

Look at ME in Rust! 🦀

Daniel Maslowski

```
01 // LABORTAGE MXXXIV
02 // Eigentlich habe ich alles getestet
03 int unit_test (void *data)
04 {
05     return SUCCESS;
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```

# Agenda

Intel (CS)ME Platforms  
Library and CLI  
Fiedka the Firmware Editor

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# Intel (CS)ME Platforms

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# Knowledge

thanks to reverse engineering, presentations and tools

Alexander Tereshkin and Rafal Wojtczuk<sup>1</sup>

Igor Skochinsky<sup>2</sup>

Dmitry Sklyarov, Maxim Goryachy, Mark Ermolov<sup>3</sup>

Peter Bosch<sup>4</sup>

Plato Mavropoulos<sup>5</sup>

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<sup>1</sup><https://invisiblethingslab.com/resources/bh09usa/Ring%20-3%20Rootkits.pdf>

<sup>2</sup><https://github.com/skochinsky/papers>

<sup>3</sup><https://github.com/ptresearch>

<sup>4</sup>[https://media.ccc.de/v/36c3-10694-intel\\_management\\_engine\\_deep\\_dive](https://media.ccc.de/v/36c3-10694-intel_management_engine_deep_dive)

<sup>5</sup><https://github.com/platomav/MEAnalyzer/>

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## Variants

TXE - Trusted Execution Engine

(CS)ME - (Converged Security &

Manageability Engine

SPS - Server Platform Services

---

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## Variants

TXE - Trusted Execution Engine  
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Manageability Engine  
SPS - Server Platform Services

## Generations / Versions

1st Gen: ME Ver 1-5,  
ARCTangent-A4  
2nd Gen: ME Ver 6-10, ARC 600  
3rd Gen: CSME Ver 11+, 486

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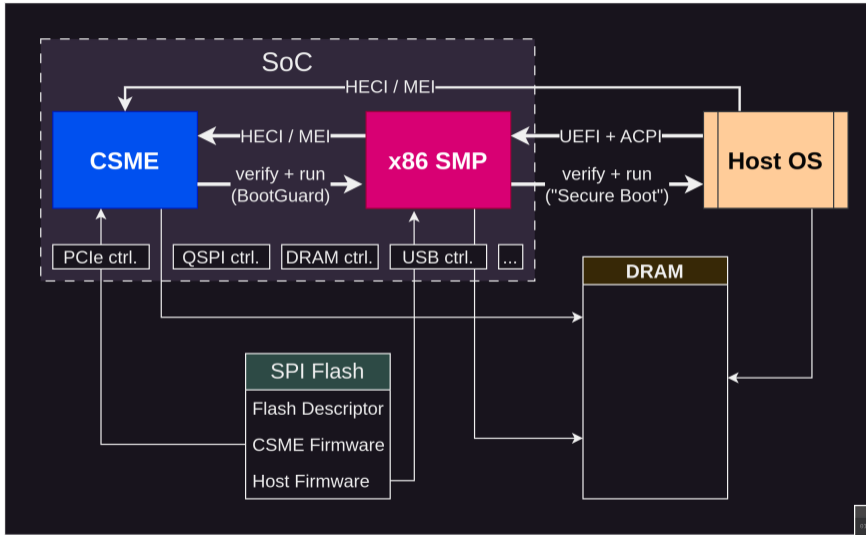
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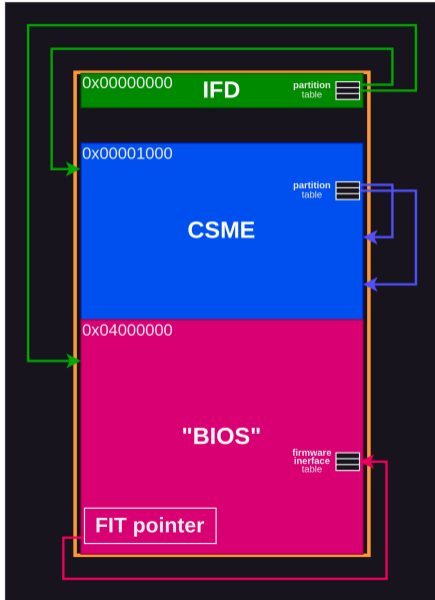
# Hardware Platform and Flow<sup>6</sup>



<sup>6</sup><https://www.intel.com/content/dam/www/public/us/en/security-advisory/documents/intel-csme-security-white-paper.pdf>

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# Flash Partitioning



Intel Flash Descriptor (IFD)  
partitions whole flash

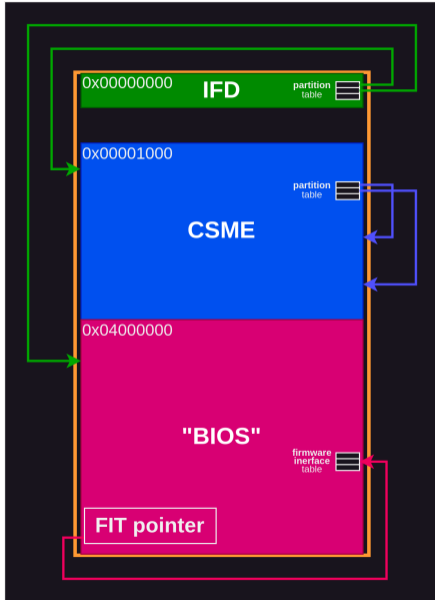
Flash Partition Table (FPT)  
partitions ME firmware

Firmware Interface Table (FIT)  
points to microcode updates, code  
modules, manifests and policies

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We are interested in FPT and FIT.

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# FPT (Flash Partition Table)

