS-directory `.../hostapps/mkflfs`. According to a posting from this time, most developers were not able to build an image. The "Guild of the Image makers" was born. Most well-known from this time are the "AlexW-Images": mainly consisting of CVS-sources, but with some, more-or-less secretly held "fixes", (probably) necessary for building a functioning image out of the CVS-sources.

In August 2003, in a project that called itself "GNU DBox2 Software Project", it became increasingly embarrassing to keep `mkflfs` secret, and the sources for `mkflfs` were checked in to CVS. Also, the Makefile gradually improved in functionality. Still, much was left to be desired: functionality, maintainability, sound software design. Building an image from pure CVS was not really possible.

In 2004 the YADI ("Yet Another DBox Image") project was born. (Do not confuse "YADI" and "YADD"!) Its goal was to automate and to simplify image creation. For this, a number of scripts and patches were incorporated and/or written. Additionally, flash-ready images were provided.

YADI was a big success. The goal was achieved. Images were made available, based (almost?) completely with free software -- both in its content, and the tools involved, in a way that was open to the user. With the YADI-script, automatic image creation was possible. However, instead of addressing the fundamental weakness in the CDK build process, they provided scripts to build images. They did not provide a build mechanism for a software project. Software project are built with a software build system, like make, or a later successor, such as Ant or Maven, not with shell scripts.

newmake, presently as alternative branch in CVS, tries to address these weaknesses.

I would like to thank everyone who have provided bug reports and feedback, in particular dietmarw, who is using *newmake* to build the dietmarw-images.

2.4.2.2. Goal

The goal of the present article is to provide the reader with basic know-how. It is not the goal to provide an idiot-proof step-by-step instruction (like the so-called HOWTOs). Prior exposure to shell scripts is required for many parts, in particular the customization chapter and the appendix, however not for image/yadd creation in its simplest form.

The present document (at least in the present version) does not try to describe the inner working of the make file and the make process. For this, the reader is referred to the sources (which *are* somewhat commented!), and to the relevant threads in the Cross Development Kit section of the Tuxbox forum. Also, we do not describe all options to `configure`, only the most common and important ones.

2.4.2.3. How hard is it?

My answer would be: It is as hard as reading this article. The reader understanding most herein should not have any problems; for the reader for which most of this is gibberish, hmm, it may be wiser to stay with ready-made images.

2.4.2.4. General

There are two possible goals when compiling the source: Either "YADD" or image. "A YADD" consists of a few files that the dBox loads using the TFTP-Service, and a filesystem, made accessible to the dBox from a NFS-Server (see this article). This mode of operation has many advantages when developing the Tuxbox software, or when learning the system. The name "YADD" once meant "Yet Another DBox Distribution". Unfortunately, this misleading and throughout silly name has stuck.

My suggestion to the apprentice image/yadd-builder is: First build a YADD with your favorite GUI, and get it to work. Next step would be to build a jffs2-image, again with your favorite GUI.

Most people would like to combine and/or automate the steps described below. As opposed to "HOWTOs", this guide is aimed at understanding the involved issues, and leaves scripting to the reader. The reader with reasonable prior exposure to shell scripts should have no problem writing his/her own build script after reading this guide.

In this article, "GUI" will denote either Neutrino or Enigma. "Filesystem" in the context of a complete image will denote the file system where the root resides: This may be *cramfs* (a compressed, read-only filesystem for embedded devices), *squashfs* (another compressed, read-only file system, often considered to be more efficient than cramfs), or *jffs2* (a journalled read-write filesystem). A "cramfs (full) image" consists of a root file system, using the cramfs file system, and a (smaller) jffs2 filesystem, that is to be mounted on `/var`. The analog statement holds for "squashfs (full) images", while a "jffs2 (full) image" does not have a separate `/var` file system, since the root files system, being jffs2, is writeable. Additionally, the full images contains an additional partition,

containing the u-boot boot loader. This part is different between dBoxes with one and two flash chips. This is indicated by "1x" and "2x". A complete image carries the name `[neutrino,enigma]-[cramfs,squashfs,jffs2].img[1,2]x`, e.g. `neutrino-jffs2.img2x`.

2.4.3. Build system prerequisites

The prerequisites on the host for building Tuxbox images and yadds can be summarized in: A modern Unix/Linux system with some 2 GB of free disk space. The Tuxbox project does not have a favorite host environment, and in general, questions like "Can Redhat x.y build it?" will not get a definite answer. The reason for this is that no-one really cares to keep track of the features of particular distributions. Requirement are instead formulated for versions of the tool, like autoconf, automake, make, etcetera. The official tool version requirement at the time of this writing is summarized in the following table:

Tool	Required Version
autoconf	2.57a
automake	1.8
libtool	1.4.2
gettext	0.12.1
make	3.80
makeinfo	any
tar	any
bunzip2	any
gunzip	any
patch	any
infocmp	any
gcc	= 2.95 or >= 3.0
g++	= 2.95 or >= 3.0
flex	any
bison	any
pkg-config	any
wget	any

The build process will automatically check some of these requirements. If you miss one of the programs, of if your version is older than the above requirements, in general it is

much quicker to installed the required version (either all compiled package, e.g. in rpm-format from your distributer, or getting it in source format, compiling and installing yourself), than to try to find out if the above requirements *really* are necessary.

Note:

Other descriptions require tools like `fakeroot`, `mksquashfs`, `mkcramfs`, `mkjffs2fs` (or `mkfs.jffs2`), and, possibly, `mklibs` to be installed on your system. In our setup, this is not required.

On my SuSE 10.0 system it was necessary to install these extra packages: `autoconf`, `automake`, `gcc`, `bison`, `flex`, `gcc-c++`, `newcurses-develop`, and `zlib-develop`.

Building on a Unix, non-Linux system should probably be possible, as long as the required GNU Tools are installed. Using a non-GNU make will almost surely not work, since GNU-extensions are used freely.

Likewise, compiling with Cygwin *"should"* work, although no-one has done it during modern times (as far as I am aware of).

2.4.4. Checking out the sources

The Tuxbox sources is distributed through the Tuxbox CVS server. Regular source releases are presently neither made, nor planned. For our purposes, the source are "checked out" (= copied to your local disk) anonymously by first creating an empty directory, say `/tuxbox/head`, at a (local) disk with "lots" of free space, cd-ing to it, and issuing the command

```
cvs -d anoncvs@cvs.tuxbox.org:/cvs/tuxbox -z3 co -f -r newmake -P .
```

Note the period at the end of the previous line! This command checks out the *newmake* files, and for the cases where no *newmake* version is available, the HEAD version.

In HEAD, there are two files `cdk/root/etc/init.d/rcS` and `root/etc/init.d/rcS.insmod`. In *newmake*, these are instead *products*, which are *generated* from its source `root/etc/init.d/rcS.m4`. It is therefore advisable to delete `cdk/root/etc/init.d/rcS` and `cdk/root/etc/init.d/rcS.insmod`, just to be on the safe side.

At this point, it may be desirable to apply some source patches to the sources. If you are compiling for the first time, it is advisable not to apply patches. If problems occur, it is much easier (both technically *and* socially) to help someone who is using the "unmodified CVS sources".

2.4.5. Configuring

Next some intermediate files are generated. Change to the `cdk` subdirectory, and issue the command

```
./autogen.sh
```

(with no arguments). This creates, among other things, a shell script called `configure`. This script is executed, given a number of options, to set up the system for building an image/a yadd according to the users wishes. For a complete list of options, use the command `./configure --help`. This guide will only describe a typical use, and some other options the author happens to consider useful. The spirit of the configuration options are like in typical GNU tools. A typical use, compatible with the selection above, may be

```
./configure --prefix=/tuxbox --with-cvsdir=/tuxbox/head
--enable-maintainer-mode
```

The `--with-cvs-dir` states where the sources are located (should have a subdirectory `cdk`), while the `--prefix` states that a number of important directories are to be created as subdirectories of said directory. Their location can be further influenced by some other configuration options, `./configure --help` produces the full list. `--enable-maintainer-mode` is practical, also for not-maintainers, since it enables the created Makefiles to be automatically rebuild when the need arise (for example after some software updates).

There are other useful options available; some are being discussed below.

Please examine the output of `autogen` for errors and warnings. The warning

```
/usr/local/share/aclocal/pkg.m4:5: warning: underquoted definition of
PKG_CHECK_MODULES
```

from `autogen.sh` can be ignored, as well as these warnings from `configure`:

```
configure: WARNING: using tuxbox mklibs
checking for mkcramfs... no
configure: WARNING: using tuxbox cramfs
checking for mkjffs2... no
checking for mkfs.jffs2... no
configure: WARNING: using tuxbox mkfs.jffs2
checking for mksquashfs... no
configure: WARNING: using tuxbox squashfs
```

Note:

The reader comparing this document to similar descriptions from "the dark ages" have noted, that the option `--with-targetruleset=[standard,flash]` is no longer used. During "the dark ages" it was necessary to, during configuration time, restrict yourself to building either yadds, or images. In *newmake* this is no longer necessary.

Warning:

Do not try to build as root!

2.4.6. Compiling

The high-level make targets relevant for building (full) images are: `flash-[neutrino,enigma,all]-[cramfs,squashfs,jffs2,all]-[1x,2x,all]`. For YADD-builds, these are: `yadd-[neutrino,enigma,all]`. For example, the

command

```
make flash-neutrino-jffs2-all yadd-enigma
```

will build flashable jffs2-only images with Neutrino, both for 1x-boxes and for 2x-boxes (filenames `neutrino-jffs2.img1x` and `neutrino-jffs2.img2x`). Also, a YADD containing Enigma will be built.

On my Athlon XP 1800 a command like `make yadd-neutrino` in a clean directory takes around one and a half hour.

2.4.7. Where do we go from here?

2.4.7.1. Booting the YADD

If a YADD just have been built, proceed to this article for setting up a YADD server. Note the make-target `serversupport` that generates some setup files for the server, interfacing the build with the server setup seamlessly.

2.4.7.2. Flashing the image

If an image has been build, next step would be to read it into the flash memory of the dBox, called "flashing". For this, I recommend either using the interactive flashing of Neutrino (dBox -> Services -> Software update -> Expert functions -> Write whole image), or the dboxflasher described here. The dboxflasher is built by the make-target `serversupport`. Other possibilities for flashing are described in Tuxbox Wiki.

2.4.8. Incremental builds

In general, people are not interested in just building the software once. Improvements to the sources are checked into CVS on a daily basis. Also, many people would like to improve the software, either by applying other peoples patches (e.g. from my patch page :-), or by programming themselves. It is then desirable for make to rebuild what is needed, no more and no less. The present "*newmake*" goes a long way in that direction. To rebuild a make-target `target`, just issue the command `make target`, and make will remake that target. It can then happen, that make starts (re-)building a completely different component! This is, at least most of the time, the right thing to do, since the target may depend on other parts, which have changed, making a renewed build of that component necessary.

In some situations, it may be desirable to *force* a rebuild of a component. Several components are downloaded in a distribution file to the directory `cdk/Archive`, and when the build takes place, unpacked, patches are applied (only in some cases), configured, compiled, installed, and the sources then deleted again. Everything takes place automatically. The installation of the particular package is recorded by a marker file in directory `cdk/.deps`. Used on unpack-compile-install-delete-packages, this technique is not as bad as when (mis-)used in other contexts (like the HEAD branch in

CVS still does). If desired, such a marker file can be removed, forcing rebuild of the associated component.

2.4.9. Cleaning targets

There is a large number of different cleaning targets:

`distclean`
The most drastic cleaning target, deleting (almost) everything that was not checked out from CVS. This is seldomly necessary.

`mostlyclean`
A smarter target is `mostlyclean`, that cleans in the directories containing "tuxbox-sources", but leaves the compilation environment, and all unpack-compile-install-delete-components alone. Also, the cdkroot directory, (i.e. the yadd-installation), as well as the TFTP-files (kernel and u-boot) are not touched.

`depsclean`
Deletes all marker files in the `.deps` directory, thus forcing recompilation of all unpack-compile-install-delete-components. This is seldomly sensible: They depend on their sources, and, possibly, a patch file, and the Makefile knows these dependencies.

`clean`
Combines `mostlyclean`, `depsclean`, and `flash-clean`. Also tries to delete as much as possible in the cdkroot directory, that was not installed during the bootstrap run. Thus, it is *attempted* to bring the environment to the stage when the build environment has just been compiled, for example by `make bootstrap`.

`flash-semiclean`
This target deletes most build directories in `$(flashprefix)`, but leaves the built boot-partitions and kernel build directories alone. This is often sensible, since these components change comparatively seldomly.

`flash-mostlyclean`
In addition to `flash-semiclean`, this target also deletes boot-partition files and the kernel build directories. Build full images are left untouched.

`flash-clean`
This target deletes all components in `$(flashprefix)`.

Some source directories can be cleaned with a command like `make -C /tuxbox/head/apps/tuxbox/neutrino clean`.

2.4.10. Updating the CVS

To update your sources with the latest commits, use a command like

```
cvs up -f -r newmake -dP > cvs.log 2>&1
```

from the top CVS directory (or from another directory, if you know what you are doing).

Possible errors are put into the log file `cvs.log`.

2.4.11. Customization

The built images and yadds can be customized without changing the Makefiles. First of all, there are some `configure`-options: using `--with-ucodesdir=DIR` a directory, containing ucodes to be included in the image, can be given. (Note that an image containing ucodes can not legally be distributed.) Secondly, the option `--with-logosdir=DIR` can give a directory containing boot logos (`logo-lcd` and `logo-fb`) to be included.

More elaborate customization is possible. For this, it is necessary to have some knowledge about the inner working of the makefile. In the sequel, `$(flashprefix)` will denote the value of the makefile variable `flashprefix` (with the configure line above `/tuxbox/cdkflash`), `$(targetprefix)` will denote the value of the makefile variable `targetprefix` (with the configure line above `/tuxbox/cdkroot`), and `$(buildprefix)` will denote the value of the makefile variable `buildprefix` (with the configure line above `/tuxbox/head/cdk`).

In order to build, say, `neutrino-cramfs.img2x`, the following directories are being built: `$(flashprefix)/root` (containing filesystem and gui-independent components), `$(flashprefix)/root-cramfs` (containing the kernel, built for root filesystem on cramfs, together with its drivers), and `$(flashprefix)/root-neutrino` (containing the neutrino-installation). From these three directories, the root filesystem directory `$(flashprefix)/root-neutrino-cramfs` and the `var`-filesystem directory `$(flashprefix)/var-neutrino` are built.

Of course, it is possible to invoke a command like `make $(flashprefix)/root-neutrino-jffs2` (whereby the user have to expand `$(flashprefix)`, it is a make variable, but not a shell variable), then manually do the desired changes to `$(flashprefix)/root-neutrino-jffs2`, and then, with the command `make flash-neutrino-jffs2-2x` have the final image build, containing the manual changes. This can be desirable for the one-time image builder. However, in many cases a more automatic and systematic methodology is desired, described next.

Many of the major targets calls a customization script, if present and executable. The name of the customization script is taken as the non-directory part of the rule, with `-local.sh` appended. The script is supposed to reside in *customizationsdir*, which is selectable with the `./configure`-option `--with-customizationsdir`. It defaults to the cdk directory. The script is given two arguments: For image targets these are `$(flashprefix)` and `$(buildprefix)`; for yadd-targets these are `$(targetprefix)` and `$(buildprefix)`.

Actually, "script" is a bit of a misnormer, since they are just executed as any programs

with two arguments. Instead of shell-scripts, these may be, e.g., compiled C programs or Perl-scripts.

However, the customization files for the make-targets `version` and `flash-version` (creating the `/.version` files in YADD and the image respectivelly) are not executed at the end of the normal actions, it *replaces* them.

The custiomization script facility is illustrated by the following example.

2.4.11.1. Example

In an image, it is desired to:

1. Use own /etc/hosts,
2. Use own neutrino.conf, bouquets.xml, services.xml
3. Include the lirc component, together with own lirc configuration files.

1. and 3. are extensions that should be done to `$(flashprefix)/root`, while 2., being a Neutrino-fix, should be done to `$(flashprefix)/root-neutrino-jffs2`, `$(flashprefix)/root-neutrino-cramfs`, or `$(flashprefix)/root-neutrino-squashfs`. To achieve 1. and 3. we write the script `root-local.sh`, say:

```
#!/bin/sh

flashprefix=$1
buildprefix=$2
newroot=$flashprefix/root
myfiles=/home/somewhere/dbox/myfiles

cp -f  $myfiles/etc/hosts                 $newroot/etc
make flashlirc
cp -fr $myfiles/var/tuxbox/config/lirc
$newroot/var/tuxbox/config
```

The script for 2., say, `root-neutrino-local.sh`, is entirely similar:

```
#!/bin/sh

flashprefix=$1
buildprefix=$2
newroot=$flashprefix/root-neutrino
myfiles=/home/somewhere/dbox/myfiles

cp $myfiles/var/tuxbox/config/neutrino.conf  $newroot/var/tuxbox/config
cp $myfiles/var/tuxbox/config/zapit/bouquets.xml
$newroot/var/tuxbox/config/zapit
cp $myfiles/var/tuxbox/config/zapit/services.xml
$newroot/var/tuxbox/config/zapit
```

Note:

These scripts are intended to serve as examples, and can probably not be used without modification.

2.4.11.2. Changing the partitioning

As of 2006-03-19, the root partition size for cramfs and squashfs images can be selected with the configure-option `--with-rootpartitionsize=SIZE`. The size of the `var`-partition is automatically computed to use all remaining flash space, i.e. everything not used by the other partitions. Default size is 0x660000. This number should be a multiple of the erase size, presently 0x20000. Ignored (while meaningless) when building jffs2-images.

2.4.12. Some "best practices"

In this section, we collect some rules that are not "necessary" to get the right result, however, they may in the long run lead to better and more reliable and maintainable software. They apply both to customizations and future changes to the Makefile (and its components) itself.

If you do not like these rules, feel free just to ignore them, at least if you are writing customization scripts for your own usage.

2.4.12.1. Idempotence

It is almost always a good idea to try to make a setup-script *idempotent*. That means, that executing it several times has the same effect as executing it once.

2.4.12.2. Use "make install", do not just snarf individual files!

"Traditionally", the Tuxbox Makefile first installed packages in `$(targetprefix)`, and then created the image directories by copying individual files from the `$(targetprefix)` hierarchy. This is not very good software engineering. First, the know-how on the installation of the package *package* should sit in *its* Makefile, not in a some general Makefile, just snarfing together already copied files. If that package changes in the sense that a configuration file is added or deleted, it is necessary to change also in the global makefile.

It is often the case, that the Makefile belonging to the package installs include files, (static) libraries, info-files etc., that are not wanted on an embedded system with restricted memory. The correct solution to this (real!) problem would be to modify the Makefile of *package*, either to write a `flashinstall` target, or to provide the Makefile with a parameter like `installsize=[full,flash]`. If this is not feasible, it is my opinion that `make -C ... install` followed by deletion of unwanted files still is better than copying individual files. Note that, in the step that makes the directories `$(flashprefix)/root-gui-filesystem`, the include directory, as well as all static libraries are deleted, and shared libraries are stripped of unused symbols.

2.4.13. Answers to some questions

2.4.13.1. What if it does not build?

There is no standard procedure on what to do when the build fails. I will here try to give some guidelines, to be read before posting to the forum.

First of all, examine the output of the first two steps, autogen.sh and configure for errors and warnings. Every warning or error, except for the five messages listed above indicates a problem that will most likely make build impossible.

If a build breaks, it may leave the build environment in an inconsistent state. This is in particular true for the directories in `$(flashprefix)`. If the build of such a make target breaks, the directory will exist, be up-to-date according to their file modification time, and a subsequent make command will treat it as finished and ok. Of course, an incorrect build will result. Therefore, if a build of a directory in `$(flashprefix)` breaks, please delete it before trying another make command.

By "it worked yesterday"-problems, probably the build environment is in an inconsistent state. Issuing a more-or-less drastic cleaning command (see above) and trying recompiling might be faster than systematic problem search.

If you need help, see below.

2.4.13.2. After flashing I get "Kein System" on the LCD/What is this "bad magic byte" business?

Uhh, I hoped the question would not come up... The short answer is: I do not know. We do not know. But if you are reading this article this far, you do not expect "short answers", but "good answers". Ok. The issue has been discussed at length here. In short the image "is" ok, it is just that some firmware in the dBox rejects it because it finds some "bad magic bytes" on certain addresses. The forum participant mogway wrote a program, in CVS available in the directory `hostapps/checkImage`. The program detects these "bad bytes", but it does nothing to correct them. My own experience says that images `checkImages` says are OK really runs. cramfs or squashfs images which `checkImage` complain about, in general do not run, in some cases they do. jffs2-images that `checkImage` complains about *in general*, but not always, runs. With these empirical observations, I leave the possible usage of `checkImage`, and the subsequent decisions, to the user, with no further recommendations.

newmake knows how to build and how to invoke this program to automatically check the generated images. The configure-option `--with-checkImage=[none,rename,warn]` may be used. If `warn` is selected, then for every image that do not pass the test, a dummy, zero-length file is generated, name as image file with `_bad` appended. If `rename` is selected, the questionable image file is instead renamed.

It can be mentioned that the "bad magic bytes" sit in one (or more!) of the partition files,

and are not generated by the final step (building the *.img1x and/or *.img2x files). It is possible to invoke `checkImage` on the image files (`*.jffs2`, `*.cramfs`, `*.squashfs`, `*.flfs1x`, `*.flfs2x`). Finally, `checkImage` has a debug-option that may be useful.

2.4.13.3. I have found a mistake or a bug!

Bugs, gripes, suggestions for improvement of the software should preferably go to the Cross Development Kit section of the Tuxbox forum. Issues regarding this text -- mistakes (technical matters, spelling, grammar, pedagogical), suggestions for improvements and extensions -- can go to me directly, however, "discussion" is probably better off in the forum.

2.4.13.4. I need help!

Requests for help can be posted in the Cross Development Kit section of the Tuxbox forum. Postings in German or English are welcome. Please include the configuration options used in the posting.

Please do not mail or PM me personally, since I do not provide personal free-of-charge support. (*After* having posted the problem, a PM/mail politely pointing to the thread and asking for my answer is ok.)

2.4.13.5. Parallel make?

Recently, when the GHz-explosion ceased, the idea of multiprocessor computers got popular again, in particular in the "budget" form of dual core processors. Builds are in general intrinsically parallelizeable, and should be able to take advantage of several processors. In particular, since many years GNU make supports parallel builds (issuing several commands in parallel) (the `-j` option, with or without an argument). Can this be used to compile the Tuxbox software in parallel?

The short answer is: "Parallel builds are not supported. But you are welcome to work on it." With the present setup, some components (kernel, u-boot, busybox,...) are built in different versions, for example, there are different kernels for YADD, and for the three different file systems. Different versions can not be build in parallel, since the same files/filenames are being used.

Also when no multiple versions of the same component are being built, a command like `make -j flash-neutrino-jffs2-2x` presently does not produce correct result. Feel free to work on it!

2.4.13.6. Kernel 2.6?

Kernel 2.6 is not supported (even if there are some lines regarding it in the source). Feel free to work on it.

2.4.13.7. Update images

Sometimes image builders have distributed "update images", consisting of the cramfs (sometimes squashfs) filesystem image, to be flashed as a partition -- in general partition 2. *newmake* also supports this habit. Just, e.g., `make $(flashprefix)/root-neutrino.cramfs`. Neutrino's "expert" flash function recognizes the *newmake* file extensions since 2006-01-02.

2.4.13.8. How do I convert 1x-images to 2x, or vice versa?

You don't. The here outlined procedure builds any, whatever the user desires. Also, all legal images are available in both 1x- and 2x-version.

2.4.14. Appendix. Some useful customization script fragments

In this appendix, some useful customization scripts will be shown. Two scripts have already been shown above.

Warning:

Although in many cases usable as they are, the scripts are intended as *examples*, not solutions to real problems. For this reason, the examples are included here as code snippets, not as downloadable files. Please do not use unless you understand how they work, at least roughly. To incorporate in the building/customization process requires at least elementary script-writing experience.

2.4.14.1. Games and Languages nuker

This file deletes all games (defined as plugins with `type=1` in their configuration file), as well as unwanted languages files (neutrino assumed). This file should probably be called from (or included in) `root-neutrino-$filesystem-local.sh`

```
#!/bin/sh

# Nukes all game plugins, as well as all locale files not listed in
LANGUAGES

newroot=$1/root-neutrino-jffs2
LANGUAGES="deutsch english"

for f in $newroot/lib/tuxbox/plugins/*.cfg; do
    grep 'type=1' $f>/dev/null && rm -f
$newroot/lib/tuxbox/plugins/`basename $f .cfg`.*
done

for f in $newroot/share/tuxbox/neutrino/locale/*; do
    (echo $LANGUAGES | grep -v `basename $f .locale` >/dev/null) && rm
-f $f
done
```

2.4.14.2. Customizing the /.version file

To create your own `/.version` file (shown by Neutrino by `dBox -> Services -> Image Version`) is surely a common requirement. Here is the file I am presently using for this:

```
#/bin/sh

if [ $0 = ./flash-version-local.sh ] ; then
    outfile=$1/root/.version
    type="image"
else
    outfile=$1/.version
    type="yadd"
fi

echo Creating $outfile ...

echo "version=`./mkversion -snapshot -version 200`"      > $outfile
echo "creator=Barf"                                     >> $outfile
echo "imagename=Barf-$type"                             >> $outfile
echo "homepage=http://www.bengt-martensson.de"          >> $outfile
```

This file can both be used with the name `flash-version-local.sh`, as well as the name `version-local.sh`, for creating the `/.version`-file for images and yadds respectively. Note the evaluation of `$0` (which contains the actual name, under which the script is called). The called script `mkversion` creates the somewhat cryptical version string, and is simply an "encapsulation" of its idiosyncrasies. It is shown here:

```
#!/bin/sh

releasetype=3
versionnumber=000
year=`date +%Y`
month=`date +%m`
day=`date +%d`
hour=`date +%H`
minute=`date +%M`

while expr $# > 0 ; do
        case "$1" in
        -release)
                releasetype=0
        ;;
        -snapshot)
                releasetype=1
        ;;
        -internal)
                releasetype=2
        ;;
        -version)
                versionnumber=$2
                shift
        ;;
        esac
        shift
done

echo $releasetype$versionnumber$year$month$day$hour$minute
```

2.4.14.3. Archiving the images

It is the task of the build process to create the flash images, not to archive them. However, the customization can easily be "mis"-used to make some sort of archiving, as the following example shows:

```
#!/bin/sh

flashprefix=$1
imagefile=`basename $0|sed -e s/-local.sh//`
imagefilebase=`echo $imagefile|sed -e s/\.img.x//`
extension=`echo $imagefile|sed -e s/[-a-z0-9]*\.//`
newfilename="barf-"$imagefilebase-`date --iso-8601`.$extension

echo Copying $flashprefix/$imagefile to $flashprefix/$newfilename...
cp $flashprefix/$imagefile $flashprefix/$newfilename
```

The script should have one or more of the names `[neutrino,enigma]-[cramfs,squashfs,jffs2].[img1x,img2x]`. It will rename the file according to the current date. Again, the script is shown to demonstrate a concept, not to be just copied.

2.4.15. References

- The GNU Make manual, online version. Also contained in the software distribution.
- The CVS Manual online, known as "The Cederqvist".
- Open Source Development with CVS, 3rd Edition. A quite useful book, downloadable as PDF (among other formats).

2.5. Flashimages und YADDs mit newmake

2.5.1. Versionen

An English version of this document is available here.

Diese Version ist eine Übersetzung des englischsprachiges Originaldokument. Bitte kontrollieren Sie ggfl. falls das Originaldokument in eine neuere Version vorliegt. Diese Version ist vom 19. Juli 2006.

Die Versionsgeschichte befindet sich nur in der englischsprachige Version.

2.5.2. Einleitung

Dieses Dokument behandelt newmake aus Sicht des Benutzers. Es behandelt Image- und yadd-Herstellung und einfache Benutzeranpassungen ("customization"). Die Architektur von *newmake* wird in einem anderen Dokument beschrieben.

2.5.2.1. Zur Geschichte

Vor einigen Jahren war Imageherstellen für die Tuxbox eine schwarze kunst. Die Makefile-Unterstützung war, insbesondere für andere Images als cramfs-images, ziemlich lückenhaft. Die CVS Werkzeuge waren schlecht, oder unvollständig. Noch schlimmer, einige Teile wurden absichtlich geheim gehalten, nämlich das Werkzeug, jetzt als `mkflfs` bekannt, jetzt im CVS-directory `.../hostapps/mkflfs` vorhanden. Laut einer Forumsbeitrag von dieser Zeit waren die meisten Entwickler nicht in der Lage, eigene Images herzustellen. Die "Gilde der Imagehersteller" wurde geboren. Von dieser Zeit sind die "AlexW-Images" weithin am bekanntesten: hauptsächlich bestehend aus CVS-sources, aber mit einigem mehr-oder-weniger den geheim gehaltenen "Fixes", (vermutlich) notwendig für das Herstellen eines funktionierendes Images aus dem CVS-Quellen.

Im August 2003, in einem Projekt, das sich "GNU DBox2 Software-Projekt" nannte, wurde es in zunehmendem Maße peinlich, `mkflfs` geheim zu halten, und die Quellen für `mkflfs` wurden in CVS eingecheckt. Auch die Funktionalität des Makefiles wurde stufenweise verbessert. Noch wurde viel zu wünschen übrig: Funktionalität, Pflegbarkeit, gesunde Software-Design. Ein Image von reinen CVS-Dateien zu bauen war nicht wirklich möglich.

In 2004 wurde das YADI ("Yet Another DBox Image") Projekt geboren. (Bitte nicht "YADI" und "YADD" verwechseln!) Sein Ziel war, Imagebuilden zu automatisieren und zu vereinfachen. Für dieses Zweck wurden eine Anzahl von Skripte und Patches gesammelt und/oder geschrieben. Zusätzlich wurden flashfertige Images zur Verfügung gestellt.

YADI war ein grosser Erfolg. Das Ziel wurde erreicht. Images wurden zur Verfügung gestellt, die sich (fast?) vollständig auf freier Software basierte -- sowohl in seinem Inhalt als auch bezüglich die involvierte Werkzeugen, in eine Weise, die für den Benutzer transparent war. Mit dem YADI-Skript war das automatische Imagebuilden möglich. Jedoch, statt die grundlegende Schwäche im CDK Imageprozeß zu adressieren, stellten sie Skripte zum Imagebauen zur Verfügung. Sie stellten nicht eine Buildsystem für ein Software-Projekt zur Verfügung. Software-Projekt werden mit einem Software-Buildsystem gehandhabt, wie make, oder ein neuerer Nachfolger, wie Ant oder Maven, nicht mit Shellskripte.

newmake, momentan als alternative Branch in CVS, versucht diese Schwächen zu adressieren.

Ich möchte mich hier bei jedem, der Bugreports und Feedback geliefert haben, bedanken. Insbesonderes gilt dies für dietmarw, der *newmake* benutzt, um die dietmarw-Images zu erzeugen.

2.5.2.2. Ziel

Das Ziel des vorliegenden Artikels ist, dem Leser mit grundlegendem Know-how zu versehen. Es ist nicht das Ziel, eine idiotensichere Schritt-bei-Schritt Anweisung

bereitzustellen (wie die sogenannte HOWTOs). Kenntnis in der Umgang mit Shellskripte wird für viele Teile, insbesondere das Customization-Kapitel und der Anhang, aber nicht für image/yadd Kreation in seiner einfachsten Form gefordert.

Das vorliegende Dokument versucht nicht die innere Funktion des Makefile und des Makeprozesses zu beschreiben. Für dieses wird der Leser auf den Quellen (die sogar ein wenig kommentiert sind) hingewiesen, und zu den relevanten Threads im cross development kit Forums des Tuxbox Forums. Alle Optionen für `configure` werden auch nicht beschrieben, nur die Allgemeinste und Wichtigste.

2.5.2.3. Wie schwierig ist es?

Meine Antwort würde sein: Es ist so schwerig wie diesen Artikel zu lesen und verstehen. Der Leser, der ohne Probleme den Inhalt versteht sollte keine Probleme haben; für den Leser, für den das Meiste von diesem Text Kauderwelsch ist, sollte vielleicht bei fertige Images bleiben.

2.5.2.4. Allgemeines

Es gibt zwei mögliche Ziele: Entweder "YADD" oder Image. "Ein YADD" besteht aus einigen Files, die das dBox vom TFTP-Service lädt, sowie einem Filesystem, von einem NFS-Server (siehe diesen Artikel) für die dBox zur Verfügung gestellt. Diese Betriebsart hat viele Vorteile, insbesonderes während Softwareentwicklung oder beim Erlernen des Systems. Der Name "YADD" bedeutete einmal "Yet Another DBox Distribution" ("noch eine dBox Distribution"). Leider hat sich dieser irreführende und durchaus alberne Namen durchgesetzt.

