DaVinci dm365 for home automation
A list of significant issues faced during the development

Developers
(ascii-sorted by name string)

Adelio Trezzi (hw)
Davide Bonfanti (hw+Linux bsp)
Fabio Mauri (sw)
Raffaele Recalcati (Linux bsp)
Simone Agresta (sw)

External suppliers
(ascii-sorted by name string)

Alessandro Rubini (Linux bsp)
Rodolfo Giometti (Linux bsp)

Speaker Raffaele Recalcati
raffaele.recalcati@bticino.it

Bticino Legrand
A company that develops and produces

THE ERBA PLANT (Italy - Como)

10.000 m²
430 Employees
1950 Finish products
11000 Components

ERBA MISSION

Europe and North Africa ASR Electronic Centre of Competence in terms of R&D, Quality and Industrial about HS.

Introduction of new and innovative products and system in group offer.
Definition of the new architectures/technologies for HS.
Introduction of new electronic technology in industrial.

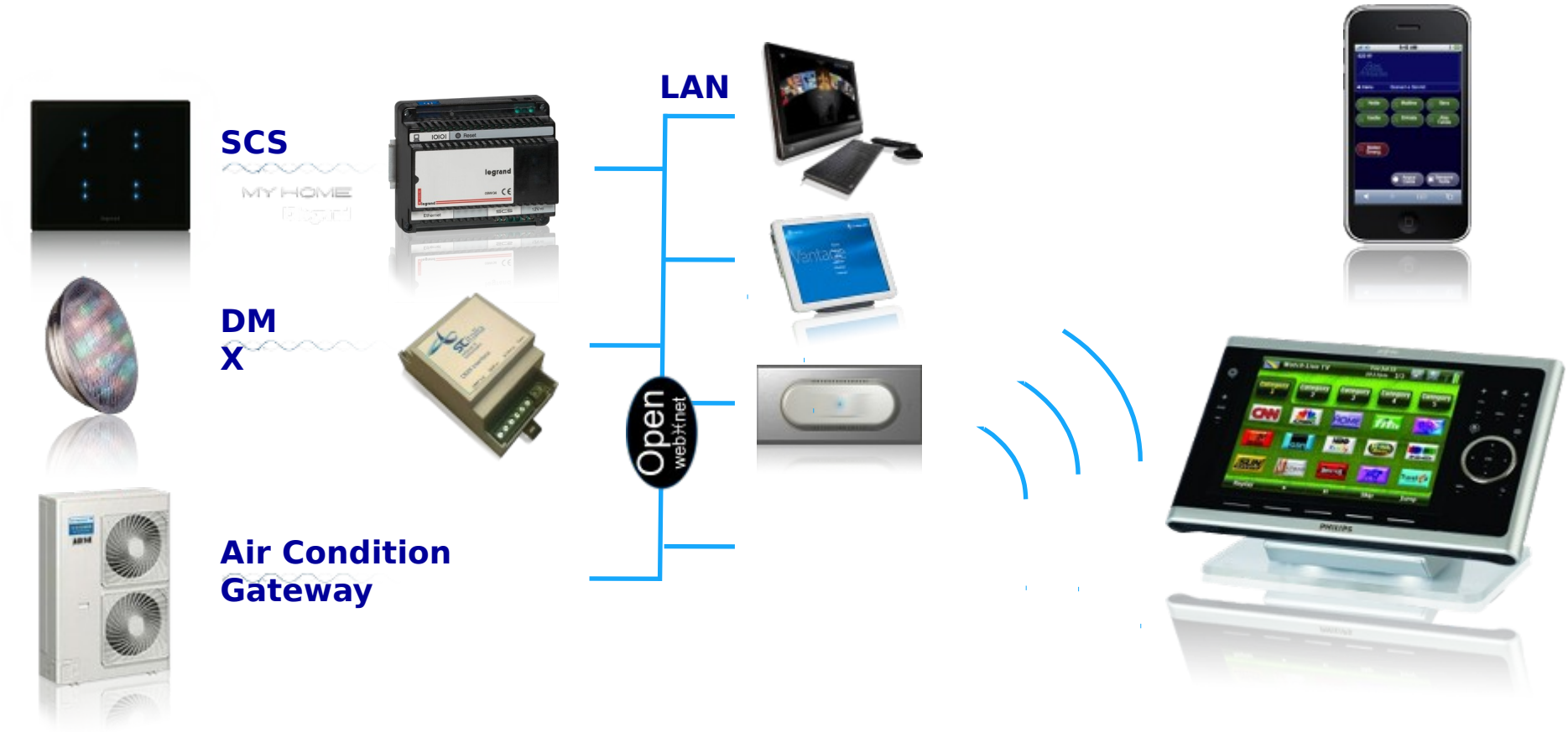
Assure by supplier network the WDS MvB policy