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# FPT (Flash Partition Table)

## Data Partitions

lots of partitions; not investigated any further

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# FPT (Flash Partition Table)

## Data Partitions

lots of partitions; not investigated any further

## Directories

flat layout

signature validated before execution

Gen 2: manifest first including entry count, then entries

Gen 3: Code Partition Directory (CPD), manifest in directory

Debug Launch Module (DLM): optionally run before other code

---

<sup>7</sup><https://www.blackhat.com/docs/eu-17/materials/eu-17-Sklyarov-Intel-ME-Flash-File-System-Explained.pdf>

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## Flash File System aka ME File System (MFS)<sup>7</sup>

<https://github.com/ptresearch/parseMFS>

<https://github.com/kakaroto/MFSUtil>

is EDFS (partition) the same?

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# FIT (Firmware Interface Table)

optional part of a full *secure boot* setup, for *OEMs*, not consumers

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optional part of a full *secure boot* setup, for *OEMs*, not consumers

*The BIOS flash must include a Firmware Interface Table (FIT) with Type 0 (FIT Header) and Type 1 (Microcode Update) entries.  
A microcode update must exist for every processor stepping supported by the platform.*

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## Documentation

<https://cdrdv2.intel.com/v1/dl/getContent/599500/view>

<https://doc.coreboot.org/soc/intel/fit.html>

<https://winraid.level1techs.com/t/fit-tool-csme-rebuild/33139>

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## Editing

Fiano? <https://github.com/fiedka/fiedka/issues/64>

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## Editing

Fiano? <https://github.com/fiedka/fiedka/issues/64>

We have another implementation in Rust (WIP). :)

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## DEMO: FPT + FIT in CLI

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# Library and CLI

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# Background

analysis problem: covering all cases is complex

depth first approach with narrow focus: Intel ME 11

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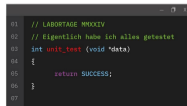
<https://github.com/skochinsky/me-tools>

MEAnalyzer:

- ▶ written in Python
- ▶ 14k lines of code, thousands of lines of spaghetti logic
- ▶ 200+ classes/structs
- ▶ ~80 helpers, 20+ for analysis:  
fd\_anl\_init, ext\_anl, mod\_anl, mfs\_anl, ...