Mein Vorschlag für den angehende Image/YADD-Lehrling ist: Bauen Sie zuerst ein YADD mit Ihrem Favorit-GUI, und lernen Sie, mit ihm zu arbeiten. Folgender Schritt würde sein, ein jffs2-image, wieder mit Ihrem Liebling GUI zu erstellen.

Die meisten Leute möchten die unten beschriebenen Schritte kombinieren und/oder automatisieren. In Unterschied zu "HOWTOs", versucht diesen Artikel grundlegende Know-How zu vermitteln, und überlassen Scripting dem Leser. Der Leser oder die Leserin mit Vorkenntnisse über Skriptprogrammierung soll nach diesem Text in der Lage sein, seine/ihre eigene Build-Skripts zu verfassen.

In diesem Artikel bezeichnet "GUI" entweder Neutrino oder Enigma. "Filesystem" im Kontext eines kompletten Images bezeichnet das Dateisystem, in dem die Wurzel liegt: Dieses kann cramfs (ein komprimiertes, Read-only filesystem für embedded Systeme) sein, squashfs (ein anderes komprimiertes read-only-Dateisystem, oft als leistungsfähiger als cramfs betrachtet) oder jffs2 (ein "journalled" Read-Write-Filesystem). Ein "cramfs (voll-)Image" besteht aus einem Wurzeldateisystem mit dem cramfs Dateisystem und ein (kleineres) jffs2-Filesystem, das an `/var` gemounted werden soll. Die analoge Aussage hält für "squashfs (voll), das Images", während ein "jffs2-(voll-)Image" nicht ein separates `/var`-Dateisystem enthält, weil das Wurzeldateisystem schon jffs2 ist, und

deswegen schreibbar. Zusätzlich enthalten die vollen Images ein zusätzliche Partition, die den u-boot Bootloader enthält. Dieses Teil ist zwischen dBoxen mit einen und zwei Flashchips unterschiedlich. Dieses wird durch "1x" und "2x" angezeigt. Ein komplettes Image trägt den Namen `[neutrino, enigma]-[cramfs, squashfs, jffs2].img[1, 2]x`, z.B. `neutrino-jffs2.img2x`.

2.5.3. Buildsystem Voraussetzungen

Die Voraussetzungen auf dem Buildhost können in etwa so zusammengefasst werden: Ein modernes Unix/Linux System mit ca. 2 GB freiem Speicherplatz. Das Tuxbox Projekt hat keine favorisierte Buildumgebung. In Allgemen bekommt Fragen wie "geht es mit Redhat x.y?" keine klare Antwort. Der Grund für dieses ist, dass; niemand sich wirklich interessiert, die Eigenschaften der bestimmten Distributionen zu verfolgen. Anforderung werden anstatt für Versionen der Werkzeuge, wie autoconf, automake, make, usw. formuliert. Die offizielle erfordeliche Toolversione beim Zeit dieses Texts wird in der folgenden Tabelle zusammengefasst:

Tool	Required Version
autoconf	2.57a
automake	1.8
libtool	1.4.2
gettext	0.12.1
make	3.80
makeinfo	irgendwelche
tar	irgendwelche
bunzip2	irgendwelche
gunzip	irgendwelche
patch	irgendwelche
infocmp	irgendwelche
gcc	= 2.95 or >= 3.0
g++	= 2.95 or >= 3.0
flex	irgendwelche
bison	irgendwelche
pkg-config	irgendwelche
wget	irgendwelche

Der Bauprozeß überprüft automatisch einige dieser Anforderungen. Wenn Ihnen eins der Programme fehlt, oder, wenn Ihre Version zu alt ist, ist es in Allgemein viel schneller, die erforderliche Version zu installieren (entweder alles kompilierte Paket, z.B. im rpm-Format von Ihrem Distributor, oder die Quellen zu besorgen, compilieren und installieren), als zu versuchen, herauszufinden ob die oben genannten Anforderungen *wirklich* notwendig sind.

Note:

Andere Beschreibungen erfordern dass Tools wie `fakeroot`, `mksquashfs`, `mkcramfs`, `mkjffs2fs` (oder `mkfs.jffs2`), vielleicht auch `mlibs`, auf Ihrem System installiert sind. In unserer Umgebung ist dies nicht erfordelich.

Auf meinem SuSE System 10.0 war es notwendig, die folgende Pakete nachzuinstallieren: `autoconf`, `automake`, `gcc`, `bison`, `flex`, `gcc-c++`, `newcurses-develop` sowie `zlib-develop`.

Builden auf einem Unix, non-Linux System sollte vermutlich möglich sein, so weit die erforderlichen GNU Werkzeuge vorhanden sind. Mit einem anderen make als GNU wird es fast sicher nicht laufen, da GNU-Erweiterungen ungehemmt verwendet werden.

Ebenso, das Compilieren unter Cygwin "soll" funktionieren, obwohl niemand es während der modernen Zeiten getan hat (soweit ich weiss).

2.5.4. Die Quellen auschecken

Die Tuxbox Quellen wird durch den Tuxbox CVS Server distribuiert. Regelmäßige Quellreleases sind niemals gemacht worden, und sind auch nicht für die Zukünft geplant. Für unseren Zwecken werden die Quelle anonym "ausgecheckt" (= kopiert zu die lokalen Festplatte), indem man zuerst ein leeres Verzeichnis erstellt, z.B. `/tuxbox/head`, auf einer (lokalen) Festplatte mit "ordentlich" freiem Platz, cd-ing zu ihr, und den Befehl

```
cvs -d anoncvs@cvs.tuxbox.org:/cvs/tuxbox -z3 co -f -r newmake -P .
```

eingeben. Merken Sie die Periode am Ende der vorhergehenden Zeile! Dieser Befehl checkt die *newmake* Files aus; in den Fälle, in denen keine *newmake* Version vorhanden ist, wird die HEAD-Version genommen.

Im HEAD gibt es zwei Files `cdk/root/etc/init.d/rcS` und `root/etc/init.d/rcS.insmod`. Im *newmake* sind diese anstatt *Produkte*, die von seiner Quelle `root/etc/init.d/rcS.m4` *erzeugt* werden. Es ist ratsam, `cdk/root/etc/init.d/rcS` und `cdk/root/etc/init.d/rcS.insmod` zu löschen, um auf der sicheren Seite zu sein.

An diesem Punkt kann es wünschenswert sein, einige Patches an den Quellen anzuwenden. Wenn Sie zum ersten Mal kompilieren, ist es ratsam, Patches nicht anzuwenden. Wenn Probleme auftreten, ist es viel einfacher (technisch sowohl als auch sozial) jemand zu helfen, das die "unveränderten CVS Quellen" verwendet.

2.5.5. Konfiguration

Demnächst werden einige Zwischenprodukten erzeugt. Ändern Sie zum `cdk` Unterverzeichnis, und geben Sie den Befehl

```
./autogen.sh
```

ein (ohne Argumente). Dieses erzeugt unter anderem einen Shellskript namens `configure`. Dieser wird ausgeführt; dabei wird eine Anzahl von Optionen übergeben, um das System für das Builden eines Image/einer YADD entsprechend den Benutzerwünschen vorzubereiten. Für eine komplette Liste von Optionen, benutzen Sie das Befehl `./configure --help`. Dieser Guide beschreibt nur einen typischen Verwendung, und einige Optionen die der Author für nützlich halten. Der Geist der Konfigurationsoptionen sind wie in den typischen GNU Werkzeugen. Ein typischer Gebrauch, der mit den Pfadnamen oben kompatibel ist, kann sein

```
./configure --prefix=/tuxbox --with-cvsdir=/tuxbox/head
--enable-maintainer-mode
```

`--with-cvsdir` sagt wo die Quellen zu finden sind, (sollte ein Unterverzeichnis cdk haben), während `--prefix` bedeutet, dass eine Anzahl von wichtigen Verzeichnissen als Unterverzeichnisse des besagten Verzeichnisses erstellt werden sollen. Ihre Position kann durch andere Konfigurationsoptionen weiter beeinflußt werden; `./configure --help` produziert die volle Liste der Optionen. `--enable-maintainer-mode` ist, auch für Nichtmaintainers praktisch, da er den hergestellten Makefiles ermöglicht, sich automatisch neu zu erzeugen, sobald die Notwendigkeit entsteht, zum Beispiel nach einem Software-Update.

Es gibt andere nützliche Optionen; einige werden unten besprochen.

Überprüfen Sie bitte den Ausgaben von autogen für Fehler ("Error") und Warnungen. Die Warnung

```
/usr/local/share/aclocal/pkg.m4:5: warning: underquoted definition of
PKG_CHECK_MODULES
```

from `autogen.sh` kann ignoriert werden, sowohl als folgende Warnungen von `configure`:

```
configure: WARNING: using tuxbox mklibs
checking for mkcramfs... no
configure: WARNING: using tuxbox cramfs
checking for mkjffs2... no
checking for mkfs.jffs2... no
configure: WARNING: using tuxbox mkfs.jffs2
checking for mksquashfs... no
configure: WARNING: using tuxbox squashfs
```

Note:

Der Leser, der dieses Dokument mit ähnlichen Beschreibungen "von den dunklen Zeiten" vergleicht, haben gemerkt, das die Option `--with-targetruleset=[standard,flash]` nicht mehr vorhanden ist. Während "des dunklen Zeitalters" war es notwendig, beim Konfigurationszeitpunkt sich auf Builds von *entweder* YADDs *oder* Images sich einzuschränken. Im *newmake* ist dieses nicht mehr notwendig.

Warning:
Versuchen Sie nicht, als root zu builden!

2.5.6. Kompilieren

Die high-level make Targets, die für das Builden von (voll-)Images relevant sind, sind: `flash-[neutrino, enigma, all]-[cramfs, squashfs, jffs2, all]-[1x, 2x, alle ]`. Für YADD-Builds, sind diese: `yadd-[neutrino, enigma, all]`. Z.B. der Befehl

```
make flash-neutrino-jffs2-all yadd-enigma
```

erzeugt flashbare jffs2-only Images mit Neutrino, für 1x-boxes und für 2x-boxes (Dateinamen `neutrino-jffs2.img1x` und `neutrino-jffs2.img2x`). Auch ein YADD, das Enigma enthält, wird erzeugt.

Auf meinem Athlon XP 1800 dauert ein Befehl wie `make yadd-neutrino` in einem leeren Verzeichnisses etwa eins und in einer halben Stunde.

2.5.7. Wohin gehen wir von hier?

2.5.7.1. Booting der YADD

Wenn ein YADD gerade erzeugt worden ist, fahren Sie zu diesem Artikel, über die Einrichtunng eines YADD-Servers, fort. Merken Sie auch das make-Target `serversupport`, das einige Konfigurationsfiles für den Server erzeugt, und den YADD-Build nahtlos an den Server-Setup anknüpft.

2.5.7.2. Flashen des Images

Wenn ein Image gebaut worden ist, ist nächste Schritt das Einspielen des Images in den nichtflüchtige Speicher der dBox, "Flashen" genannt. Für dies empfehle ich entweder, das interaktive Flashen von Neutrino (dBox -> Service -> Software-Aktualisierung -> Expertenfunktionen -> ganzes Flashimage einspielen) zu benutzen, oder der dboxflasher zu verwenden, das hier beschrieben wird. Der dboxflasher wird durch das Make-Target `serversupport` erzeugt. Andere Möglichkeiten des Flashens werden in Tuxbox Wiki beschrieben.

2.5.8. Inkrementelle Builds

Im allgemeinen sind Leute nicht an einem einmaligen Build der Software interessiert. Verbesserungen zu den Quellen werden in CVS täglichen eingecheckt. Viele Leute möchten die Software verbessern, indem sie Patches anwenden (z.B. von meiner Patchseite :-), oder durch eigene Programmierung. Es ist dabei wünschenswert, dass genau die Teile neu erzeugt wird, die neu erzeugt werden muss, nicht mehr und nicht weniger. Das vorliegende "*newmake*" geht ein langer Weg in dieser Richtung. Um ein

Target `target` neu zu bauen, benutzen Sie das Befehl `make target`, und make wird es, falls notwendig, neu erzeugen. Es kann dann passieren, dass make zusätzlich ein vollständig anderer Bestandteil neu erzeugt! Dieses ist, am mindestens in der Regel, die richtige Sache, da das Target von anderen Teilen abhängen kann, die sich geändert haben, und machen deswegen einen erneuerten Build von diesem Bestandteil notwendig.

In einige Situationen kann es wünschenswert sein, ein erneutes Build eines Komponents zu erzwingen. Einige Komponente werden in einem Distributionsfile zum Verzeichnis `cdk/Archive` downloadet, und wenn das Build stattfindet, ausgepackt, Patches werden angewendet (nur in einigen Fällen) , konfiguriert, kompiliert, installiert, und die Quellen dann wieder gelöscht. Alles findet automatisch statt. Die Installation des bestimmten Pakets wird durch das Anlegen einer Markerdatei im Verzeichnis `cdk/.deps` notiert. Verwendet auf Auspacken-kompilieren-installieren-löschen-paketen, ist diese Technik nicht so schlecht wie wenn in anderen Kontexten (miss-)braucht (wie in den MAIN-Branch in CVS). Falls gewünscht, kann solch eine Markierердatei entfernt werden um das Neuerzeugen des verbundenen Komponents zu erzwingen.

2.5.9. Cleaning targets

Es gibt mehrere unterschiedliche Aufräum-Targets:

`distclean`
Das drastischste Reinigungs-Target, (fast) alles löschend, das nicht von CVS ausgecheckt wurde. Dieses ist selten notwendig.

`mostlyclean`
Ein intelligenteres Target ist `mostlyclean`, säubert in die Verzeichnisse, die Tuxboxquellen enthalten; lässt aber die Kompilationsumgebung und in alle Auspacken-kompilieren-installieren-löschen-Komponente unberührt. Auch das `cdkroot` Verzeichnis, (d.h. die Yadd-Installation), sowie die TFTP-Files (Kernel und u-boot) werden nicht angefasst.

`depsclean`
Löscht alle Markerdateien im `.deps` Verzeichnis und zwingt so Neucompilation aller
Auspacken-kompilieren-installieren-löschen-Komponente. Dieses ist selten sinnvoll: Sie hängen von ihren Quellen und vielleicht von einer Patchfile ab, und der Makefile kennt diese Abhängigkeiten.

`clean`
Kombiniert `mostlyclean`, `depsclean`, und `flash-clean`. Versucht auch soviel wie möglich im `cdkroot`-Verzeichnis zu löschen, das nicht während des Bootstrapdurchlaufes installiert waren. So wird er *versucht*, die Umgebung in einem Zustand zu bringen, wo die Buildumgebung gerade kompiliert worden ist, z.B. mit `make bootstrap`.

`flash-semiclean`
Dieses Target löscht die meisten Verzeichnisse in `$(flashprefix)`, mit Ausnahme von den Boot-Partitionen und den Kernelbauverzeichnisse. Dieses

ist oft sinnvoll, da diese Bestandteile verhältnismässig selten sich ändern.

`flash-mostlyclean`
Zusätzlich zum`flash-semiclean` löscht dieses Target auch Bootfiles und die Kernbauverzeichnisse. Vollimages werden unberührt gelassen.

`flash-clean`
Dieses Target löscht Alles in $(flashprefix).

Einige Quellverzeichnisse können mit einem Befehl wie `make -C /tuxbox/head/apps/tuxbox/neutrino clean` gesäubert werden.

2.5.10. Aktualisierung des CVS

Um Ihre Quellen mit dem spätesten checkins zu aktualisieren, verwende Sie einen Befehl wie

```
cvs up -f -r newmake -dP > cvs.log 2>&1
```

vom toplevel CVS Verzeichnis (oder von einem anderen Verzeichnis, wenn Sie wissen, was Sie tun). Mögliche Fehler werden in das logfile `cvs.log` aufgeführt.

2.5.11. Customization

Die erzeugte Images und die yadds können angepasst ("customized") werden, ohne die Makefiles zu ändern. Erstmals, gibt es einige Konfigurationsoptionen: mit `--with-ucodesdir=DIR` kann ein Verzeichniss angegeben werden, das ucodes inthält, die im Images enthalten sein soll. (Ein Image das ucodes enthält kann nicht legal verteilt werden.) Zweiten, mit der Option `--with-logosdir=DIR` kann ein Verzeichniss angegeben werden, das boot logos (`logo-lcd` und `logo-fb`) enthält, die im Image enthalten sein soll.

Durchdachtere Customization ist möglich. Für dieses ist es notwendig, etwas Wissen über die innere Funktion des Makefiles zu haben. In der Folge bezeichnet `$(flashprefix)` den Wert des Makefile Variablen `flashprefix` (mit Konfiguration wie oben `/tuxbox/cdkflash`), `$(targetprefix)` bezeichnet den Wert des Makefile Variablen `targetprefix` (mit Konfiguration wie oben `/tuxbox/cdkroot`), und `$(buildprefix)` bezeichnet den Wert des Makefile Variablen `buildprefix` (mit der Konfiguration oben `/tuxbox/head/cdk`).

Um z.B. `neutrino-cramfs.img2x` zu erzeugen, werden die folgenden Verzeichnisse erstellt: `$(flashprefix)/root` (enthält Filesystem- und GUI-unabhängige Bestandteile), `$(flashprefix)/root-cramfs` (enthält den Kernel, für Wurzel-Filesystem auf cramfs konfiguriert, zusammen mit seinen Treibern) und `$(flashprefix)/root-neutrino` (enthält die Neutrinoinstallation). Aus diesen drei Verzeichnissen, werden das Rootfilesystemverzeichniss `$(flashprefix)/root-neutrino-cramfs` und das `var`-filesystemverzeichnis `$(flashprefix)/var-neutrino` gebaut.

Selbstverständlich ist es möglich, einen Befehl wie `make`

`$(flashprefix)/root-neutrino-jffs2` einzugeben (wobei der Benutzer `$(flashprefix)` selbst ersetzen muss; es ist eine make-Variabel, aber nicht eine Shell-Variabel), dann manuell gewünschten Änderungen an `$(flashprefix)/root-neutrino-jffs2` durchzuführen, und dann, mit dem Befehl `make flash-neutrino-jffs2-2x` den Imagebau abschließen, um ein Image zu erstellen, das die manuellen Änderungen enthält. Dieses kann für den einmaligen Imagesbau sinnvoll sein. Jedoch in vielen Fällen wird eine automatischere und systematischere Methode gewünscht, zunächst beschrieben.

Viele der wichtigeren Targets rufen ein Customization-Script auf, falls vorhanden und ausführbar. Der Name des Customization Scriptes wird als das Nicht-Verzeichnis Teil der Regel genommen, mit `-local.sh` angefügt. Der Script soll im *customizationsdir* liegen. Dies ist mit der configure-Option `--with-customizationsdi`r auswählbar. Default ist das cdk-Verzeichnis. Das Script wird zwei Argumente übergeben: Für Imagetargets sind diese `$(flashprefix)` und `$(buildprefix)`; für Yaddtargets sind diese `$(targetprefix)` und `$(buildprefix)`.

Die Bezeuchnung "Script" ist ein bisschen irreführend, da sie als normale Programme mit zwei Argumenten ausgeführt werden. Anstelle von einem Shell-Script können dies z.B. ein kompilierte C Programme, oder ein Perl-Script, sein.

Jedoch werden die Customization Filen für die Targets `version` und `flash-version` (die `/.version`-Files in YADD bzw. im Image erstellt) nicht am Ende der normale make-Actions ausgeführt, es *ersetzt* sie.

Der Custiomizationscripting wird durch das folgende Beispiel veranschaulicht.

2.5.11.1. Beispiel

In einem Image wird es gewünscht:

1. Eigene /etc/hosts benutzen,
2. Eigene neutrino.conf, bouquets.xml, services.xml benutzen
3. Inkludiere die lirc-Komponente, zusammen mit eigenen lirc Konfiguration Files.

1. und 3. sind Erweiterungen, die zu `$(flashprefix)/root` erfolgt werden sollten, während 2., seiend Neutrino-regeln, sollten zu `$(flashprefix)/root-neutrino-jffs2`, zu `$(flashprefix)/root-neutrino-cramfs` oder zu `$(flashprefix)/root-neutrino-squashfs` getan werden. Um 1. und 3. zu erzielen. schreiben wir das Script `root-local.sh`, z.B.:

```
#!/bin/sh

flashprefix=$1
buildprefix=$2
newroot=$flashprefix/root
myfiles=/home/somewhere/dbox/myfiles

cp -f  $myfiles/etc/hosts                  $newroot/etc
```

```
make flashlirc
cp -fr $myfiles/var/tuxbox/config/lirc
$newroot/var/tuxbox/config
```

Das Script für 2. nennen wir es `root-neutrino-local.sh`, ist völlig ähnlich:

```
#!/bin/sh

flashprefix=$1
buildprefix=$2
newroot=$flashprefix/root-neutrino
myfiles=/home/somewhere/dbox/myfiles

cp $myfiles/var/tuxbox/config/neutrino.conf  $newroot/var/tuxbox/config
cp $myfiles/var/tuxbox/config/zapit/bouquets.xml
$newroot/var/tuxbox/config/zapit
cp $myfiles/var/tuxbox/config/zapit/services.xml
$newroot/var/tuxbox/config/zapit
```

Note:
Diese Scripte sollen als Beispiele dienen und können vermutlich nicht ohne Anpassung verwendet werden.

2.5.11.2. Ändern der Partitionierung

Ab 2006-03-19, kann die Rootpartitionsgröße für cramfs und squashfs Images mit der Configure-Option `--with-rootpartitionsize=SIZE` angegeben werden. Die Größe des `var`-Partitions wird automatisch berechnet, um den restlichen Flashspeicher zu benutzen, der nicht durch die anderen Partitionen benutzt wird. Defaultgröße ist 0x660000. Diese Zahl sollte eine Multiple der Erasesize, momentan 0x20000 sein. Wird ignoriert (wenn sinnlos) beim jffs2imageerstellung.

2.5.12. Einige "best practices"

In diesem Abschnitt sammeln wir einige Richtlinien, die nicht "notwendig" sind um korrekte Ergebnisse zu erhalten, jedoch werden sie langfristig helfen, um bessere, zuverlässigere und pflegbare Software zu erstellen. Sie wenden sich sowohl an den Customizationen an, sowie zukünftige änderungen am Makefile (und zu seinen Bestandteilen) selbst.

Wenn Sie nicht diese Richtlinien mögen, ignoriern Sie sie, am mindestens wenn Sie Customization Scripte für Ihren eigenen Brauch schreiben.

2.5.12.1. Idempotens

Es ist fast immer eine gute Idee zu versuchen, ein Installationsscript *idempotent* zu schreiben. Dies bedeutet, dass das mehrmalige Ausführen den gleichen Effekt hat wie das einmalige Ausführen.

2.5.12.2. Benutze "make install", mopse nicht einzelne Files!

In der Vergangenheit hat das Tuxbox Makefile die Komponente zuerst in `$(targetprefix)` installiert, und dann die Imageverzeichnissen durch Kopieren der einzelnen Files von der `$(targetprefix)` Hierarchie erstellt. Dieses ist nicht sehr gute Softwaretechnik. Zuerst gehört das Know-how bzgl. Installation des Paket dem Makefile des Pakets, und soll nicht einem allgemeinen Makefile sitzen, das einfach einzelne Files rüberkopiert. Wenn dieses Paket sich ändert, z.B. dadurch eine Konfiguration File zugefügt oder gelöscht wird, wird es auch notwendig, in das globale Makefile zu ändern.

Es ist häufig der Fall, dass das Makefile, das dem Paket gehört, include-Files, (statische) Bibliotheken, Info-Files etc. installiert, die nicht auf einem enbedded System mit beschränktem Speicher gewünscht sind. Die korrekte Lösung zu diesem (wirklichen!) Problem würde wurde sein, das Makefile des Pakets zu ändern, entweder, um ein `flashinstall`-Target zu schreiben, oder das Makefile mit einem Parameter wie `installsize=[full,flash]` zu versehen. Wenn dieses nicht durchführbar ist, ist es meine Meinung, daß `make -C ... install` gefolgt vom Löschen der unerwünschten Files besser ist als das kopierend einzelne Files. Zu erwähnen ist auch, daß in dem Schritt, der die Verzeichnisse `$(flashprefix)/root-gui-`*filesystem* erzeugt, das include-verzeichnis, sowie alle statischen Bibliotheken gelöscht werden und dynamische Bibliotheken von unbenutzten Symbolen gestrippt werden.

2.5.13. Antwort auf einige Fragen

2.5.13.1. Falls das Build nicht gelingt

Es gibt kein Standardverfahren auf was zu tun, wenn das Build schiefläft. Ich versuche hier einige Richtlinien zu geben, zu Lesen bevor Posten zum Forum.

Zuerst, überprüfen Sie den Output der ersten zwei Schritte, `autogen.sh` und `configure` für Fehler und Warnungen. Jede Warnung oder Fehler, außer den fünf Warnings, die oben verzeichnet werden, zeigt ein Problem an, das wahrscheinliche Build unmöglich macht.

Wenn ein Build bricht, kann es die Umgebung in einem inkonsequenten Zustand hinterlassen. Dies gilt insbesondere für die Verzeichnisse in `$(flashprefix)`. Wenn der Bau solch eines Make-Targets bricht, besteht das Verzeichnis, ist entsprechend ihrer Änderungszeit aktuell, und ein folgendes make Befehl behandelt ihn wie fertig und okay. Selbstverständlich wird ein fehlerhaftives Build das Ergebniss. Wenn ein Build eines Unterverzeichnisses von `$(flashprefix)` in den Brüchen geht, bitte lösche es, bevor Sie einen anderen Make Befehl versuchen.

Bei "es funktionierte gestern"-Probleme, ist vermutlich die Umgebung in einem inkonsequenten Zustand. Ein mehr-oder-wenige drastische Reinigungsbefehl (sehen Sie oben) ist hierbei oft schneller als eine systematische Problemsuche.

Wenn Sie Hilfe benötigen, sehen Sie unten.

2.5.13.2. Nach dem Flashen bekomme ich "Kein System" auf dem LCD/Was ist diese "bad magic byte" Zeugs?

Uhh, ich hoffte, daß die Frage würde nicht kommen wurde... Die kurze Antwort ist: Ich weiß es nicht. Wir wissen es nicht. Aber, wenn Sie diesen Artikel so weit lesen, erwarten Sie nicht "kurze Antworten", sondern "gute Antworten". O.K. Das Thema ist ausführlich hier besprochen worden. Kurz gesagt, das Image "ist" in Ordnung, es ist nur dass irgendwelche Firmware in der dBox es zurückweist, weil es einige "schlechte magische Bytes" auf bestimmten Adressen findet. Der Forumteilnehmer mogway hat ein Programm geschreiben, in CVS im Verzeichnis `hostapps/checkImage` zu finden. Das Programm ermittelt die "schlechten Bytes", aber es tut nichts, um sie zu beheben. Meine eigene Erfahrung sagt, daß Images, die `checkImages` für gut findet, wirklich laufen. cramfs-, oder squashfs Images, worüber sich `checkImage` beschweren, läufen im allgemeinen nicht, in einigen Fällen läufen sie aber doch. jffs2-images, worüber sich `checkImage` beschwert, läufen oft,aber nicht immer. Mit diesen empirischen Beobachtungen überlasse ich dem möglichen Benutzung von `checkImage` und den folgenden Entscheidungen, dem Benutzer, ohne weitere Empfehlungen.

newmake weisst, wie dieses Programm angeruft werden kann, um die erzeugten Images automatisch zu überprüfen. Die Konfigurationsoption `--with-checkImage=[none,rename,warn]` ist dazu zu verwenden. Falls `warn` gewählt ist, wird für jedes Image, das den Test nicht bestehen, eine leere Datei erzeugt, Name gleich Imagefile mit `_bad` angehängt. Wenn `rename` gewählt wird, wird anstatt die fragliche Imagefile umbenannt.

Es kann erwähnt werden, daß die "schlechten magischen Bytes" in einem (oder mehrere!) von den Partitionsimages sitzt, und werden nicht durch den abschließenden Schritt erzeugt (die `*.img1x` und/oder `*.img2x` Files erschaffen). Es ist möglich, `checkImage` auf den Partitionsfiles aufzurufen (`*.jffs2`, `*.cramfs`, `*.squashfs`, `*.flfs1x`, `*.flfs2x`). Schließlich hat checkImage eine Debugoption, die nützlich sein kann.

2.5.13.3. Ich habe ein Fehler gefunden!

Bugs, Unklarheiten, Verbesserungsvorschläge, etc. der Software sollten vorzugsweise zum Cross Development Kit Abteilung des Tuxbox forum gehen. Was diesen Text direkt betrifft -- Fehler (die technische Angelegenheiten, Rechtschreibung, Grammatik, pädagogisch), Verbesserungsvorschläge und Verlängerungen -- können zu mir direkt gehen. "Diskussion" ist vermutlich besser im Forum abgehoben.

2.5.13.4. Ich benötige Hilfe!

Supportanfragen können imCross Development Kit Abteilung des Tuxbox Forum geposted werden. Postings in deutsch oder englisch sind willkommen. Bitte vergessen Sie nicht, die benutzte Konfigurationsoptionen zu erwähnen.

Bitte mailen/PM-en Sie nicht mich persönlich, da ich nicht persönliche Gratissupport anbiete.

2.5.13.5. Parallel make?

Siehe die englische Version.

2.5.13.6. Kernel 2.6?

Siehe die englische Version.

2.5.13.7. Update images

Siehe die englische Version.

2.5.13.8. How do I convert 1x-images to 2x, or vice versa?

Siehe die englische Version.

2.5.14. Appendix. Einige nützlige customization script Fragmente

In diesem Anhang werden einige nützliche Customization Scripte gezeigt. Zwei Scripte sind bereits oben gezeigt worden.

Warning:

Auch falls in einige Fällen benutzbar wie sie sind, werden die Scripte als Beispiele, nicht Lösungen zu den realen Problemen gezeigt. Aus diesem Grund sind die Beispiele hier als Codefragmente, nicht als downloadbare Datein, veröffentlicht. Bitte verwenden Sie sie nicht, es sei denn Sie am mindestens ungefährlich verstehen wie sie funktionieren. Es wird am mindestens grundlegende Script-Erfahrung erfordelig.

2.5.14.1. Games und Languages nuker

Diese File löscht alle Spiele (definiert als plugins mit type=1 in ihrer Konfiguration File), sowie unerwünschte Sprachfiles (Neutrino angenommen). Das File sollte vermutlich von `root-neutrino-$filesystem-local.sh` aufgerufen werden.

```
#!/bin/sh

# Nukes all game plugins, as well as all locale files not listed in
LANGUAGES

newroot=$1/root-neutrino-jffs2
LANGUAGES="deutsch english"

for f in $newroot/lib/tuxbox/plugins/*.cfg; do
    grep 'type=1' $f>/dev/null && rm -f
$newroot/lib/tuxbox/plugins/`basename $f .cfg`.*
done

for f in $newroot/share/tuxbox/neutrino/locale/*; do
```

```
    (echo $LANGUAGES | grep -v `basename $f .locale` >/dev/null) && rm
-f $f
done
```

2.5.14.2. Customizing die /.version file

Ihre eigene `/.version`-File herzustellen (gezeigt von Neutrino durch dBox -> Services -> Image-Version) ist sicher ein allgemeinee Wunsch. Hier ist die File, die ich momentan für dieses benutze:

```
#/bin/sh

if [ $0 = ./flash-version-local.sh ] ; then
    outfile=$1/root/.version
    type="image"
else
    outfile=$1/.version
    type="yadd"
fi

echo Creating $outfile ...

echo "version=`./mkversion -snapshot -version 200`"      > $outfile
echo "creator=Barf"                                     >> $outfile
echo "imagename=Barf-$type"                             >> $outfile
echo "homepage=http://www.bengt-martensson.de"          >> $outfile
```

Dieses File kann sowohl mit dem Namen `flash-version-local.sh`, sowie mit dem Name `version-local.sh`, für das Erstllen des `/.version-` File für Images beziehungsweise yadds benutzt werden. Merken Sie die Auswertung von `$0` (die den tatsächlichen Namen enthält, unter dem der Script aufgerufen worden ist). Das benannte Script `mkversion` stellt die etwas kryptische Versionszeichenkette her und ist einfach eine "Verkapselung" davon. Es wird hier gezeigt:

```
#!/bin/sh

releasetype=3
versionnumber=000
year=`date +%Y`
month=`date +%m`
day=`date +%d`
hour=`date +%H`
minute=`date +%M`

while expr $# > 0 ; do
        case "$1" in
        -release)
                releasetype=0
        ;;
        -snapshot)
                releasetype=1
        ;;
        -internal)
                releasetype=2
        ;;
        -version)
                versionnumber=$2
                shift
```

```
        ;;
        esac
        shift
done

echo $releasetype$versionnumber$year$month$day$hour$minute
```

2.5.14.3. Archivierung der Images

Es ist die Aufgabe des Buildprozesses, die flashbare Images zu erstellen, und nicht sie zu archivieren. Jedoch kann die Customization leicht missbraucht werden, um irgendeine Art vom Archivieren zu erschaffen, wie das folgende Beispiel zeigt:

```
#!/bin/sh

flashprefix=$1
imagefile=`basename $0|sed -e s/-local.sh//`
imagefilebase=`echo $imagefile|sed -e s/\.img.x//`
extension=`echo $imagefile|sed -e s/[-a-z0-9]*\.//`
newfilename="barf-"$imagefilebase-`date --iso-8601`.$extension

echo Copying $flashprefix/$imagefile to $flashprefix/$newfilename...
cp $flashprefix/$imagefile $flashprefix/$newfilename
```

Das Script sollte einen oder mehr der Namen `[neutrino, enigma]-[cramfs, squashfs,jffs2].[img1x, img2x]` haben. Es benennt die Files entsprechend dem Tagesdatum um. Wieder wird das Script gezeigt, um ein Konzept zu zeigen, nicht gerade kopiert zu werden.