Lead the growth of other ASR centers (development, quality and industrial)

Why dm365?

Replacing pxa255

Analyzed many different cpus, examining pros and cons for Bticino MyHome automation system

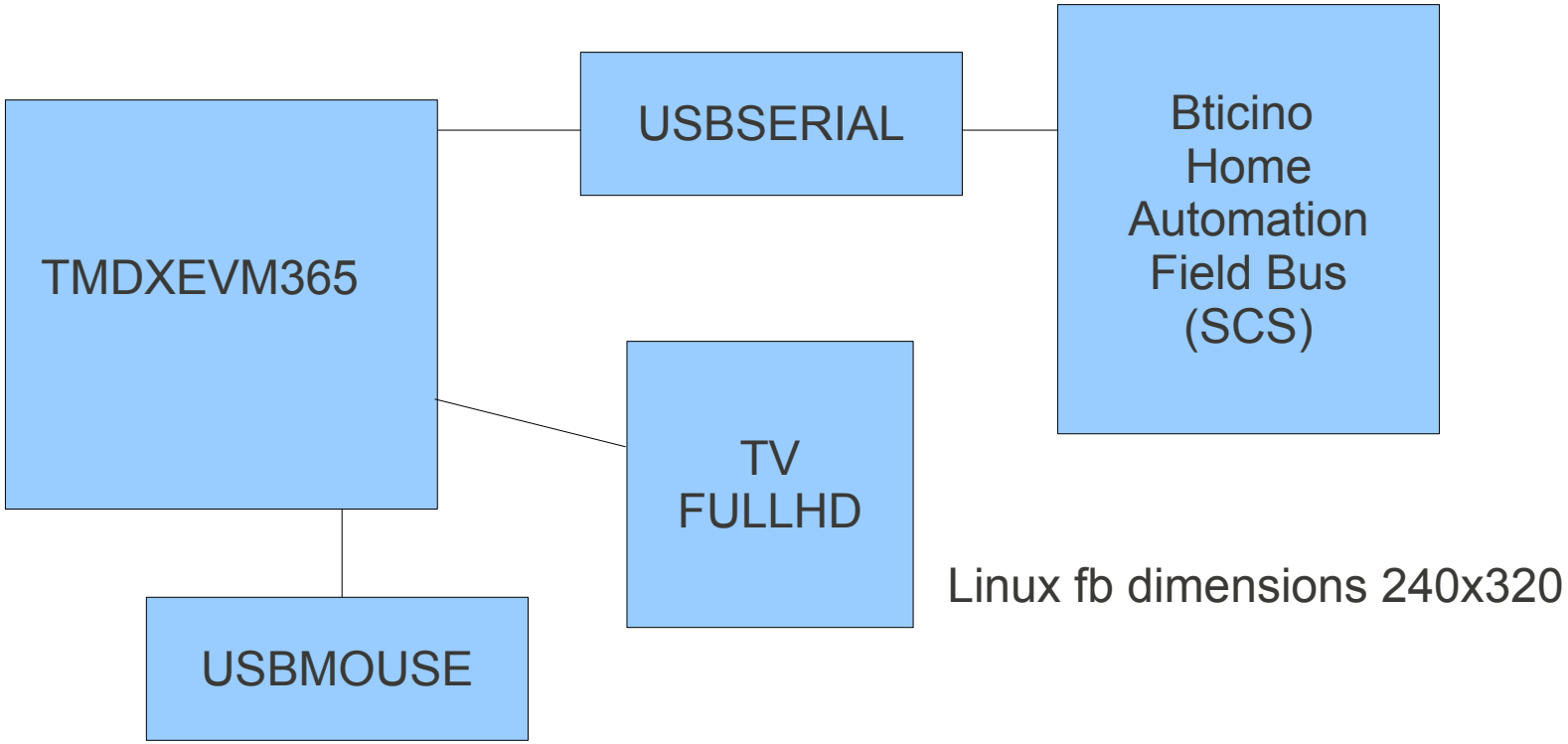


Is dm365 cpu powerful enough to replace pxa255 ?

pxa255 400Mhz
240x320 LCD
32bit,100Mhz SDRAM

dm365 270Mhz
240x320 LCD 1
16bit, 216Mhz DDR2

