Using OSHW and OSS for building your custom hardware platform

Yet another talk about Olimex Lime2 hardware

Priit Laes @plaes

AboutPAF.com / K-Space.ee

February 2, 2020

FOSDEM'20

AboutPAF.com

Ålands Penningautomatförening

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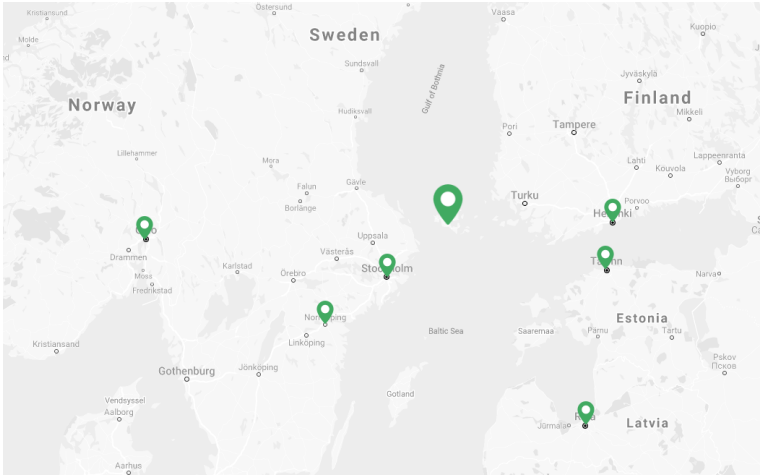
Ålands Penningautomatförening aka **PAF**



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- **Mariehamn** (Åland)
- Helsinki (FI)
- Stockholm (SE)
- Norrköping (SE)
- **Tallinn** (EE)
- Oslo (NO)
- Riga (LV)
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Global leader in responsible gaming

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...also operating on ships - limited network connectivity

Buy the solution

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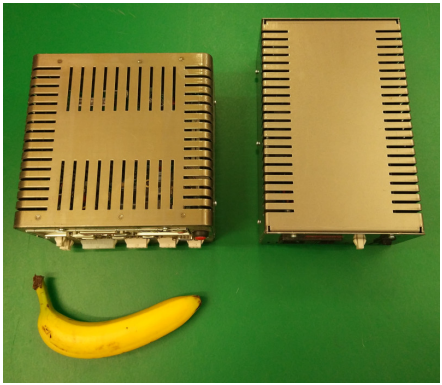

Figure: Gen. 2 of TCD Hardware (2015?)

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Hired by PAF in 2018 to take a look of existing hardware-software solution (also including the whole automated meter reporting backend) and improve it.

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Nope - Not gonna happen.. :(

Let's go shopping

Our requirements for "slot" computer:

- Small form factor
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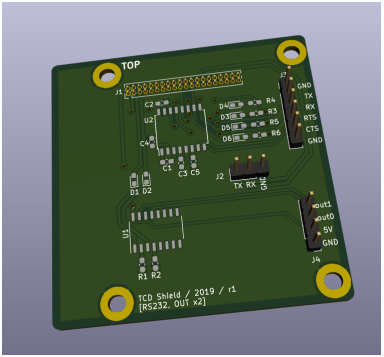
- Finish layout

Almost ready?



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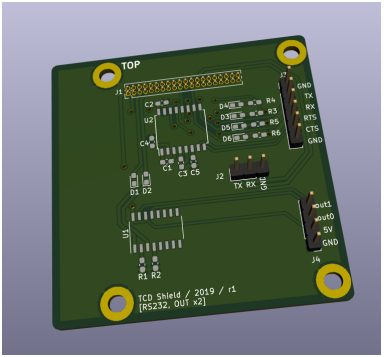

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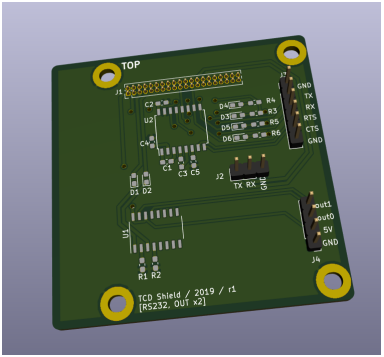

Are we there yet?

