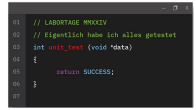
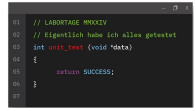
Look at ME in Rust!

Daniel Maslowski



Agenda

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



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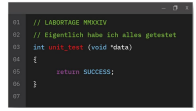
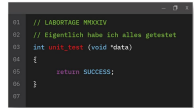


Knowledge

thanks to reverse engineering, presentations and tools

Alexander Tereshkin and Rafal Wojtczuk[1]
Igor Skochinsky[2]
Dmitry Sklyarov, Maxim Goryachy, Mark Ermolov[3]
Peter Bosch[4]
Plato Mavropoulos[5]

[1] https://invisiblethingslab.com/resources/bh09usa/Ring%20-3%20Rootkits.pdf
[2] https://github.com/skochinsky/papers
[3] https://github.com/ptresearch
[4] https://media.ccc.de/v/36c3-10694-intel_management_engine_deep_dive
[5] 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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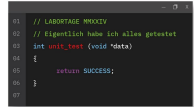

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Variants

TXE - Trusted Execution Engine
(CS)ME - (Converged Security &) 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

[1] https://invisiblethingslab.com/resources/bh09usa/Ring%20-3%20Rootkits.pdf
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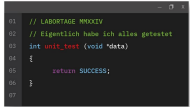
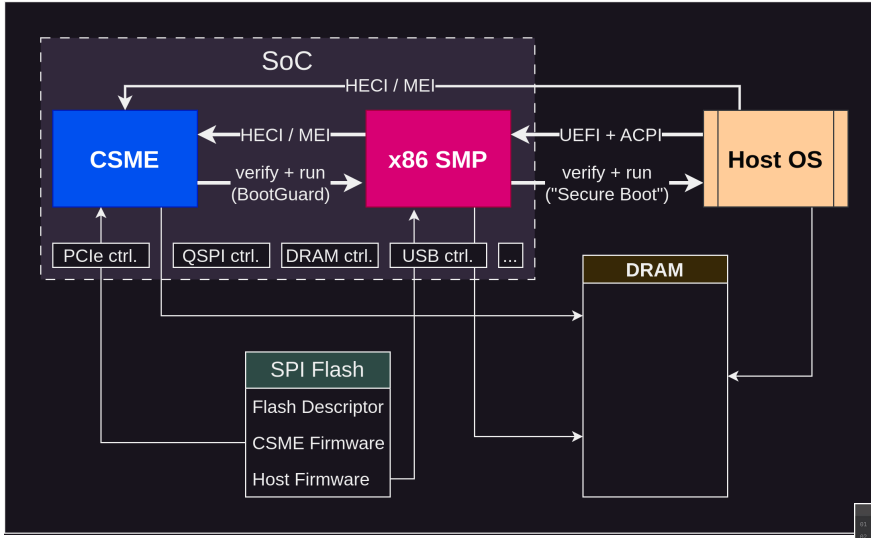
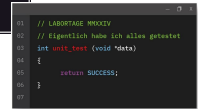


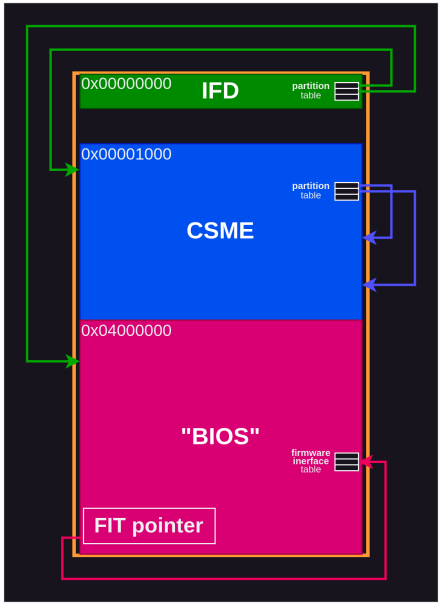
Hardware Platform and Flow[6]



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



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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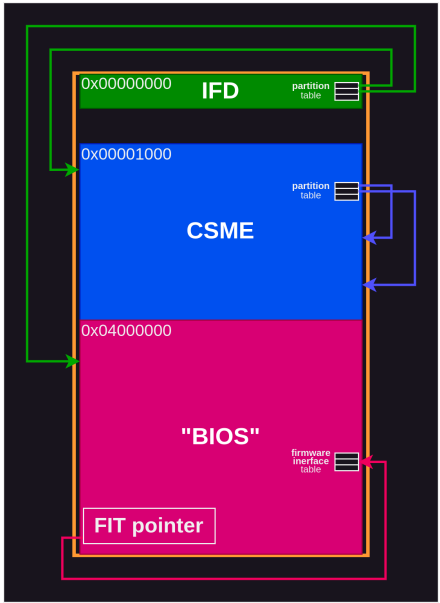

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We are interested in FPT and FIT.