Early prototyping OK!



Linux fb dimensions 240x320

Free SD/HD video codecs at low cost

The arm9 dm365 is **scalable** up to 432Mhz (dm368)

- HDVCIP hw codec can encode/decode H264 up to 720p (1080p for dm368).

Aggressive cost confronted to Sitara (omap3) socs

- that we are instead developing for more powerful boards, see DM3730.

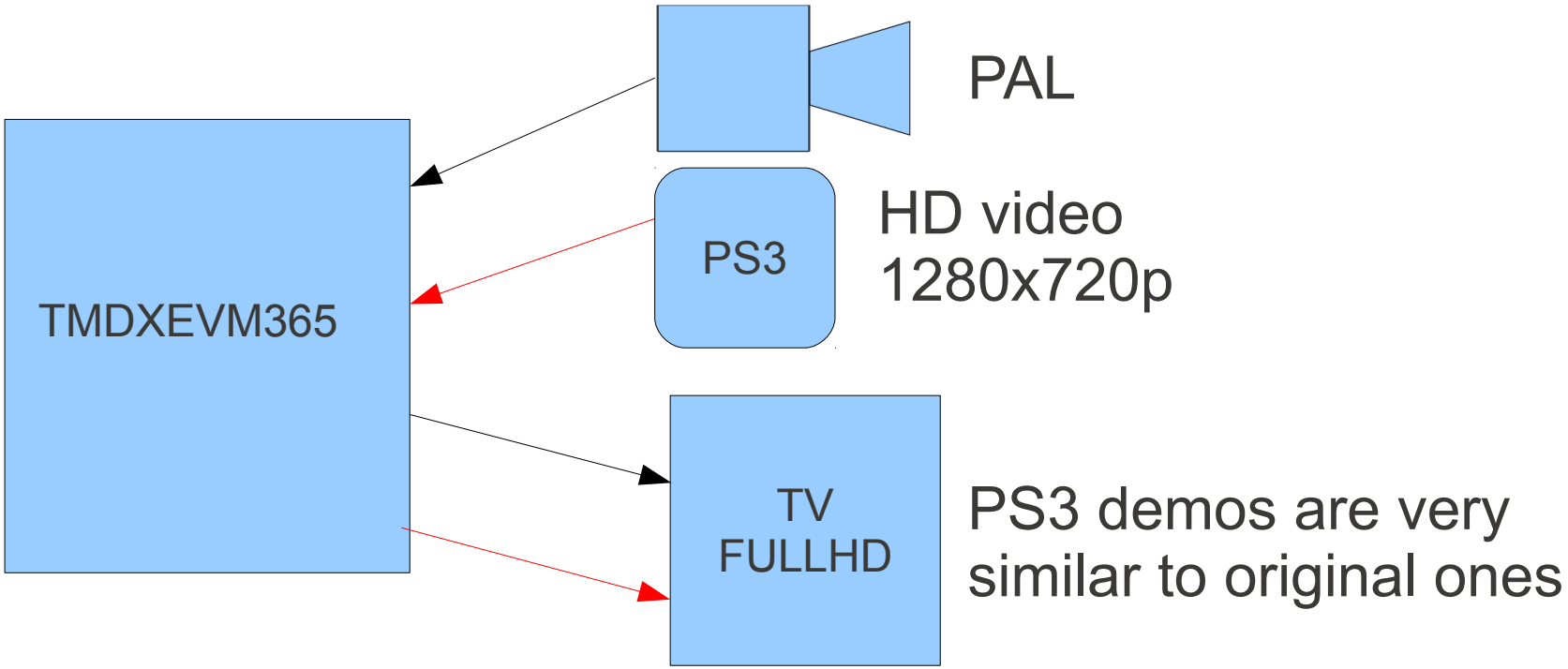
dm365 is not only a cpu ...

