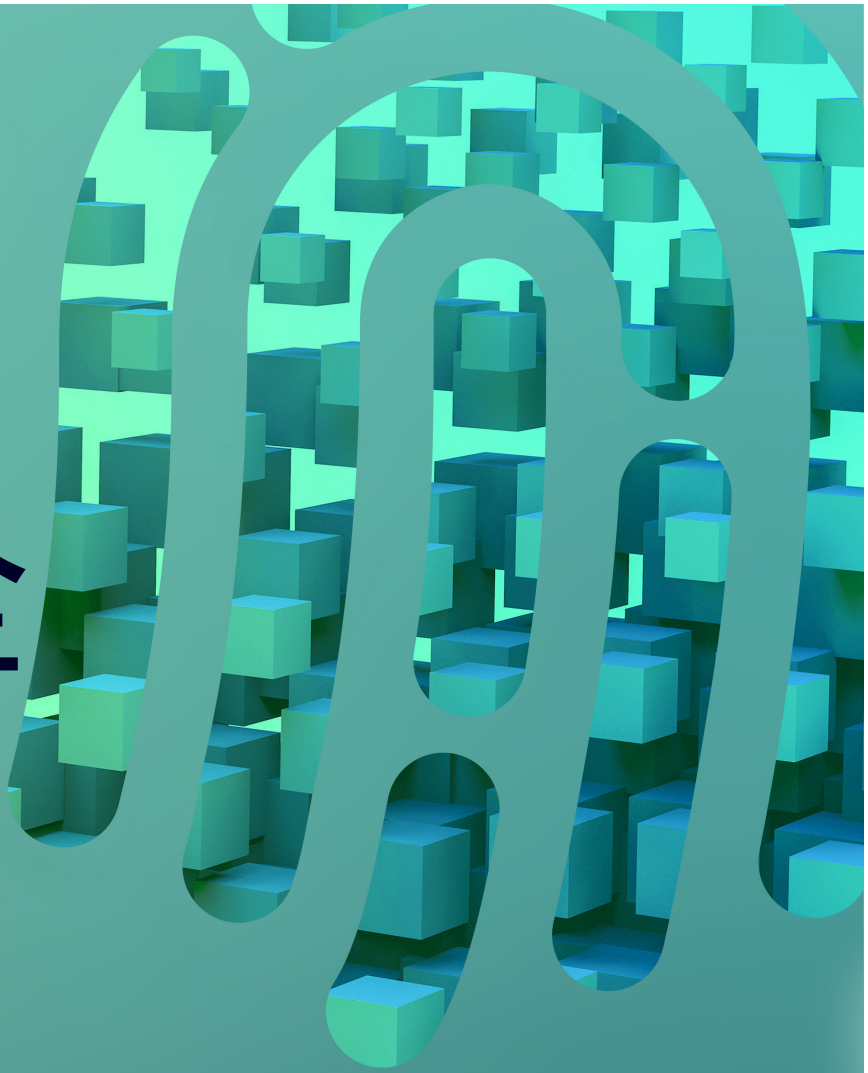
开源嵌入式安全

苏宝成 | SIEMENS DI FA



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目录

综述

In a glance

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赛博安全在（工业）嵌入式世界变得越来越重要

Cyber Security is becoming more and more important in industrial embedded world

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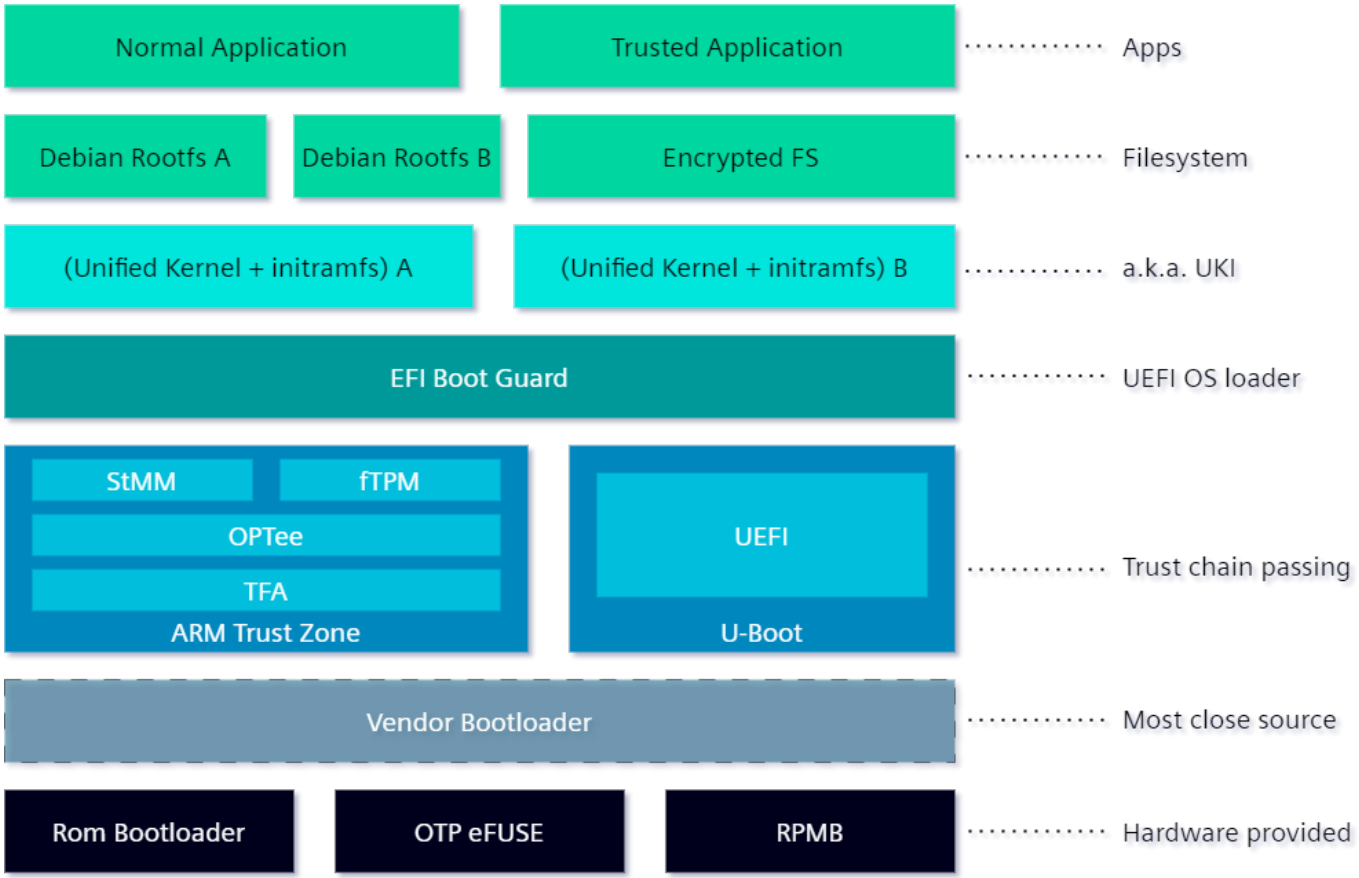
通用安全启动
Generic Secure Boot



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安全锚点

Security Anchor

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信任根
Root of Trust

ROM 启动器 Bootloader

- 芯片厂商预先编程
- 固化到芯片内部，无法修改
- 加载和验签第一级bootloader
- **One Time Programming eFUSE 一次编程电子熔丝**
- 固化在芯片内部，外部无法接触
- 在工厂编程
- 一次编程，一旦编程无法修改
- 小容量
- 一般用于存储公钥的哈希