2.5.15. Referenzen

Siehe die englische Version.

2.6. The Architecture of newmake

2.6.1. Revision history

Date	Description
2006-04-15	Initial version.
2006-04-17	Added the References section.

2.6.2. Introduction

The present documents tries to give a description of the involved concepts in newmake. The emphasis is on concepts, not on details. It will describe a large number, but not all of the target. It does not aim at a complete up-to-date descriptions of all targets, their prerequisites, side effects, etc. For this, the reader is referred to the sources, which even contains some comments(!).

Good documentation is not program code translated to English.

The reader is supposed to know the "introductory" document, and to have some experience and understanding of compiling programs in the GNU automake/autoconf-environment.

The Tuxbox build system has grown over a long period of time. The original developers are, with very few exceptions, no longer active within the project. In several cases, quite horrible techniques have been employed. Newmake is an attempt to clean up some of the problems; to solve it as it should have been done the first time. However, I have not went through all components. There are still some fundamental problems inherited from "old make".

Tuxbox uses the GNU automake/autoconf system. Understanding this on the surface is not too hard, however understanding the inner workings, and its customizations is not a trivial undertaking. Here we just mention that from the file `configure.ac` the non-interactive configuration script `configure` is created, while a Makefile is generated from the file `Makefile.am`. For this, some Tuxbox-specific m4-macros are found in the file `acinclude.m4`.

2.6.3. Organization of the file systems

2.6.3.1. cvsdir

The top level directory that was checked out from CVS (it contains a subdirectory named `cdk`) will be denoted *cvsdir*. (There is no make-variable with that name!)

2.6.3.2. cvsdir/cdk

Located as a subdirectory to *cvsdir*. This is the directory where the make-commands are issued. Corresponds to the make-variable `buildprefix`.

2.6.3.3. cdk

The file system `$(hostprefix)`, for example `/tuxbox/cdk`, contains the "Cross Development Kit (CDK)". (We will refer to it as *cdk*.) Contained therein is the cross C and C++ compiler (with support files), as a number of utilities for creating and manipulating programs to be run on the dBox. Also, some programs, built during the tuxbox build, like `mkflfs` are installed here. Include-files for the C++-compiler and stdc++ library are found here. Documentation files for some of the installed component (man- and GNU info-files) are also installed. This directory hierarchy is build during the "bootstrap" build.

2.6.3.4. cdkroot

The file hierarchy `$(targetprefix)` (typically `/tuxbox/cdkroot`) is mounted as

root file system for a YADD-setup. (We will refer to it as *cdkroot*.) However, it plays some more roles. In the original makefile, images were built by first installing (using the component's makefiles) in *cdkroot*, then selectively copying over selected files to the image file systems. The directly hierarchy is "mainly" built during the cdk build, however, some crucial components (belonging to the C library `glibc`) are installed during the "bootstrap" build.

Through symbolic links, the above described *cdk*-directory depends on *cdkroot*, and secondarily, through links from *cdkroot* to the kernel sources, on the kernel sources in *cvsdir*`/cvs/linux`. In the future, it would be desirable to eliminate this dependency, in my opinion also if this means multiple copies of the same file. "Single sourcing" does not prohibit multiple copies, it means that you know where every copy came from.

Warning:

It is often tempting to delete *cdkroot*, in order to bring the compilation environment back to the state where the cross development environment CDK has been build, but none of the real Tuxbox software. For reasons just described, this will break CDK.

2.6.3.5. cdkflash

The file hierarchy `$(flashprefix)` (typically `/tuxbox/cdkflash`, henceforth denoted by *cdkflash*) is a scratch area for building images. It will be described in detail later. It can be deleted when needed/desired without any side effects.

2.6.3.6. bootprefix

For the purpose of this article, `bootprefix` is the target location of the yadd kernel and the corresponding `u-boot` boot loader. Typically, this is the base directory for the TFTP service.

2.6.4. Organization of the files for Make

There are hundreds of targets in the top level "Makefile". To improve the overview, it has been split in different components. The top level `Makefile.am`, in the current version 1.480.2.21, is shown in the Appendix. This file first defines some high-level targets (in terms of some other targets), then it includes a large number (presently 54) of makefile fragments, defining other targets. The inclusion is preceeded by a comment stating the purpose of the included fragment.

2.6.5. Download-unpack-patch-configure-build-install-clean targets

The Tuxbox software needs a number of third-party software. The build mechanism will download the needed software sources on demand. These are stored in the directory *cvsdir*`/cdk/Archive`. (When having several source trees on the disk, it is a good idea to share this directory, to save disk space and downloads.) When "make-ing" the package, the following things occur:

1. The package source code, typically with a `.tar.gz` or `.tar.bz2` extension, is downloaded to the *cvsdir*`/cdk/Archive` directory,
2. It is unpacked into a temporary directory, residing in the `cdk` directory,
3. In some cases, a patch (residing in the directory *cvsdir*`/cdk/Patches` is applied,
4. The package is build using a package specific build command, typically a configure-command, followed by a make-command, possibly with parameters,
5. The package is installed, typically in *cdkroot*, typically with a "make install"-command, possibly with parameters,
6. The build directory is deleted,
7. The successful build is recorded by creating a zero-length file, having the same name as the package, in the directory *cvsdir*`/cdk/.deps`.

It was attempted to have this behavior completely parameterized, using the files `rules-make`, `rules-archive`, `rules-installrules-install-flash`. To this end, `rules-make` defines the package name, version, name of the build directory, name of the current source code distribution file, a command to unpack and possibly to patch. The file `rules-archive` contains a mapping from file names (as given in the `rules-make` file) to download-URLs. Finally, `rules-install` and `rules-install-flash` contain the commands to install the package. HEAD-make, if configured for image building, first consults `rules-install-flash` for the install rules, if not found there, it searches `rules-install`. If not configured for flash images, it only searches `rules-install`. Newmake, for compatibility, first searches `rules-install-flash`, then `rules-install`.

To the implementation: For every such package, `configure.ac` contains the a call to the local autoconfig macro `TUXBOX_RULES_MAKE` (defined in `acinclude.m4`), using the package name as argument. Thus, during executing of `configure`, a few Perl programs are executed, operating on the `rules-*`, thereby defining the shell variables `DEPENDS_`*package*, `DIR_`*package*, `PREPARE_`*package*, `VERSION_`*package*, `INSTALL_`*package*, `CLEANUP_`*package*. Thus, in `Makefile.am` (or its included parts), constructs like `@VERSION_`*package*`@` can be used; when automake creates `Makefile` out of `Makefile.am`, these will be appropriately substituted.

This has been an interesting, but not completely successful experiment. The "parameterization" of the build has not been a success; every make rule still looks different. To keep used versions in a separate file still is a good idea, however, this can just as well be achieved with the include-mechanism of (auto-)make.

A re-write would be desirable.

2.6.6. Three main sets of targets

There are three main categories of targets in the Makefile: Targets for building the cross compilation environment ("CDK"), targets for YADDs, and targets for flash image creation.

2.6.6.1. The development environment CDK

The top level target is `bootstrap`. It turns out, that this is nothing but the gcc target. Almost all non-cdk targets depend on this; in the case this dependency is not in the Makefile, it is likely a bug. There are five components required:

`directories`
Sets up a directory skeleton in *cdk* and *cdkroot*.
`binutils`
Installs the GNU binutils, containing programs for creating and manipulating binary files, like the assembler `as` and loader `ld`.
`linuxdir`
Installs the sources for the Linux kernel. This is necessary for building the compiler, since the latter needs include files from the kernel.
`glibc`
The main C library. Since the C compiler needs this, first a "bootstrap compiler" (target `bootstrap_gcc`, a mini C compiler, not needing `glibc`, just intended to compile `glibc`) is first built.
`gcc`
The C cross compiler, in both C and C++-version.

These targets, with the exception of `directories`, are all download-unpack-patch-configure-build-install-clean targets, in the sense above. The rules are all found in the file `make/bootstrap.mk`.

2.6.6.2. YADD builds

Useful high-level targets include: `yadd-neutrino`, `yadd-lcars`, `yadd-enigma`, and `yadd-all`.

`yadd-neutrino`
Installs the targets `yadd-none`, `neutrino`, as well as the plugins appropriate for Neutrino (targets `neutrino-plugins` and `fx2-plugins`).
`yadd-micro-neutrino`
This target has mainly theoretical interest, to document the minimal usable Neutrino installation.
`yadd-enigma`
Installs the targets `yadd-none`, `enigma`, as well as the plugins appropriate for Enigma (targets `enigma-plugins` and `fx2-plugins`).
`yadd-lcars`
Installs the targets `yadd-none`, and `lcars`.
`yadd-all`
Installs the targets `yadd-none`, `neutrino`, `enigma`, and `lcars`.
`yadd-none`
The GUI-independent parts on a working yadd, consisting of `bare-os`,

together with a number of other, non-GUI-based targets (config, tuxbox_tools, procps, ftpd, yadd-ucodes, version).

bare-os
The minimal setup to run Linux on the dBox, allows to login and `ls`. Depends on targets yadd-u-boot, kernel-cdk, driver, yadd-etc, busybox, modutils, tuxinfo.

plugins
Depends on neutrino-plugins, enigma-plugins, and fx2-plugins.

neutrino-plugins
The name is strictly speaking misleading; the target installs plugins usable with any GUI, except for the plugins in target fx2-plugins. Presently, these are tuxmail, tuxtxt, tuxcom, tuxcal, and vncviewer (all of these correspond to their own individual targets). Defined in make/plugins.mk.

enigma-plugins
Plugins that require Enigma. Defined in make/plugins.mk.

fx2-plugins
Plugins that require the fx2-library. Usable by any GUI. Defined in make/plugins.mk.

neutrino
The Neutrino GUI. Defined in make/neutrino.mk.

enigma
The Enigma GUI. Defined in make/enigma.mk.

lcars
The LCARS GUI. Defined in make/lcars.mk.

config
Installs some configuration files, presently cables.xml and satellites.xml. Defined in make/dvb-config.mk.

tuxbox_tools
installs several different tools, most of which are pretty special, some (like `switch`) absolutely essential. Defined in make/tuxbox_tools.mk.

procps
A download-unpack-patch-configure-build-install-clean target. Installs the commands `ps` and `top`. Defined in make/rootutils.mk.

ftpd
The ftp-daemon. A download-unpack-patch-configure-build-install-clean target. Defined in make/ftpd.mk.

yadd-ucodes
Provided that --with-ucodesdir was given when configuring, installs that directory's content in the yadd. Defined in make/ucodes.mk.

version
Creates the `/.version`-file in the yadd. Defined in make/version.mk.

yadd-u-boot
Creates both the "smart" `u-boot`, as the "dumb" `u-boot-yadd`, both in the

$(bootprefix) directory. The default u-boot relies on a DHCP-server (a bootp server will not do) to tell the name of the kernel file, and the location of the NFS-root. Sometimes this is not available, for example when using the Windows dBox manager. For these cases, an alternate u-boot is provided, which, out-of-the-box, has the file name u-boot-yadd. This offers less flexibility, having most file names/paths compiled in. Using this u-boot for booting, the file name of the kernel is kernel-yadd, and the NFS root will be yaddroot. As a side effect, a tool called mkimage, needed for building some images, will be installed in *cdk*/bin. (This can also be achieved by calling the target $(hostprefix)/bin/mkimage directly). Defined in make/u-boot.mk.

kernel-cdk
Creates and installs the Linux kernel, using the path name $(bootprefix)/kernel-cdk. Also installs the kernel and a map file in *cdkroot*/boot. Defined in make/linuxkernel.mk.

driver
Compiles and installs device drivers, corresponding to the kernel. Defined in make/linuxkernel.mk.

yadd-etc
Installs the content of the etc directory. Defined in make/etc.mk.

busybox
Configures the busybox for usage with yadd, compiles and installs it. This is an download-unpack-patch-configure-build-install-clean target. Defined in make/busybox.mk.

modutils
Installs some utilities for manipulating loadable kernel modules, e.g. modprobe. This is an download-unpack-patch-configure-build-install-clean target. Defined in make/rootutils.mk.

tuxinfo
Installs the crucial tuxinfo program. This target is actually a subset of the target tuxbox_tools. Defined in make/tuxbox_tools.mk.

camd2
Installs the camd2 program. This target is actually a subset of the target tuxbox_tools. Defined in make/tuxbox_tools.mk.

2.6.6.3. Flash images

The high-level flash targets flash-[neutrino,enigma,all]-[cramfs,squashfs,jffs2]-[1x,2x,all] were introduced in the introductory article. Here we will describe the image building process in more detail. In the sequel, *gui* will denote either neutrino or enigma, *filesystem* will denote either cramfs, squashfs, or jffs2 (the file system of the root partition), while img*X*x will denote either img1x or img2x.

Fundamental for the creation of a *gui-filesystem*`.imgXx`-image are the three directory hierarchies `$(flashroot)/root` (containing parts not depending on the root file system type or the GUI), `$(flashroot)/root-`*filesystem* (containing parts depending on the root file system, in particular the kernel and the drivers), `$(flashroot)/root-`*gui* (containing the GUI component). There are no "short" make targets for these directories, however they are all, with their full path names, make targets. The flashable directories (`root-`*gui-filesystem* and `var-`*gui*) are created by copying the contents of the previously mentioned three directories into one, performing the library reduction and finally installing some additional components, for example by calling appropriate "make install"-commands in the directory *cvsdir*`/cdk/root`.

From the flashable directories, partition image files are created using the commands `$(MKJFFS2)`, `$(MKCRAMFS)`, and `$(MKSQUASHFS)`. The expansion of these commands will be determined during the configuration run.

Finally, the partition images are combined with a suitable u-boot bootloader, packed in a flfs-partition image, to a full images using the `flashmanage.pl` program, or, in the case of a jffs2-image, simply concatenated together.

The major targets are listed next.

`flash-`*gui*`.img`*Xx*
This has as only prerequisite the file `$(flashprefix)/`*gui*`.img`*Xx*. Defined in the file `make/flash-expand-targets.mk`.

`$(flashprefix)/`*gui-filesystem*`.img`*Xx*.
The partition images (`root-`*gui.filesystem*, possibly `var-`*gui*`..jffs2`, and *filesystem*`.flfs`*Xx*) are combined to a full image. Defined in `make/fullimages.mk`.

`$(flashprefix)/root-`*gui.filesystem*
The partition image is created from the flashable directory `$(flashprefix)/root-`*gui-filesystem*. Defined in `make/partition-images.mk`.

`$(flashprefix)/var-`*gui*`.jffs2`
The partition image is created from the flashable directory `$(flashprefix)/var-`*gui*. Defined in `make/partition-images.mk`.

`$(flashprefix)/`*filesystem*`.flfs`*Xx*
The appropriate u-boot bootloader is build, and packed into the flfs-partition image, using the program `mkflfs` (code residing in *cvsdir*`/hostapps/mkflfs`), which may be build when needed. Defined in `make/partition-images.mk`.

`$(flashprefix)/root-`*gui-filesystem*
The contents of the directories `root`, `root-`*filesystem*, and `root-`*gui* are first copied together into this directory, library reduction is performed by "making" the target `$(flashprefix)/root-`*gui-filesystem*`/lib/ld.so.1`, bootlogos are installed (if applicable), some additional files are installed, for

example by calling "make install" in the directory *cvsdir*/cdk/root.

`$(flashprefix)/var-`*gui*

The contents of the directories `root/var` and `root-`*gui*`/var` are first copied together into this directory. Bootlogos are installed (if applicable), some additional files are installed, for example by calling "make install" in the directory *cvsdir*/cdk/root.

`$(flashprefix)/root-`*gui-filesystem*`/lib/ld.so.1`

Due to the limited flash memory of the dBox (8 MiB), it is not feasible just to include all possible shared libraries in the image. This step, called "library reduction", makes sure that only actually needed libraries are included, and that they are reduced in size as much as possible. Executable files and shared libraries are stripped (= symbols removed) to reduce their size. The necessary libraries are gathered together, mainly from *cdkroot*, as needed. The work is carried out by the mklibs program. Unneeded files are deleted. The file `ld.so.1` is the runtime loader, and serves as a "marker file" for make, in that the make target has many more "side effects" than just creating this file. The target is defined in the file `make/reduce-libs.mk`.

`$(flashprefix)/root-`*gui*

"Installation" of the corresponding GUI. There is a synonym (target having this as only prerequisite, and no actions) `flash-`*gui*. Defined in `make/neutrino.mk` and `make/enigma.mk`.

`$(flashprefix)/root-`*filesystem*

Installation of kernel and drivers for an image having *filesystem* as its root file system type. Defined in `make/flashroot-fs.mk`.

`$(flashprefix)/root`

Essentially, all components, which do not depend either of the GUI, nor of the file system type of the root file system are installed here. Do not confuse with non-GUI components; for example plugins usable by any GUI are also installed here. This target does not depend on very much, instead it calls make recursively, to install required components. We do not describe this in further detail; the interested reader is referred to the file `make/flashroot.mk`. Many of the targets there, for example `flash-ftpd` are the flash versions of the yadd targets described above, of course then without the `flash-` prefix.

2.6.7. Odds and Ends

2.6.7.1. GNU Make "Order-Only Prerequisites"

GNU Make 3.80 introduced a facility, the "order-only prerequisites", that I have found indispensible for newmake. (For this reason, GNU make 3.80 is required for newmake, while HEAD-make is satisfies with 3.79.) Since this feature is not very well known, the name is badly chosen, and the description in the manual not very enlightening, I explain it in detail next.

Consider the following Makefile:

```
buildir=/home/me/somewhere
sourcedir=/home/me/somewhereelse

$(builddir)/prog: $(sourcedir)/prog.c $(builddir)
        $(CC) -o /tmp/foobar $<
        sleep 1
        mv /tmp/foobar $@

$(builddir):
        mkdir $@
```

The intention is to create the build directory (if required), and then to compile `prog` in it. This also works. However, the next time `make` is issued, the compilation is redone! Why? Since the target depends on `$(builddir)`, which gets its timestamp set by the `mv`-command, the target is older than its prerequisite (`$(builddir)`), and thus is scheduled for re-making! (`sleep 1` is inserted in the example to guarantee that the file system dates from prog and the directory differs; it is hard to make a really simple realistic example.) This is most likely not what the Makefile-author had in mind. What is needed is a way to say: $(builddir) need exist, but, as long as it exists, its date should never be taken into account. This is exactly the "order-only" (better would be "existence-only") prerequisite does. Order-only prerequisites are separated from normal prerequisites using the bar "`|`". Thus, changing the first prerequisite line to:

```
$(builddir)/prog: $(sourcedir)/prog.c | $(builddir)
```

achieves the effect the author of the original makefile wanted.

2.6.7.2. Maneuvering within the make sources

Emacs users can maneuver quite comfortable within the make sources. For this, first issue the shell command "make TAGS" in the directory *cvsdir*`/cdk`, thereby creating a so-called TAGS-file. Now it will be possible to use the command `find-tag` (normally bound do M-.) to directly jump to the file that defines a particular target. Also other editors have similar tags-support.

2.6.8. References

- The GNU Make manual, online version. The only Make book you need.
- The Autoconf manual, online version.
- The Automake manual, online version (slightly outdated version).
- The GNU Coding standards. There is *good stuff* in here. Unfortunately, not observed by the Tuxbox project.
- GNU Autoconf, Automake, and Libtool by Gary V. Vaughan, Ben Elliston, Tom Tromey and Ian Lance Taylor. I just discovered it, and have not read this (yet), however, the table of contents looks very promising.

2.6.9. Appendix. Top level Makefile.am.

```
## Makefile for Tuxbox

all:
	@echo "You probably do not want to build all possible targets."
	@echo "Sensible targets are, e.g. yadd-enigma or
flash-neutrino-jffs2-2x."
	@echo "If you REALLY want to build everything, then \"make
everything\""

if TARGETRULESET_FLASH
everything: yadd-all flash-all-all-all serversupport extra
else
everything: yadd-all extra serversupport
endif


#####################################################################
# High-level yadd targets

bare-os: yadd-u-boot kernel-cdk driver yadd-etc busybox modutils tuxinfo
	@TUXBOX_YADD_CUSTOMIZE@

yadd-none: bare-os config tuxbox_tools procps ftpd yadd-ucodes version
	@TUXBOX_YADD_CUSTOMIZE@

yadd-micro-neutrino: bare-os config yadd-ucodes camd2 switch neutrino
	@TUXBOX_YADD_CUSTOMIZE@

yadd-neutrino: yadd-none neutrino-plugins fx2-plugins neutrino
	@TUXBOX_YADD_CUSTOMIZE@

yadd-enigma: yadd-none enigma-plugins fx2-plugins enigma
	@TUXBOX_YADD_CUSTOMIZE@

yadd-lcars: yadd-none lcars
	@TUXBOX_YADD_CUSTOMIZE@

yadd-all: yadd-none plugins neutrino enigma lcars
	@TUXBOX_YADD_CUSTOMIZE@

extra: libs libs_optional contrib_apps fun dvb_apps root_optional udev
devel bash

# Set up some default values (used only by serversetup).
include make/defaultvalues.mk

# Set up the build environment
include make/buildenv.mk

# Set up the cross compilation enironment, including linux kernel
# source and directory structure
include make/bootstrap.mk

# The automounter (optional)
include make/automount.mk

# The busybox (implements most standard Unix commands, like ls,...)
include make/busybox.mk
```

```
# Populate the etc directory in YADD
include make/etc.mk

# The ftpd
include make/ftpd.mk

# Some core tools (important and less important)
include make/rootutils.mk

# A number of libraries, some of which necessary for neutrino or enigma
include make/contrib-libs.mk

# Some non-GUI applications, none of which are essential
include make/contrib-apps.mk

# Tools (debugger etc) for the Tuxbox developer
include make/development-tools.mk

# The kaffe java-implementation (nonessential, presently does not build)
include make/java-stuff.mk

# Gaming platforms (gnuboy scummvm sdldoom)
include make/fun.mk

# Nonessential DVB application
include make/dvb-apps.mk

# Bluetooth (nonessential)
include make/bluetooth.mk

# FUSE and djmount for uPnP support (non-essential)
include make/upnp.mk

# The u-boot boot loader
include make/u-boot.mk

# Build kernel and its drivers
include make/linuxkernel.mk

# Install dvb configuration files (cables.xml & satellites.xml)
include make/dvb-config.mk

# dvbsnoop is a tool for analyzing dvb streams (non-essential)
include make/dvbsnoop.mk

# A nonessential library
include make/libdvb++.mk

# The zapit daemon
include make/zapit.mk

# More dvb tools, of which only streampes is installed per default
include make/dvb_tools.mk

# More misc libs, mostly nonessential
include make/misc_libs.mk

# Misc tools, not essential
include make/misc_tools.mk
```

```
# Enigma GUI
include make/enigma.mk

# nonessential entertainment, like "screensavers" for the lcd display
include make/funstuff.mk

# The LCARS GUI
include make/lcars.mk

# LCD tools
include make/lcd.mk

# Essential, and some less essential, libraries
include make/tuxbox_libs.mk

# A small, but absolutely essential library
include make/libtuxbox.mk

# The Neutrino GUI
include make/neutrino.mk

# Plugins
include make/plugins.mk

# Some small command line tools, several of which are essential
include make/tuxbox_tools.mk

# Application that run on the build host
include make/hostapps.mk

# Generate some support files for a YADD- or flashing-server
include make/serversupport.mk

# Optionally install ucodes in the image
include make/ucodes.mk

# Generate a /.version file in the image
include make/version.mk

if TARGETRULESET_FLASH
# High-level flash targets are:

# flash-[neutrino,enigma,all]-[cramfs,squashfs,jffs2,all]-[1x,2x,all]
# Expand all flash targets containg the word "all"
include make/flash-expand-targets.mk

# Create complete images ("without BN bootloader")
include make/fullimages.mk

# Create images of the root and var file systems
include make/partition-images.mk

# Create root and var filesystems, ready for image creation
include make/flashable-dirs.mk

# Strip libraries of symbols not needed.
include make/reduce-libs.mk
```

```
# Create the root file systems for jffs2-only, cramfs, and squashfs
# images (containing kernel but not GUI)
include make/flashroot-fs.mk

# Create the root file system, without kernel and GUI
include make/flashroot.mk

# The streampes stuff
include make/flash-streampes.mk

# Build distribution lists in neutrino internet update format
include make/distribution-lists.mk

# /etc/cramfs.urls contains URLs for update lists
include make/cramfs.urls.mk
endif

# Files not to be deleted, even though they are intermediate products
include make/precious.mk

# "Phony" make targets
include make/phony.mk

# Create the TAGS file
include make/tags.mk

# A number of cleaning targets
include make/cleantargets.mk

# Target for building source distributions (hardly used these days of
CVS :-)
include make/disttargets.mk

# Give the user rope to hang himself :-).  (Note: read from the
# generated Makefile during make run, automake or configure does not
# see it.)
-include ./Makefile.local
```

2.7. Setting up and using the automounter

2.7.1. Revision history

Date	Description
2006-02-22	Initial version.
2006-06-05	Added ghosting and the ghosting patch.

2.7.2. Introduction

In the 1990s, workstation/server networks were growing from large to huge. Typically, a large site had a number of servers, exporting the users' home directories (as well as possibly project directories), and number of workstations, importing ("mounting") these directories. This lead to a large number or mounts, having bad impact on both performance and reliability. Typically, a client importing a file system from a server that,

due to own or networks failure, was temporarily unaccessible, was either extremely slowed down, or it simply hang. Also, for file systems mounted, but not really used, network traffic was generated just to keep the mounts active. As a solution to these problems, the automounter was suggested. With the automounter, file systems (like user home directories) was mounted only when accessed, and unmounted after a certain period of inactivity. Typically, there was a user data base, consisting on information on what file system, from what server to mount for a particular user. This was typically taken from a LAN-wide user database, such as NIS (formerly called YP), later NIS+, LDAP, or other.

How does this relate to the situation with a dBox in a home network? The large workstation net problems are hardly an issue. The ability to take mount maps from information systems like NIS is most definitely not there. However, the automounter gives some more comfort: It is not necessary for a file system to be available when booting the dBox, in order to access it later. The need to manually mount file system before recoding (or through files like `recording.start`) is eliminated.

There seems to be a general consensus that the automounter is for large networks. I have personally been using it for my home network, consisting of two or three hosts (Solaris and/or Linux), since 1999. It is not too hard to setup, has very low overhead, is highly reliable, and makes life a little bit more comfortable.

2.7.3. Building an image (or YADD) with automounter support

Support for the automounter is contained in the Tuxbox CVS. In the *newmake* CVS branch, this support *almost* allows for automatic build. It would probably not be major effort to port the *newmake* the MAIN files, however at the time of this writing, this has not been done.

To support the automounter, the kernel configuration option `CONFIG_AUTOFS4_FS` has to be turned on. For this, the line

```
CONFIG_AUTOFS4_FS=y
```

has to be added to the kernel configuration file, `cdk/Patches/linux-$version-dbox.config` (for YADD) and `cdk/Patches/linux-$version-dbox.config-flash` (for images). Here, `$version` denotes the actual kernel version used, at the time of this writing it amounts to "2.4.32".

In *newmake*, automake is an unpack-patch-build-install-delete-target. Installing in YADD is done with the make target `automount`, for images with the make target `flash-automount` (installing in `$flashprefix/root`). Therefore, the elegant way is to include the line `make automount` in (e.g.) `yadd-neutrino-local.sh` and/or the line `make flash-automount` in `root-local.sh`, possibly together with an appropriate `/etc/auto.net` configuration file instead of the default one (which is effectively empty).

That's all!

2.7.4. Setting up the automounter

The typical Unix/Linux setup has been simplified. I believe that not very many dBox users are interested in reading NIS-maps for the automounter, however, they may have some servers, NAS-devices, and some Notebooks around. The automounter is therefore, per default, configured only with one "map", and one configuration file. The startup file, `/etc/init.d/start_automount` also contains some configuration possibilities. Possibly the most interesting is the variable `AUTOFSMOUNTDIR`, indicating the directory under which the mounts will take place. This directory must be absolute, must reside in a writable area, and should not exist at booting time. The default file defines it to `/var/autofs`.

The default file loads the necessary modules for mounting NFS file system. When mounting CIFS file systems, it may be necessary to load the CIFS module; uncomment the appropriate line in `start_automount`.

2.7.4.1. The configuration file /etc/auto.net

Every (non-comment) line in the configuration file `/etc/auto.net` describes a mount file system. It has three fields: the mount name, the mount parameters (see the example for syntax), and the server file system. For example, the first (non-comment) line states that the file system `/pictures` on the server `myserver` will be mounted as `$AUTOFSMOUNTDIR/pictures` (with the default values, this is `/var/autofs/pictures`). Names instead of IP-numbers are accepted, as long as they can be resolved using the normal host name resolving mechanisms (normally `/etc/hosts`, sometimes supported with a name server, declared in `/etc/resolv.conf`).

```
# This is an example of an automounter map
#
# Mount name    Parameters              server file system
pictures       -fstype=nfs,ro,nolock   myserver:/pictures
music          -fstype=nfs,ro,nolock   yourserver:/audio
movies         -fstype=nfs,ro,nolock   192.168.42.42:/filme
recording      -fstype=nfs,rw,nolock   herserver:/garbage
#
# This example is from Papst
musik
-fstype=cifs,ro,soft,user=root,password=dbox2,unc=//192.168.0.2/Musik
//192.168.0.2/Musik
```

If sent the `USR1`-signal, the automounter will unmount the unused file system (that it has mounted). The `TERM` will force the automounter (the `automount` process) to unmount unused file systems, and to exit cleanly. A convenient way for this is

```
kill -USR1 `cat /var/run/automount.pid`
```

and

```
kill -TERM `cat /var/run/automount.pid`
```

respectively.

2.7.4.2. Ghosting

Users often find the standard behavior of the automounter confusing: When listing a directory, it is nothing there, although the automounter will create entries under certain circumstances! Even worse, trying to select, for example a recording directory from Neutrino, is simply not possible if the directory is not presently mounted.

For this, recently so-called *ghosting* was implemented in the automounter and the Linux kernel. Using this feature, the top level mounted directories will still be visible, also when the directories are not mounted. Thus it is possible to use the Neutrino file selector to select an automounted directory, also if it is not mounted when the file selector starts.

To use ghosting, a patch needs to be applied to the kernel. Using this patch (which patches the kernel configuration files for `CONFIG_AUTOFS4_FS=y` too) will integrate the patching into the build process. Furthermore, the automount deaemon needs to be started with the `-g`-option. (This is the default in the newmake setup).

2.7.4.3. Troubleshooting

First of all, what cannot be mounted from the command line, the automounter cannot mount either. Try the mounts from the command line, to check for misspellings, that the options are sensible, and that the server's export permissions are appropriate.

Check that the automount process is running using the `ps` command. Check that the `$AUTOFSMOUNTDIR` (default is `/var/autofs`) is present. Using the example above, the command `ls /var/autofs/pictures` (note: cannot use the "TAB"-command line completion in the shell as long as the file system is not mounted) should mount the appropriate file system on `/var/autofs/pictures`. The `df` command can be used to list the file systems presently mounted.

2.7.5. Questions and answers

2.7.5.1. Neutrino "automounts" file systems. How does this relate?

Not at all. Since everything a program makes can be called "automatic", someone (probably who never had heard of automounting in our sense) decided to call non-interactive mounting on boot "automounting". Sad. And confusing.