- it is a cheap soc with strong video codecs.

Are dm365 video codecs nice?

The PAL standard is a good choice for home automation.

Testing MPEG4/H264 encoding/decoding performances with SD and HD video formats.



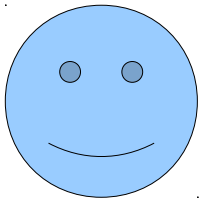
Skills needed to develop a dm365 board

Experience in:

ARM cpu board hardware

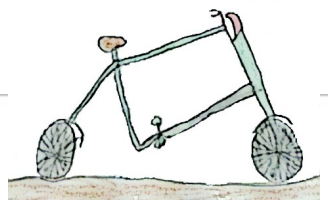
ARM Linux BSP developing
U-boot, Linux kernel

ARM Linux user-space software
Distros, Applications



We think to have these skills!

Our first complete board (called Bmx)



Bmx logo made by Elia

A company that contributes to the community

A big patchset to davinci-linux-open-source ml.

- The maintainer explains us (me and Davide) whom to send patches to.

Dividing the big patchset in many small patches

- arch/arm/mach-davinci
- drivers/media/video/davinci
- sound/soc/davinci

Keep patches functionally separated

- Also in your custom board development functionally;
- You can rebase your work quickly to newer kernel, even if your patches are not accepted upstream!!

Time to market is to be insured .. anyway!

Sending a patch

1. Check if anybody is doing it (ask to the right ml)

2. Change the files ..... … …
(only one simple functionality added: max dozens of lines, not hundreds)

3. Test on the target

4. Commit to your git tree

5. Create the patch

6. Check your sources (Documentation/CodingStyle)

7. Add setup information after the '---' line

8. Verify your git send-email is working (--dry-run)

9. Finally send it (Documentation/SubmittingPatches)

10. Wait for the maintainer to answer for at least 10 days

The innovation comes from the know-how

It is possible that company developers interact between each other?
Some kind of development information is not a secret.

Does it sound strange?

We proved that it is useful, we learn more and create better solutions.

Can we go to a conference and talk about our work?

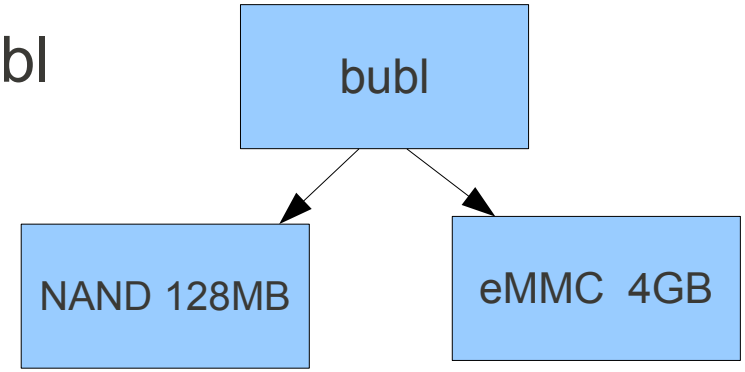
YES, I'm here !!!