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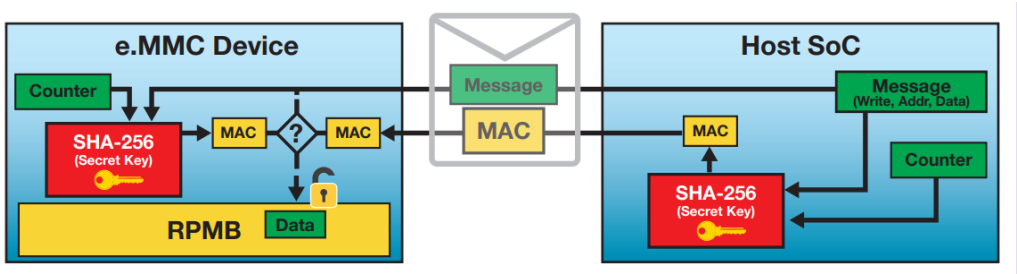
EMMC的RPMB分区
RPMB of eMMC

- 防篡改 – 任何写请求都需要对称加密密钥的参与
- 重放攻击保护 – a unique counter is included in each writing



典型用例: 可信执行环境TEE的安全可信任存储

1 Diagram is from https://documents.westerndigital.com/content/dam/doc-library/en_us/assets/public/western-digital/collateral/white-paper/white-paper-emmc-security.pdf

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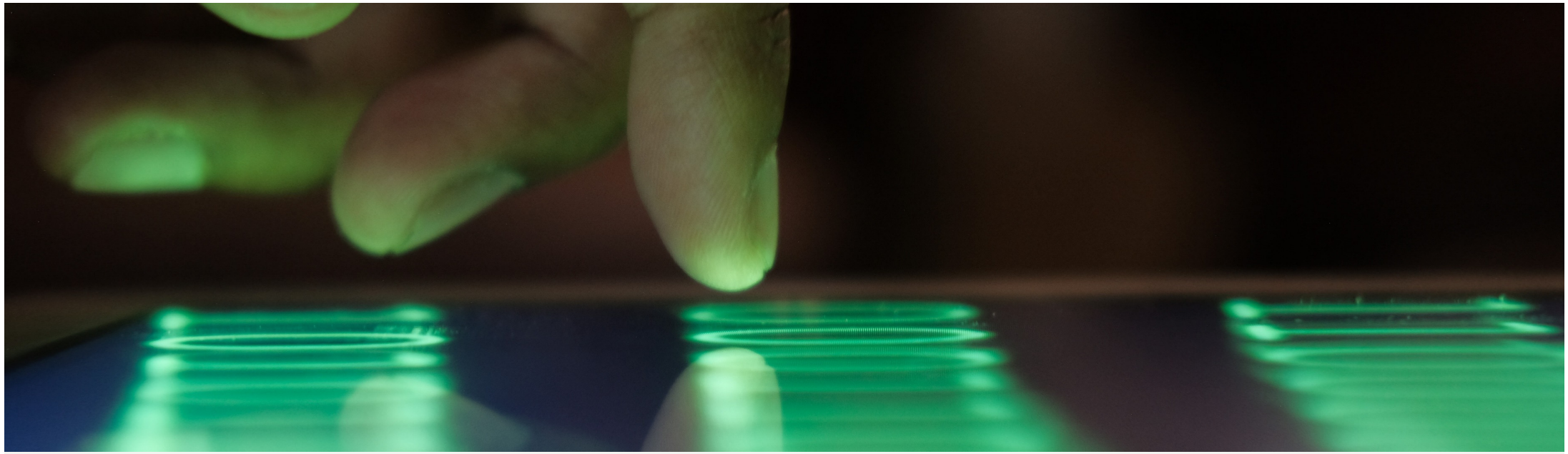

