Run upstream coreboot on an ARM Chromebook

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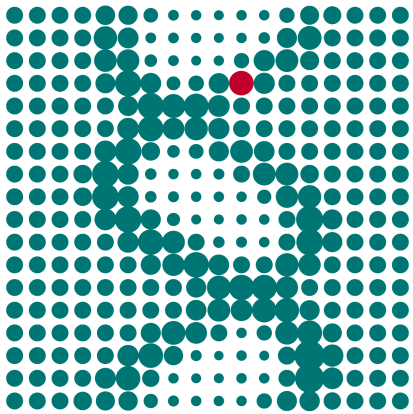
Thanks

Who am I?

- (Economic) Mathematician by studies at TU Berlin
- Free Software enthusiast
- Active in coreboot since 2005 (still LinuxBIOS back then)



- System architect at Max Planck Institute for Molecular Genetics

Google Chromebooks

Architectures

1. x86
2. ARM
3. MIPS

x86

1. Currently only Intel based devices
2. BLOB: Intel FSP (Firmware Support Package) (formerly MRC)
3. BLOB on co-processor Intel Management Engine
4. BLOB: Microcode updates

x86 – Graphics driver in Linux

1. BLOBs required by recent Intel graphics devices

```
$ ls /lib/firmware/i915/
bxt_dmc_ver1_07.bin          skl_dmc_ver1_23.bin
bxt_dmc_ver1.bin             skl_dmc_ver1_26.bin
bxt_guc_ver8_7.bin           skl_dmc_ver1.bin
bxt_huc_ver01_07_1398.bin    skl_guc_ver1.bin
kbl_dmc_ver1_01.bin          skl_guc_ver4.bin
kbl_dmc_ver1.bin             skl_guc_ver6_1.bin
kbl_guc_ver9_14.bin          skl_guc_ver6.bin
kbl_huc_ver02_00_1810.bin    skl_huc_ver01_07_1398.bin
```

x86 – Ecosystem

1. More payloads in coreboot
2. Good eco system
   - 2.1 https://mrchromebox.tech/ – custom images
   - 2.2 https://johnlewis.ie/ – custom images
   - 2.3 GalliumOS – GNU/Linux distribution for x86 Chrome OS devices

ARM

1. Small bootblock fused in system
2. No legacy, easier to set up
3. No co-processor
4. U-Boot, Barebox as free alternatives
5. Bad user space situation with BLOBs for graphics drivers
6. Few payloads
7. No ecosystem

Samsung Chromebook Plus (RK3399)

See thread *Current, BLOB free laptop available Europe?* on coreboot mailing list

- Device with Rockchip RK3399, but only available in the USA
- No BLOBs in firmware

Linux support

BLOBs required for

- hardware video decoding
- Wi-Fi and Bluetooth
- GPU support

Acer Chromebook R 13

Specifications

Processor	Mediatek MT8173C 4x 2.10 GHz
Cache	1 MB
RAM	4 GB LPDDR3, PC3L-12800 (1600MHz)
Format	2in1 Convertible
Display size	33 cm (13,3“)
Display	Acer CineCrystal™ Multi-Touch Full-HD IPS Display with
Resolution	1920 x 1080 Pixel (Full HD)
IGD:	PowerVR GX6250
eMMC	32 GB
Dimensions	326 x 228 x 15,5 mm (B x T x H)
Weight	1,49 kg
Battery time	up to 12 hours
Capacity	4.670 mAh

- On October 24th, 2017, 384 € at notebooksbilliger.de

BLOB status

No BLOBs

- Chrome EC for Embedded Controller as on all Chrome OS devices

BLOBs

- PCM firmware in ARM Trusted Firmware
- Maybe USB C device
- Maybe ANX7688: PD + HDMI→DP converter

  It contains a firmware that we update from the AP-FW, at boot time, which is the only reason to have a driver for it in depthcharge.

  See commit 9859ac55 (anx7688: Add support for ANX7688) in Depthcharge.

BLOB status – Linux support

- hardware video decoding
- Wi-Fi and Bluetooth
- GPU support

Mediatek device and coreboot

- Google Oak reference design
- Acer Chromebook R 13 is Google Elm variant of Google Oak

TLDR

```
$ make crossgcc-arm crossgcc-aarch64 CPUS=160
$ make menuconfig
```

Select Google Elm, Chrome OS, and Depthcharge

```
$ make
```

Copy to Chromebook, deactivate write protection.

```
$ flashrom -p internal -w coreboot.rom
```

Libettereboot

- New build system for Libreboot written by Paul K.

```
$ git clone https://git.code.paulk.fr/libettereboot.git
$ cd libettereboot
$ for project in coreboot depthcharge vboot arm-trusted-fi
$ # gelöschte Firmware in arm-trusted-firmware wieder einb
$ ./libreboot cook coreboot depthcharge elm
```

Board status

- Upload to board status repository

Longer version

Developer mode and write protection

Developer mode

1. Key combination
2. Ctrl + d
3. Data is deleted

Now type `shell` in Crosh Shell to get GNU Bash.

Write protection

1. Open device
2. Remove screw

Look at shipped image

Components

1. Vboot2
2. ARM Trusted Firmware

ARM Trusted Firmware

ARM Trusted Firmware provides a reference implementation of secure world software for ARMv8-A, including a Secure Monitor executing at Exception Level 3 (EL3). It implements various ARM interface standards, such as:

- *The Power State Coordination Interface (PSCI)*
- *Trusted Board Boot Requirements (TBBR, ARM DEN0006C-1)*
- *SMC Calling Convention*
- *System Control and Management Interface*

As far as possible the code is designed for reuse or porting to other ARMv8-A model and hardware platforms. ARM will continue development in collaboration with interested parties to provide a full reference implementation of Secure Monitor code and ARM standards to the benefit of all developers working with ARMv8-A TrustZone technology.

License

- BSD-3-Clause

Operating system

1. Chrome OS
2. Arch Linux
3. Debian GNU/Linux

Chrome OS

- Ships Linux 3.18
- Boot in 10 seconds with shipped firmware

Depthcharge

- Configure default boot

FMAP regions and fallback

- Goal: Similar setup to shipped image with fallback

Questions?