Building a deeper knowledge for having always better improvements.

The software multiboot

We boot bubl from SPI flash and launch u-boot from NAND or eMMC.

Different from ubl



Linux Kernel

Customized Angstrom

Bticino Middleware

Bticino High Level Software
(hackable with SDK)

Mass Storage: eMMC or NAND?

Data retention (...) is the same … 30 years.
Forget NOR specifications (100 years).

eMMC

from mobile world ... very very dangerous in industrial environment and changing every month, look at JESD84-A441 specifications for the actual one, but the **PERFORMANCE** ARE THE BEST (>50MB/Sec with 8bit).
Powerfail problems are possible (wear leveling always running)
More capability than NAND
Remember eMMC! = SD

NAND

Low price if 128MB are enough.
The cpu directly accesses the data blocks, but the ECC has to be calculated, and forget the SW ECC calculation (too slow) for good performances.

Mass Storage: we choose both

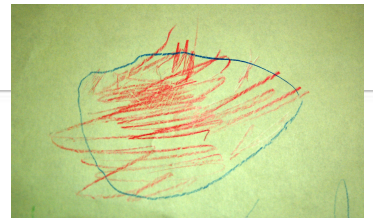
Cheaper solution, less storage → NAND

More storage and performance needed → eMMC

Anyway keep in mind that are consumer chipsets,
so, **secondary sources** for each ones are mandatory.

Found problems with eMMC not responding to CMD8
(eMMC description in EXT_CSD), changing it with another chip the problem disappears... not yet completely understood, but ...

The first subset of Bmx board (called Basi)



Basi logo made by Elisa

I2C
PAL-DECODER
CVBS_IN
JTAG connector
Vs PIC SCS AI
UART expander
DDRII RAM 1Gbit – 128MByte
Asyncronous Bus 16-bit wide
Syncronous Bus 16-bit wide up to 216-MHz
Versus USB CONNECTOR miniB
eMMC FLASH 4GB
CAMERA AFE
JTAG
Data Bus
DDR controller
SPIx5
VOICE CODEC
I2C
McBSP
CPU DM365
USB HS OTG
MMC/SDx2
UARTx2
VIDEO ENCODER
GPIO
EMAC
FON_RX
FON_TX
I2C
EEPROM 32KByte
RTC
Vs PIC SCS
Vs Console
ETH PHY
TRAFO
RJ45 connector
3.3V
Power Supervisor
POE 3.3V Connector
Vcc
Downconverter
Double DC-DC converter
1.3V
1.8V
-abil_amp
-abil_dem_hifi
-abil_dem_video
-abil_fon
-abil_fon_ip
-abil_i2s
-abil_mod_hifi
-abil_mod_video
-backlight
-buzzer
-ctrl_hifi
-ctrl_video
-hw_version
-led
-power_sense
-usb_connected
-virt_conf

The Basi board, the right kernel baseline

Video accelerated codecs are opensource, but have to keep in mind the **kernel compatibility** (a possible nightmare with the wrong kernel).