(line breaks added to fit on slide)

```
fd_exist, reading, file_end, start_man_match, end_man_match,  
start_fd_match, end_fd_match, fd_count, fd_comp_all_size,  
fd_is_ich, fd_is_cut, reading_msg = \  
fd_anl_init(reading, file_end,  
            start_man_match, end_man_match)
```



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## More Sources

BIOS modding community (Win-Raid forum<sup>8</sup> etc)

[https://github.com/corna/me\\_cleaner/wiki/How-does-it-work%3F](https://github.com/corna/me_cleaner/wiki/How-does-it-work%3F)

[https://github.com/mostav02/Remove\\_IntelME\\_FPT](https://github.com/mostav02/Remove_IntelME_FPT)

[https://github.com/hardenedlinux/firmware-anatomy/blob/master/hack\\_ME/me\\_info.md](https://github.com/hardenedlinux/firmware-anatomy/blob/master/hack_ME/me_info.md)

Fiano<sup>9</sup> + CSS<sup>10</sup> + Immune<sup>11</sup>

- ▶ written in Go
- ▶ CSS uses Fiano (some code moved over)
- ▶ special purposes covered, not for more general use

Romulan<sup>12</sup>

- ▶ written in Rust ;)
- ▶ forked from Jeremy Soller / System76

---

<sup>8</sup><https://winraid.level1techs.com/t/intel-converged-security-management-engine-drivers-firmware-and-tools-2-15/30719>

<sup>9</sup><https://github.com/linuxboot/fiano/>

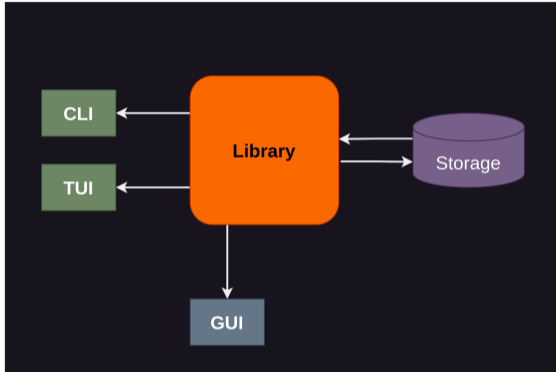
<sup>10</sup><https://github.com/9elements/converged-security-suite/>

<sup>11</sup><https://github.com/immune-gmbh/guard-oss>

<sup>12</sup><https://github.com/orangecms/romulan>

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# Trinity of Representations

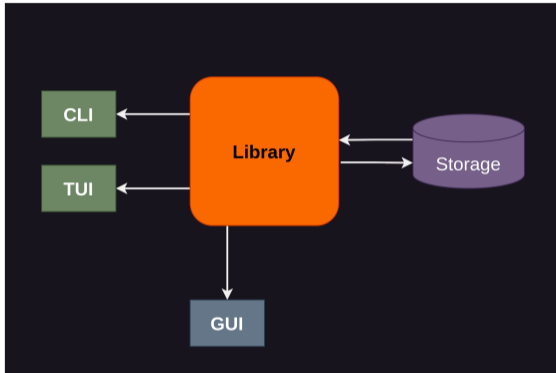


internal  
external (API, JSON)  
binary (memory, file)

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# Trinity of Representations



internal  
external (API, JSON)  
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Example

<https://github.com/oxidecomputer/amd-apcb>  
src/{ondisk,serialization}.rs

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me\_fs\_rs

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library for parsing ME file systems

FIT

FPT (partitions)

manifests

Gen 2 directories

Gen 3 CPDs

MFS (WIP)

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Crates

zerocopy for parsing

serde for JSON serialization

clap for CLI

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Let's have a look!

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# Fiedka the Firmware Editor

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# What is Fiedka again?

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# What is Fiedka again?

Fiedka is the graphical desktop  
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<https://fiedka.app>

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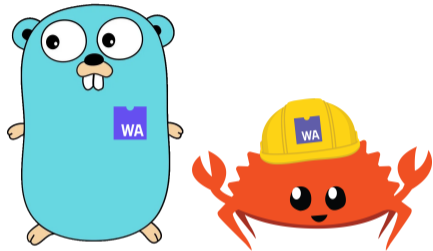
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The backend runs in WebAssembly.