2.7.5.2. Will the changes to the kernel configuration file have any bad effects when cvs update-ing?

In general, no. CVS will detect that the file is locally modified, and, as long as possible, merge future changes in CVS with local changes. However, watch out when the kernel version changes!

2.7.5.3. What needs to be done the MAIN branch to support automount?

`cdk/Makefile.am` needs to be updated (probably just inserting the content of the *newmake* file `cdk/make/automount.mk`), `rcS` and/or `rcS.insmod`, as well as the image building rules (for installing `auto.net` and `start_autofs`, probably in a writable place). Then modify the image building rule to install the required kernel modules and `/sbin/automount`.

2.7.5.4. Can I extend my favorite image with the automounter?

Sure. Just replace the kernel with one with CONFIG_AUTOFS4_FS enabled, add the required kernel modules, make sure that they match the kernel version, install `/sbin/automount`, `auto.net`, modify `rcS`, and install `start_automount`.

Shorter version of the above: If you are able to all this, you will be building your own images anyhow. Therefore, it does not seem very logical.

Even shorter version: Forget it!

2.7.5.5. Is this stuff restricted to Neutrino? Will it work with Enigma?

No. Yes.

2.7.5.6. Can I combine Neutrino mounting with the automounter?

Yes, as long as the mount points do not conflict.

2.7.5.7. How do I get at the debug messages?

Unfortunatelly, automount is designed to do all its logging though the syslog facility, an this is per default not present on the Tuxbox, at least not in images. To enable the syslog facility, enable the option `CONFIG_SYSLOGD` in the busybox configuration file, and recompile busybox.

2.8. Setting up online updates for Neutrino

2.8.1. Revision history

Date	Description
2006-02-22	Initial version.
2006-03-29	Updated to take into account the now less experimental character.

2.8.2. Introduction

As far as I am aware, almost from the beginning of the distribution of dBox images, it was possible to update images online. Already the AlexW-images had this property. This requires one setup file in the image, pointing to the server, and one, "table-of-content"-like file on the server, pointing to the files the client are offered to download and install.

The last few years, this possibility has not been abandoned, but has "faded". Originally, "update image" meant the root partition, using the cramfs filesystem, that was replaced, while leaving the `/var`-partition, containing the user settings and preferences, intact. Today, many (but not everyone!) prefers full images, which the Neutrino online update mechanism, for no obvious reason, does not support.

Some years ago, images where the root partition used the so-called squashfs-filesystem emerged. The update mechanism of Neutrino was updated to reflect this, however, the programmer(s) implementing the change seemed to strive for making the world a better place for squashfs-users, while the rest of the world population should blame themselves for being stupid. The file `update.cpp` relied on the C Preprocessor symbol `SQUASHFS` conditionally compiling in either the code for flashing squashfs partitions, *or*, cramfs-partitions. Thus, a high-level GUI-program was (intended to be) differently compiled dependent on the underlying file system!

A patch to Neutrino fixing these shortcomings was checked in in 2006-03-19, with a subsequent fix the day after (thanx JtG-riker!). The rest of this article applies only to CVS after that date.

2.8.3. The setup files

2.8.3.1. The /etc/cramfs.urls configuration file

The only setup file for the update mechanism residing on the dBox was traditionally called `/etc/cramfs.urls`, and contained one or many lines pointing to URLs containing "table-of-content"-files, listing image files offered for download. (Configurable through `dBox -> Service -> Software Update -> Expert Functions -> config file`.) Although the name is an anachronism, it is suggested to stay with it.

2.8.3.2. The "Table-of-Content"-file, *.list

The "Table-of-Content"-file, traditionally with a `.list` suffix, lists the images the server makes available in machine readable format. Each line describes a downloadable image, and has four or more white-space separated fields: The first contains the URL of the downloadable image, the second the MD5-checksum, the third the version string in the Tuxbox SBBBYYYYMMTTHHMM convention (see, e.g. mkversion). The subsequent fields (at least one must be present) consists of a informal verbal description for the user. (Due to restrictions in present Neutrino updating, only very short strings are suitable.)

2.8.3.3. Creating the setup files with newmake

newmake supports automatically creating the `/etc/cramfs.urls` and some `.list`-files. To enable, use the option `--with-updatehttpprefix=URL`, where the argument should be the URL of the `.list`-files, with the last component removed. Thus, an `/etc/cramfs.urls`-file will be generated, containing URLs to `.list`-files. See `cdk/make/cramfs.urls.mk`. This make target is customizable with the usual *newmake* customization mechanism. There are also make targets `cramfs.list`, `squashfs.list`, `img.list`, and `allimages.list`, see `cdk/make/distribution-lists.mk`, that will create some suitable `list`-files. Using the customization facility of these targets to copy the `list`-files and the corresponding images to a distribution server might be a good idea.

2.8.4. Neutrino's online update function, revisited

The above mentioned patch changes Neutrino's behavior in the following way: First, the MD5-checksum of the downloaded image is computed, and compared to the MD5-sum in the `list`-file. If they are different, the image is rejected. (Previously, this test was made only with squashfs-images.) If the file name (or, more correctly, the last component of the URL) contains the string "`.cramfs`", the images is required to be a correct cramfs-image, and rejected if a test fails. Then the image size is compared to the size of the "Flash without bootloader"-partition. If equal, it is attempted to flash the image as a full image. The corresponding partition is the partition with the description "Flash without bootloader", it is not assumed to be partition `/dev/mtd/4`. If not, if the size is less or equal to the root partition, the images will be flashed into the root partition (always assumed to be `/dev/mtd/2`, since this presently holds true for all images built from CVS). Otherwise the image is rejected.

One beauty spot is that the Neutrino GUI presents the same error message (`LOCALE_FLASHUPDATE_MD5SUMERROR`) for different reasons. However, on the console, more detailed error information is presented.

2.9. Analog and Digital Video- and Audio-outputs on the dBox with Neutrino

2.9.1. Revision history

Date	Description
2006-01-05	Initial version.
2006-01-17	Added digital audio. Added volume control (analog and digital). Some more information on the Philips. Reference to controldc. Moved "Connectors" as the first subsection of "Hardware". Misc. small improvements.
2006-01-22	Added reference to modding article. No analog

	output by DD.
2006-02-22	Added comments on muting.
2006-03-29	Delete Sagem bug: it has been fixed.
2006-06-05	Updated for my recent CVS check-ins, in particular extended syntax for `scart.conf`. Merged in the avsstuff article, which is now obsolete.
2006-06-14	Wrote the Appendix. Moved the fblk-table to there.
2006-06-17	Small fixes to the tables in the appendix, in particular, the case a2 = 4.
2006-06-25	Extended and corrected info on the Philips audio/video switching.
2006-07-01	Still more on the Philips (thx Pleymo): replaced a1 and a2.

2.9.2. Introduction

In this article, the analog audio and video outputs, their possibilities and limitations are discussed. From the software side, only Neutrino will be considered.

An understanding of the Scart connector is essential. For information, including pin-out, on the Scart connector, see Wikipedia. For the sequel, we remark that the FBLK-Signal (pin 16) ("Fast BLanKing") can be considered as having the semantics: "when active, an RGB signal is available and should be used".

For a general overview of the dBox hardware, we refer to this block diagram.

2.9.2.1. Tuxbox is a hobby project!

It should always be kept in mind that the present project is a hobby project. This means, among other things, that tools get written for two purposes: For exploring and debugging, and for presenting actual functionality to the user. In a professional project, the exploring and debugging parts are generally never distributed to customers, or disabled (cf. the debug mode of the dBox). In a hobby project, based on open source, things are different: if something is not finished, or works only partially, it is, at most, "hidden" behind an option like ENABLE_EXPERIMENTAL_FEATURES. The goal is more often to take the hardware to the limit, rather than just releasing perfectly working, well documented and easily understandable features to the customers. Please keep this in mind when griping!

For example, the dBox was almost surely not intended to generate YUV video -- then it would have had RCA-outputs. It turns out that the video encoder used (see below) is

perfectly able to generate YUV as well as the formats Betanova needed. If a low-cost-version, not containing YUV-capacities, were available, it would probably have been used instead.

Another issue here is configuration options and -files. Often, in particular when, as is here the case, writing software for hardware for which no complete documentation is available, the software author writes his software as a qualified guesswork. To guard for guessings or design decisions that turned out to be wrong, configuration options are thrown in. Although better than the alternative, this is not a good thing: It basically means that the programmer is delegating the work to the user. Getting it right is better than making it configurable!

2.9.2.2. Terminology

YUV
The signal format we refer to as "YUV" should properly be called "YCbCr". Since the latter is awkward both to write and to pronounce, and since Neutrino uses the former, we will say "YUV" (which strictly speaking means something different).

dBox
refers to a dBox2 from Nokia, Philips, or Sagem, in either cable or satellite version.

2.9.2.3. The dBox can...

- Generate the following video formats on the TV-Scart output:
  - YUV (+ CVBS)
  - YUV (+ VBS)
  - RGB (+ CVBS)
  - SVideo
  - CVBS
- Generate the following video formats on the VCR-Scart:
  - CVBS
  - SVideo
- Pass *any* video format (using up to 4 signals (RGB, YUV, SVideo, CVBS,...)) (+ audio) from the VCR-Scart to the TV-Scart. The Sagem can do this even in deep standby.
- Pass CVBS-Video and analog sound *from* the TV-Scart to the VCR-Scart and RCA audio outputs.
- Generate correct aspect ratio information on pin8 on TV Output
- Generate correct FBLK signal on pin 16 on the TV-Scart

2.9.2.4. The dBox can not...

- Not all video-format combinations can be generated simultaneously. In particular,

when generating RGB or YUV, only CVBS and VBS are possible in addition.
- Generate progressive video.
- Generate analog output from Dolby digital (AC-3) sound. (Would require decoder, costing license fee.)
- Digitalize video from the VCR-Scart
- Make any conversion on the video (or audio) from the VCR-Scart
- Sagem cannot deliver different audio output on the TV-Scart and the RCA audio outputs.
- Generate correct aspect ratio information on pin8 on VCR output (at least not on Nokias, hardware is missing)
- Output digital video in the sense of e.g. IEEE 1394 ("Firewire"). (However, it can, supported by a suitable server, capture digital video to disk files.)
- Some models (equipped with AViA 500) cannot disable the S/P-Dif output once enabled, see below.
- Not all analog audio output can be attenuated or muted.

2.9.2.5. General on volume control

To prepare for the sequel, we give a general discussion of *volume control* for a signal source (like a DVB receiver). First of all, the term "volume control" is a bit of a misnormer: A signal source is generating an audio signal. This signal is typically sent to an amplifier (or a TV), which amplifies the signal and sends it to loudspeakers. The volume is normally "controlled" from the amplifier by its volume control, which effectively determines the gain of the amplifier. What the signal source can do, is to *attenuate* the signal. We will use this term for the rest of the article.

Normal usage should therefore be to bypass attenuation, i.e. all "volume controls" in signal sources should be set to maximum. At least theoretically, all usage of attenuation will lead to *some* quality loss.

It is generally accepted that perceived "loudness" relates logarithmically to sound pressure. This means that a "volume knob" should preferably take the logarithmic dependence into account and invert it, otherwise almost all of the "regulating power" will come at the right end of the scale. A volume control/attenuation with this property is called *logarithmic*. (Strictly speaking, "exponential" would be more appropriate, since what it does is to *invert* a logarithmic function...) A volume control not having this property is sometimes called *linear*, while it maps user input to attenuation linearly.

2.9.3. The Hardware

2.9.3.1. Connectors

The dBox comes with two SCART connectors, marked "TV" and "VCR" respectively. We will subsequently refer to these as "the TV-Scart" and the "VCR-Scart", even if they are connected to something else. Note that they are differently located on different

hardware: The Sagem has the TV-Scart on top, and the VCR-Scart on bottom, while it is the other way around on Nokia and Philips.

For our purposes, the TV-Scart has four video-output pins, two audio-output pins, one video-input pin, and two audio input pins. Pin 8 (aspect ratio) and pin 16 (FBLK) are to be considered as outputs. The VCR-Scart has four video-input pins; however one of those (R (or Y), pin 15) can also be an output (necessary for SVideo output signal). There is one (alternatively two, see last sentence) video output pin(s). Finally, there are two audio inputs and two audio outputs. Pin 8 and pin 16 both exclusively work as inputs.

There are also a pair of RCA audio outputs, and an optical Toslink S/P-Dif digital audio output.

2.9.3.2. The Video Encoder

All dBoxes share the same digital video encoder, a SAA7126H from Philips. Data sheet is available here. It generates analog video signals in RGB, CVBS, SVideo, or YUV format, depending on what commands it has been sent from its driver (source). Most importantly, it generates up to four output signals, so we can immediately conclude that, for example, RGB and SVideo output simultaneously cannot be possible, since it would require 3 (R, G, B) + 2 (Y and C) = 5 signals.

The video encoder can be manipulated from the command line using a nifty little program named `saa`.

2.9.3.3. Digital audio

Digital audio is generated by the AViA chip from the DVB stream, which is then feed to the S/P-Dif output directly. For this reason, it is not possible for, e.g., the Neutrino audio player to use it.

The AViA chip can attenuate the volume in the digital domain. It can also mute the signal. This is in Neutrino called *ost* volume control or *digital volume control*. It cannot attenuate, or mute, Dolby Digital signals. The current software does not make "logarithmic volume control".

Often, the dBox is connected to an AV-Amplifier using both digital and analog audio connections. If the AV-Amplifier detects a signal on the digital input, this is selected instead of the analog input. Thus, for analog sound to be reproduced, the digital output has be be turned off. Unfortunately, the AViA 500 cannot turn off the S/P-Dif output once activated. Therefore, users of this setup may have to turn their AV-Amplifier manually to analog input.

There is an open bug in the OST-muting, see this Tuxbox Wiki Article, that after a channel zap, "breaks" muting, despite Neutrino claims muting is still on.

2.9.3.4. The AV-Switch

There are three sources of analog video and audio inside the dBox: From the DVB-receiver (up to four video signals + audio), from the VCR-Scart (to be considered as four signals + audio), and from the TV-Scart (one signal (CVBS) + audio). To select which of these inputs are sent to the different outputs is the task for a component we refer to as the AV-Switch. Here, the different vendors differ considerably: Nokia uses a CXA2092 chip, for which no data sheet is known. (See this however.) (Probably the author of the driver for the chip had a very good connection to SONY?) Sagem uses a CXA2126Q (data sheet here), while Philips uses a STV6412A (data sheet here). For our purposes, the differences between the chips has been conveniently wrapped in the drivers, with the exception of the configuration, see below. Most importantly, however, is that the chip in the Sagem has only two output channels (video as well as audio). This means that the RCA outputs always output the same audio as the TV-Scart, and that some configuration options are accepted, but meaningless on the Sagem. The Nokia has a third video output from the AV-Switch, however, the corresponding pins on the chips are not connected to anything. It is possible to solder appropriate components to the right pins, and thus to achieve a third, independently controllable, video output (CVBS only). For the Nokia, pin 27 on the CXA2092 should be used. (I have done this modification to my Nokia. This is described in this article.)

Analog volume attenuation

The AV-Switch can also attenuate or mute some of its analog audio outputs. In all cases, what can be attenuated, can be muted, and vice versa. Again, here the boxes from the different vendors differ:

Nokia
The Nokia (at least the AViA 500 models) attenuates the TV-Scart, but not the VCR-scart and not the RCA jacks. (It has been claimed that there are AViA-600 based Nokias that does attenuate the RCA jacks, despite the fact that they also uses CXA2092. I do not consider these rumors plausible.)

Sagem
The Sagem attenuates the first audio switch, feeding the TV-Scart and the RCA jacks. The other audio switch, feeding the VCR-scart is not attenuated.

Philips
The Philips, also having "only" two audio-switches, behaves almost identically to the Sagem. The only difference is that the chip (stv6412) would allow the driver to decide whether the RCA jack output is being attenuated or not. The driver author has decided to turn on the attenuation unconditionally.

We mention that controld uses a volume scale from 0 (sound off) to 100 (no attenuation), while the AV-switch uses 63 (sound off) to 0 (no attenuation), the latter roughly corresponding to the attenuation in dB (disposing the minus-sign). The mapping from controld-volume to AV-switch-volume is exponential, to make up a logarithmic volume control.

The Switching matrix

The AV-Switch consists of two or three selectors for audio and video respectively. Each selector (switch) is controlled by a three-bit number (i.e. an integer between 0 and 7), selecting a particular input to send to its output. This input consists of one (CVBS), two (SVideo), or four (RGB/YUV + [C]VBS) signals.

For Sagem, v1 (a1) is the switch selecting the video (audio) to be sent to the TV-Scart (and the RCA audio outputs), while v2 (a2) is selecting video (audio) to be sent to the VCR-Scart. For the Nokia, v1, a1, and v2 are as with the Sagem, however, the audio switch selecting audio to the VCR-Scart is called a3. The audio switch a2 selects audio to the RCA outputs. I do not have access to a Philips box, but this is how I interpret the data sheet of the STV-chip and the code of the STV6412 driver: v1 selects the output to the VCR Scart (like v1 for the others). v2 selects the RGB-source, i.e., the output from the RGB-pins on the TV Scart. Finally, v3 selects the "composite output" (pin 19) on the TV Scart. There are two audio switches, a1 and a2, selecting audio for TV Scart and VCR Scart respectively. The RCA-outputs are feed with the same signal as the TV-Scart. The chip makes it possible to select whether they are volume attenuated or not. Optionally, it is even possible to select between stereo and mono (= just replacing L and right by their average) on the TV- and VCR-Scart, but not on the RCA jacks. These possibilities are presently not used by the driver.

The CXA2126 driver does not recognize the ioctl commands `AVSIOSASW3` and `AVSIOGASW3` (setting and getting of a3 respectively). The STV6412 driver recognizes them as *synonyms* (!!) to `AVSIOSASW2` and `AVSIOGASW2` (setting and getting of a2). (We should preferably change this.)

The semantics of the entries in the routing tables are given in the Appendix.

The FBLK Setting

The FBLK setting in the switch determines how the FBLK output on the TV-Scart (pin 16) is controlled. The semantic of the entry is given in the Appendix. For passing VCR-Scart video input to the TV-Scart, it would be natural to let FBLK follow the VCR-Scart input.

The settings of the AV-Switch can be examined as well as manipulated from the command line with the program `switch`.

2.9.4. The Software: controld

For our discussion, the dBox operates either in *DVB-mode* (generating video from DVB transmissions) or *Scart-Mode* (routing analog video from the VCR-Scart). The task for the high level software is to, according to vendor, the selected operating mode, and the preferred formats for "TV-" and "VCR-Output", to send the appropriate commands to the saa-driver, enabling it to generate suitable signals on its four output lines, and to send the

correct routing commands to the AV Switch. For this, the daemon controld is responsible. The neutrino main program sends controld messages, and can provide controld with user configurable parameters.

`controld` is a daemon program, responding to messages sent to it. There exists messages for setting and getting video format, volume, aspect ratio, etc. A command line program, named `controldc`, for sending these messages is presented on my patch page. This is roughly speaking a "brother" to `switch` and `saa`.

2.9.4.1. The configuration file scart.conf

The present controld knows 6 cases, depending on vendor (Nokia, Sagem, Philips) and operating mode (DVB, Scart). There is a configuration file, `/var/tuxbox/config/scart.conf`. In the simplest case, for all the different cases (in the sense above), there is an array of 6 (or optionally 7) numbers, in turn: v1 a1 v2 a2 v3 a3 fblk (their meaning was explained above). These numbers are fed to the respective switching matrices, and, in the case of Scart-Mode, to the FBLK-switch. A `scart.conf` using this "classic" syntax might look like:

```
#typ_vcr/dvb:          v1 a1 v2 a2 v3 a3 (vcr_only: fblk)
nokia_scart:         3  2  1  0  1  1
nokia_dvb:         5  1  1  0  1  1
sagem_scart:         2  1  0  0  0  0
sagem_dvb:         0  0  0  0  0  0
philips_scart:          3  3  2  2  3  2
philips_dvb:         1  1  1  1  1  1
```

This is not a complete solution. There are simply too few parameters to be able to cover all cases we have with different TV formats. There is not even a possibility to select the output format of the VCR-Scart: Either you get CVBS or SVideo, in the latter case, when using a CVBS-Connection, the VCR picture turns black-and-white (the "Terminator bug" in the Tuxbox forum). People often could not use the same `scart.conf` for SVideo as for RGB.

Since 2006-05-27, controld understands an extended syntax and semantic for `scart.conf`, containing many more parameters, thus (hopefully) enabling one configuration to work in all situations. A `scart.conf` adhering to the new syntax may look like

```
#              v1      a1           v2                    a2       v3   a3
fblk
nokia_scart:     {3 3 3 3 3} 2 {{1 7} {1 7} {1 7} {1 7} {1 7}} 2 {3 3 3
3 3} 2 2
nokia_dvb:       {1 5 4 5 5} 1 {{1 2} {1 7} {1 2} {7 7} {1 7}} 1 {0 0 0
0 0} 1
sagem_scart:     {2 2 2 2 2} 1 {{0 0} {0 0} {0 0} {0 0} {0 0}} 1 {0 0 0
0 0} 1 3
sagem_dvb:       {0 0 1 0 0} 0 {{0 1} {0 7} {0 1} {7 7} {0 7}} 0 {0 0 0
0 0} 0
philips_scart:   {3 3 3 3 3} 3 {{2 2} {2 2} {2 2} {2 2} {2 2}} 2 {3 3 3
```

```
3 3} 2 3
philips_dvb:     {1 1 1 1 1} 1 {{1 1} {1 1} {1 1} {1 1} {1 1}} 1 {1 1 1
1 1} 1
```

For v1, instead of a single number, it is now possible to give an array (using the syntax above) consisting of five numbers, corresponding to the TV-Video signal format (in order) CVBS, RGB, S-Video, YUV+VBS, and YUV+CVBS. Using a single number, like in the old version, is also possible, For v2, there is a double array, the pairs correspond to the TV-Video format as in v1; the first digit in the pair corresponds to VCR-Signal type CVBS, while the second one corresponds to VCR-Signal type S-Video. Also here the old syntax is possible. Finally, v3 has the same syntax as v1.

It should be noted that, due to restrictions in the hardware (discussed above), the VCR-Signal type S-Video is possible only together with TV-Signal format CVBS and S-Video. For this, Neutrino makes it impossible to select non-working combination.

2.9.5. Passing the DVD-Player through

Passing the analog video and audio from the VCR-Scart is really quite straightforward. Both the four video-signals are passed through, as well as the aspect ratio on pin8 and the FBLK signal on pin 16. In particular, the video format on TV-output is the same as on VCR-Input, *no matter* what TV-Video Format you have selected in the Neutrino menus!

As far as I am aware of, no significant quality reduction result.

2.9.5.1. ... in deep standby?

The Sagem can route VCR-Video through in deep standby. It will not be started by active-going pin 8 on the VCR-Scart. The Nokia can not do this, and will boot on active-going pin8 on the VCR-Scart. The Philips is reported to behave like the Nokia.

Although it is "correct behavior" of the Nokia to boot by active-going pin 8, this can be annoying at times: say that you want to play a CD with your DVD-Player that is connected to the VCR-Scart. Since the front processor is responsible for this behavior, there is nothing we can do to affect it. Of course, cutting pin8 either in the Scart-cable or within the dBox may be acceptable. However, aspect ratio switching will no longer work, which may or may not be acceptable.

In my modding article a hardware modification is described, that will stop the wake-up, but will not cripple the aspect ratio switching: Cut the pin8-connection within the dBox. Connect the connection from the VCR to the base of a simple NPN-transistor (e.g. BC547). Connect its collector to a point that is around 12 V in operation, but 0 V when in deep standby. The emitter of the transistor goes to the remaining part of the pin8-connection, facing the dBox electronics. This makes up an emitter follower. When the collector is 12 V, the emitter follows the base (= pin8 of the SCART), when the collector is 0 V, the emitter is also 0 V.

When Neutrino has booted, it will not go into Scart-mode even if the VCR-Scart is active

(pin 8), as opposed to Betanova. A fix for this is presented on my patch-page.

2.9.6. Hooking up for YUV-Output

Although not originally planned by the hardware designers, the dBox is capable of high-quality YUV-output. As should be clear from the above, this requires neither special hardware, funny parameters, or black magic in any form. YUV is delivered on the RGB pins on the SCART: Y on the Green pin (pin11), U (really Cb) on the Blue pin (pin 7), and V (really Cr) on the Red pin (pin 15). Since TVs, Projectors, and AV Receivers inputting YUV almost exclusively use RCA jacks, an appropriate cable and/or adapter is required. It is not hard to solder one (using 75 ohm RG-59 coaxial cable), however, an off-the-shelf "SCART-to-RGB" cable of good quality, like the Clicktronic HC 401-100, will work and is not too expensive. Attach a "Y"-label to the Green plug, "U" (or "Cb") to the Blue plug, and "V" (or "Cr") label to the Red plug if it makes you feel more comfortable :-). In the menu dBox -> Settings -> Video -> VideoOutput select the entry "YUV + CVBS". Ready!

Using the above settings, an ordinary TV will present an acceptable picture, using the CVBS input. Using the CVS version, FBLK will be active, and the TV will (because instructed so by FBLK!) take YUV for RGB, presenting a very greenish picture. Everything looks like "The Matrix"...

2.9.6.1. Myths

Do I need a special cable/adapter?
No. Rumors exist, that Y "should" be taken from the CVBS-pin (pin 19). There may, at some point in time, have been images around for which this was either necessary or sensible. If it was ever true, it is not true for current CVS sources, or current (legal) images.

I have heard that I must select "YUV + VBS" as video format.
You can select "YUV + VBS" or "YUV + CVBS", it produces the same YUV output. Using "YUV + CVBS" has no disadvantages, using "YUV + VBS" makes (color) video output on the VCR-Scart impossible. This myth seems to be related to the first one.

2.9.7. Open Topics, loose ends

2.9.7.1. Data Lines

Pins 10 and 12 of the Scart connector are "Data Lines", used for such applications as synchronizing channels on TVs and VCRs. There are a number of commercial names around (AV-Link, EasyLink, ...) but to my knowledge, no open protocols have been proposed for this. According to the circuit diagram for the Nokia, pin 10 of the TV-Scart carries the label "SCART_AV_LINK", and is connected to the CPU. To the best of my knowledge, this has never been put to use, nether by Betanova or from any free software.

Pin 12 is not connected.

2.9.7.2. Random Problems

My Sagem show the following behavior: If selecting RGB or YUV as TV-Format, inputting an RGB Video signal and letting FBLK go active, then somehow the output consists of the DVD-Picture with a DVB-picture *superimposed*! Workarounds would be to lower FBLK, or selecting another TV Video format (it is not used anyhow during Scart-mode pass-thru).

2.9.8. Feedback wanted

Found any mistakes or holes? Have information I don't have (in particular regarding the Philips dBox)? Feedback of any sort is solicited, either in the forum or to me directly.

2.9.9. Appendix. Semantics of the routing table entries

Signal sources are denoted by DVB, VCR, and TV, the latter being the CVBS signal input (pin 20) on the TV-Scart. The number behind the slash is the number of useful connected lines. Identical entries in the column, e.g. "DVB/2" appears twice in v1/Nokia, do not always generate identical results, since they may correspond to different input pins on the AV-Switch, hooked up through slightly different passive components. By Philips, "AUX" denotes an auxiliary input to the switch, almost surely not useful in an unmodified Philips dBox. A hardware modification may be possible, enabling these to be connected to a video/audio source. By a1 and v2 on the Philips, only two bits are used, instead of three by Nokia and Sagem. Therefore, the values 4 – 7 are "impossible".

Value	Nokia (TV)	Sagem (TV)	Philips (VCR)
0	TV/1; DVB/3	DVB/4	Off
1	DVB/1	DVB/2	DVB/2
2	DVB/2	VCR/4	DVB/2
3	VCR/4	Not used	TV/1
4	DVB/2	DVB/2	AUX/1
5	DVB/4	TV/1	Not allowed
6	DVB/3	Not used	Not allowed
7	Off	Off	Not allowed

Table 1: v1

Value	Nokia (VCR)	Sagem (VCR)	Philips (TV (RGB-Pins))
0	TV/1	DVB/2	Off

1	DVB/1	DVB/2	DVB/3
2	DVB/2	VCR/2	VCR/3
3	VCR/2	Not used	Not allowed
4	DVB/2	DVB/2	Impossible
5	Off	TV/1	Impossible
6	Off	Not used	Impossible
7	Off	Off	Impossible

Table 2: v2

Value	Nokia (only with HW mod.)	Philips (TV/CVBS (Pin 19))
0	TV/1	Off
1	Off	DVB/1
2	DVB/1	DVB/1
3	VCR/1	VCR/1
4	DVB/1	AUX/1
5	Off	Not allowed
6	Off	Not allowed
7	Off	Not allowed

Table 3: v3

Value	Nokia (TV)	Sagem (TV+Aux)	Philips (VCR)
0	Off	DVB	Off
1	DVB	VCR	DVB
2	VCR	Not used	TV
3	Off	TV	AUX
4	Off	Off	Impossible

Table 4: a1

Value	Nokia (Aux)	Sagem (VCR)	Philips (TV+Aux)
0	Off	DVB	Off
1	DVB	VCR	DVB
2	VCR	Not used	VCR
3	TV	TV	AUX

4	Off	Off	TV

Table 5: a2

Value	Nokia (VCR)
0	Off
1	DVB
2	Off
3	TV

Table 6: a3

Value	Nokia	Sagem	Philips
0	Forced inactive	Forced inactive	Forced inactive
1	Forced active	Forced active	Forced active
2	Follows the FBLK of the VCR-Scart input	Follows the FBLK of the DVB video encoder	Follows the FBLK of the DVB video encoder
3	?	Follows the FBLK of the VCR-Scart input	Follows the FBLK of the VCR-Scart input

Table 7: fblk

2.10. Some Hardware Modifications of the Nokia dBox

2.10.1. Introduction

This article describes some hardware extension that I felt "was necessary" to my Nokia dBox. First of all, although the box is fairly well equipped with video outputs (see this article), I wanted outputs to be simultaneously connected (although they could still not be simultaneously used) to YUV-inputs, SVideo-inputs, and RGB-inputs. I wanted to see if the mysterious "v3"-output worked. Also some other minor modifications are described herein.

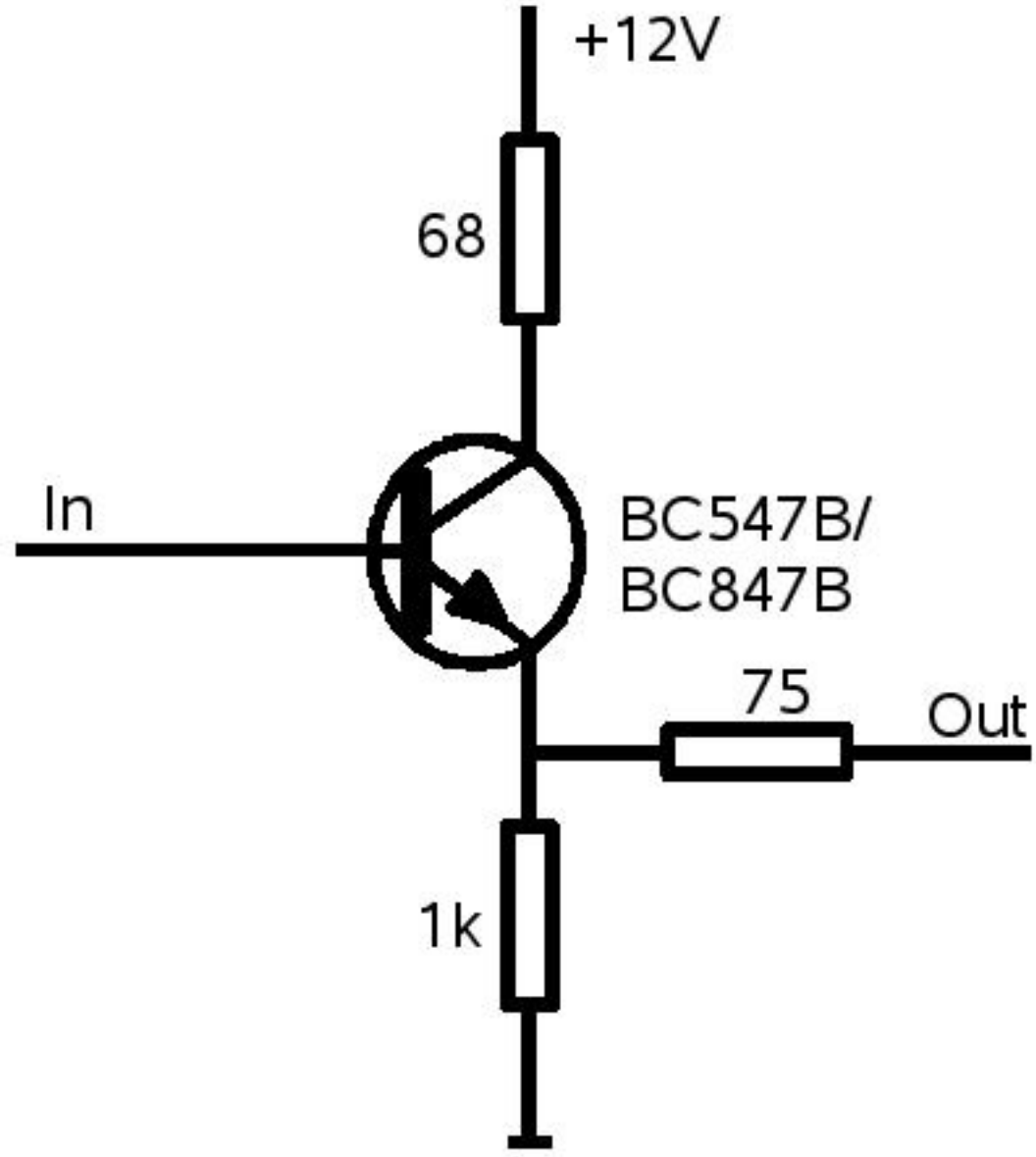
This is the back plate of the modified dBox:

This article uses terminology and facts from the previous article. A reasonable understanding of electronics is assumed.