DVSDK (4.01 now) depends on PSP

- a 2.6.32.17 with some Ti patches on it for DaVinci peripherals

Forget davinci-linux-open-source (2.6.37 now) for quick time to market, but look at it to know the news

- for example a completely rewritten v4l2+fbdev for DaVinci is coming, it means that Ti believes in DaVinci also for the future

Basi board kernel is ready (based on DVSDK 4.01)

- The H264 encoding of tvp5151 video signal is in progress

Basi board, the complete patchset on DVSDK 4.01 2.6.32.17 kernel

```
$ grep MACH_BASI arch/arm/tools/mach-types
    basi                MACH_BASI                   BASI          2948
```

e1664d3 DIRTY: Board basi : mmc re-enabled
d60b5fe Basi Board: config reduced
a322c99 DIRTY: Basi Board: cleaned the file
b50fce2 DIRTY: Board Basi: powerfail disabled, TO BE eliminated
3dada86 Basi Board: SCS microcontroller out of reset at power up
e34aa98 Basi Board: Support for external uart
62f60b7 Basi Board: add support for power fail management
96fc38e Basi Board: added support for multiple interrupr on GPIO0 port
50df047 davinci: basi board support
0b0ccd0 media/video: davinci: vpfe: added enum for tvp5150
a900605 dm365: isif: pinmux setting in platform_data for 2.6.32
16b7149 mmc: partition number extended above 7
66cfc5c ASoC: DaVinci: basi support
248d775 davinci: dm365: support for voice codec resources
b851857 ASoC: DaVinci: VoiceCodec: 2.6.34 to 2.6.32 backport, snd_soc_init_card needed
4b11d46 ASoc: DaVinci: 2.6.34 to 2.6.32 backport compatibility
9246f09 ASoc: DaVinci: 2.6.34 to 2.6.32 backport - dma fix
4a65811 V4L/DVB: tvp515x support
6d7ebbf MFD: DaVinci Voice Codec
46dbf26 ASoC: DaVinci: CQ93VC Voice Codec
60b244b ASoC: DaVinci: Voice Codec Interface
3dfc501 V4L/DVB: tda9885: chipset support
f9a90af davinci: dm365: Adding some gpios and their pinmux settings.
a2774a9 davinci: DM365: fixed second serial port
99c9596 Partitions: added bubl partition table

e21a013 commit of linux-2.6.32.17-psp03.01.01.38 from ti-dvsdk_dm365-evm_4_01_00_09

Bmx, some patches on the mainline

Thanks very much Davide Bonfanti

```
$grep bmx arch/arm/tools/mach-types
bmx                 MACH_BMX            BMX                 2744

commit 5f7ddae6104d85e27c0fbcb508cfe8286a01a5e1
Author: Raffaele Recalcati <raffaele.recalcati@bticino.it>
Date:   Mon Aug 9 17:20:59 2010 -0700

    checkpatch: fix handling of leading spaces

commit ec6375533748806a1a49dad7ce124cc02886854a
Author: Raffaele Recalcati <raffaele.recalcati@bticino.it>
Date:   Tue Jul 6 10:39:03 2010 +0200

    ASoC: DaVinci: Added selection of clk input pin for McBSP

commit ec6375533748806a1a49dad7ce124cc02886854a
Author: Raffaele Recalcati <raffaele.recalcati@bticino.it>
Date:   Tue Jul 6 10:39:03 2010 +0200

    ASoC: DaVinci: Added selection of clk input pin for McBSP

commit a4c8ea2ddaed2f461606c2828b19786524b551ac
Author: Raffaele Recalcati <raffaele.recalcati@bticino.it>
Date:   Tue Jul 6 10:39:02 2010 +0200

    ASoC: DaVinci: Added two clocking possibilities to McBSP (I2S)
```

Partitions: added bubl partition table

Why do we need many partitions?