- Build (or order) the board
- Order components
- Solder it together
- Test it

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Hackerspace in Tallinn, Estonia

Community driven co-working and meeting space.

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Basic fabrication capabilities

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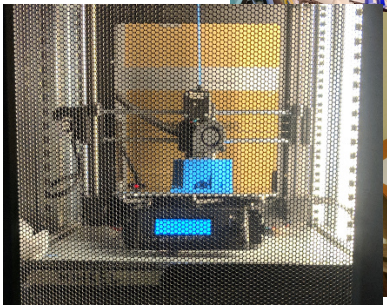

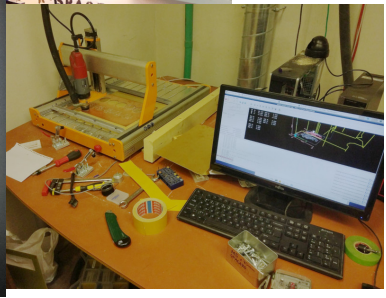

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- **CNC machine**
- Laser cutter
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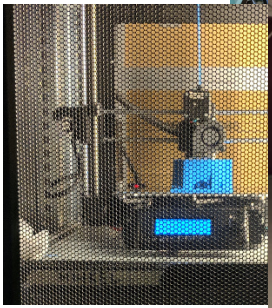

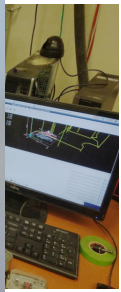

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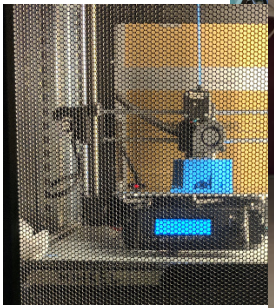

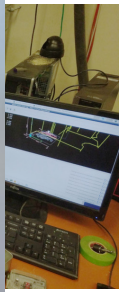

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Also home to **Armbian.com** :)

Milling your own PCB?

Howto steps for the K-Space CNC in our wiki:

- Export front, back, drill and outline Gerbers from your favourite PCB design software
- Convert Gerbers to G-code using pcb2gcode command below (on next slide)
- Dump the files to the K-Space Nextcloud share
- Approach the CNC setup, in web browser open bookmarked link for the same share, download files
- Under supervision by **Lauri**, **Kaarel** or **Silver**: mill front, drill holes, flip, mill back, cut outline

Generating G-code using pcb2gcode (1)

KiCAD already generated our gerbers, so let's turn it something that CNC can eat..

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```
git clone https://github.com/pcb2gcode/pcb2gcode/
cd pcb2gcode
# Pull usable version
git checkout eeee27db62b6b447f84d020cd80a65a81daa54b1
apt install libboost-all-dev libgtkmm-2.4-dev gerbv shtool autogen
autoreconf -fv
./configure --prefix=$HOME/opt
make -j4 && make install
```

Generating G-code using pcb2gcode (2)