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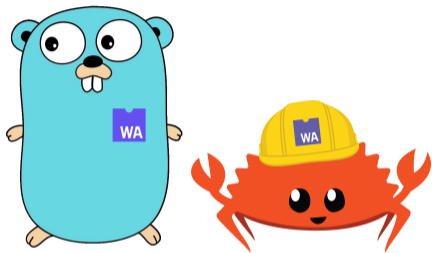
<https://fiedka.app>

Rust support is being added using

Romulan: <https://github.com/system76/romulan/>

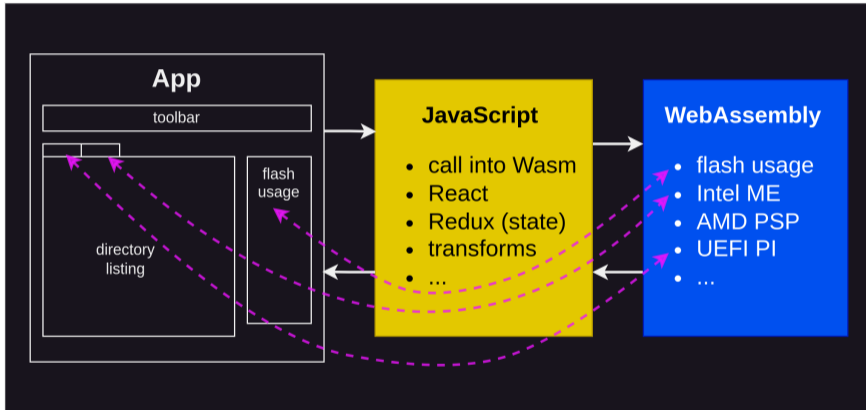
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# App Architecture



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# Fiedka in Action

**analyze a firmware image** | Select file | Reanalyze | Save | LinuxBoot | FAUCET | Export | Outline | Feedback

Intel ME

Intel (CSME)  
**x270.rom**

undefined, 47 files  
**FTP**

File	compression	address	size	blocks used
FTP.man	none	0x478	0xbec	1
rbe	none	0x2003a80	0x5000	6
rbe.met	none	0x1064	0x96	1
fptemp	none	0x6a80	0x2000	3
fptemp.met	none	0x10fa	0x38	1
kernel	none	0x2008a80	0x14000	21
kernel.met	none	0x1132	0x8e	1
syslib	none	0x2018c00	0x17000	24
syslib.met	none	0x11c0		
bup	none	0x202ad40		

**Flash Usage**

Category	Count	Percentage	Size
blocks	4096	100%	16M
zero (0x00)	41	1%	0.16M
free (0xff)	2295	56.03%	8.96M
used	1760	42.97%	6.88M

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## DEMO: ME Firmware in Fiedka

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## Related

Look at ME! - Intel ME firmware investigation (FOSDEM 2020)

[https://archive.fosdem.org/2020/schedule/event/firmware\\_lam/](https://archive.fosdem.org/2020/schedule/event/firmware_lam/)

Fiedka the Firmware Editor (OSFC 2021)

<https://www.osfc.io/2021/talks/fiedka-the-firmware-editor/>

Rust WebAssembly in Electron (Labortage 2023)

[https://wiki.das-](https://wiki.das-labor.org/w/Labortage_2023#Rust_WebAssembly_in_Electron)

[labor.org/w/Labortage\\_2023#Rust\\_WebAssembly\\_in\\_Electron](https://wiki.das-labor.org/w/Labortage_2023#Rust_WebAssembly_in_Electron)

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Thank you! :)

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# Follow Me



Daniel Maslowski

<https://github.com/orangecms>  
<https://twitter.com/orangecms>  
<https://mastodon.social/@cyrevolt>  
<https://youtube.com/@cyrevolt>  
<https://twitch.tv/cyrevolt>

<https://metaspora.org/look-at-me-in-rust-labortage2024.pdf>

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# BootGuard

<https://designintools.intel.com/intel-bootguard-info.html>

<https://edc.intel.com/content/www/us/en/design/ipla/software-development-platforms/client/platforms/alder-lake-desktop/12th-generation-intel-core-processors-datasheet-volume-1-of-2/010/boot-guard-technology/>

<https://www.intel.com/content/www/us/en/developer/articles/technical/software-security-guidance/resources/key-usage-in-integrated-firmware-images.html>

<https://eclipsium.com/blog/the-keys-to-the-kingdom-and-the-intel-boot-process/>

<https://eclipsium.com/blog/firmware-security-realizations-part-2/deguard>

<https://codeberg.org/libreboot/deguard>

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