We need a reliable and automatic remote update

Based on multiboot with recovery in case of update breaks !!!

u-boot chooses the right kernel+rootfs couple: operative or recovery

U-boot + u-boot_env
uImage + rootfs
uImage_rec + rootfs_rec
conf +conf_copy
rw_store

At least 9 partitions

TVP5151: V4L2 support for a new PAL decoder

tvp5151 is similar to tvp5150

Lacking some V4L2 commands as tvp5146 (TMDXEVM365)
- Needed for DMAI, gstreamer accelerated codecs
- Making the driver compatible to the mainline

2.6.37 tests are possible with Basi board

Work in progress now... but this command already works:

gst-launch v4l2src ! video/x-raw-yuv ! filesink location=video.raw

```
static const struct v4l2_subdev_video_ops tvp5150_video_ops = {
        .s_routing = tvp5150_s_routing,
+       .querystd = tvp515x_querystd,
+       .enum_fmt = tvp515x_enum_fmt_cap,
        .g_fmt = tvp5150_g_fmt,
+       .try_fmt = tvp515x_try_fmt_cap,
        .s_fmt = tvp5150_s_fmt,
+       .g_parm = tvp515x_g_parm,
+       .s_parm = tvp515x_s_parm,
+       .s_stream = tvp515x_s_stream,
        .g_sliced_vbi_cap = tvp5150_g_sliced_vbi_cap,
};
```

Openembedded Basi board support

OE is armv5te compliant whereas Linaro is armv7 compliant
Completely scalable, but slow learning curve
git pull: a risk or a benefit?

It is better an overlay or a branch of OE metadata?

- overlay: it is a separate git tree
+ local branch: better for rebase

Features

ext2/ext3 readonly support added
g_ether – dhcp fixed configuration
compiling bubl,u-boot,kernel,application for Basi board
tested external toolchain Code Sourcery
New recipe to send email → nmh

Problems

Struggling against libphp5 ABI version
(ABI4 doesn't work, ABI5 works)

Bubl: why replacing ubl?

Can be placed in SD, MMC and SPI flash

We are more confident to boot from SPI flash than from NAND/eMMC
(the bubl can integrate more tries to read u-boot from NAND or eMMC)

We prefer a complete rework than developing on the original ubl

It is GPLv2

Is JTAG useful or is it time-consuming?

Quick board bring up (dm365 boot, DDR2 interface)

Flasher for testing u-boot and linux kernel drivers

- SPI flash
  - Without it every test needed an SPI flash to be re-flashed with an external programmer, taking about 5 minutes for each test
- eMMC (thx Lauterbach)
  - We were new to these devices!
  - It doesn't work … it is a software or an hardware issue?

Debug and optimization

- Stop mode cpu load per process, bottle neck analysis with ETB

JTAG limitations on custom boards

Stop-mode debug for bubl-u-boot-kernel-apps

ETB (4KB) for program tracing through JTAG connector,
without the need of other pins (not possible on Basi board)
(ETM not available on dm365)

No space on Basi board neither for ARM-20 nor Ti-14 connectors

Small custom 8 pins connector

REMEMBER RTCK

It is very important to speed up the communication.
(10X speed using it)

Bticino SDK: the IDE environment

Needed features
- SDK for QT, C++, Android like developers
- Free graphics IDE, basic emulator

Possibilities
- CCSv5
  - Not tested, because it is made by a cpu vendor
- DS-5
  - ARM linux ready (streamline), very nice GUI, but not free
- Lauterbach gdb frontend
  - gdbserver 7.2 compatible, same powerful t32 script as stop mode (cpu load per process possible), not free
- Yoctoproject
  - nice, the easiest, but Poky rootfs dependency

Bticino SDK: going on

A “simple” eclipse plugin

Cross-debugging

- emulator or real target

Minimal peripheral supported in the emulator

- eth,serial,storage (maybe ...)

An Ubuntu 10.04 LTS 32bit Virtualbox setup

- also for Windows users

Openembedded SDK finally

The innovation comes from collaboration

It is not new

Temporary GITHOSTING = GITHUB

possible changes will be notified in README files inside each project

Bubl:	$GITHOSTING/bubl.git
U-boot:	$GITHOSTING/u-boot.git
Linux Kernel:	$GITHOSTING/linux.git
OE branch	$GITHOSTING/openembedded.git
Customized Angstrom	$GITHOSTING/bt-overlay.git

Bticino Hackable Software (with SDK) – next future