Some more photos are collected here.

2.10.2. Additional Video Outputs

Although the dBox is in the position (see this background article and this improved controld) I wanted to be able to connect YUV-cables (preferably fitted with RCA jack) simultaneously with the RGB-connection. An S-Video Hosiden connector would be nice too. Unfortunately, "snarfing a video signal" is not as easy as making an additional analog audio output where you can just connect them in parallel. It turned out that all the video signal outputs where using the same emitter follower as output step, see the following figure.



The working of an emitter follower is described in every elementary electronics textbook. We just remark that the voltage of "Out" follows "In" very closely, while loading the input very little.

In all cases, "In" is connected to pins of the AV-Switch, and "Out" to different pins on the Scart connectors. The transistor BC547B is the discrete component, while BC847B is the SMD version, used in the Nokia. I duplicated this circuit for all extra video outputs desired, taking the "In" signal from the appropriate pin of the AV-Switch, and feeding the output to an RCA- (or Hosiden) jack. In this way, I have made separate RCA jacks for the four output pins (labeled Y, Cb, Cr, and CVBS respectively). These correspond to the "v1" video output channel, also connected to the TV-Scart. From the "v2" video output channel (connected to the VCR-Scart), both signals are taken to a Hosiden connector. The CVBS-Signal is taken to an RCA-jack. Finally, the mysterious "v3" video output was taken from pin 27 on the CXA2092.

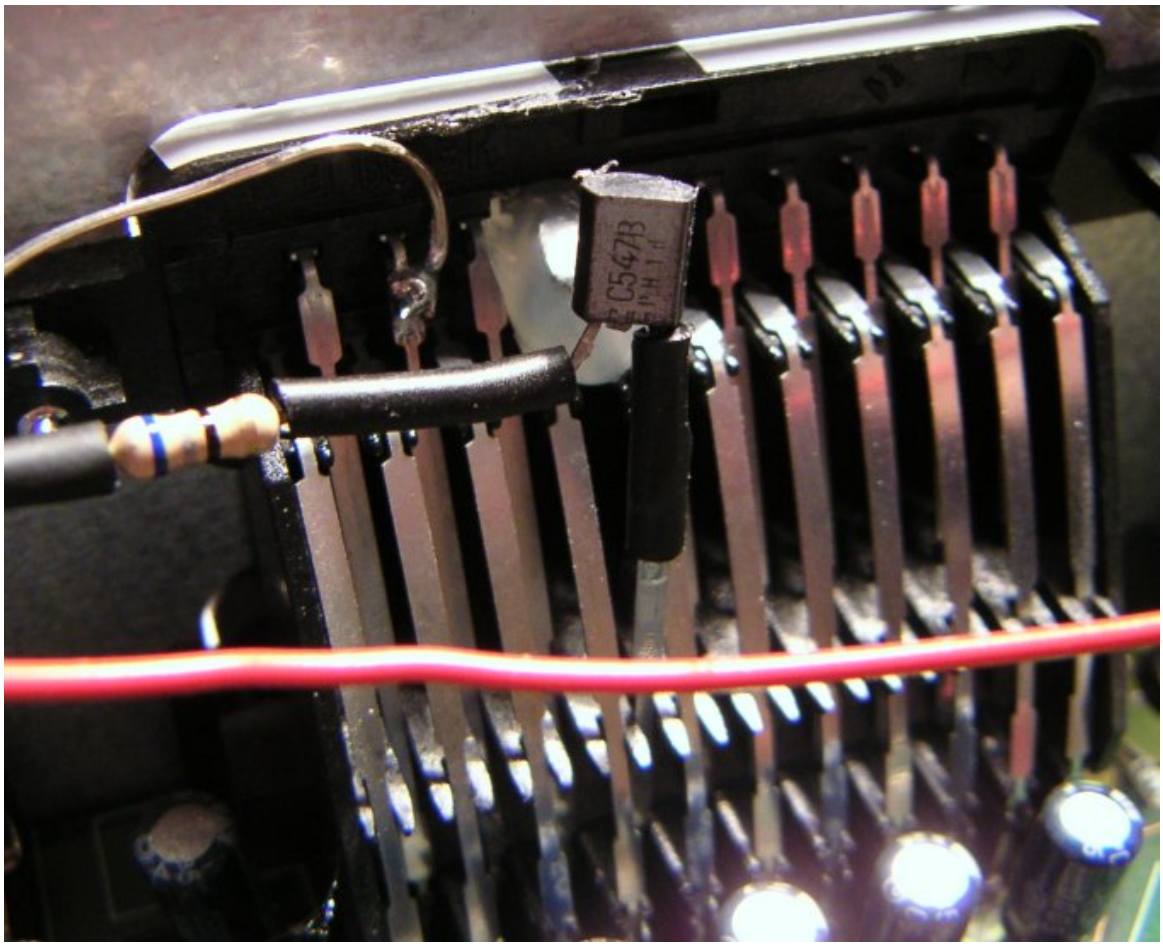
Holes were drilled in the back plate and appropriate RCA and Hosiden jacks were mounted. The components were essentially soldered to the output jacks, with cables to connect the base of the transistor to the AV-Switch's pins. It turns out that 75 ohm resistors are slightly hard to get by; Conrad sells them, but only in quantities of 100 (Order number 408948 - 62).

The outcome of this modification is quite pleasing. In particular, I not need to use my Scart-Switcher as a signal splitter.

2.10.3. Inhibiting Wake-Up from SCART-Inputs

As described in the previous article, it may be desirable not to let active-going pin8 on the VCR-Scart wake up the dBox. For this, we used exactly the same circuit, but where "+12V" has to be taken from a point that is 0V during deep standby. The connection for pin8 on the VCR-Scart was cut, "In" connected to pin8 of the VCR-Scart, and "Out" to the PCB, where pin8 had gone previously. It turned out that the most difficult part was to find an appropriate 12/0V supply. For this, I used the signal denoted +12V_OPB on the circuit diagram, available just under the modem connector, see the green wire on photos.

The emitter follower is shown here:



It turns out that a Scart-connector with one pin cut on the inside is mechanically prone to problems. For this, I fixed the pin with hot glue, as can be seen from the picture.

2.10.4. Miscellaneous

The power cable was a non-detachable cable, equipped with a Euro plug. A detachable cable has some advantages, when swapping my Nokia dBox and my Sagem, or when (occasionally) the need for power cycling occurs. It was also my intention to replace the fairly useless modem with a second RS232 output. At the time of this writing, this is unfortunately not yet working. (In Internet available pin-outs for the modem connector appear not quite accurate.)

Finally, as can be seen from the photographs, the different connectors were labeled in a more readable fashion than in original.

2.11. Modding the Nokia dBox

2.12. Setting up a Linux/Unix Server for the dBox

2.12.1. Yet another guide on setting up a Linux server?

The goal of this guide is to proved help on setting up a Unix or Linux server for providing the dBox with some useful services. It is aimed at the beginner to intermediate user. Nothing really new is presented here. The emphasis is on traditional Unix services, getting them to work, to troubleshoot them.

2.12.2. General

It is only when you network the dBox, that you can take advantage of its full power. A number of services exist, and new are invented regularly. Some of these are multimedia related, and enables the box to digitally record DVB-transmissions, or to reproduce video or audio material. This is not the topic for the present guide, that instead focuses on the more traditional Unix services.

The three services we will cover are:

NFS
Provides file server service
TFTP
Provides the client with a file to boot
DHCP
Provides the client with parameters, that it needs for booting

Typically, but not by necessity, they reside on the same host.

It is sometimes sensible to set up only, e.g., an NFS-Server.

If using newmake to compile the CDK, outlines for `/etc/hosts`, `/etc/exports`, and `/etc/dhcpd.conf` are generated, by the target `serversupport`.

2.12.2.1. YADD and its advantages

It is possible for the dBox (in debug mode!) to boot entirely from a server, not using any (nonvolatile) internal memory. The necessary parameters for booting will be received from a server, another (possibly different) server provides it with the necessary boot loader (u-boot, in the past "ppcboot") and secondly with a Linux kernel. The root file system is NFS-mounted from a server. This mode of operation is called YADD ("Yet Another Dbox Distribution"), or CDK ("Cross Development Kit"), an extraordinarily silly, but established, name. This mode of operation has many advantages:

- The flash memory, i.e. "its" operating system, is not affected in any way.
- Using the flash functions of, e.g. Neutrino, the flash can be read out, or the flash can be new programmed.
- Disk space, also in the root partition, is "unlimited".

- Very practical for development: After a successful build, the changed software immediately resides on the dBox, without need for flashing.

2.12.2.2. Host name resolving

In many situations, computers have to be referred to in a unique fashion. This can be done with IP-Numbers, or, if the involved computers can understand it, symbolic names. To translate the symbolic names to IP-numbers ("hostname resolving"), a number of mechanisms have been proposed. For home networks, usually the file `/etc/hosts` is used. For a small home network, this may look like:

```
127.0.0.1       localhost
192.168.1.1     workcomputer
192.168.1.2     server
192.168.1.5     dbox nokia
192.168.1.6     sagem
```

This file is then distributed to all computers in the network. Now the symbolic names can be used in configuration files.

2.12.3. The DHCP Server

The dhcpd-daemon supplied with most Linux distribution is a very versatile program. It implements, not only the DHCP-protocol, but also the BOOTP protocol. It provides a client, providing only its MAC-address, with the information necessary to boot from a TFTP- and NFS-server. I recommend not to configure it using the system administration tool, but instead to generate a suitable configuration file `/etc/dhcpd.conf`. If using newmake to compile CDK, a suitable `/etc/dhcpd.conf` will be generated by the target `serversupport`, adapted to the parameter used when running the `configure`-command. This file will typically look like:

```
# This is a template for dhcp.conf
# Copy to the appropriate location for your server,
# typically /etc/dhcp.conf.
# You may have to modify this file manually.
# Please see the documentation for your server and for dhcpd.

ddns-update-style none;
subnet 192.168.1.0 netmask 255.255.255.0 {
}

host dbox {
        fixed-address 192.168.1.5;
        hardware ethernet 00:50:9c:xx:xx:x;
        allow bootp;
        server-name "godzilla";
        next-server "godzilla";
        option root-path "/tuxbox/cdkroot";
        if exists vendor-class-identifier {
                filename "kernel-cdk";
        } else {
                filename "u-boot";
        }
}
```

where "godzilla" is the name of the DHCP-, TFTP-, and NFS-server.

The MAC-address of the dBox needs to be entered here. Often, it is printed on the back plate of the dBox. Otherwise, a command like `arp -a` can often be used to determine it. The MAC-number of a dBox always starts with "00:50:9C".

As of CVS-Stand 2006-02-01, the root path can be entered in the form `IP-Address:/directory`, not forcing TFTP- and NFS-server to coincide. However, using IP-Name instead of IP-Address is not possible.

The dhcpd-daemon can be started either from the system administration tool, or directly with `/etc/init.d/dhcpd start`.

For more information, see the man-pages for `dhcpd` and `dhcpd.conf`, or the source of the software, ISC.

Unfortunately, unless you remove the Ethernet cable from the dBox when booting, unlike the NFS-server and the TFTP-server, the dhcpd-daemon interferes with normal operation of the dBox -- it will simply force the box to boot from the server. I do not know of a really elegant solution: personally I let dhcpd be off by default, and start it, using `/etc/init.d/dhcpd start`, when needed.

2.12.3.1. Troubleshooting

As can be inferred from the configuration file, there is a fair number of things that can go wrong. Also, as is discussed in this thread, some versions of dhcpd do not work with the Tuxbox. For troubleshooting, use the system log, typically `/var/log/messages`. For reference, we show a successful boot ("godzilla" is the server, "dbox" the dBox, having MAC-address 00:50:9c:xx:xx:xx):

```
Jan 23 14:28:21 godzilla dhcpd: BOOTREQUEST from 00:50:9c:xx:xx:xx via
eth0
Jan 23 14:28:21 godzilla dhcpd: BOOTREPLY for 192.168.1.5 to dbox
(00:50:9c:xx:xx:xx) via eth0
Jan 23 14:28:22 godzilla dhcpd: DHCPDISCOVER from 00:50:9c:xx:xx:xx via
eth0
Jan 23 14:28:22 godzilla dhcpd: DHCPOFFER on 192.168.1.5 to
00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:22 godzilla dhcpd: DHCPREQUEST for 192.168.1.5
(192.168.1.1) from 00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:22 godzilla dhcpd: DHCPACK on 192.168.1.5 to
00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:23 godzilla dhcpd: DHCPDISCOVER from 00:50:9c:xx:xx:xx via
eth0
Jan 23 14:28:23 godzilla dhcpd: DHCPOFFER on 192.168.1.5 to
00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:23 godzilla dhcpd: DHCPREQUEST for 192.168.1.5
(192.168.1.1) from 00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:23 godzilla dhcpd: DHCPACK on 192.168.1.5 to
00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:27 godzilla dhcpd: DHCPDISCOVER from 00:50:9c:xx:xx:xx via
eth0
```

```
Jan 23 14:28:27 godzilla dhcpd: DHCPOFFER on 192.168.1.5 to
00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:27 godzilla dhcpd: DHCPREQUEST for 192.168.1.5
(192.168.1.1) from 00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:27 godzilla dhcpd: DHCPACK on 192.168.1.5 to
00:50:9c:xx:xx:xx via eth0
Jan 23 14:28:37 godzilla rpc.mountd: authenticated mount request from
dbox:800 for /tuxbox/cdkroot (/tuxbox/cdkroot)
```

The last line is not from dhcpd, but shows that the NFS-mount of the root succeeded.

2.12.4. The TFTP Server

TFTP is a very simplified file transfer protocol. For the Tuxbox, it serves the client with the boot loader `u-boot` and the Linux kernel `kernel-cdk`, as well as (optionally) the logo files `logo-fb` and `logo-lcd`. The TFTP-Service is normally set up using the system's administration tool. The only real interesting setup option is its base directory (called "Boot image directory" in YAST2/SuSE). This is where `u-boot` and `kernel-cdk` reside. It should normally be the same as the `--with-bootdir` parameter to `configure`.

2.12.4.1. Troubleshooting

There is not too much that can go wrong, basically only "File not found". These messages can often be found in the system log, typically `/var/log/messages`.

Since the TFTP-daemon "chroot"-s to its base directory, all file names are interpreted with respect to this directory, which can sometimes be confusing.

2.12.5. The NFS Server

The Network file system (NFS) is the most common remote file system in the Unix world. For a file server for the dBox, there appears to be a consensus that it offers better performance and reliability than other alternatives.

The NFS server is turned on using your standard system administration tool, like YAST2 in SuSE. For the configuration (what file systems are exported, to what client, and with what properties), it really all boils down to editing the file `/etc/exports`, although system administration tools may offer "user friendly" ways of editing this file.

Typically, the file may look like:

```
/tuxbox/cdkroot          dbox(rw,sync,no_root_squash)
/multimedia/music          dbox(ro)
/multimedia/streaming          dbox(rw)
```

This file says that the directory `/tuxbox/cdkroot` (on the server) is exported to the host with the name "dbox" (as found in /etc/exports), the host may mount it with write-access. The options "sync" and "no_root_squash" should be used for the file system to be mounted as root, otherwise it is not needed. The second line states that the filesystem `/multimedia/music` may be mounted by host "dbox", but not with write

access.

After changing `/etc/exports` the NFS-daemon does not automatically take changes into account. The system is told to re-read `/etc/exports` by, e.g., a command like `exportfs -a` or `/etc/init.d/nfsserver restart`.

Solaris does not use `/etc/exports` but a `share`-command.

If using newmake to compile the CDK, it generates am `/etc/exports`-fragment, suitable for exporting the used cdkroot to the dbox -- assuming that the compile host is the same as the NFS-Server of course.

2.12.5.1. Troubleshooting

The NFS server is in general quite robust, and seldomly makes problems. Most problems are permissions problems. Look in the log file(s) on the server (typically `/var/log/messages`) for problems. However, the Tuxbox does not implement file locking over NFS, so file systems have to be mounted using the "nolock" option (on the client, that is), otherwise the mount may hang.

2.12.6. Other possible services

There is a vast number of different services that may or may not be of interest. Multimedia related services are, e.g. shoutcast and VLC. There are also the traditional Unix-Services. These can, possibly after installing some client software component, in general be used with the Tuxbox.

2.12.6.1. DNS Name server

To have your own nameserver in your LAN may be useful, or at least nice. That way, it is not necessary to keep `/etc/hosts` up to date on all hosts on the LAN.

2.12.6.2. RARP server, Bootp server

The dhcpd daemon, setup like here proposed, takes over the task of these services, which are therefore not needed.

2.12.7. Flashing

In this article a non-interactive flashing using the "dboxflasher", a specially compiled u-boot, is described. This is an application using DHCP and TFTP.

Booting from YADD and flashing, using either Neutrino's (or Enigma's) flashing functions (or, from the command line, the commands `eraseall` or `fcp`) is a viable possibility both for reading and writing of the flash memory (partition `/dev/mtd/4`, "Flash without bootloader").

2.12.8. Troubleshooting

For trouble shooting, a log from the serial console (also called bootlog) is indespensible. See wiki for some more details. Without it, no sensible debugging is possible, just guessings. Also, the log on the server (typically `/var/log/messages`) can give many important hints, in particular regarding NFS- and DHCP-problems.

2.12.9. Links

- CDK YADD Boot Procedure"> in Tuxbox Wiki. Also in German as CDK (YADD) Bootvorgang. Describes the steps involved in booting a CDK setup.
- DHCP software from ISC.

2.13. Non-interactive Flashing using dboxflasher

2.13.1. Introduction

The present article describes a method for non-interactive flashing of dBoxes using a server with DHCP and TFTP capacities, like a Linux computer.

The use of the u-boot as flashing tool was introduced by Homer in "dboxflasher mit/ohne Nullmodem-Kabel", however without sources. It was checked in to CVS by yours truly, who also wrote Makefile rules (in newmake) and the script described later.

A serial connection ("nullmodem cable") is not required. However, troubleshooting without it is fairly meaningless.

2.13.2. General

The dboxflasher really "is" nothing else than a configuration file for the u-boot. This file is checked in in the Tuxbox CVS, `u-boot.flasher.dbox2.h`. The interesting part is the boot command, which reads:

```
#define CONFIG_BOOTCOMMAND                      \
"tftp \"dboxflash.img\";protect off 10020000 107fffff; " \
"erase 10020000 107fffff;cp.l 100000 10020000 1F8000;reset"
```

This means: first, get the file `dboxflash.img` from the TFTP-server. Then make the appropriate area in the flash memory (everything except for the first 128KiB, which is used by the BR boot loader) writable and erase it. Finally, copy the just downloaded file to the just erased flash area. Then reboot.

To use dboxflasher for flashing, the TFTP-server have to first provide it as the first boot-file (replacing the normal u-boot, taking the name from the DHCP-parameters), then provide `dboxflash.img` (for which the name is known). Optionally, logo files `dboxflasher-fb` and `dboxflasher-lcd` may be provided, also by the TFTP-server. Finally, the DHCP-server have to be shutdown by the time the dBox

reboots, otherwise the same procedure will start all over again. Preferably, this should all co-exist with a setup of DHCP and TFTP for booting YADDs (see this document).

To automate these tasks is the object of the following section.

2.13.3. A script for automated flashing

The script do-flash is an attempt to satisfy these requirements. It is invoked as:

```
do-flash filename
```

where *`filename`* is the filename of the image file to be flashed. The script first checks the size of the file, makes a backup of possible previous u-boot, and copies the dboxflasher to its location, and the flash-file to `dboxflash.img`. Then, to be sure we are in a known state, a possibly running dhcpd is terminated. dhcp is subsequently started, and the dbox (that is assumed to have the IP-name "dbox") is rebooted using the Neutrino web API. Of course, this will reboot the dBox only if running Neutrino, otherwise the user have to reboot the dBox manually. The script waits for two minutes. During this interval, the dBox is supposed to boot (only the DHCP-related services are required to be completed during this interval). After two minutes, the flashing is supposed not to be completed, the DHCP server is terminated, preventing the flashing to start anew. The original u-boot is then restored. In the case of interruption (with e.g. Control-C), the signal is trapped, dhcp terminated, and the original u-boot restored. The flashing is also logged to a local file.

2.13.4. Building, or downloading, dboxflasher

The dboxflasher configuration file is a part of the Tuxbox CVS. Users of the newmake branch can build it automatically within the CDK setup using the make target `dboxflasher`. This target will install dboxflasher in the tftp-directory.

Here, a compiled dboxflasher can be downloaded.

2.13.5. Performance

My Nokia (2x) is flashed in approximately 2 minutes. Unfortunately, flashing my Sagem (1x) does not work that well, but takes approximately 10 minutes. I do not know why.

2.14. The dBox IR-Keyboard

2.14.1. Revision history

Date	Description
2006-02-20	Initial version.
2006-03-29	Fixed some minor errors. Mention kb2rcd. Update and describe patch.

2.14.2. Introduction

Originally, the dBox was designed as a "multimedia terminal", with applications such as pay-per-view ordering, email, and home banking in mind. This design consideration amounts for the second (never officially used) card slot, the modem, and the optionally available infrared keyboard. This is all history, in particular, the keyboard was quite hard to get. Recently, they are available on German eBay for a quite reasonable price. (Search for "dbox tastatur").

The keyboard events are intercepted by the front processor of the dBox, making it possible both to read the keyboard as a generic computer keyboard, and to interpret the keys as coming from a normal remote control.

Some plugins access the keyboard. This topic is not covered by the present article, but may be found on Tuxbox WiKipedia, on the IR Keyboard page or on the Tuxbox commander page.

The empirical statements in this article has been verified on a Nokia, as well as on a Sagem dBox. It is believed that the Philips acts similarly.

The picture has been shamelessly stolen from Tuxbox WiKipedia.

2.14.3. The hardware

The keyboard is in laptop design and size, and comes exclusively in German qwertz-layout with German labeling. See the picture. There is a "fire button" on the extreme left, and a "joystick like" thing to the right. Below the "joystick", there is another

"fire button". On the front, there are four IR-Diodes, that appear to provide quite reliable communication. I tried with a distance of 7 meters with no problems, probably much larger distances are possible.

The unit is powered by 4 AA-type batteries. It is suitable both for desktop- and sofa-usage. The mechanical quality is quite acceptable, in particular considering the low price.

2.14.4. Low-level interface

All keys send different infrared signals. The driver in `.../driver/fp/dbox2_fp_keyboard.c` translates these in keycodes and events. The keycodes are listed in the source code file `.../apps/tuxbox/neutrino/src/driver/rcinput.h`. These keycodes are in general from the Linux include file `include/linux/input.h`. The "Fn"-key to the lower left is made into a shift-key: it sends no keycode, but makes some keys (the ones having blue lettering) sending other keycodes. These are: KP0 to KP9, KPASTERISK, KPMINUS, KPPLUS, KPDOT, KPENTER (on the return key), KPSLASH. Until recently, the two Windows keys, and the key marked "Druck S-Abf" were left out.

As opposed to the remote control, no keys on the keyboard makes the dBox wake up from deep standby.

The left "fire button" sends the BTN_LEFT keycode, and the right one the BTN_RIGHT keycode. Usage of the "joystick" can be identified by the event type.

2.14.5. The keyboard as a computer keyboard

A front processor driver (`dbox2_fp_keyboard.o`) makes it possible to use the keyboard as a normal computer keyboard. With the command `loadkeys` (normally executed from `rcS`) it is possible to load a proper keyboard translation table. Since the keyboard is labeled as a German qwertz-keyboard, the `de-latin1-nodeadkeys` keymap is recommended. (`de-latin1`, used in the HEAD branch of CVS, is an alternative, however, for a computerist in general unsuitable.)

The appropriate keymap is loaded with the command like `loadkeys /share/keymaps/i386/qwertz/de-latin1-nodeadkeys.kmap.gz`. The following files must be installed for this to work:

```
/bin/loadkeys
/share/keymaps/i386/qwertz/de-latin1-nodeadkeys.kmap.gz
/share/keymaps/i386/qwertz/de-latin1.kmap.gz
/share/keymaps/i386/include/linux-keys-bare.inc.gz
/share/keymaps/i386/include/linux-with-alt-and-altgr.inc.gz
/share/keymaps/i386/include/qwertz-layout.inc.gz
```

Around 100 kB space in the root partition is required. With this keyboard tables,

everything (but the Windows keys) works, as far as I know, flawlessly.

Through `/etc/inittab`, there are more possibilities. With keys `Alt-F2` thought `Alt-F6` a virtual console is opened on the framebuffer. It is hidden (not closed) by the key `Alt-F1`. Finally, `/etc/inittab` instructs the system to reboot on the Cntrl-Alt-Del ("Strg-Alt-Enf" on German keyboards) key press.

2.14.6. The keyboard as a remote control for Neutrino

The first impression when trying the keyboard out of the box is that Neutrino recognizes very few of the keys. These are: The numerical keys 0 to 9, "Pos1" = Home, Bild ^ = Page Up, "Bild v" = Page Down (seldomly used, found only on very old remote controls), as well as the cursor keys. There is nothing wrong with this — the keyboard is a "keyboard", not a bulky replacement remote control!

In the menu `dBox -> Settings -> Key Setup`, it is possible to bind certain functionality (e.g. switching between TV- and radio-mode) to arbitrary keys. All keyboard keys (except for "Fn") can be used for this. With CVS from 2006-02-17 (2006-03-26 for the remaining three: KEY_SYSRQ, KEY_LEFTMETA, and KEX_RIGHTMETA), Neutrino also knows sensible names for those keys.

To be able to programmatically use the key, `rcinput.h` was extended. The keycodes have names taken from `include/linux/input.h`. From the keycodes, Neutrino key events are being named in an obvious manner.

Unfortunately, the event belonging to key on the German labeling denoted with ß, should logically be named `RC_minus`. However, this name was previously taken in a previous version of the file to denote the key for lowering the volume (`RC_volumedown` would have been better). For this reason, the name `RC_hyphen` was chosen.

2.14.6.1. Really turning the keyboard into a bulky remote control

Neutrino does not offer a clean way to, for example, add another "red button". So, instead the original version of this article presented a dirty way :-). (Just hard coding some translations into `rcinput.cpp`.)

2.14.6.2. The kb2rcd-daemon

Possibly as an answer, robspr1 in the Tuxbox forum wrote the daemon `kb2rcd`, see this posting (and following ones), as well as this thread in the Jack-the-Grabber forum. This is no doubt an interesting approach. It is a daemon that gets events (from `/dev/input/event0`), translates them, (not necessarily 1-1, but possibly 1-0 (Scripts), or 1-n (macros)) and pushes them back in the device. The advantage is the modularity, as it works with "everything", including plugins as well as Enigma. Also, it is easily added to an existing image, even cramfs/squashfs-Images. The drawback is that it works on the event-level; therefore everything like timing, up/down-Events etc. must be

considered. As I tried it, at first it did not work at all, only for very long key presses. I found out that the initial delay (200ms) needed to be lowered. It can be configured using a configuration file `kb2rcd.conf`. It can execute commands, as well as plugins, directly. Recent versions can translate joystick actions to cursor keys, and can also interpret the Alt-key as a shift key, as well as assigning a binding to delayed keys. It is (partially) described in this Wiki-contribution (as well as the threads quoted). It has been checked in to CVS, in the directory `.../apps/tuxbox/tools/kb2rcd`.

2.14.6.3. A patch for rcinput

The patch for rcinput, available here, has been vastly improved. The translation is now governed by a configuration file, in spirit similar to the configuration file for `kb2rcd`. The patch works by translating keys, (not events), therefor no 1->n translation (macros) are possible. In particular, instead of key presses, several Neutrino-messages (see `.../apps/tuxbox/neutrino/src/neutrinoMessages.h`) can be generated, optionally with data. In this way, it is also possible to execute plugins directly .The configuration file should be located in `/var/tuxbox/conf/rc.conf`. A sample configuration file is shown in the Appendix.

To the file format of the configuration file: Every line is of the form *keyword=action* or *keyword=action(data)*. All other lines are ignored. A hash sign ("#") is taken as a comment character. Here *keyword* in general is the name of a key (translated to lower case), but there are also additional keywords:

Keyword	Allowed Values	Description
keyname (lower case)	*action* (lower case)	Have *action* be executed at press of key *keyname*.
`debug`	`on` and `off`	Turns on and off tracing on the system console.
`no_neutrinoevents_when_v`	`on` and `off`	If on, whenever a virtual console is visible (opened with F2 – F6), key presses will not be forwarded to neutrino.

Allowed actions are the key names, as well as some additional actions. These often, but not always, are the same as the corresponding Neutrino messages, translated to lower case.

Action	Data	Description
keyname		Have Neutrino execute the action associated with *keyname*.
`system`	*command*	The data is taken as argument to a `system` command; in normal english, "is executed".

		Output is output to the system console. The return status is reported to the console.
`mode_tv`		Switches neutrino to TV mode
`mode_radio`		Switches neutrino to radio mode
`vcr_on`		Switches on SCART-mode.
`vcr_off`		Switches off SCART-mode.
`standby_on`		Switches on standby-mode.
`standby_off`		Switches off standby-mode.
`show_epg`		Shows the EPG.
`show_infobar`		Shows the infobar.
`lock_rc`		Locks the remote control (and the keyboard). Press the red key followed by the dBox key to re-enable. See this Wiki-article.
`show_volume`		Shows the volume bar.
`evt_popup`	*message*	Shows *message* in a temporary popup.
`evt_extmsg`	*message*	Shows *message* in an extmsg popup.
`evt_plugin`	*pluginname*`.cfg`	Starts the popup with the name *pluginname*.
`reload_conf`		Reload the configuration file.
`shutdown`		Shutdown the system. Note that this is a way of implementing a bona-fide discrete power-off-key.

2.14.7. Appendix. A sample rc.conf

```
# Demo rc.conf

A comment do not need a `#', as long as it does not contain an equal
sign

# Do not turn on debugging yet (it babbles while parsing this file),
# just at the end of the file
#debug=on

# Do not let Neutrino see the keys when a virtual console is open
```

```
no_neutrinoevents_when_vc=on

key_kp1=system(date)
key_kp2=system(ls)

# Projector suitable params (requires controldc)
key_kp5=system(controldc setVideoOutput 4) # YUV

# TV suitable params
key_kp8=system(controldc setVideoOutput 1;controldc setVideoFormat 0) #
RGB + auto
key_kp9=system(controldc setVideoFormat 1) # 16:9

key_minus=key_help
key_esc=key_home

key_f1=key_red
key_f2=key_green
key_f3=key_yellow
key_f4=key_blue
key_f5=mode_tv
key_f6=mode_radio
key_f7=vcr_on
key_f8=vcr_off
key_f9=standby_on
key_f10=standby_off
key_numlock=show_epg
key_sysrq=show_infobar
key_scrolllock=lock_rc
key_insert=show_volume

key_btnleft =key_ok
key_btnright=key_power
key_102nd=key_volumedown
key_grave=key_volumeup
key_pause=key_mute
key_delete=key_setup

evt_popup and evt_extmsg  works!
key_leftmeta=evt_popup(Barf rulez)
key_rightmeta=evt_extmsg(This nonsense stays on the screen for a LOOONG
time)

plugins can be started by evt_start_plugin
key_end=evt_start_plugin(tuxtxt.cfg)

special function: reload_conf reloads this file
key_tab=reload_conf

key_bottomright=shutdown

# NOW, turn on debugging
debug=on
```

2.14.8. Appendix. Installing the keyboard mapping file with newmake.

Here is a `root-local.sh` file that will install the above mentioned files in a newmake run. It violates this "style recommendation" severly ;-). Note that the value of

`targetprefix` has to be manually edited in the file.

```
#!/bin/sh
newroot=$1/root
targetprefix=/tuxbox/cdkroot

make console_tools

install $targetprefix/bin/loadkeys $newroot/bin
install -d $newroot/share/keymaps/i386/qwertz
install -d $newroot/share/keymaps/i386/include
install -m 444
$targetprefix/share/keymaps/i386/qwertz/de-latin1-nodeadkeys.kmap.gz
$newroot/share/keymaps/i386/qwertz
install -m 444 $targetprefix/share/keymaps/i386/qwertz/de-latin1.kmap.gz
$newroot/share/keymaps/i386/qwertz
install -m 444
$targetprefix/share/keymaps/i386/include/linux-keys-bare.inc.gz
$newroot/share/keymaps/i386/include
install -m 444
$targetprefix/share/keymaps/i386/include/linux-with-alt-and-altgr.inc.gz
$newroot/share/keymaps/i386/include
install -m 444
$targetprefix/share/keymaps/i386/include/qwertz-layout.inc.gz
$newroot/share/keymaps/i386/include
```

2.15. FAQ for Barf's dBox page

2.15.1. Questions

2.15.1.1. 1. Warum schreibst du nicht auf Deutsch? Du bist ja offensichtlich auf einem deutschen Server/(Why don't you write in German?)