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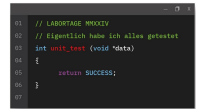
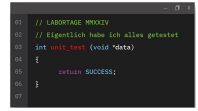


FPT (Flash Partition Table)

Data Partitions

lots of partitions; not investigated any further



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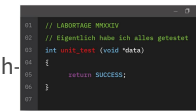
Directories

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

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



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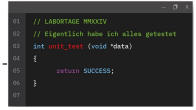
Flash File System aka ME File System (MFS)[7]

https://github.com/ptresearch/parseMFS
https://github.com/kakaroto/MFSUtil
is EFFS (partition) the same?



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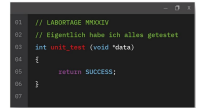
optional part of a full *secure boot* setup, for *OEMs*, not consumers



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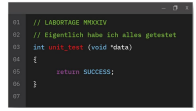

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https://cdrdv2.intel.com/v1/dl/getContent/599500/view
https://doc.coreboot.org/soc/intel/fit.html
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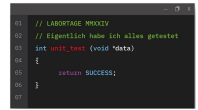

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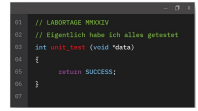

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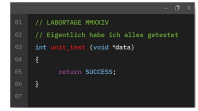
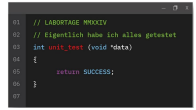
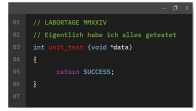
We have another implementation in Rust (WIP). :)



DEMO: FPT + FIT in CLI

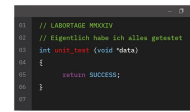


Library and CLI



Background

analysis problem: covering all cases is complex
depth first approach with narrow focus: Intel ME 11



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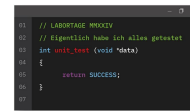
https://github.com/skochinsky/me-tools
MEAnalyzer:

- 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)
```



More Sources

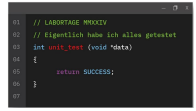
BIOS modding community (Win-Raid forum[8] etc)
https://github.com/corna/me_cleaner/wiki/How-does-it-work%3F
https://github.com/mostav02/Remove_IntelME_FPT
https://github.com/hardenedlinux/firmware-anatomy/blob/master/hack_ME/me_info.md
Fiano[9] + CSS[10] + Immune[11]

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

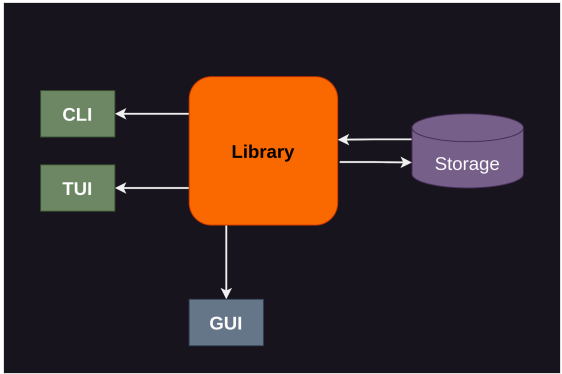
Romulan[12]

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

[8] https://winraid.level1techs.com/t/intel-converged-security-management-engine-drivers-firmware-and-tools-2-15/30719
[9] https://github.com/linuxboot/fiano/
[10] https://github.com/9elements/converged-security-suite/
[11] https://github.com/immune-gmbh/guard-oss
[12] https://github.com/orangecms/romulan



Trinity of Representations



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

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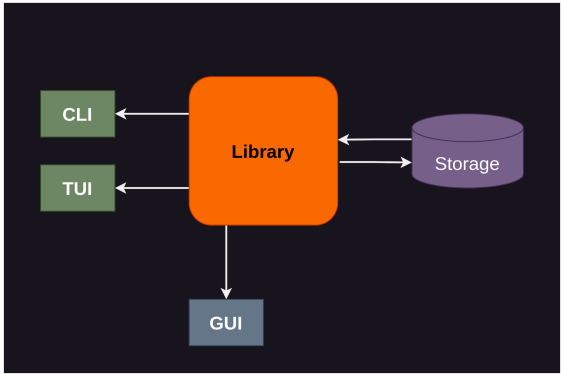

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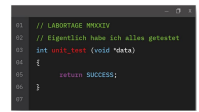
Example

https://github.com/oxidecomputer/amd-apcb

`src/{ondisk,serialization}.rs`



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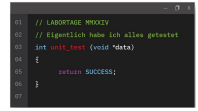

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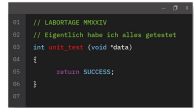
- FIT
- FPT (partitions)
- manifests
- Gen 2 directories
- Gen 3 CPDs
- MFS (WIP)



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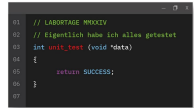
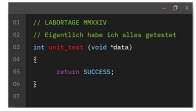
Crates

- `zerocopy` for parsing
- `serde` for JSON serialization
- `clap` for CLI



Let’s have a look!



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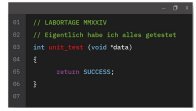

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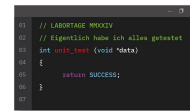

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Fiedka is the graphical desktop **fi**rmware analyzer and **ed**itor.

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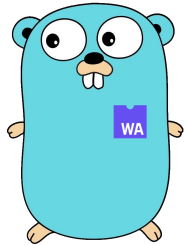


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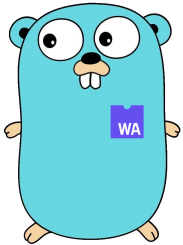
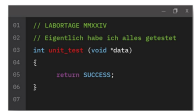


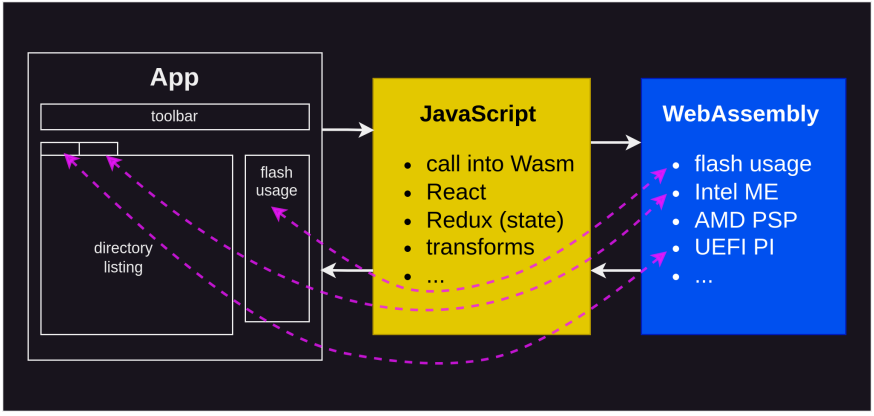
Rust support is being added using

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

`me_fs_rs`: https://github.com/fiedka/me_fs_rs/

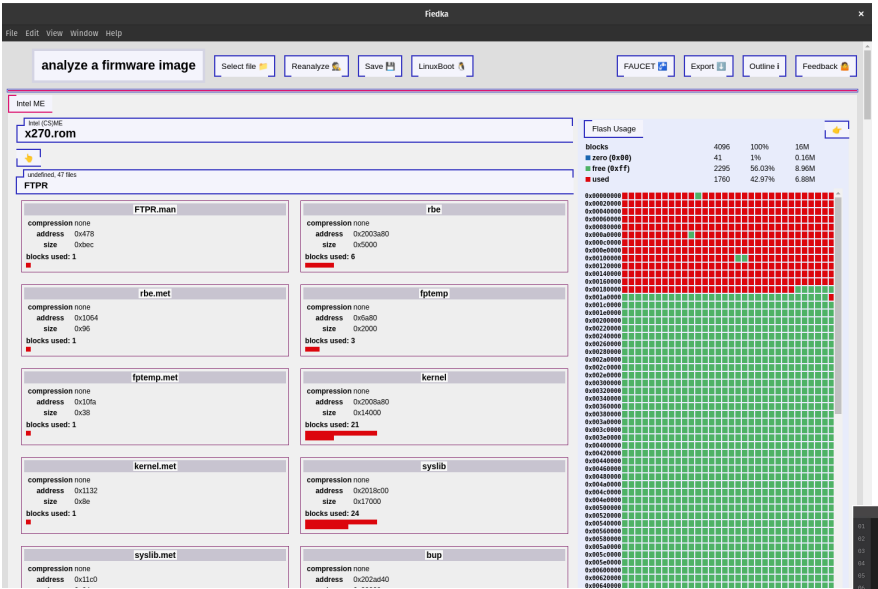


App Architecture

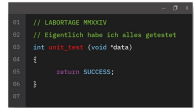



```
01  // LABORTAGE MMXXIV
02  // Eigentlich habe ich alles getestet
03  int unit_test (void *data)
04  {
05      return SUCCESS;
06  }
07
```

Fiedka in Action



DEMO: ME Firmware in Fiedka

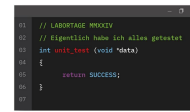


Related

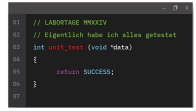
Look at ME! - Intel ME firmware investigation (FOSDEM 2020)
https://archive.fosdem.org/2020/schedule/event/firmware_lam/

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-labor.org/w/Labortage_2023#Rust_WebAssembly_in_Electron



Thank you! :)


// LABORTAGE MMXXIV
// Eigentlich habe ich alles getestet
int unit_test (void *data)
{
return SUCCESS;
}

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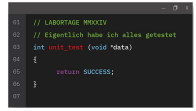
https://metaspora.org/look-at-me-in-rust-labortage2024.pdf



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/

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https://eclypsium.com/blog/the-keys-to-the-kingdom-and-the-intel-boot-process/

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https://codeberg.org/libreboot/deguard