通用安全启动流程

Generic Secure Boot Flow

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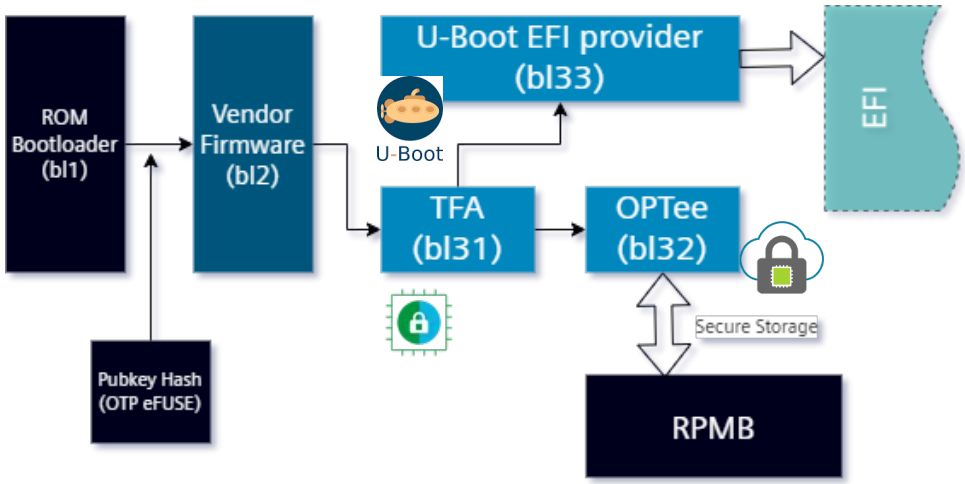
ROM Bootloader 之后…
Just after the ROM Bootloader



Trusted Firmware ARM
git.trustedfirmware.org/TF-A/trusted-firmware-a.git

OPTee-OS
https://github.com/OP-TEE/optee_os

Das U-Boot
https://source.denx.de/u-boot/u-boot.git

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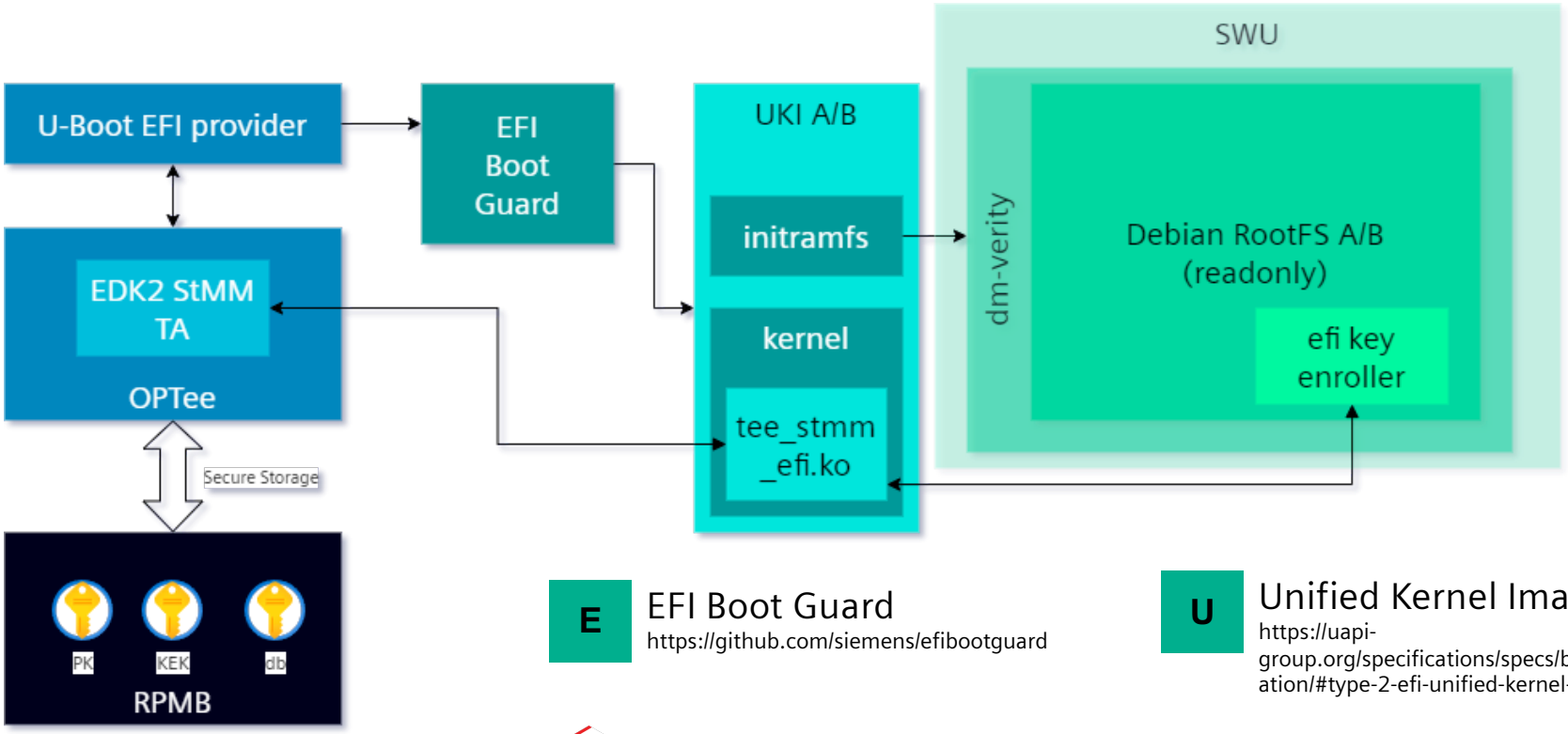
UEFI 安全启动
UEFI Secure Boot