Englisch ist die Nummer 1. internationale Spache der Wissenschaft und Technik, genau so wie latein für die Medizin, französisch für das Postwesen, oder Deutsch für die Theologie. Entweder schreibe ich auf Deutsch, und schliesse nicht Deutschsprechende aus, oder schreibe ich auf Englisch, und schliesse nicht Englischsprechende aus. Ich glaube das zweite ist besser. Die eigentliche Zielgruppe dieser Seite versteht Englisch, da bin ich mir ziemlich sicher.

Ausserdem gibt es recht wenige englischsprachige dBox-Sites. Und die, die es gibt, gehören fast ausschließlich zu "der dunkle Seite".

2.15.1.2. 2. Why isn't this stuff in CVS?

It differs. Some of the stuff are, or will be checked in. In some cases the patch is not quite reliable, or there are other reasons for not committing it. This site makes it possible to publish patches that are not to be committed.

2.15.1.3. 3. What is a patch? What can I do with it?

Short answer: If you really need to ask, then it is not for you. Long answer: A "*diff*"

describes the difference between two files, one "original" and "fixed". It is generated by the program `diff`. It contains the changed lines, together with a few content lines around the changed lines. These content lines makes the patch and the patching procedure somewhat robust, for example if the original file changes in a different place. When the diff is distributed, in the intent of making it possible for people in the possession of the original file to generate the fixed file, the diff is called a *patch*. With e.g. a text editor, the original file and the patch, the fixed file can be constructed. There also exists a program which automates this task. It was written by Larry Wall possibly 20 years ago, and, surprisingly, carries the name `patch`. Typical use of the patch program is: `patch foobar.c < foobar.c-patch`. This is called "applying the patch" or "patching". This may go wrong, you must check the output of the program! See next Q:

2.15.1.4. 4. What if the patching goes wrong?

You must not go on without thinking! Most likely, the "original file" has changed in a way that makes automatic applying of the patch impossible. If you have a reasonable understanding of the syntax and semantic of the files you are patching, you may be able to use your understanding and your brain to manually apply the patch in a way consistent with the original intention. Independently of this, you should inform the author of the patch, he/she may or may not be willing to update the patch (for you and for the rest of the community!).

2.15.1.5. 5. Can you give me an idiot-proof step-by-step description of what I have to do to get one (or several) of your patches on my dBOX?

Short answer: No. Because there is no such thing. Slightly longer answer: Main steps are: Checking out the sources of the CVS, applying the patch(-es), configuring, compiling, possibly customizing, building an image, flashing it.

2.15.1.6. 6. I don't know anything about this Unix/C crap. How much effort would it take to learn do all this?

Consider it as getting into a new hobby. If you have no previous experience, it will probably take months before you have successfully built and flashed your first working image. Don't want to scare anyone away...

2.15.1.7. 7. Patching and compiling is sooo complicated, can't you provide a binary?

In some cases (like zapit) this makes sense. For programs that changes almost daily (like Neutrino) this would make no sense.

2.15.1.8. 8. Ok, I have a binary (e.g. zapit). I use an image that I want to keep using. How can I put the new binary into my image?

First of all: if your image is considerably different from the current CVS, it may not work at all, since the API and the communication between the programs tend to change fairly

often. If your image has its root filesystem writable (so-called *jffs2-only-image*), you can just overwrite the old file (after making a backup :-) with the new one. Unfortunately, this is seldomly the case :-(. The images with non-writable root filesystem have their `/var` file system writable. It may be possible to put your binary there (say in `/var/bin`), and somehow tell the system to look for it there. If also this in not feasible, you have to extract the root file system partition, transfer it to a PC, unpack it, modify the unpacked file system, make a new file system, transfer it to the dBOX and flash that partition. How to do this is outside the scope of this FAQ.

2.15.1.9. 9. Where does the name "Barf" come from?

"Barf" is one of the main characters in one of my favorite movies of all time, Spaceballs by Mel Brooks. In today's English, "to barf" means to vomit or puke (literally or symbolically). Googling for "barf" also gives a number of acronyms.

3. Home Theatre

3.1. My Home Theater Page

3.1.1. Revision history

Date	Description
2005-05-23	Initial version.
2005-12-21	Added initial Mk 4 information including photos.
2006-02-24	Integrated the Mk 4 stuff. Put mk3, HD, remote control, and DVD Audio in separate pages. General fixes.
2007-06-18	Updated Sanyo projector including photos. Moved Home automation and Remote Control (previously "Remote Control"). General fixes. (Actually, this version was never published...)
2009-07-19	Major reorganization. Moved most stuff to separate pages. Still much left to do.

3.1.2. Introduction

High-tech Audio/Video reproduction is a fascinating hobby. It encompasses "Hi-Fi" (audio only). It is hard to find a good one-word summary, but the word "Home Theater" (and variations in other languages, for example in German "Heimkino") has gained widespread usage and acceptance.

I avoid the term "high-end", since, to me, this is just too close to voodoo and senseless money destruction—cables in the three or four digit price range, to be (in the case of

loudspeaker cables) burned-in (or, in the case of even-more expensive burn-in-free cables) not needing burn-in.

On these pages, I present "my hobby". A superior sound and a superior picture is of course part of the goal. Just as well as light, remote control and home automation, decoration, even flowers. But it is not a matter just of buying sufficiently expensive components, but also of technical problem solutions, since often the desired solution cannot just be bought, at least not within the budget of a mortal. An above all, everything must be combined with a personal style and taste, which does include more than just the technical elements.

Of course, high-quality equipment is not cheap. However, achieving the goal within a reasonable budget is a challenge. Also, I often try to (re-)use old equipment, repairing and/or modernizing if necessary and/or desired. Or to modify equipment beyond its original capacities.

Said many times before: Enjoying fantastic movies and music within the comfort of your own four walls does have its thrill.

Oh, by the way: High-tech, movies and music are not everything. For example books are much easier to transport, and requires very little resources. To me, there are few things the world needs less than, say, the possibility to watch movies on the beach on a mobile phone display...

3.1.3. Articles and Links

The bulk of this previously very long "page" has been put into different articles, listed below. Note that issues concerning remote control and home automation has been moved to its own section.

3.1.3.1. On the development of the home theatre

These articles describes different stages of the evolution of the home theatre.

- Mk 0. The Dawn of Man.
- Mk 1. The Pro Logic/Laserdisk Period.
- Mk 2. The 5.1/DVD Period.
- Mk 3. The big-screen period.
- Mk 4. Real loudspeakers.
- Mk 5. High Definition. *Present setup*.

3.1.3.2. Different projects

Here some articles are collected, describing experiences, and, to some extent, opinions:

- On 2+2+2 multichannel setup. (Planned)
- An ir-controlled high-quality analog 8-channel audio switch.(In preparation, see this forum contribution (in German) in the meantime.)

- A simple loudspeaker relay switch box. (In preparation, see this forum contribution (in German) in the meantime.)
- High-Definition (from 2005, thereby highly obsolete, for historical interest only.)
- Multichannel Music, DVD Audio, and SACD. (Needs updating)
- Fixing the Wellington Scart switch ("Vivanco AV Control 5")
- Ipod docks (Planned)
- Bedroom and kitchen (Planned)
- Work desk sound (Planned)
- Multimedia Shelf

3.1.3.3. External internet resources

In other places on this site, I mention several Internet resources, that has somehow been useful for me, and I feel I can recommend. Here are some more. Links related to home automation and remote control are presented on the corresponding page.

- beisammen.de. Qualified German language discussion forum. I participate using the nickname "Barf". Very low tolerance level against "silliness" in all forms.
- avsforum.com America high-volume home theater forum
- Schaltungsdiest Lange Service manuals ("all" languages) for "everything", in general in printed format. Sold to everyone, very fast deliveries. On the downside, pretty expensive (typically 10–20 Euro), and the rather weak WWW-site.
- Wiki for the Tuxbox project, aiming for a free, Linux based operating system for the dBox Satellite/Cable digital receiver. Further comments are given on my dBox page.

Also see My DVD/Bluray/HD-DVD collection.

3.2. Mk 1. The Pro Logic/Laserdisk Period.

3.2.1. Introduction

The new TV and the new video recorder had watered my appetite: In January 1994 I bought a Pro Logic receiver (Onkyo TX-SV9041), a laserdisk player (Sony MDP 650D) and, as front Left/Right/Center speakers the Bose Acoustimass 7. Surround speakers also from Bose (VS100). This (essentially) completes the setup that I refer to as *Mk 1*. This was a fantastic feeling. Surround sound! No-one had seen anything like the sound and picture quality of the laserdisk before. Audio and video completely integrated. Both me and my friends were deeply impressed. Except for the tiny TV-picture, it was hard to imagine anything (essentially) better. A drawback was of course the extraordinary prices and the bad availability of software in form of laserdisks: 100 DM and more were common. The disadvantage was somewhat lessened by the fact that one of Germany's largest laserdisk importers (Cinemabilia, seems to have gone out of business now) had their store located within walking distance from my apartment in Bremen. A big source of inspiration was the mailing list Europe-LD (and later Europe-DVD).

Time went on, and I started to get annoyed by the tonal quality (or, rather, lack thereof) of the Bose system. By movies, it could make a considerable amount of Ka-boom, but in particular for listening to music the un-detailed, bodiless, bass weak and colored characteristic started to get on my nerves. I learned, what amount of marketing hype goes into Bose, and what reputation its products hold on Internet (see, e.g. here.) The surround-speakers VS-100 (VS for "Video-Speaker", a name that Bose apparently have selected to mean "quality not even attempted") was a simplistic 1-Way system, with the cheapest parts possible. Not even claimed to be full-range, but a "video speaker". It is hard to imagine that the cost more than, say, 10 Euro to manufacture. Nevertheless, they cost 299 DM (German Marks; slightly more that 150 Euro) *each!*

To fit in optically, the Thorens turntable was painted with a matt black spray paint. (I cannot stand the walnut look of the 1970's.)

3.2.1.1. PALplus

Some years later, for a limited period of time, PALplus (a technologically quite advanced trick to send (analog) 16:9-Programs without annoying the 4:3-crowd) was considered the best thing after sliced bread, and I bought a set-top standalone decoder. (It was available under several different names, but all manufactured by Nokia.) (This, technologically not uninteresting, experiment, has been put on the historical garbage dump by digital TV. Probably very few persons (one of them is me :-) has ever taken advantage, or even noted. As far as I am aware, this experiment has probably cost the European tax- and license-payers enormous sums...

Probably not many persons (in Germany) know it, but at the time of this writing (June 2005), German public ("Öffentlich-rechtliche") TV channels (ARD, ZDF, Dritte, 3sat, arte,...) all send a considerable amount of its 16:9-Programs in PALplus: often several hours per day and channel.

3.2.2. Details on Mk 1. (Bremen 1994–München 2000)

- TV: Philips Matchline 28ML8805
- Loudspeakers (Left/Center/Right): Bose Acoustimass 7
- Surround Loudspeakers: Bose VS100
- Laserdisk Player: Sony MDP 650D
- Receiver Onkyo TX-SV9041
- VHS Recorder: Panasonic NV-F55EG
- Receiver: Marantz SR-60
- CD Player: Marantz CD42
- Tape Deck: Marantz SD-53
- Timer: Pioneer DT-555
- Turntable Thorens TD150/II (purchased 1972), equipped with SME Model 3009 Series II Improved Arm and ADC XLM MKII stylus.
- "Telefunken" PALplus-decoder (manufactured by Nokia)

- Premiere analog pay-tv decoder
- Stax SR-X Mark 3 electrostatic earphones, with SRD-6 adapter. Purchased in 1982.
- Remote Control: Many, e.g. Lapeschi Telegenius

3.2.2.1. Kitchen, Bedroom, and Computer

The kitchen and the bedroom were powered from the Marantz SR-60 amplifier. The kitchen had two IQ Mini Lady Loudspeakers, while the bedroom was equipped with homebuilt so-called Voigt-horns with Louther elements. These were connected in parallel.

For the computer desk, a pair of JBL Control 1G speakers were used, connected as the secondary speaker pair of the Onkyo.

3.2.3. Photos (Bremen 1999)

Continue to Mk 2. The 5.1/DVD Period.

3.3. Mk 2. The 5.1/DVD Period

3.3.1. General

In 2000, I,

- felt sick and tired over my music being massacred by Bose,
- felt disappointed with the bad musical properties of Pro Logic matrix surround,
- had stopped buying laserdisks, due to the high prices, nonexistent future, limited possibilities in comparison to DVD, and bad selection,
- was very interested in real, discrete, five-channel sound (originally "AC-3", later "Dolby Digital 5.1"),
- wanted to explore the possibilities of the new emerging media, DVD,
- and, finally, was economically healthy again :-).

A new generation was due. I sold the the Bose Acoustimass (I answered a BMW Newsgroup advert explicitly seeking Bose — so my consciousness is clean! I even gave the buyer the VS-100's free of charge.). Instead, I bought a set from Nubert, including active sub-woofer. The receiver was replaced by a Yamaha RX-V 596. The analog Pay-TV decoder was replaced by a digital receiver, a Nokia dBox II, running the (infamous) software from Betanova.

The tuner of the old video recorder had somehow developed severe picture disturbances (the customer service department at the store in Bremen where I originally bought it claimed it was in order, and recommended me to use a SCART-cable (i.e., problem is not the device, but that the customer is such a stupid sod, that connects a VCR and a TV with an HF-cable! For the record: written proofs of these statements exist, including a

Panasonic service center report, in which the tuner is characterized as broken.) As replacement, the Philips VR-1100 (S-VHS ET) was selected. (It turned out to be somewhat loud, mechanically.)

As DVD-Player, the Pioneer DV 525 was selected, with a code free/Macrovision free modification (Macrovision removal was legal then, unfortunately not now) from Chiptech (out of business since 2006-12-31) was selected.

In this context, I attempted to modify the Laserdisk player (Sony MDP 650D) to be able to reproduce the AC-3 (nowadays "Dolby Digital") digital sound found on some laserdisks. During this work, I managed to break the laser disk player severely (a short-circuit on -12 Volts, that had no sensible fusing, and several secondary problems. Altogether a large number of components replaced.) Due to problems borrowing a sensible oscilloscope, and since the number of laserdisks with AC-3 sound I own amounts to exactly 6, and these titles are available as DVD anyhow, I abandoned that project.

The TV had to be repaired twice due to problems in the vertical deflection, and the vertical deflection circuit.

With the number of devices increasing, some sort of universal remote control was absolutely necessary. I have had somewhat mixed experiences with conventional remote controls, so I bought the most advanced remote control around (in 2000) a Philips Pronto, the RU 890 model (now obsolete since a long time). See the section on home automation and remote control.

The Betanova software in the digital receiver was getting increasingly annoying. Fortunately, some smart people manage to "hack" the dBox II and port the Linux kernel to it, see my dBox page, and references therein. Since then, my involvement in this project has dramatically increased.

To reduce power consumption during standby, all devices but the dBox and the VCR (these may be recording) were connected to a master-slave power outlet box. Thus, in standby, (except for the VCR and dBox) only the Yamaha receiver (which is known to have low (< 1 Watt) standby power consumption) is connected to the power.

As a whole, I was very happy with this setup. In particular, the new loudspeakers brought life to my music collection. I was fascinated by the possibilities of the DVD's, and their comparatively moderate prices (compared to laser disks).

Due to the large number of devices (at times, also the tape deck and the CD-Player was connected) and the comparatively small number of inputs to the Yamaha, there was a need for quite a "creative" connection, see the wiring diagram.

3.3.2. Details Mk 2 (München 2000–2004)

- TV: Philips Matchline 28ML8805
- Loudspeakers:

    - Front Left/Right: NuBox 460 (2000-07-07)
    - Center: NuBox CS-3
    - Surround Left/Right: NuLine RS-3 (using Vogel's VLB 100 wall brackets)
    - Subwoofer: NuBox AW-850
- Laserdisk Player: Sony MDP 650D
- Yamaha RX-V 596 (Purchased 2000-07-15)
- Receiver Onkyo TX-SV9041
- Tape Deck: Marantz SD-53
- Pioneer DV 525 Code Free 2000-05-13
- S-VHS ET Recorder Philips VR-1100
- Nokia dBox II running the infamous Betanova software
- Timer: Pioneer DT-555 (only used as clock)
- Turntable Thorens TD150/II (purchased 1972), equipped with SME Model 3009 Series II Improved Arm and ADC XLM MKII stylus.
- "Telefunken" PALplus-decoder (manufactured by Nokia)
- Stax SR-X Mark 3 electrostatic earphones, with SRD-6 adapter. Purchased in 1982.
- Bass shakers: 2 Sinus live bass pump
- Remote Control: Philips Pronto RU 890
- TV-Live Light 13W

Wiring diagram (not showing loudspeaker or power cables).

3.3.2.1. Kitchen and Bedroom

Loudspeakers in the kitchen and the bedroom were powered from the old Onkyo receiver. A composite-video cable from the Yamaha to the bedroom allowed for certain video viewing in the bedroom, using a small Philips TV.

For the computer desk, a pair of JBL Control 1G speakers were used, connected as the secondary speaker pair of the Onkyo.

3.3.3. Photos (Munich 2004)

Continue to Mk 3. The big-screen period.

3.4. Mk 3. The big-screen period.

3.4.1. General

Already since Mk 1 in 1994, I had dreamed of a projector. However, the high prices, moderate quality, and to a certain extent the very bulky devices made it stay a dream. Ten year later, in 2004, the prices had gone down and the quality up, and I saw in the Panasonic PT-AE 500 the device I had been waiting for in 10 years. (Many other persons obviously felt similarly, so I had to wait almost two months for delivery...). The problem

with shortage of inputs was solved by the new Yamaha Receiver (RX-V 1400). Since that device supports 7.1 channels, two more loudspeakers (Nubert NuWave RS-5) "were necessary". I also bought a relatively simple pull-down screen (16:9 format, 2.34 meters wide, gain 1.0) from Mediastar.

Getting this stuff to work, and work well, turned out not exactly to be "unpacking, connecting the wires, go". To get the picture right, the screen and the projector has to be correctly aligned within centimeters, preferably millimeters. A roof lamp had to be removed. At that time, a sensible, and reasonably priced projector mount did not seem to be available. Therefore, the projector mount is of my own construction, although I acknowledge the influence of this thread in AVS-Forum. It consists of a furniture foot (!) in the shape of a solid iron tube, attached to a plexi glass piece by only one (but large) bolt (thus it can be rotated). The projector is attached to the plexi glass sheet using four iron rods with M4 thread. Using wing nuts and springs, position and angel of the projector can be adjusted. The mount thus provides four degrees of freedom. Total cost: around 15 Euros.

To make screen, TV, and other devices fit, TV table and Hifi Tower had to be lowered (thanx to Günter for cutting the steel tubes for me).

The now over 11 years old TV has started to show signs of its age (had had problems with vertical deflection, see above). The tuner broke, so I replaced it early 2004. There was also a problem with 16:9-mode, that I managed to fix. (Thanx again to Günter, this time for lending me the oscilloscope.)

The roller-curtain mechanism for the screen did not stop exactly where I wanted it to. So I threw it out, and replaced it with an electric tube motor from a local hardware store. For remote control, it was connected with an IntertechnoCMR - 500 switch, see the section on home automation. Finally, recently the lower bar was made heavy by a solid iron bar, to keep the screen hang as flat as possible.

Video signals, in CVBS, S-Video, or YUV format are feed into the Yamaha receiver. In the first two cases, the signal is up-converted to YUV by the Yamaha, and feed through three RG-59 cables (20 meters) to the projector. The drawback with this method is that the format information is lost (no pin-8 on SCART, no WSS on line 23), thus I have to adjust the aspect ratio of the projector manually.

Both the dBox, and the DVD-player deliver YUV signals to the projector, and RGB (through the Vivanco SCART-Switch) to the TV. Unfortunately, for both of them, they cannot deliver YUV and RGB at the same time (the number of Video DA-Converters is simply not enough). Both of them are "reconfigured" between RGB mode and YUV (+ CVBS)-mode. For the dBox, I have my own shortcut on a certain key doing this with just one key press (with the standard software this is not possible). For the DVD player, I have to go into the setup menus, enter the video section, and make the change there. I have two Pronto macros for this. As with all elaborate macros of this kind, the reliability is not 100%.

Many, or rather the most, of my favorite movies are not 16:9 aspect ratio (or, approximately the same, 1.85:1), but the wider 2.35:1 format ("Cinemascope"). Thus, it leaves black "letter-box" bars on the 16:9 screen. To "frame" the picture better, I made masking boards of solid wood, covered with black velvet-type adhesive film ("dcfix"). Thus, the black bars are not medium-gray, but really black, which adds quite a lot to the cinematic experience. (Using subtitles, this may have a drawback, in particular if the subtitles falls partly on, partly outside of the board. This disadvantage can to some extent be circumvented by the DVD-Player, that is able to adjust the vertical position of the subtitles.)

I love the wide Cinemascope movies. Unfortunately, it is pretty hard to reproduce at home (which is probably a part of the explanation of why the movie industry invented it in the first place :-) — either (for the case of a 4:3 screen), half of the screen is just black (so-called letter-boxing), or, half of the content is brutally chopped ("Pan and Scan", a practice just too common both in commercial and public TV. (Really, it is all depending on whether you consider the TV to be there to show the movie, or the movie to be there to fill up the TV.)

To do some tuning on the projector in the sense of, e.g., cine4home, the projector was equipped with a 52 mm red filter KR3.

Unfortunately, I was somewhat unhappy with the usage concept of the Panasonic projector, see the section on remote control.

3.4.2. Details on Mk3.

- Projector Panasonic PT-AE500 [1280 x 720 resolution] (2004-03-05)
- Receiver Yamaha RX-V 1400 (2004-01-20)
- Loudspeakers:
  - Front Left/Right: NuBox 460 (2000-07-07)
  - Center: NuBox CS-3 (2000-07-07)
  - Surround Left/Right: NuLine RS-3 (using Vogel's VLB 100 wall brackets)
  - Left/Right Back Surround: NuWave RS-5 Antrait (2004-01-23)
  - Subwoofer: NuBox AW-850
- Screen Mediastar 16:9, 2.34 meters wide
- Turntable Thorens TD150/II (purchased 1972), equipped with SME Model 3009 Series II Improved Arm and ADC XLM MKII stylus.
- Timer: Pioneer DT-555 (only used as clock)
- TV: Philips Matchline 28ML8805
- Laserdisk Player: Sony MDP 650D
- DVD Video/Audio Player: Panasonic S75. Regional Code free (using a special remote control).
- S-VHS ET Recorder Philips VR-1100
- Nokia dBox II running Tuxbox
- "Telefunken" PALplus-decoder (manufactured by Nokia)

- Stax SR-X Mark 3 electrostatic earphones, with SRD-6 adapter. Purchased in 1982.
- Remote Control: Philips Pronto RU 890 (purchase 2000-09-05)
- TV-Live Light 13W
- Vivanco Control 5. Modified.

3.4.3. Photos from Mk 3

Continue to Mk 4. Real loudspeakers.

3.5. Mk 4. Real loudspeakers.

3.5.1. General

I was by no means unhappy with the sound of the NuBox speakers, however, I felt more could be had. So I ordered new front and center speakers, namely Nubert's top-of-the-line NuWave speakers. These were the NuWave 125, and the center NuWave CS-65 (delivered on 2005-08-01). First, I switched the surround left/right and the back surround speakers, using the RS-5s as surround left/right speakers.

The difference to the previous setup was stunning. In particular, the precision and the sheer power was a clear indication that "size does matter". The homogeneity of the five NuWave speakers was also superior to the previous setup.

Just as an experiment, I tried the old large NuBoxes as surround speakers — and was again surprised, this time how much better multichannel music sounded with large speakers also in the back. For serious multichannel music listening, small surround loudspeakers like the RS-5 are simply not acceptable. The drawback with the experiment setup was: the homogeneity was broken; the NuBoxes could not match the precision of the NuWaves. Also, there was no way to accommodate boxes of that size at the required position in the apartment — I definitely wanted wall-mounted speakers. I ordered two NuWave DS-55 (delivered 2005-10-13), which turned out to tonally match the from NuWaves perfectly, and have bass power approaching that of a "big box". Wall-mounting a 16 kg speaker is not really a trivial endeavor. However, Vogel's VLB 200 wall mounts turned out to be perfectly capable for this. Also the design matches the NuWaves. See the photographs below.

Also the design of the NuWaves suits my style much better than old wannabe-wooden NuBoxes. I do not like loadspeakers pretending to be pianos. The NuWaves say to me: "Hey here I am, made of metal and synthetic materials, and I am proud of that. I am not a piano, but a loudspeaker!". According to this, the look of the old subwoofer Nubert AW-850 did not fit to the new NuWave speakers. so I made it black by using self-adhesive foil (see the photos). Although not perfect, I consider the result quite acceptable.

Most cables have been replaced by Clicktronic products. Also the Stax Headphone driver

unit has been replaced by the Stax SRD-7 (bought on eBay). The body shakers in the sofa (now powered from the "computer" amplifier) have been re-enabled. The Thorens turntable was tuned again, with a new stylus, new drive belt, and new paint.

The old center and surround speakers have been moved into the bedroom setup, which is now 5.1. The old front speakers (NuBox 460) have been sold.

The Nokia dBox was modified to, among other things, provide separate YUV-Outputs. This modification is described in detail in this article.

To switch between analog multi channel sources, together with some additional possibilities, a switch box was constructed, see this article.

In November 2006, I replaced the Panasonic projector by the slightly more modern (but already by the time of purchase not quite up-to-date) Sanyo PLV-Z4. This is intended to be in use until "Full HD"-projectors (1080p/24p) economically accessable. The Panasonic now resides with my brother.

A projector mount was constructed along the same lines as the previous one, however with the board in plywood, covered with adhesive foil in blackwood look (see photos). The projector is connected through YUV-cables, as with the Panasonic. The DVD-DVI-cable has been replaced by a DVI-HDMI-cable (for the HPTC). Additionally, there is a serial connection, which I intend to describe in detail here.

The new Sanyo offers considerably better contrast, and a much better usability concept. On the downside, Panasonic's advertised "smooth screen technology" is obviously not just advertisment; close to the screen the "chicken net effect" is much more noticable than with the Panasonic.

3.5.2. Details

- Projector Sanyo PLV-Z4 [1280 x 720 resolution] (2006-11-23)
- Receiver Yamaha RX-V 1400 (2004-01-20)
- Loudspeakers:
  - Front Left/Right: NuWave 125, anthracite (2005-08-01)
  - Center: NuWave CS-65 anthracite (2005-08-01)
  - Surround Left/Right: NuWave DS-55 anthracite (2005-10-13) (using Vogel's VLB 200 wall brackets)
  - Left/Right Back Surround: NuWave RS-5 anthracite
  - Subwoofer: NuBox AW-850
- Screen Mediastar 16:9, 2.34 meters wide
- Turntable Thorens TD150/II (purchased 1972), equipped with SME Model 3009 Series II Improved Arm and ADC XLM MKII stylus.
- Timer: Pioneer DT-555 (only used as clock)
- TV: Philips Matchline 28ML8805
- Laserdisk Player: Sony MDP 650D

- DVD Video/Audio Player: Panasonic S75. Regional Code free (using a special remote control).
- S-VHS ET Recorder Philips VR-1100
- Nokia dBox II running Tuxbox
- "Telefunken" PALplus-decoder (manufactured by Nokia)
- Stax SR-X Mark 3 electrostatic earphones, with SRD-7 adapter. Purchased in 1982, adapter in 2005.
- Remote Control: Philips Pronto RU 890 (purchase 2000-09-05)
- Cables mainly Clicktronic.
- TV-Live Light 13W
- Vivanco Control 5. Modified.
- Analog 8 channel switch.

3.5.3. Photos (2005--2007)

Continue to Mk 5. High definition.

3.6. Mk 5. High definition.

3.6.1. General

I had previously done quite a bit of experimenting with high definition videos using a Windows PC and movies on DVD-Rom in Windows media format, see this article (which, although the content is severely obsolete, represents a historic standpoint). From that article it should be clear, that getting a real high-definition setup was a must. Also, in 2007, HD-DVDs and BluRay discs appeared, and I purchased a BluRay player (Samsung BDP 1400, still in use).

For switching HDMI-sources, and converting between digital and analog video, a new receiver was needed. For me, the possibility to integrate it into an automation systems was essential. All AV-Receivers in the "midrange" price segments come with an RS232 control port. However, I considered Ethernet to be a vastly superior solution. It turned out that several AV Recivers contained Ethernet interfaces for Internet radio and streaming, but, except for one extremely expensive device, only the Denon was *controllable* from Ethernet. For this reason, the Denon AVR-3808 (later per software upgraded to AVR-3808A) was selected.

To complete the (full) HD setup, a full HD projector was necessary. In January 2008, affordable projectors were available, and I bought a Sanyo PLV-Z2000 with ISF-Calibration. At about the same time, the destructive "format war" ended. As a result, the prices for both HD-DVD players and discs plummeted, and, dancing on the grave of HD-DVD, I bought a player (Toshiba HD-EP30) as well as fairly large number of HD-DVDs, all to prices unthinkable while the format war lasted...

Not without sadness, I retired the old TV, and bought a new LCD TV. It hangs on the wall using a Vogels wall mount. The old TV table has also been retired, thus the center speaker is also mounted on the wall, using wall brackets intended for a microwave oven!

The DVD player was replaced with an Oppo DV-983H, enabling, among other things, SACD and better possibilities for integration in the automation systems through the bidirectional RS-232 port.

To my disappointment, Nubert decided to discontinue the NuWave series. At this time, I ordered two RS-5 (dipole) surround speakers to complete the 2+2+2 setup.

To switch between analog multi channel sources, together with some additional possibilities, a switch box was constructed, see this forum contribution. However, since modern HDMI-connections can transfer e.g. DVD-Audio or SACD formats losslessly, its use is nowadays more limited.

It is planned to replace the Samsung Bluray player by an Oppo BDP-83 in the near future.

The system can be controlled over my LAN network, using different Ethernet-IR gateways etc. This will be the subject of a future article.

3.6.2. Details

- Projector Sanyo PLV-Z2000, ISF-Calibrated (2008-01-25)
- Receiver Denon AVR-3808, upgraded to 3808A (purchase 2007-10-12, upgrade 2008-11-05)
- HD-DVD Player Toshiba HD-EP30, code free (2008-03-25)
- Bluray Player Samsung BDP-1400
- OPPO DVD player DV-983H, code free (2008-05-31)
- Loudspeakers:
  - Front Left/Right: NuWave 125, anthracite (2005-08-01)
  - Center: NuWave CS-65 anthracite (2005-08-01)
  - Surround Left/Right: NuWave DS-55 anthracite (2005-10-13) (using Vogel's VLB 200 wall brackets)
  - Left/Right Back Surround: NuWave RS-5 anthracite
  - Height: NuWave RS-5 anthracite (2008-04-29)
  - Subwoofer: NuBox AW-850
- Denon ASD 11R Ipod dock (2008-08-26)
- Screen Mediastar 16:9, 2.34 meters wide
- Turntable Thorens TD150/II (purchased 1972), equipped with SME Model 3009 Series II Improved Arm and ADC XLM MKII stylus.
- Timer: Pioneer DT-555 (only used as clock)
- TV: Philips 37PFL9603 (2008-08-27)
- Vogels EFW6345 TV wall mount
- S-VHS ET Recorder Philips VR-1100
- Nokia dBox II, with hardware modification, running Tuxbox

- Stax SR-X Mark 3 electrostatic earphones, with SRD-7 adapter. Purchased in 1982, adapter in 2005.
- Remote Control: Mainly UFC-7781 (One for All OFA Digital 12) (2008-04-08)
- Cables mainly Clicktronic.
- Selfmade analog 8 channel switch; an article is planned, see this forum contribution (in German) in the meantime.
- Selfmade loudspeaker relay switch box; article planned, see this forum contribution (in German) in the meantime.

