Run upstream coreboot on an ARM Chromebook

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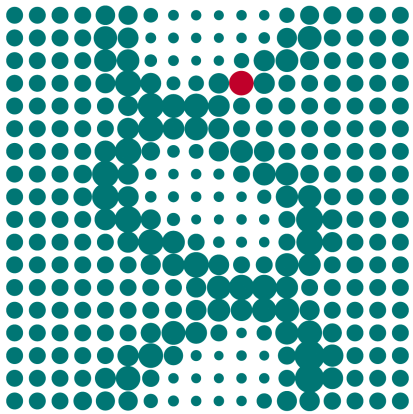
Thanks

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. Chrome OS verified boot: Vboot
2. ARM Trusted Firmware

Vboot

1. Very good documentation in `Documentation/Intel/vboot.html`

Four sections needed for Vboot.

1. Read-only section
2. Google Binary Blob (GBB) area
3. Read/write section A
4. Read/write section B

RO section contains CBFS with required pieces for system recovery.

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

Firmware

`plat/mediatek/mt8173/drivers/spm/spm_hotplug.c`

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?