```
pcb2gcode --vectorial \
  --software linuxcnc --zero-start --tile-x 3 --tile-y 2 \
  --front *-F.Cu.g* --front-output front.ngc \
  --back *-B.Cu.g* --back-output back.ngc \
  --drill *.drl --drill-output drill.ngc --drill-side back \
  --outline *-Edge.Cuts.g* --outline-output cutout.ngc \
  --metric --metricoutput --noconfigfile \
  --zsafe 1 --zchange 100 \
  --cut-feed 150 --cut-speed 6000 --cut-infeed 0.6 --zcut -1.5 \
  --zbridges -1 --bridges 3 --bridgesnum 4 --cutter-diameter 2 \
  --mill-feed 500 --mill-speed 6000 --zwork -0.2 --offset 0.2 \
  --drill-feed 500 --drill-speed 6000 --zdrill -3 \
  --spindown-time 2 --spinup-time 2
```

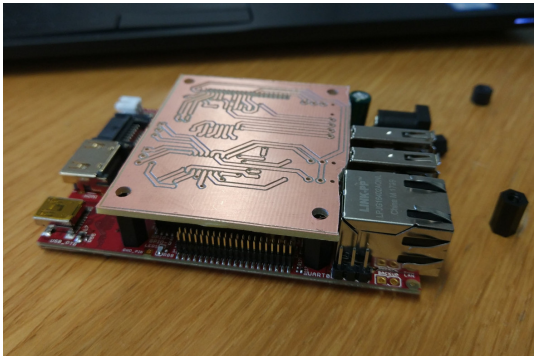
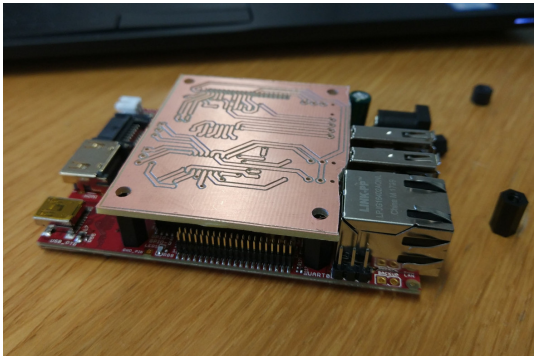


Figure: First fit!



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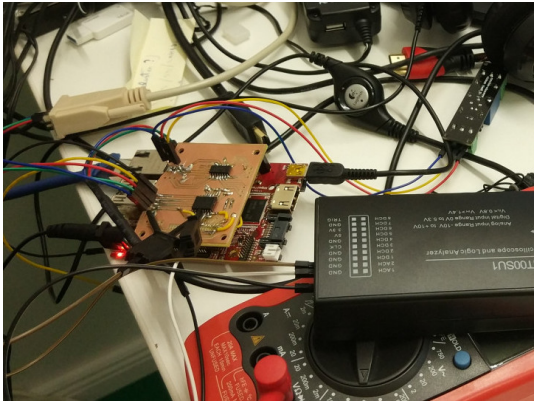
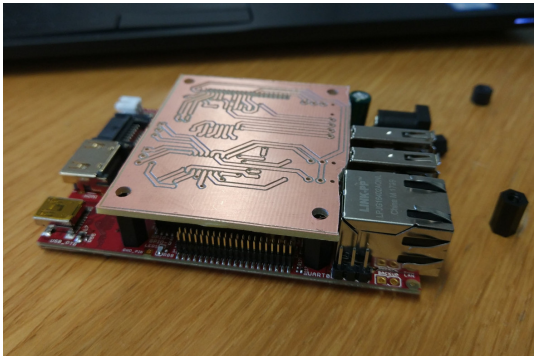


Figure: Why does it not work?!



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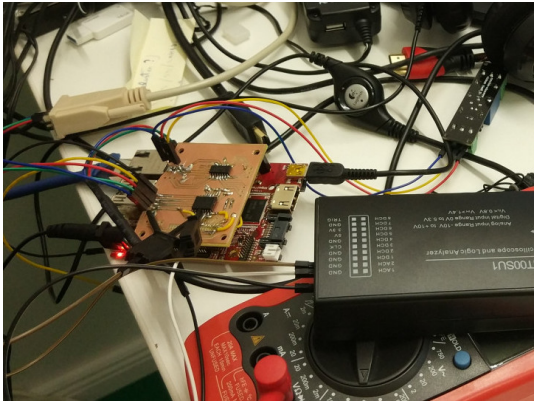

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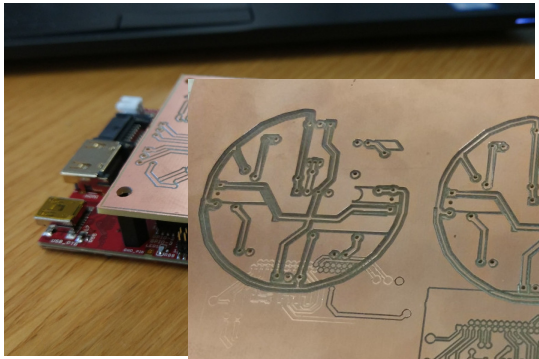
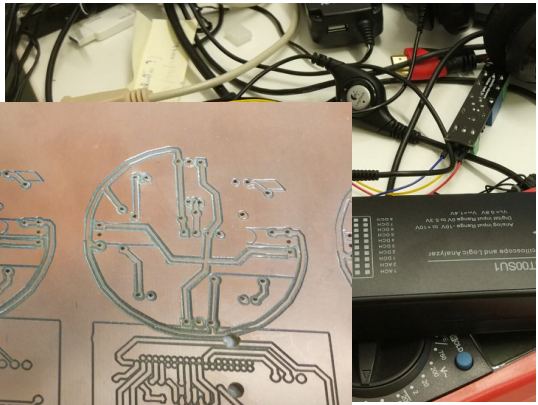
Conclusion: CNC is too much work.. Let's try the fabs.





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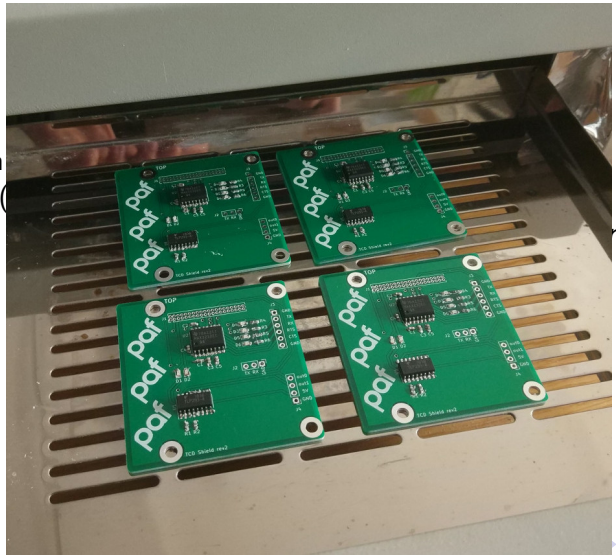

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- Olimex Lime2-eMMC running Debian stable (aka Ticket Check Device)
  - Somewhat custom kernel and bootloader setup
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  - Ticket check device for tables - Lime2 with I2C display for croupiers
    ...using devicetree overlays

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  - WIP: Hosts our own APT repository (Aptly)
  - WIP: Log collection and aggregation (rsyslog)
  - TODO: Proper monitoring... (MQTT maybe?)

Software platform (3)

Provisioning Lime2 devices in two minutes

- Prerequisites (`sunxi-fel` and `fastboot`):
  - `u-boot` image
  - Basic Debian image `325MB` with ssh keys and avahi service
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- Preparation tasks (collect MAC address and format eMMC):
  - `sunxi-fel uboot $DATA/u-boot-sunxi-with-spl.bin write 0x43100000 $DATA/env.txt`
  - `echo $(fastboot getvar uboot:ethaddr 2>&1|head -n 1 |cut -f 3- -d ':' )`
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- And now the flashing process:
  - `sunxi-fel spiflash-write 0 $DATA/u-boot-sunxi-with-spl.bin`
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- And now we can continue with `ansible-playbook`

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- Update the avahi service txt-record with the correct slot location

Software platform (5)

How do we know the location of the devices?

Each device advertises its location using avahi service record:

```
$ cat /etc/avahi/services/paf-ssh.service
<?xml version="1.0" standalone='no'?><!--*-nxml-*-->
<!DOCTYPE service-group SYSTEM "avahi-service.dtd">
<service-group>
<name replace-wildcards="yes">PAF ssh %h</name>
  <service>
    <type>_ssh._tcp</type>
    <port>22</port>
    <txt-record>slot=unknown</txt-record>
  </service>
</service-group>
```

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```
$ avahi-browse -d local _ssh._tcp --resolve -t -p |grep slot
```

Bonus: Hardware picture

Figure: Gen. 1 of TCD Hardware (2009?)

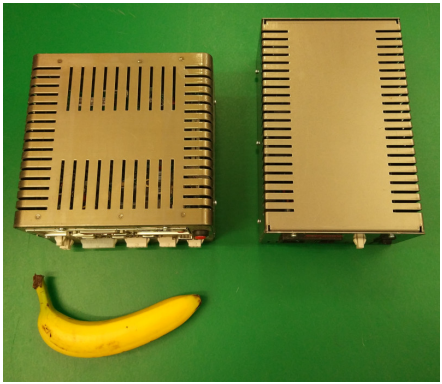

Figure: Gen. 2 of TCD Hardware (2015?)

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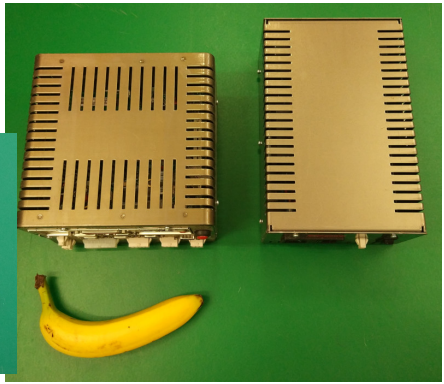

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PAF In-House TCD Hardware

Overview of problems encountered and solved

GPIO pins not working?

Symptom: GPIO pin not being able to push out `3.3V` to trigger relay.

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Cause: Missing regulators for GPIO banks:

```
+++ b/arch/arm/boot/dts/sun7i-a20-olinuxino-lime2.dts
 &pio {
+       vcc-pa-supply = <&reg_vcc3v3>;
+       vcc-pc-supply = <&reg_vcc3v3>;
+       vcc-pe-supply = <&reg_ldo3>;
+       vcc-pf-supply = <&reg_vcc3v3>;
+       vcc-pg-supply = <&reg_ldo4>;
+
        led_pins_olinuxinolime: led-pins {
                pins = "PH2";
                function = "gpio_out";
```

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- Lots of device shuffling from our side

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Please submit your stuff upstream!

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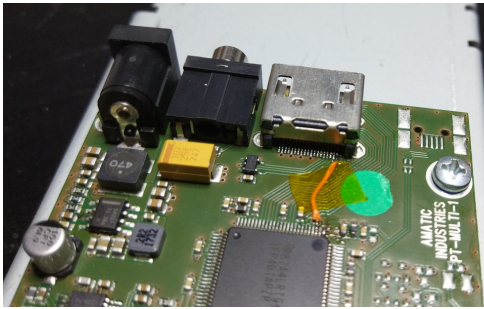

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+++ b/drivers/gpu/drm/sun4i/sun4i_hdmi_enc.c
@@ -92,6 +92,8 @@ static void sun4i_hdmi_disable(struct drm_encoder *encoder)
+ clk_disable_unprepare(hdmi->tmds_clk);
 }

@@ -102,6 +104,8 @@ static void sun4i_hdmi_enable(struct drm_encoder *encoder)

+ clk_prepare_enable(hdmi->tmds_clk);
```

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from gi.repository import Gdk
disp = Gdk.Display.get_default()
num = Gdk.Display.get_n_monitors(disp)
for m in range(0, num):
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Fix: `https://gitlab.gnome.org/GNOME/gtk/merge_requests/848`

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Solution: `apt install haveged`

Networking troubles (1)

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Cause: Buggy silicon in PHY chip
Solution: Enable correct PHY in defconfig (9567832aba7)

```
+++ b/arch/arm/configs/sunxi_defconfig
 CONFIG_STMMAC_ETH=y
 # CONFIG_NET_VENDOR_VIA is not set
 # CONFIG_NET_VENDOR_WIZNET is not set
+CONFIG_MICREL_PHY=y
 # CONFIG_WLAN is not set
 CONFIG_INPUT_EVDEV=y
 CONFIG_KEYBOARD_SUN4I_LRADC=y
```

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Easy, right :)

So long, and Thanks for All the Bugs!
Questions?