E EFI Boot Guard
https://github.com/siemens/efibootguard

U Unified Kernel Image
https://uapi-group.org/specifications/specs/boot_loader_specification/#type-2-efi-unified-kernel-images

EDK2 StMM
https://github.com/tianocore/edk2/tree/master/StandaloneMmPkg

SWUpdate
https://github.com/sbabic/swupdate

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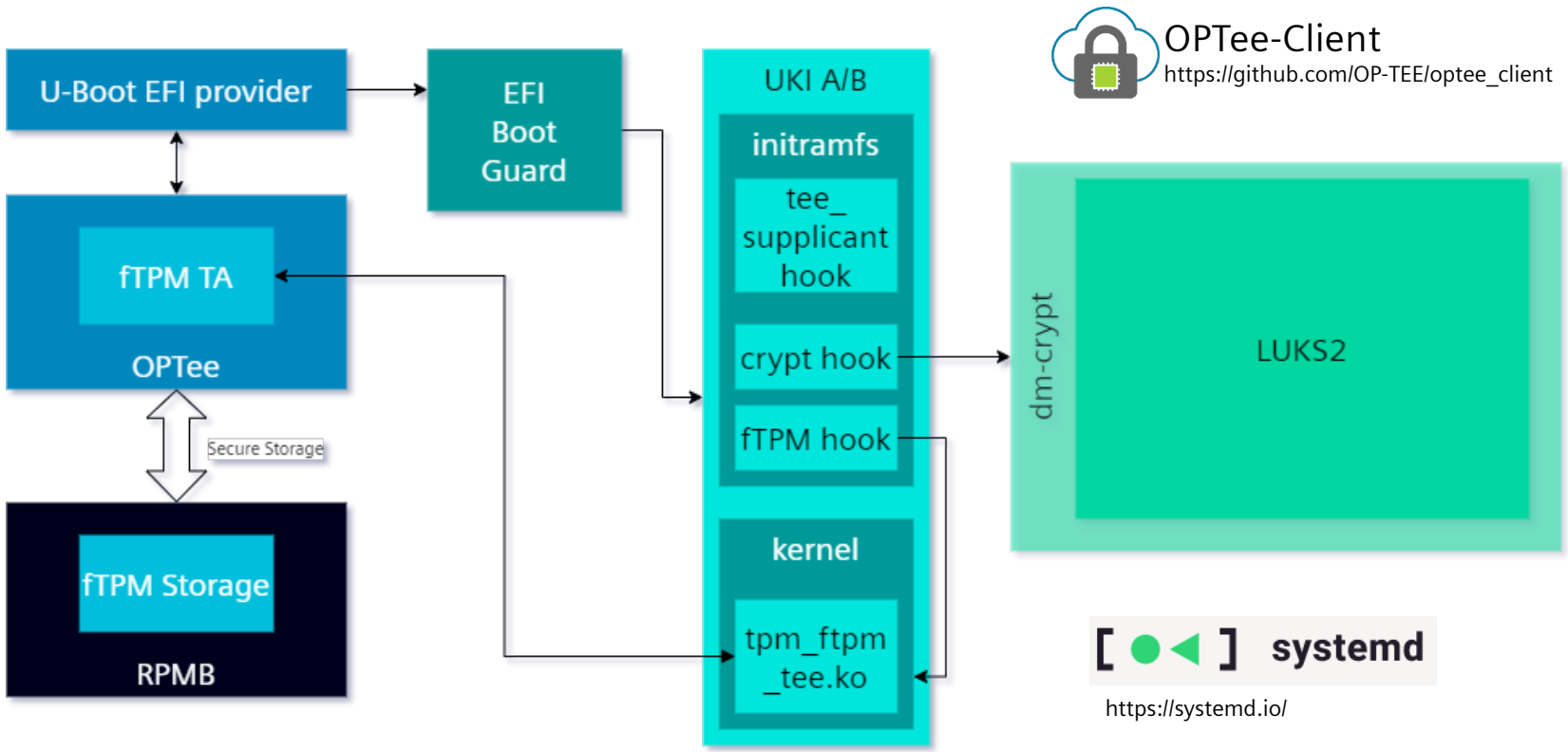
固件TPM
Firmware TPM

Official Complete TPM 2.0 Reference Implementation (by Microsoft)

- Provide a TEE Trusted application
- Use RPMB as the secure storage
- No hardware chips required -> cost efficient
- Upgradable

https://github.com/microsoft/ms-tpm-20-ref

磁盘加密
Disk Encryption – Protect Data-at-rest



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集成

Integration

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ISAR
Integration System for Automated Root filesystem generation

Isar is a set of scripts for building software packages and repeatable generation of Debian-based root filesystems with customizations

Integrated components:

- trusted-firmware-a
- optee-os & optee-ftpm & optee-client
- u-boot & kernel customization base
- initramfs-tee-ftpm-hook
- initramfs-tee-supplicant-hook, etc.

https://github.com/ilbers/isar

isar-cip-core

ISAR layer to provide CIP Core (Generic Profile) package set

Responsible for developing, testing and maintaining tools to generate CIP Core reference file system images

Integrated components:

- edk2-standalonemm-rpmb
- efibootguard
- swupdate
- initramfs-crypt-hook, initramfs-verity-hook, etc.

https://www.cip-project.org/
https://gitlab.com/cip-project/cip-core/isar-cip-core

示例

Example

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Example: SIMATIC IOT2050 & meta-iot2050

连接数字化世界 – 支持工业边缘计算和云连接的智能网关。

Meta-iot2050: ISAR layer contains recipes, configuration and other artifacts that are specific to Debian-based IOT2050 product.

- ./kas-container build kas-iot2050-boot-pg2.yml:kas/opt/secure-boot.yml
- ./kas-container build kas-iot2050-swupdate.yml:kas/opt/secure-boot.yml

https://github.com/siemens/meta-iot2050

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