3.6.3. Photos

Photos will appear shortly.

3.7. High definition video, view of 2005

Note:

This article was written in 2005, as both BluRay and HD-DVD were unavaiable. The content is therefore highly irrelevant with respect to today's problems. Nevertheless, I think my thoughts from 2005 are quite (historically) interesting, so I decided to leave it unchanged (except for this note).

3.7.1. General

In a setup like the above described, there is a bottleneck: the resolution. The NTSC, and later, the PAL TV standard were established in the 1950s and 1960s. (Strictly speaking, this is wrong: NTSC and PAL denotes how the color information is encoded, not the parameters like the number of lines etc. However, by convention the traditional parameter values are referred to as "NTSC" or "PAL".) While the sound of a setup like the above describe is at least equal to all but the very best cinemas, the resolution is not really adequate. Even the simplest digital camera, and, since some time, even the cameras of camera-equipped mobile phones, provide higher resolution. A visit to "any" local movie theater will also confirm this. Fortunately, improvement is on the way: HDTV. HDTV comes in three flavors:

- 720p (1280 x 720 pixels in progressive scan),
- 1080i (1920 x 1080 pixels, interlaced,
- 1080p (1920 x 1080 pixels, progressive scan,

all in aspect ratio 16:9. The frame rate may be different — a movie fan like myself find it slightly disappointing that 24 pictures per second is not preferred, but the NTSC/PAL-compatible 50/60 frames per second.

In the US and in Japan, regular TV transmissions in HDTV already takes place. In Europe, there have some test transmissions. The German pay-tv provider Premiere has announced three HD-Channels (documentation, sport, movies) for November 2005. However, many details are unclear. However, for a movie fan like myself, high-quality

movies for purchase on a "DVD-like medium" is of course the first priority. This is, to a certain extent, already reality:

In the Internet, there are many places where HDTV-demos can be downloaded: for example the Windows Media (9 or 10) from Microsoft and from DivX. There are several stunning demos, both in 720p format and in 1080i/1080p format. They can be played on a powerful PC. There are also some DVD's in Windows Media format available. The first (?) was the Terminator 2 Ultimate Editon. Unfortunately, this shows the Digital Rights Management (DRM) biting, prohibiting play unless you are in the possession of a North-American IP-number!

Later, the IMAX Corporation released a number of attractive IMAX movies (or rather, documentaries), in both 720p and 1080p format (Amazon, Stormchasers, Journey into the Amazing Caves, Discoverers, Dophins, The Living See, Step into Liquid (Location-based DRM protection), Coral Reef Adventure, Speed, The Magic of Flight). (Search on amazon.com for "wmvhd".) These are only available in "Region 1", but can be imported from any international Region-1 store.

In France, (and only there!!) the Taxi 3 movie is available in High-Definition. That version, almost surely deliberately, comes without non-French language versions or even subtitles!

High-Def has several attractive movies available as WMV-HD. They contain two 5.1 sound tracks, in German, *and* in English. The quality is, in general, stunning. (The site also contains several good technical articles, although their admiration for Microsoft is annoying.)

Using a highly proprietary format like WMV from Microsoft is of course a problem. Through the use of Digital Rights Management (DRM), Microsoft can, with its license policy, decide on who can make a player and who can not. For example, a Linux player, or more generally, a free software player appears not possible. However, to envision commercial HD material without heavy restrictions is probably naive.

3.7.1.1. My HTPC

Presently, HD material can only be reproduced on a, fairly "fat" PC (2.4 GHz Processor etc according to Microsoft, more according to High-Def.) (Often, the term HTPC ("Home Theater PC") is used.) This is my (present) HTPC:

- AMD Athlon 1800 XP (1533 MHz)
- Motherboard ASUS A7V333 with 1 GiB RAM
- Sapphire ATI Radeon 9600XT Ultimate Edition 128 MiB (passive cooling)
- Creative Soundblaster Audigy 2 ZS (24 bit, 192 kHz, 7.1 channels)

Despite of being far below the requirements for CPU-Power, the HTPC manages to reproduce the 720p material described above in very satisfying quality.

The video card is connected to the Yamaha receiver using a Y/C (S-Video) connection,

and with the projector using a 7.5 meter DVI-HDMI cable. (I first tried a cheap (10m) cable, but this caused severe picture disturbances, in particular in blue.) There is a digital SPDIF coaxial audio cable from the sound card to the Yamaha receiver, as well as an 8-wire analog cable for analog sound to the analog multi-channel inputs of the Yamaha. Unfortunately, it is not possible (nor desirable) to output the 5.1 (or 7.1) sound from the WMVHD-Movies through the SPDIF digital output. All channels are connected with hum-suppressing transformers (from car-hifi) to a special connection box, in detail described here.

The picture (and sound) of this setup is simply stunning...

3.8. Multichannel Music and DVD Audio

3.8.1. Multichannel Music and DVD Audio

In the early years, fantastic sound meant fantastic music. With the advent of "surround sound", the emphasis shifted a bit, in the direction of film sound. Also, my present speakers (Bose Acoustimass 7) did not really make music sound "musically". Surround sound in the sense of matrix encoded "Dolby surround" also does not "promote" audiophile music. Already Dolby Digital 5.1 and DTS offer more for multichannel music (five discrete full-range channels, although with some compression). DVD Audio, together with Super Audio CD (SACD), presently offers the ultimate in modern audiophile audio reproduction. DVD Audio offers a sampling depth up to 24 bits, sampling frequence up to 192 kHz, and up to 6 channels. Instead of lossy compression, the music date may be compressed losslessly using Meridian Lossless Packing. DVD-Audio can also contain multimedia content like pictures, lyrics, etc. It can also be combined with video content, although audio of highest quality/bandwidth and video cannot coexist (for bandwidth reasons). DVD Audio comes with digital copy protection that is part of the specification, and not based on deliberately specification-violations and production of deliberately defect discs (like "copy protected" CD's). SACD has similar properties, however, it cannot be combined with multimedia content. It is said, e.g. by Wikipedia, that there is a format war between SACD and DVD Audio. It appears to me that formats wars in the 2000's run differently than the format war between VHS, Betamax and Video 2000; also compare the "format war" DVD-R vs. DVD+R.

Unfortunately, DVD-Audio (as well as SACD) has not spread very much. Hardware vendors are not advertising the format. The music industry seems more interested in inventing defective "copy protected" "CD's" than to provide the customers with the best possible quality. How many titles on the present "Top-10" are available as SACD or DVD-Audio?

The selection of DVD-Audio discs is not overwhelming. Several albums were obviously made during the quadraphony years, possibly never as such released, and just recently released in multichannel. Two examples are Chicago II and Deep Purple's Machine Head, both sound absolutely amazing (not only considering their age): mixed for 4 or 5

channels, instead of up-mixes.

Some of my favorite multichannel DVD-Audios (see My DVD collection) :

- Deep Purple: Machine Head
- Pat Metheny Group: Imaginary Day
- Off Space
- The Crystal Method: Legion of Boom
- Blue Man Group: Audio
- Yes: Magnification

3.9. Fixing the Vivanco AV Control 5

3.9.1. Revision history

Date	Description
2005-05-23	Initial version.
2009-07-19	Added last paragraph.

3.9.2. Fixing the Vivanco AV Control 5

The number of SCART inputs is "always" to small. Actually, with my present setup, with the Yamaha switching video signals of different types, the need of a SCART input selector was not there as before. Rather, I needed a signal splitter, so that the dBox could provide both RGB for the TV, and YUV for the Yamaha, to me forwarded to the projector. For this, the Vivanco AV Control 5 appeared to be an interesting alternative, completely RGB(/YUV) capable, with remote control, reasonable band width, and moderate price tag . I purchased one such on 2004-04-13. Unfortunately, it turned out to have three problems:

- The infrared remote control protocol is strange, using alternating codes (I fail to see for what reason)
- The housing was extremely ugly, cheapish silver-plastic look, absolutely incompatible with the rest of my equipment, or with my taste for that matter...
- The format switching voltage on pin 8 of the SCART plug did not work properly: On voltages that indicated 4:3 format, although somewhat low but still within the specs, the device erroneously went into 16:9-mode.

The problem with the silly remote codes was solved with some systematic work with the Pronto, analyzing the codes. Every key on the remote control can send two different codes, one "501"-code, and one "701"-command. These are sent alternating in the following sense: Assume that the first key you press sends a 501-code, and the device reacts on it. Then the next key, regardless of which, will send its 701-code, the following its 501-code, and so on. So far so good. However, after having received a 501-command (701-command), the device is in a state where it only reacts for 701-commands

(501-commands)! I.e., both the device and have an internal two-state state-machine, and they need to be synchronized for the remote control to work! Needless to say, this makes the life of users and designers of alternate remote controls more difficult. For usage in an integrated home-theater environment, it is desirable to put the device in a known state. To achieve this, I have selected a brute-force method: every key on the Pronto sends both the 501-code and the 701-code. This works reliably, but of course has increased cost associated, both in time for sending two codes, and in added memory requirement.

The ugly plastic front was replaced by an aluminum angle, appropriately cut and drilled, bought at a local hardware store. The rest of the housing, together with the aluminum profile, was spray painted matt black. See pictures.

The incorrect switching voltage was somewhat harder. I emailed the Vivanco hot line (on 2004-04-16) regarding the problem. I received a reply somewhat later, stating that they (or their manufacturer) were aware of the problem, but (of course...) other manufacturers were to blaim, because they equipped their boxes with too weak power supplies(!). Looking deeper into the circuit, it turned out that there were some badly selected Zener diodes that were responsible for the mis-behavior. Changing these (D32 (for input AV1), D22 (AV2), D17 (AV3), and D27 (AV4)) to, say, 5.6 Volts fixes the problem. Vivanco was informed on 2005-02-06.

On 2007-02-15 Samuel Wong of Welkintec Ltd. wrote me a very nice mail and presented himself as the designer of the device. He described in detail the changes his firm has made to fix the problem with erroneous switching voltages. He also described the the used IR protocol as the original Philips RECS 80 codes (SAA3008); Transmission Mode: Mode 1 (reference time REF equals 3To), Subsystem Address: -100. This protocol is described in detail here. My project Harc contains an implementation of the protocol (file `recs80.xml`), and the device is supported through the device file `avcontrol5.xml`.

Pictures!

3.10. Modifying the Vivanco AV Control 5

3.11. Buying a shelf off-the-shelf is not for me!

Of course, the collection of media (CD, DVD, Laserdisks, Vinyl LP, Music Cassettes, VHS Tapes) keeps growing. To keep track of the content, I use an XML-Based system designed by myself (some day, I may publish it on this page), and for the DVD's the (paid) version of Invelos' DVD Profiler. Here is my DVD collection online. But of course, just keeping track of the content is not enough — the "download" generation may be of a different opinion though — the medias must reside somewhere, physically. Buying an off-the-shelf shelf (sorry...) was not an option for a person like myself. Instead, to hold CD's, DVD's and VHS tapes (the number of which *should* decrease in the future) I made my own construction, that can be seen in the photo gallery. It is made with iron wall brackets holding glass boards, with aluminum profiles at the edges.

Some picture of the multimedia shelf in the constricuction phase. For more pictures in populated state, see the photo galleries of Mk3, Mk4, and Mk5.

3.12. General Photo Gallery

3.12.1. New Photos from my home theater

Some general pictures

4. Home Autom. & Remote Control

4.1. Home Automation and Remote Control

Here, a page on remote control with applications to home automation will occur. Both theory, practical solutions, as well as program code will be presented.

4.1.1. Revision history

Date	Description
2009-07-18	Initial version.

4.1.2. My project — HARC

- This article describes my current project in the area of home automation and remote control (in particular infrared remote control).

4.1.3. Articles

- Modifying a Philips Pronto RU890 for 433 MHz RF-control.
- Blinds. Modifying the Rollotron 9200 for remote control.
- Balcony door control with Rademacher Samson. Planned.
- DIY Power IR-Blasters to be used (for example) with the GlobalCache GC-100. Planned.
- Creating the ultimate hard-button remote for the Tuxbox. Planned.

4.1.4. Downloadable files

- The project HARC, including source code.
- Listing of all possible codes, in Pronto format, for controlling the Intertechno family of 433 MHz RF controlled products. (Note that (almost) identical units are also sold by other names, such as Düwi and One for all). The codes are computed, not learned.
- Listing of all possible codes, in Pronto format, for controlling the RS200 series of 433 MHz RF controlled products, once sold by Conrad electronics under their own name.

The codes are computed, not learned.

4.1.5. External links

4.1.5.1. Projects

- Openremote is a brand new project that looks very interesting and promising. There is also a large number of similarities between their approach and Harc, like the emphasis on using open standards and free software. Forum (not very active presently), Twitter, YouTube.
- The JP1-Project and Forum is a very unique project. It aims at complete control over the remotes made by Universal Electronics (UEIC), which include the brand names "One For All" and "Radio Shack". Through careful study of its hard- and firmware, techniques and programs for custom programming a remote, equipped with a 6-pin connector (on the remote's PCB called "JP1", giving the project its name) were developed. Thus, an off-the-shelf remote can be taken much beyond its original capacities. Most importantly, it can be programmed from a computer to generate "arbitrary" IR-signals. Very knowledgeable when it comes to decoding of obscure IR protocols.
- LIRC (Linux InfraRed Control)LIRC is well established, mature, and active free software project. It is used in very many free software projects. It contains support for a large number of infrared senders as well as receivers. There are also a large number of user contributed configuration files for different IR remote controls and devices, in general consisting of leaned commands. No forum, however a mailing list exist, archived here.
- Tonto is normally referred to as an alternate configuration ("CCF") editor for the first generation of the Philips Pronto remote controls. It is a free replacement for the original ProntoEdit program. Unfortunately inactive since 2004.
- "Eventghostis an advanced, easy to use and extensible automation tool for MS Windows. It can use different input devices like infrared or wireless remote controls to trigger macros, that on their part control a computer and its attached hardware. So it can be used to control a Media-PC with a normal consumer remote." Since it is Windows-only, it is presently of limited interest, at least to me. Written in Python, there should be hope however... It can be considered as a free (GPL) alternative to Girder.
- Bettyhacks.com (in German). Recently (2006–2007), some German TV channels tried to establish the "interactive remote" called "Betty". The project failed miserably and was discontinued in 2007. However, the hardware is quite powerful (see the WiKi pages of the link) with LCD 160 x 128 Pixel, LPC2220 - 32bit arm7tdmi-s cpu, and 8 Mbyte flash. It can be had "used" for surplus prices. An open-source project "Boop" was started to write free software for it.
- sbprojects.com. This site contains a number of good theoretical background articles on IR control.

4.1.5.2. Discussion forums

- Remotecentral is possibly *the* premium site for issues like discrete code search. Hardware reviews etc is unfortunately often of limited interest outside of the U.S.A., since much of much of hardware is only available on one side of the Atlantic. Their collection of IR-codes is vast, but, IMHO, severely flawed: there is a gigantic number of configuration files available, each one tied to a particular remote control (-family), containing a lot of irrelevant "cruft" like button layout etc, having a more-or-less arbitrary name. The codes are in general learned and not always cleanly leaned. (It is one of the goals of Harc to overcome this problem by proposing a general code exchange format, using canonical commands names, without the cruft.)
- In the German language home theater forum Beisammen, for this topic interesting postings (some by me using the nickname "Barf") are, somewhat step-motherly, delegated to the sub-forum "Zubehör" (Accessories). Very qualified in many areas, remote control is not one of them — not even a dedicated sub-forum exists.
- AVSForum

4.1.5.3. Manufacturer

- IRTransNice IR sender/receiver hardware. Forum.
- GlobalCachéNetworked IR-Sender etc.
- EZControl Networked sending of RF control signals for, e.g., Intertechno switches. Forum. German only.
- Promixis is known for its products Girder (windows based automation tool) and Netremote (Programmable, network dependent remote control GUI for Windows or Windows Mobile/CE). Forum.
- USB-UIRT. An IR sender/receiver with USB connection. Forum
- Philips Pronto
- Intertechno. Cheap RF-Controlled switches and dimmers. In German only.
- Marmitec. X10 for use in Europe.

4.1.5.4. Some of my forum contributions

- Review and analysis of the One for all Light Control In German.

4.2. Harc: Home Automation and Remote Control

4.2.1. Revision history

Date	Description
2009-07-18	Initial version.

4.2.2. Introduction

Since 2006 I have been writing software, designed file formats, and classified remote control signals, revolving around infrared remote control and home automation. It presently consists of around 18000 lines of source code in Java and XML. Very much code has been junked or re-written. Since I do not have an immediate goal, and my possibility to work on the project is limited, I have decided to make the outcome available.

The present version is copyrighted by myself, and available under the GNU General Public License version 3. In the future, it may also be available under additional conditions, so-called dual licensing. File formats are in the public domain, including their machine readable descriptions, i.e. dtd and schema files.

As a working project name, as well as in the Java module names, I have been using the name *Harc*, which is simply an acronym for "Home Automation and Remote Control". Unfortunately, the name is far too generic to register as an Internet domain. There is even a Sourceforge project named Harc, (inactive since 2002).

It is proposed to call a user or developer of the system an harc-eologist.

The present document is aimed more at a high-level description of the system, rather than being a user's manual. It describes most aspects of Harc at most very roughly.

Warning:

This is unfinished, experimental software, aimed at the expert user. "Non-programmers" will probably not find anything of use herein. No warranty of any kind is given.

4.2.3. Overview of the system

The "system" consists of a number of data formats, and Java classes operating on those formats. It has been the goal to formulate file formats allowing for a very clean description of infrared protocols, the commands of devices to be controlled (in particular, but not exclusively audio- and video equipment), networking components, topology of an installation, as well as macros. From these very general universal formats configuration files in other formats, used by other systems, can automatically be generated.

There is also a quite universal GUI that gives access to most of the functionality within the Java classes. This has been written to demonstrate the possibilities for the expert user. Convenience and accessibility for the novice user has not been a priority. (Such user interfaces are conceivable, however.)

Directly supported communication hardware and software are GlobalCache GC-100, IRTrans LAN (only the LAN version is supported directly), RS232 serial communication through the GlobalCaché or ser2net, TCP sockets, HTTP, RF 433 and 868 MHz through EZcontrol T10 as well as through an IR->RF translator like Conrad Eggs or Marmitek pyramids. Indirectly, through LIRC, a vast number of IR senders are supported.

4.2.4. Data model

Next a somewhat technical description of the file formats will be given. These are all defined in the form of XML files with a rather strict DTD. The discussion to follow will focus on the concepts, not on the details. Of course, the semantics of the files are defined by the DTD file.

Necessary theoretical background on IR signals can be found for example in this article.

4.2.4.1. The command names

Harc has higher requirements on the data quality of its input files than other related projects. For example, in LIRC, a configuration file consists of a device name, and a number of commands with associated IR signals. The names of the commands there are in principle completely arbitrary, and it appears to be common to try to follow the vendor's naming. In Harc, there is instead a fixed (but of course from the developer extensible) list of command names, intended to uniquely denote a command for a device. A command name in principle is a verb, not a noun, and should describe the action as appropriate as possible. There is, for example, no command `power`, instead there are three commands: `power_on`, `power_off`, and `power_toggle` (having the obvious semantics). Also, a command which toggles between play and pause status may not be called `play`, but should be called `play_pause`.

The names are defined in the XML file `commandnames.xml`, from which a Java enum `command_t` is created through an XSLT style-sheet `mk_command_t.xsl`. Further rules for command names are found as comments in that file.

4.2.4.2. The protocol files

By "(infrared) protocol" we mean a mapping taking a few parameters (one of those a "command number", one a "device number", sometimes others) to an infrared signal. A protocol file is an XML file describing exactly how the IR signal is made up from the parameters. The format is quite close to an XML version of the "IRP notation" of the JP1-Project. It is a machine readable description on how to map the parameters into a modulated infrared signal, consistent with a technical description. The protocol is identified by its name. A protocol takes a certain number of parameters, although sometimes one is defaulted.

At his point, the reader may like to compare this prose description of the protocol we (and the JP1 project) call `nec1` with the XML code in `nec1.xml`. Note that our description, using an arbitrary subdevice number, corresponds to the author's "Extended Nec protocol".

The naming of the different protocols is of course somewhat arbitrary. In general, I have tried to be compatible with the JP1-Project.

It can be noted that the supported radio frequency protocols are nothing but IR-signals with the carrier consisting of infrared 950nm light substituted by suitable radio carrier, typically of 433 MHz.

Ideally, most users should not have to worry with the protocol files. This is only necessary when introducing a device with a IR-protocol that has not yet been implemented. At the time of this writing the 17 protocols have been implemented, this covers the most important ones, but not all known to e.g. the JP1 project.

4.2.4.3. Device files

A device file is an XML file describing the commands for controlling a device. In Harc a device file truly describes the device and its commands, stripped from all information not pertaining to the very device, like key binding on a remote, button layout, display name, the IR blaster it is connected to, location, IP-address, MAC-address, etc. (This is in contrast to many other systems, like Pronto CCF-files or JP1 device updates).

There may be many different types of commands for the device, like IR, RF signals (this is, at least for the few cases presently supported, nothing else but IR signals with the infrared light as carrier replaced by an radio signal, for Europe of 433 or 868 MHz frequency), commands over serial RS232 interfaces or TCP sockets, or utilizing a WEB API. Also "browsing" the device (pointing a Web browser to its www server), pinging and sending WOL-packages are considered commands, as well as suppling power, sometimes "in reverse direction" (like a motorized blind going up or down). Possibly the same command can be issued over different media. Some commands may take arguments or deliver output. For this (and other) reasons, care should be taken to use the "correct" command names, not just a phrase the manufacturer found cool. Commands are grouped in *commandsets*, consisting of commands having its *type* (ir, serial, tcp,...), device number etc in common.

IR signals within a device file may contain codes in Pronto CCF format in addition (or instead) if the structured information (protocol, device number, command number etc). Actually, "exporting in XML format" means generating an XML file augmented with the raw CCF codes. In may cases, also so-called cooked Pronto codes (Background, written by remotecentral) are included, as well as JP1 protocol information.

The device configuration file is processed by an xinclude-aware parser, allowing a certain include-file structure, that can be used to structure the data.

Example

As an example, consider the Oppo DV-983HDVD player with serial support. This is supported by Harc with the file `oppo_dv983.xml`. Its commands can be downloaded directly from the manufacturer (hats off!), both the infrared and the serial commands. As can be found in the spreadsheet on the IR code, the device uses the previously mentioned `nec1` protocol, with device number equal to 73. This corresponds to the first command

set in the mentioned device file. The serial commands form another commandset, subdivided into *commandgroups*, depending on whether they take an argument and/or deliver output. Note that some commands (for example `play`) are available both as IR and as serial commands.

Other interesting examples are the `*_dbox2.xml` files (referring to the German dbox with the open source tuxbox software) , each containing two (`sagem_dbox2.xml`, `philips_dbox2.xml`), or three (`nokia_dbox2.xml`) different infrared command sets as well as an elaborate web-api command set. Another very interesting example is the Denon A/V-Receiver `denon_avr3808.xml` having several infrared command sets using the `denon` protocol (which, ironically, is called the "Sharp protocol" by the firm Denon), as well as several command sets using the `denon_k` (Denon-Kaseikyo protocol). Then there is a large number of "serial" commands, available through both the serial box as well as through the (telnet) tcp port 23.

Importers

Since Harc is so picky with command names and their semantics, the value of an import facility is limited — necessary information is simply not there (or is wrong). There exists a large number of IR signal data in the Internet (for example from LIRC configuration files, JP1 device updates, or the large collection (mainly CCF) of files on Remotecentral. Presently, Harc has "importers" for Pronto/CCF and JP1's device upgrades in RemoteMaster format. I "sort-of" wrote a LIRC-to-CCF translator a few years ago, possibly I will finish it someday. However, the importers have as their goal to create a first iteration of a device file (not even guaranteed to be valid XML!) to be tweaked manually.

Exporters

Writing an exporter is in principle easier. Harc presently can export the IR signals of a device in CCF format, LIRC-format (either a particular device, or all devices connected to a particular LIRC server defined in the home file), JP1's device upgrades in RemoteManager format, as well as the rem-files used by IRTrans. Individual IR-signals can be exported in wav-format for usage with an audio output driving an IR LED after full wave rectification, see for example this article This feature is presently not available through the GUI.

Many other things are possible. I have had some success creating a program that, given an XML configuration file, creates a full JP1-type image that can be flashed on a URC-7781 (that is, not just one or a few device updates).

4.2.4.4. The "home file"

The protocol and device files described up until now are a sort of universal data base — common and invariant to every user, at least in principle. In contrast, the "home file" (possibly the name is not very well chosen) describes the individual setup ("home"). It is

a good idea to think of the device files as class definitions, classes which can be instantiated one or more times, in that one or more devices of the same class are present in the home configuration, each having its individual (instance-)name.

It is instructive to have a look at the supplied file `home.xml` at this point. In the home file the different devices are defined as class instances. They can be given alternate names (aliases) and groups can — for different purposes — be defined. For example, this can be useful for generating GUIs taking only a certain group of devices into account. Gateways are defined: a gateway is some "gadget" connecting some other media together, for example, the GlobalCache (among other things) connects the "tcp connector" on the local area network (`lan`) to its output connectors, which may be e.g. an infrared blaster or stick-in LED controlling an IR-device. Devices that can be controlled declare the said device/connector combination as a "from-gateway", or indirectly as a from-gateway-ref (using the XML idref facility). (Yes, there are a lot of details here which ideally sometime should be described in detail.) Thus, a routing is actually defined: how to send commands to the device in question. Note that there may be many, redundant, paths. The actual software is actually using this redundancy, thus implementing a certain failure-safeness. The actual from-gateways, and their associated paths, are tried in order until someone succeeds in sending the command. (Of course, only to the extent that transmission failures can be detected: non-reachable Ethernet gateways are detected, humans blocking the way between an IR-blaster and its target are not...).

Also the interconnection between AV devices can be described here, see the example. Thus, it is possible to send high-level input selecting commands like "turn the amplifier `my_amplifier` to the DVD player `my_dvdplayer`", and the software will determine what command (IR or other) to send to what device. (This is later called "select mode".)

There is a great potential in this concept: Consider for example a "Conrad Egg transmitter", which for our purposes is nothing but IR->RF gateway. Assume that a IR stick-on emitter is glued to the egg, and connected to a Ethernet -> IR gateway. If there is, say a RF controlled Intertechno switch, interfacing with an electric consumer, it is possible to just issue the command for turning the electric consumer on or off, and the software will find out that it has to send the appropriate IR signal to the IR gateway.

However, writing the configuration file is a job for the expert...

4.2.4.5. Macros

A simple macro facility has been implemented. This is presently in the form of one XML file, see the example file `macros.xml`. The syntax was inspired by Lisp.

Macros may call commands (XML element `command`), wait (`delay`), "print" a message (`message`), call other macros (also recursively) (`macrocall`), use select-mode (`select-src`) and contain conditionals (`cond`, using the syntax of the Lisp `cond`). The recursion facility eliminates the need for a loop construct.

For the convenience of programs acting on the macro file, macros can be bundled into groups (XML element `macros`). They may be "public" or "private", the latter can only be called from other macros.

Macros can be executed by the macro engine (`macro_engine.java`). However, also other usages are possible: Being all XML, XML transformations are conceivable which generate all sort of output, such as creating shell scripts, generating HTML pages, or macro definitions for smart remote controls like Netremote (using its extension language Lua).

Macros with arguments are presently not implemented.

4.2.5. Basic Java classes

There is a large number of Java classes operating on the data objects. Some classes operates on protocols, some on device classes (through device files), some on device instances in the sense of the home file. In most cases when it is sensible to call use the class individually, it contains a `main`-method, i.e. can be called from the command line. In general, there are a number of arguments. A usage message can be generated in the usual GNU way, using `--help` as argument.

4.2.6. Program usage

The main entry point in the main `jar`-file is called `Main`. Its usage message reads:

```
        harc --version|--help
        harc [OPTIONS] [-g|-r|-l [<portnumber>]]
        harc [OPTIONS] <macro>
        harc [OPTIONS] <device_instance> <command> [<argument(s)>]
        harc [OPTIONS] -s <device_instance> <src_device_instance>
where OPTIONS=-A,-V,-M,-h <filename>,-t
ir|rf433|rf868|www|web_api|tcp|udp|serial|bluetooth|on_off|ip|special,-m
<macrofilename>,-T 0|1,-# <count>,-v,-d <debugcode>,-a <aliasfile>, -b
<browserpath>, -p <propsfile>, -z <zone>,-c <connection_type>
```

Using the `-g` (as well as no argument at all, to allowing for double clicking the `jar`-file) starts Harc in GUI mode, described in the next section. Invoking Harc with the `-r`, `-l` *portnumber* starts the readline and port listening mode respectively. Otherwise Harc will run in non-interactive mode, executing one command or macro, and then exit.

4.2.6.1. Non-interactive mode

If there is only one argument, it is considered to be a macro, and it is attempted to execute it. (Using "?" as argument, the available macros will be listed.) The `-s` option enables the select mode, described previously. Otherwise, the arguments are considered as a device instance name, followed by a command name, and optionally by arguments for the command. If the command name is missing or "?", the possible command names for the

device will be listed.

The remaining options are as follows:

-A
switch only audio on target device (if possible)
-V
switch only video on target device (if possible)
-M
use so-called smart-memory on some devices
-h *home-filename*
use *home-filename* as home file instead of the default one
-m *macro-filename*
use *macro-filename* as home file instead of the default one
-t *type*
prefer command of type *type* regardless of ordering in home file (if possible)
-T *zero_or_one*
for codes with toggles (like RC5), set the toggle value to the argument.
-v
verbose execution.
-d *debug code*
set debug code. See `debugargs.java` for its precise meaning. Use -1 to turn on all possible debugging.
-a *aliasfile*
Normally, aliases (allowing the software accept e.g. "enter" and "select" as synonyms for "ok") are taken from the official `command.xml`. This option allows the usage of another alias file.
-b *browserpath*
Allows using an alternative path to the browser used to invoke `browse`-commands, instead of the default one.
-p *propsfile*
Allows using an alternative properties file, instead of the default one.

The following options apply only to the select mode

-z *zone*
Select for zone *zone* (if possible)
-c *connection*
Prefer connection type *connection* for the selection (if possible)

4.2.6.2. Readline mode

The "Readline mode" is an interactive command line mode, where the user types the commands one at a time. If GNU readline is available, the extraordinary facilities of GNU readline allows not only to edit present command and to recall previous commands, but also for an intelligent completion of relevant names for macros, devices, and commands.

If GNU readline is not available, Harc's "readline mode" will still work, only these "comfort features" are missing. The semantics of the typed command are like the non-interactive arguments. There are also some extra commands, introduced by "--"; these in general correspond to the command line options described above. The normal command line options are ignored.

4.2.6.3. Port listen mode

Starting Harc in port listening mode starts a multithreaded server, listening for commands on the TCP port given as argument, default 9999. The server responds to a connection on that port and spawns off a new thread for each connection. It listens to commands on that port, sending output back. The semantics of the command line sent to the server is the same as for the non-interactive invocations, with the addition of the commands `--quit`, which makes the session/thread close, and `--die`, which in addition instructs the server not to spawn any more threads, but to die when the last session has ended.

4.2.6.4. The GUI

The present GUI was not designed for deployment. It does not offer a user friendly way for allowing a nontechnical user to control his home or home theater. Rather, the goal was a research-type GUI, to allow the expert user to access to most of the functionality of the Java classes, without having to look in the Javadoc class documentation.

Hopefully, in the near future, there will be one or more "cool" GUIs for the system. This need not be additions to the present system, but rather integrations with other technologies and projects, like Openremote.

The main properties of the present GUI will be described next.

The GUI consists of a title bar with pull-down menus for File, Edit, Options, Misc., and Help. These are believed to be more-or less self explanatory. There are six panes, that will be described in order. Many interface elements have a short tool-text help messages, which are displayed when the cursor is hoovering above the element. The lower part of the main window is occupied by "the console". The latter is a read-only "pseudo paper roll console", listing commands, tracing- and debugging information as directed by the user's selections, as well as command output and error messages.

Except for the mandatory about-popup (which is of course non-modal!), popups are not used.

The GUI resides almost completely within the file `gui_main.java`. It was designed using the Netbeans IDE version 6.5.

The Home/Macros pane

This pane corresponds to using Harc through the Home configuration file. Devices, using

their instance names as defined in the home configuration file are sent commands, possibly with *one* argument, possibly returning output in the console. (Commands taking two or more arguments cannot be sent through the GUI.) The first row is for sending commands to devices, the second for the select mode, while the third one can execute macros. Note that both the execution of macros and of commands are executed in separate threads.

This pane is the only one coming close to "deployment usage". The other panes can be useful for setting up a system, defining and testing new devices or protocols, or for "research usage".

The Device classes pane

This pane allows for sending *infrared* signals (no other command type!) to the using either a GlobalCache or an IRTrans, that has been selected using the "Output HW" pane, including output connector to use. The home configuration file is not used. The devices are called by their class names.

The IR Protocols pane

This pane has more of research character. For a protocol in the protocol data base, a device number, possibly a subdevice number, and a command number is entered, pressing the "Encode" button causes the corresponding IR code in Pronto CCF format to be computed and displayed. Pressing the send button causes the code to be sent to a GlobalCache or IRTrans that was selected in the "Output HW" pane. Note that it is possible to hand edit (including pasting from the clipboard) the content of the raw code before sending. Whenever there is content in the raw code text area, the decode button can be invoked, sending the content to the DecodeIR library, thus trying to identify an unknown IR signal (if possible).

Log files from the Irscope program (using `.icf` as their file extension) can be imported using the `icf` button.

There presently appears to be some "glitches" in the button enabling code; click e.g. in the "raw code" text area to enable buttons that are incorrectly disabled.

The Output HW pane

This pane has three subpanes: GlobalCache (for selecting the GlobalCache, and its output connector, used on the Device classes and on the IR Protocols pane), IRTrans (dito), and EZControl. The latter is sort of an interactive toolbox for the EZcontrol T10, allowing to send different commands, inquiry the status of one or all of the preselected switches, as well as getting a list of its programmed timers.

The IRcalc panel

This pane is a sort-of spreadsheet for computing IR signals in the Pronto or JP1 context. The exact way it works is left as an exercise for the reader...

The Options panel

This pane allows the user to set a few more options. On-off options are sometimes instead available through the Options pull-down menu.

4.2.6.5. Properties

Harc uses a properties file in XML format. For some of the properties there is no sensible access in the GUI. For this reason, it may therefore sometimes be necessary to manually edit this file with a text editor (or XML editor).

4.2.7. Interaction with other projects

HARC interacts with other projects within the area. It can be pointed out that in the case of Java projects, Harc uses unmodified jar-files; in the case of shared libraries (`.so` or `.dll`) these are also used in an unmodified state. In no case, Harc "borrows" code from the projects. Also, in this way additional functionality is implemented, none of which is of essential (like import/export of a certain file format). Differently put: should the need arise to eliminate "derivedness", only minor, nonessential functionality will be sacrificed (or needs to be implemented anew).

4.2.7.1. LIRC: Linux InfraRed Control

LIRC is a well established, mature, and active free software project. It is used in very many free software projects. It contains support for a large number of infrared senders and receivers, some sane hardware designs, other possibly less sane. There are also a large number of user contributed configuration files for different IR remote controls and devices, in general consisting of leaned commands. A network enabled LIRC server consists of the software running on a host, listening on a network socket, containing one or more IR transmitter or transmitter channels. A client sends requests to, e.g., transmit a certain command for a certain device type. Since Harc can talk to a network LIRC server (see source in the file `lirc.java`), there is a large number of IR senders that Harc in this way "indirectly" supports. Unfortunately, the configuration files are residing on the LIRC server only; there is no way to request the transmission of a signal the server does not know in its data base. (A patch for this was submitted by myself, but rejected by the maintainer. I plan to make it available on my web server.) From its IR data base, Harc can generate configuration files for LIRC. There is presently no possibility to import LIRC files.

Presently, there is no support for selecting output channels on LIRC servers with multiple IR devices or IR channels. (This can probably be fairly easily implemented using the

LIRC server command `SET_TRANSMITTERS` and the `connector` attribute in the `home.xml` file.)

LIRC is licensed under GNU General Public License, version 2 or later. However, Harc is not a derived work; it contains no LIRC code, and is not linked to any libraries. It optionally "talks" to a LIRC server, but this functionality is entirely optional.

4.2.7.2. JP1

The JP1 project is a very unique project. It aims at complete control over the remotes made by Universal Electronics (UEIC), which include the brand names "One For All" and "Radio Shack". Through careful study of its hard- and firmware, techniques for custom programming a remote, equipped with a 6-pin connector (on the remote's PCB called "JP1", giving the project its name) was developed. Thus, an off-the-shelf remote can be taken much beyond its original capacities. Most importantly, it can be programmed from a computer to generate "arbitrary" IR-signals.

RemoteMaster is a program for, among other things, creating so-called device updates. These device updates can be produced by Harc, as rmdu-exports. Thus, for an IR-controlled device in the Harc database, a suitable JP1-enabled remote control can be made to send the appropriate IR-signals. (There are some details, that will be documented somewhere else.) RemoteMaster is presented as an interactive GUI program, however, it can also (although this is not supported) be called through a Java API. Harc presently uses version 1.89, which is not the current version. Although it seems to lack all copyright notices, it is referred to as "open source" and GPL.

Another tool from the JP1 project is DecodeIR by John Fine, available under the GNU General Public License, version 2 or later. It consists of a shared library (`DecodeIR.dll` or `DecodeIR.se`), written in C++, together with a Java wrapper (`DecodeIR.jar`). To build that jar file, also this file is needed. The tool attempts to decode an IR-signal in CCF form into a well known protocol with device number, command number, possibly subdevice number and other parameters. See the IR protocols pane in the GUI.

4.2.7.3. IRScope

Together with appropriate hardware, the Windows program IRScope by Kevin Timmerman is very useful to "record", and optionally analyze unknown IR-signals (again, using the same DecodeIR as above). The log files generated by this program can be directly parsed, see the code in `ict_parse.java` or the IR protocols pane. The program is licensed under GNU General Public License, version 2 or later. Harc neither uses code or links to it, and is not a derived work.

4.2.7.4. Tonto

Tonto is normally referred to as an alternate configuration ("CCF") editor for the first

generation of the Philips Pronto remote controls. It is a free replacement for the original ProntoEdit program, written by Stewart Allen, licensed under the GNU General Public License, version 2. Being written in Java, it runs "everywhere", in contrast to the original Windows-only program. It also contains a Java API. Harc uses the Tonto API (in the form of the file `tonto.jar`) to import CCF files, and to generate CCF files for devices in its data base. (The latter are supposed to be more of a target for aliasing, than a directly usable user interface.) Unfortunately, the project is (essentially) inactive since 2004.

4.2.7.5. wakeonlan

Harc uses wakeonlan (licensed under the GNU Lesser General Public License), a small Java library for implementing WOL-functionality.

4.2.7.6. Java Readline

The interactive command line uses the Java Readline (licensed under the GNU Lesser General Public License), which of course only makes sense when used in conjunction with the GNU Readline library, which is licensed under GNU General Public License, version 2 or later.

4.2.8. Future development

The big missing piece is of course the complete lack of a "pretty" user interface.

Minor improvements:

- Replace the DTD based file formats with scheme based. This should be a real migration to more intelligent formats, not just a syntax change.
- Implement support for multi-transmitter LIRC servers.
- Eliminating the need to configure a LIRC server by finishing and publishing the LIRC patch described above, and making corresponding changes to `lirc.java`.
- Scripting facility, for example with Rhino/Javascript. Should this replace or complement the present macro engine?

Presently, I do not want to commit myself to maintaining Harc. The goal is not, and has never been, to present a full solution for (for example) home automation, but rather to produce some reusable data exchange formats, and some useful tools, that fit with other projects. Nevertheless, I welcome both bug reports, bug fixes as well as enhancements. I also welcome new configuration files for devices and protocols.

I look forward in particular to a cooperation with the Openremote Project.

4.2.9. Downloads

Download Harc! Relevant third-party libraries in jar-format are included.

A version of `libJavaReadline.so` for 64-bit Linux can be downloaded here.

Precompiled dynamic libraries `libreadline.so` and `libhistory.so` should be available from any Linux distributor, package name probably `readline` or so. Precompiled `libDecodeIR` (version 2.36) can be downloaded for Windows, 32-bit Linux x86, and 64-bit Linux x86. Note that these components are needed only to enable some special functionality of Harc. There is no need to get them just to try things out. Corresponding sources can either be downloaded from the Internet using URLs published in this page, or (as required by the GPL) requested from me.

4.3. Modifying the Pronto RU890

4.3.1. Putting a IR -> RF converter inside of the Pronto case

I had purchased some 433 MHz radio controlled equipment from Conrad, like for example three of their power outlet strip "Funk-Steckdosenleiste RS-300". The problem was to get the Pronto to generate the radio signals. For this, it turned out to be possible to use half of a remote control extender set, meant to receive an infrared signal with a transmitter that transfers it using 433 MHz radio signals. Later, a receiver converts the signal in infrared again. I removed the receiver board, cut with a Dremel it to fit into the Pronto, and connected it to the Pronto batteries.

4.4. Remote Control of Blinds

In southern Germany, external blinds made up of heavy plastic profiles are extremely common. For home theater, these are excellent: they provide an almost perfect darkness, even with sunlight outside. Electric motors are available, like the Rollotron 9200. Even remote control, and light sensible controls, are available. The drawback with such solutions is of course (not counting the price!) that it is unclear if and how such devices can be integrated in the whole system. For obvious reasons, I wanted to use the Intertechno CMR-500. This thing switches two "channels" with one connector in common. The objective was to remotely control the "up" and the "down" button. Unfortunately, a look at the signals with an oscilloscope showed that there were no "common" for both "up" and "down". Therefore, I equipped the Rollotron with two reed relays, feed by 5 Volts. The modification is described in pictures.

On two windows, more space was available, so instead of the somewhat expensive Rollotron, a cheaper and bulkier device could be used. Also it has the advantage that it can be controlled by the CMR-500 directly, with no relays.

All five blinds in my apartment are remotely controllable.

5. Software

5.1. Software

Since many years, I am a supporter, and, to some extent, a contributer of free software, for example in the sense of the Free Software Foundation. This page contains the following software, written by myself:

- Harc, a system of utilities for Home Automation and Remote Control,
- Gnans, a simulation program for dynamical systems, and
- The Einstein Puzzle, a treatise on a famous puzzle (-family).

In all cases, the software can be used, redistributed, modified etc in accordance with the GNU General Public License.

5.2. Gnans

5.2.1. Digging in the Closet

So, I decided to make this 13 year old (first version) program available again. (With some Googling effort, it was probably possible to find the, up until now, most recent version, 1.6.1, somewhere on the web.) In particular, to make the necessary modifications to make it compile in a modern GNU/Linux environment. (It was more work than I expected :-\ ). This version only "supports" GNU/Linux, but it should not be awfully hard to get to work on other similar system.

Some aspects of the program (in particular the GUI...) look awfully dated now. Still, there is a sound core, and, to my knowledge, there is no, and has never been, any other free software offering this functionality (Scilab?).

5.2.2. Limitations and Bugs in the Modern-Day Version

Let's make one thing clear: The main reason for digging up Gnans again is to make the source available for the Community to use, develop, and learn from. It is not to provide those who cannot afford Simulink with a free alternative, or to provide Octave with "its Simulink".

Unfortunately, in the modern-day port I did not succeed to get the classes in gnanslib to work. This means the classes `delay`, `histo`, and `delay`. Possibly worse, the "close-window"-functionality (i.e. the closing by clicking the closing icon on the window, nowaday (when even Gnome and KDE developers try to re-engineer Windows) denoted by "x". That is, *clicking the close-window icon does not work as expected, it kills the program (without even cleaning up) instead of closing the present window*. Therefore, don't do it!. (This is not a "bug" but a "limitation". The functionality was not common when the program was developed, and I have never implemented it.)

5.2.3. What is this thing anyhow?

Gnans is a program (and language) for the numerical study of deterministic and stochastic

dynamical systems. The dynamical systems may evolve in continuous or discrete time.

Gnans loads a system, a definition of a dynamical system in a special, equation oriented language. The description consists of declarations of states etc, and equations describing the dynamics of the system. As an advanced feature, arbitrary C++-code may also be contained in the system description. Gnans sorts the equations, translates them into C++, which is subsequently compiled and linked into the running program. It is then able to solve the system equations numerically with the speed of a compiled (as opposite to interpreted) program. Several numerical integrators, also for stochastic differential equations, are provided. Gnans has an intuitive user interface, making it possible control the program and to change all relevant parameters using an intuitive point-and-click interface. In this operation, it can be considered ``an initial value problem (IVP) engine". Using a simple script language, this IVP-engine can be programmed. As a by-product, this offers the possibility of a command line interface. (Actually, as another by-product, Gnans contains a rather powerful pocket calculator!) Simple interactive two-dimensional plot routines are provided.

Gnans is copyrighted, but freely distributable under the Gnu General Public License.

The GCC C++ compiler is required, even if you just get the binaries.

The current version is version 1.6.2. Click here for a list of changes from the previous version.

Download either the source or the a binary Linux distribution. Both contain full documentation, except for some large PostScript figures, which are only "needed" for the printed manual. These figures are available in a separate file. (These are the same as included in the 1.2 distribution, so there is no need to get them again if you already have them.) Pick up the formatted version only in you cannot print the documentation otherwise. In that case, you don't need the figures.

5.2.4. Downloads

File	Version	Size	Description
gnans-1.6.2.tar.gz	1.6.2	1.4 MB	Source for the current version.
gnans-1.6.2-bin-i686-sus	1.6.2	0.5 MB	Binaries of the current version.
gnans-doc-pictures.tar.g	0.97	1.0 MB	Postscript figures for the manual.
gnans.pdf	0.97	4.1 MB	Manual in PDF format.
gnansdoc-0.97.ps.gz	0.97	1.2 MB	Manual in PostScript format.

5.3. The Einstein Puzzle

5.3.1. Revision history

Date	Description
2005-05-23	Initial version.
2007-01-22	Added the parkinlot problem. Some minor improvements. Note on Wikipedia.

Note:

The original version of this article was witten on 2005-05-23, and referred to a Wikipedia-Article for the "original" version of the problem and some historic notes. Since then, the said article has been thoroughly rewritten, probably to the better. Among other things, the article has been renamed to `Zebra_Puzzle`, and another formulation is considered "first known publication". Also see the discussion page. I have selected *not* to rewrite the present article to take these changes into account.

5.3.2. The Puzzle

The so-called "Einstein's Puzzle" is a well-known logical puzzle. Commonly, it is claimed to have been invented by Albert Einstein, and it is also claimed that he should have stated that only 2 percent of the world's population was able to solve it. There is no authoritative source for these claims. Likely, the claims were invented by the "everything-is-relative"-people. Nevertheless, I will call a puzzle of this sort "an Einstein puzzle" for the rest of this article.

There are many, more or less "isomorphic", versions of "the puzzle". The version in Wikipedia (which I have allowed myself to copy here), goes:

- There are 5 houses. each a different colour.
- A person of a different nationality is in each house.
- The 5 owners each drink a certain drink, each smoke a certain brand of cigarette, and each have a certain pet. No owner has the same pet, smokes the same brand of cigarettes nor drinks the same drink as any other.
- The question is: Who has the fish?

CLUES

- The British man lives in the red house.
- The Swedish man has a dog for a pet.
- The Danish man drinks tea.
- The green house is to the left of the white house.
- The owner of the green house drinks coffee.
- The person that smokes Pall Mall has a bird.
- The owner of the yellow house smokes Dunhill.
- The person that lives in the middle house drinks milk.

- The Norwegian lives in the first house.
- The person that smokes Blend, lives next to the one that has a cat.
- The person that has a horse lives next to the one that smokes Dunhill.
- The one that smokes Bluemaster drinks beer.
- The German smokes Prince.
- The Norwegian lives next to a blue house.
- The person that smokes Blend, has a neighbour that drinks water.

There have been many versions around, in many cases simply with other names of some of the involved properties. More significantly, most versions involve only 14 clues, not 15 as above. With the program presented later, it is easy to show that one rule (but not two!) can be omitted, while still guaranteeing a unique solution.

I was fascinated by this puzzle already as a child, (This is the version that I had) and I felt immensely proud when I succeeded to solve it. I have seen several different versions of such puzzles, some very similar, or even "isomorphic" (equal after a relabeling of properties or property values). This article presents four different Einstein-puzzles, clearly non-isomorphic. They differ in their number of properties (= p) and their values (= v), the type of predicates in the rules. The puzzle "Table" below also uses subsets of values (for example: from the property first_name the sex of the person can be inferred. Some rules state that a certain property-value pair is associated with a certain sex.)

It also deserves to be pointed out, that all of the puzzles originate in verbal form, and the translation to properties, values, and predicates in some case is quite non-trivial, and involves other than pure logical reasoning. In the original problem, it is (somehow?!) obvious that "neighbor" means immediate neighbor, an interpretation that is not the same as the meaning in normal day use (nor the meaning in mathematics). Also, for example, the German wording of the table-puzzle contains clues (in particular regarding the sex of the persons), that for someone with only elementary knowledge of the language may not catch. Even worse, in some cases, cultural interpretations may be implicitly assumed: A person whose mothers tongue is a right-to-left-language may interpret the statement "The Norwegian lives in the first house." different from a left-to-right-"speaker".

We define an "Einstein-problem" to consist of

- p *properties*, each with
- v *values*, together with
- a number of *rules* (predicates) which restrict the possible solutions

As defined, an Einstein-puzzle can have zero, one, or many solutions. Of course, a "good" Einstein-puzzle should have exactly one.

If "position" (in any disguise) is a part of the problem, we will count it to the number of properties, p. With no rules, it is easy to see that the number of solutions is v!^(p-1). (The "-1" comes from the fact that one property, which normally can be interpreted as a position, is used to to "index" a solution.) For the original Einstein puzzle, this number amounts to 5!^5 = 2.4883200000 * 10^13.

A rule like "The owner of the green house drinks coffee" (we will call such a rule an *equivalence* in the sequel) restricts the number of solutions with a factor of v. A rule like "The person that smokes Blend, lives next to the one that has a cat." is already more complicated to analyze: If the Blend-smoker lives in one of the two edge-houses, this nails the cat-owner as his (only) neighbor, if the Blend-smoker does not live in an edge-house, he has two neighbors, one of them must be the cat-owner. It is easy to come up with some upper and lower estimates for the number of rules necessary for a unique solution, but it is probably at most in trivial special cases possible to come up with criteria for a unique solution. Oh well, we do not know an optimal strategy for chess either... :-)

However, the program presented later can be used to compute the number of solutions for a particular Einstein puzzle. Thus, e.g., for a problem with a unique solution, for every rule it can be tested whether it is necessary for the uniqueness of the solution.

We also remark that the property "position" (possibly in some disguise), as opposed to most other properties, has more structure (for example, it is a totally ordered set, and also has a metric), and therefore concepts like neighbor, facing, preceeding etc make sense, which would not make sense on an arbitrary set.

5.3.3. Five Einstein-Puzzles

In the following table, four different, clearly non-isomorphic, Einstein-puzzles are presented. Clicking on the name will open the puzzle description page. The meaning of the XML-column will be explained shortly.

Name	XML	Props	Values	Used Predicates	Subsets	Source	Comment
Einstein	XML	6	5	equivalence neighbor, to_right	-	The original puzzle, according to Wikipedia	The Original! This version has non-minimal rule set (15 rules, while 14 suffice. For example, rule 15 can be deleted.).
Doctors	XML	4	4	exclusion	-	Source: this forum, (contributio from quantumflu which	Uses exclusions exclusively (sorry :-)

						almost surely is not the original source.	
Table	XML	4	8	equivalence exclusion, neighbor, property_in, gegenueber	yes	From the German magazine "Die ZEITMagaz See scan of the original article.	The verbal formulations are somewhat tricky, containing a good deal of the difficulties, therefore I do not provide a translation, but leave it it in German.
Elskaren	XML	6	10	equivalence facing, exclusion, neighbor, not_neighbo	left_side, right_side	Found in a local student magazine "Elskaren" for/by the electrical engineering students at Lund Institute of Technology Translated from Swedish. Scan.	This is basically a blown-up version of the original puzzle, with ten houses instead of five. Non-minimal rule set (rules 16 and 27 can be eliminated).
Parkinglot	XML	6	5	equivalence neighbor, not_neighbo	-	Found in German student forum www.mathe	Translated from German.

5.3.4. Making it formal

To be able to solve a puzzle with computer, we first have to translate it to a formal notation. I have selected to design an XML DTD for this task. Generated documentation

for this DTD is found here. Thus, for a, verbally described Einstein puzzle, an XML file, valid with respect to said DTD, has to be (manually) written. For example, einstein.xml is the XML-File in which the problem in the Wikipedia version is formulated. Actually, the XML-version of the puzzles in the table above, is available through a click in the second column.

We now give an informal description of the semantics of the XML file. The XML file first defines the different properties, and their possible values. The used names have to adhere to the syntax of identifiers in the C language (ascii-letters, digits, and underscore "_"). If necessary, subsets can be defined here, too. Then a number of rules are defined. A rule consists of one or more predicates, predicates being `equivalence`, `exclusion`, and *if* position is among the properties, `neighbor`, `facing`, `gegenueber`, `to_right`, and `not_neighbor`. A predicate takes two or more property-value pairs. So is the rule "The British man lives in the red house" translated into

```
<equivalence>
   <property-value name="nationality" value="english"/>
   <property-value name="color" value="red"/>
</equivalence>
```

For a property-value in a subset, there is the predicate `property_in`.

A peculiarity, that somehow sneaked into the code, is that for the property position, the values are ignored, and instead C-style indexing is used (i.e. starting with 0). For example, the rule "The person that lives in the middle house drinks milk" should be translated into

```
<equivalence>
   <property-value name="position" value="2"/>
   <property-value name="drink" value="milk"/>
</equivalence>
```

The DTD also allows for textual information, as well as pictures.

Later, the XML file is translated into a C++-program, that will solve the puzzle. Also, on this web-site, based on Apache Forrest, HTML-Files, like for example einstein.html, are automatically generated from the XML-files, with no human inputs.

5.3.5. Programming

The transformation of the XML-File to a C++ program is carried out by a Metamorphosis script. Metamorphosis is a powerful and generic tree transformation tool from Ovidius. It is a commercial program, but can be downloaded free of charge.

To run, you need Metamorphosis (any version should do), a C++-compiler (I have only tried gcc, but there are no special requirements), and make (preferably). Download the Puzzle Kit from the download section, unpack in an empty directory, make sure Metamorphosis and the C++ compiler works, adjust the paths in the Makefile, and type "make".

There are some command line options, most are only of interest for debugging. (See the code in `generic.cc`.) However, the command line option `-#` makes the program give out *all* possible solutions; the default behavior of the program is to terminate as soon as one solution has been found. This option can be used to determine the number of solutions; in particular to determine the uniqueness of "the" solution.

The execution of most puzzle solvers take only some milliseconds. The "elskaren" puzzle, due to its larger size, takes somewhat longer: With maximal optimization (this makes a huge difference for elskaren) it takes 2.3 seconds on my Athlon 1800XP.

5.3.6. Contributions

I would be happy for other "Einstein Puzzles", in particular if they are not isomorphic with any of the herein presented.

Note:

If you have never compiled C++ programs before, you may need assistance. There is nothing wrong with that, and does not make anyone stupid. However, I kindly request not to be sent questions on how to compile C++ program, etc.

5.3.7. Downloads

File	Version	Description
Puzzle Kit	2005-05-27	Complete kit with Metamorphosis script, include file, XML-Files, and Makefile
C++ Files	2005-05-27	The generated C++ Files `einstein.cc`, `elskaren.cc`, `table.cc`, and `doctors.cc`. Only for those without Metamorphosis.

5.3.8. Links

This is of course not the only web page that deals with the Einstein puzzle. Here are some links, that was not mentioned earlier.

- http://www.mindspring.com/~mccarthys/puzzle1.htmStraightforward, pen-and-paper type solution.
- http://www.stanford.edu/~laurik/fsmbook/examples/Einstein'sPuzzle.htmlElegant solution based on logical programming.
- http://www.rakkav.com/homeworlds/brainstem/pages/einstein.htmSome interesting discussion, in particular on verbal formulations and ambiguity. And, of course, a solution of the standard puzzle.

6. Misc.

6.1. Miscellaneous stuff

Here are some random ramblings on different themes. The inclusion of a matter here does not mean that I consider it more important than issues not covered here.

6.1.1. Revision history

Date	Description
2005-05-23	Initial version.
2009-07-19	Renamed from "likes-dislikes" to "misc" (directory). Reorganized. Removed http://www.daniel-rehbein.de/urteil-landgericht-hamburg.html link; it is no longer pertinent in that the sillyness it argues against is hardly found any more (goal achieved!). Removed link to www.amazingcameron.com due to insufficient up-to-dateness. Added antipolygraph.org, ternary operator.

6.1.2. Articles

- On the "Kilobyte" and computerists' obsession for power of 2's.
- Modal popups are evil!

6.1.3. Other Items

- The ternary operator (like in `days == leapyear ? 366 : 365`) is often frown upon, and considered as bad programming style by some individuals or style guides. However, as this Wikipedia article shows, when used properly, the ternary operator is very helpful to write logical, redundancy free code, producing better and more maintainable code than when avoiding it. *My dress code is, if I have a meeting, then tie, otherwise jeans* is actually better than *If I have a meeting, then my dresscode is tie, otherwise my dress code is jeans*, since the latter is redundant ("my dresscode is" is duplicated), and the exterior if-clause hides the ultimate purpose, namely to *select* a dress code, not to *perform* different actions depending on whether a meeting occurs or not.
- For many of us who are forced to work with MSDOS or Windows, the selection of the path-component separator, the backslash character "\", is a never ending source of annoyance, since it violates the established semantics of that character, e.g. within the C programming language, see Wikipedia. This note contains a plausible explanation.

6.2. On the "Kilobyte" and computerists' obsession for power of 2's.

6.2.1. The misuse of a century-old prefix

In the 1970's, (semiconductor) computer memory got out of the doors of the research laboratories. Since it is addressed by a finite number of address lines, each carrying a binary signal, the number of cells in a computer memory chips is almost always a number that is equal to a power of two. Thus, there was a need for a short form of saying "this chip contains 1024 memory cells". Since 1024 = 2^10 is close to 1000, the convention of calling 1024 bytes "1 kByte" was born. Everyone knew that it was strictly speaking wrong, but the community understood it unambiguously. When computer memory, both semiconductor memory and non-volatile memory, increased their capacity, words like "Megabyte" and even "Gigabyte" were born, and, according to the convention, "given" the values of 2^20 = 1048576 and 2^30 = 1073741824 respectively.

This story has been told many times, Googling gives more that enough hits.

Prefixes like "kilo" have been used in science and technology since centuries, and cannot just be "redefined" because someone needs another prefix, no more than pi can be redefined. Since the 1960s they are known as SI prefixes. To provide at least some intellectual consistency, esoteric rules were invented, like: "It is not `kilo-Bytes', it is 'KBytes (pronounced 'kay-bytes')", writing the "k" large, etc.

Not all computer memory is semiconductor memory, addressed with a number of binary signals. Hard disk manufacturers (which did not address their drives like semiconductor memory) sold their products with capacity given in SI Megabytes or Gigabytes, to the extreme rage of the "1 KByte = 1024 Bytes" fraction, who accused the disk manufacturers for using "misleading information", instead of their misused and non-standardized "prefixes".

Psychologically, in such cases, the one claiming that the slightly smaller number is the correct one, a priori tends to make the more serious impression. The one saying "100 Watt RMS" must be more serious than the one saying "150 Watt music effect", just as "76 kWatt" sounds more serious than "100 Horsepowers". Or the one saying that the hard disk contains 100 GB instead of 107 GB... (See this footnote for an almost conspiracy-theory version.)

6.2.2. The "binary prefixes"

So, there was a need for prefixes of the type 2^10n, while leaving the classical SI-prefixes alone. In December 1998 the International Electrotechnical Commission (IEC) defined a number of such prefixes in the standard IEC 60027-2, see NIST or Wikipedia. The following prefixes were defined:

Factor	Name	Symbol
2^10	kibi	Ki
2^20	mebi	Mi
2^30	gibi	Gi

2^40	tebi	Ti
2^50	pebi	Pi
2^60	exbi	Ei

Thus, the usage of binary prefixes using SI-names is, at least now, not only misleading, but also unnecessary, and should be considered discouraged, see NIST.

6.2.3. Binary is for geeks

Even if we settle for a sensible, common and universally accepted language, calling different things by different names, the binary prefixes, often is not a natural, or even good, choice. It is without doubt that it is practical and natural to speak of a "1 GiB" computer memory or a 32 kiHz clock frequency. However, an advantage of "A one-layer DVD contains 4.377 GiB" over "A one-layer DVD contains 4.7 GB" is not obvious, or, rather, not there. But who cares: both these numbers are equally ugly, why should one ugly number be preferred over the other? However, when we are to do arithmetics, the difference shows:

> **Problem 1:**
> Will a 3.83 GB plus a 870 MB file fit on a 4.7 GB DVD?
> **Problem 2:**
> Will a 3.567 GiB plus a 829.7 MiB file fit on a 4.377 GiB DVD?

This is the same problem, but first in base 10 and then in base 2. (There are more decimals in the second case, but that is not the point.) In both cases, it will fit exactly. In both cases, the formulation is mathematically unambiguous, and the problem uniquely solvable. However, in the first case, the answer requires a simple addition, which many people can do in their heads (even I :-). The second case is not a hard task as a math assignment, but it feels silly to compute 3.567 + 829.7/1024 to find out if you need one or two DVDs. Just adding 3.567 and 0.8297 simply gives the wrong answer! The "1.44 MB" Floppy disk (which has a capacity, not 1.44 MB or 1.44 MiB, but 1.44*1000*1024 = 1.47MB = 1.41MiB, exactly double that of the "double-density" 720MiB floppy disk!) probably is a victim of the comparative difficulty of making arithmetics in the base-2-world.

But of course, base-2 to is to computer science what Latin is to medicine...

6.2.4. Other external links

- The Wikipedia article on Kilobyte previously took the same standpoint as this article, which is probably not correct for an encyclopedia article. Presently, it says "Kilobyte ... equal to either 1,000 bytes (10^3) or 1,024 bytes (2^10), depending on context.", probably as some compromise. This is bad; it is simply not a statement for which a consent exists, see the next entry, in particular its Footnote 1.
- This article, written by a 1KB=1024B proponent, quite well illustrates the mess the you get into with the 1024B interpretation. Of course, this was not the author's

intention. Footnote [7] is entertaining ("Nearly everyone (including the experts) gets this wrong..."). Interestingly enough, the author suggests using "BB" for "billion bytes" instead of "GB", not taking into account that billion is a word that means differently in different regions of the world...
- A plea for sanity. Comes close to the same article as this one, quite funny.

6.3. Modal popups are evil!

I have been using early windowing systems, in particular the X-Windows system (with Xt/Athena Widget tools etc). These worked quite well, without resorting to modal popups. Then Windows started to spread, and with it, the usage of modal popups. I was immediately repelled by the restrictions these meant. Unfortunately, the usage of modal popups has spread outside of the Windows world, for example to Java, KDE, Gnome.

A modal popup prohibits the user from any interaction with the application, except for that popup window. This often feels like an insult to the user, who may have other ideas of what he wants to do with the program, and the order in which he wants to do it. In many cases, they simply constitute a usability catastrophe: Assume an error message, to which the user is expected to react ("cannot write file..."). In order to analyze the problem (why could the file not be written?), the user want to utilize other parts of the program, like the help facility. He can't. Because the modal popup is blocking the application. Or he want to look up "Error E6553-6633-995A2" in the documentation. Problem is that he has to destroy the information (contained in the modal popup) before he can access the documentation...

In some cases, modal popups are justified. (fatal errors, ending dialogs,...) In most cases not. The are just a way of unnecessarily restricting (and annoying) the user. In general, the more complex a program is, the harder it is for the programmer to anticipate the user's (sensible) wishes, and the more modal popups should be avoided.

So why are modal popups so widely used? Even by "Microsoft-criticals"? Possibly because people are used to being forced and do not question? Or because the programmers were lazy (It should also be said that using modal popups in some cases makes it easier to write correct programs; when limiting the user's choices, there is less that can go wrong...)

There is also an issue with program robustness: If a complex application somehow goes haywire, like generating "many" error popups, possibly in an infinite loop, the modal-popupper in general must be killed from the OS; a non-modal popupper can more easily be recovered.

The similarities between modal popups and DVDs UOP is striking: It is like disabling the Audio-key; "no need to use it, the user can go to the menu and there select his audio track".

7. All