Eclipse oniro

Secure boot, TEEs, different OSes and more

Making sense of the trusted computing landscape in the Eclipse Oniro embedded distribution

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ABOUT MARTA

- 20 years in software development and Open Source
  - Including 15 years in embedded
- PhD in Telecommunications - on network security
- Worked in embedded product development, silicon…
  - Now moved to distributions
- Guest author at LWN
- Contributing to Oniro from April 2021, consulting for OSTC

MOTIVATION FOR THIS TALK

- **Confusion** of developers not directly in the field
  - *What is the difference between ARM TrustZone and AMD SEV?*
  - *TF-A, TF-M, what's all that?*
- **Mistrust in the community,** fear of locked-down platforms
- Oniro is a **distribution** for embedded and IoT
  - **Multiple-OSes** (Linux, Zephyr and more)
  - **Various hardware** platforms (small and big)
  - Interested in **unified** approach from the bootloader to apps

All opinions here are my own

MOTIVATION FOR SECURE BOOT

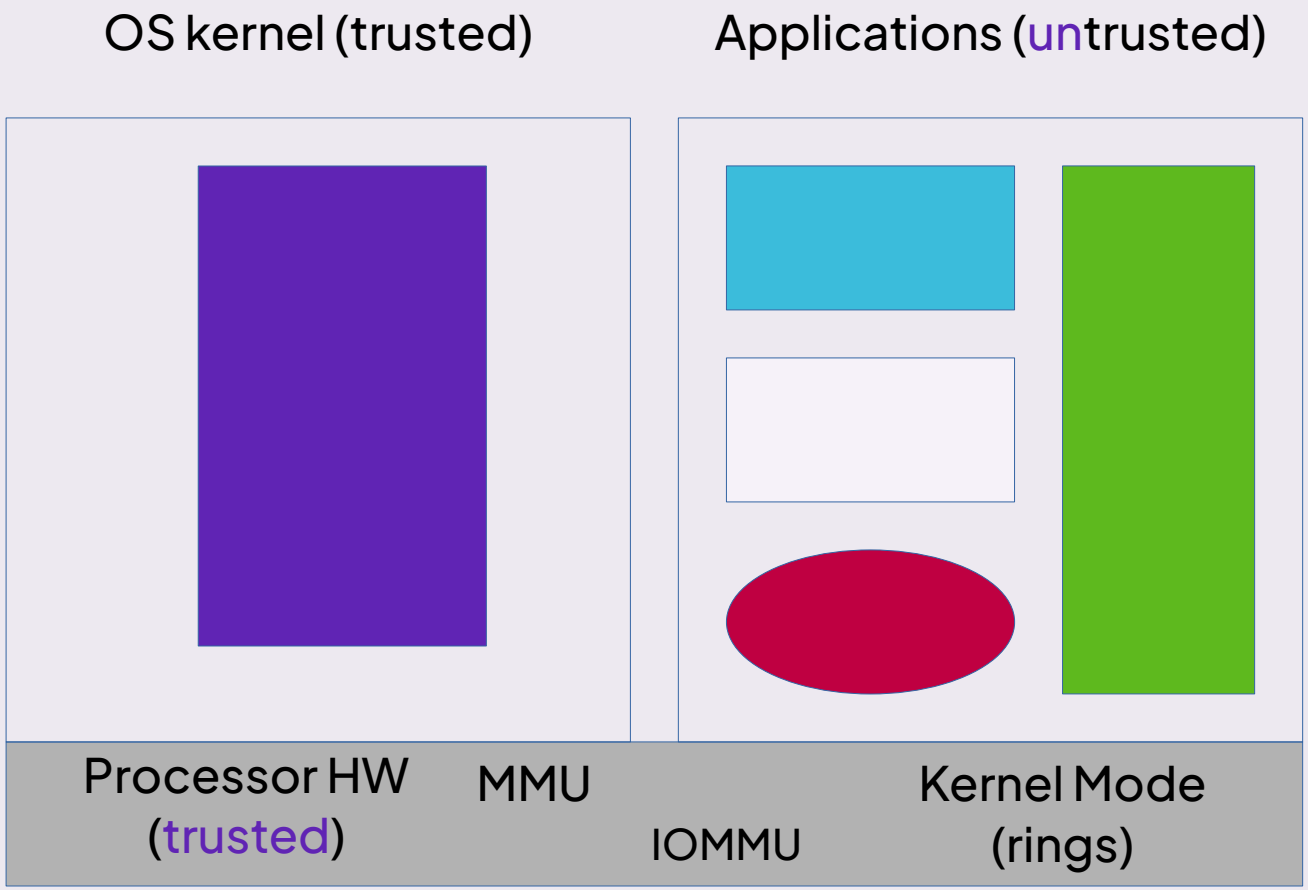
- Detect if a device is running the expected software
- Make sure the device is running software under control
- Updates with verified images
- Encrypted images and file systems
  - If it makes sense for the use-case

All opinions here are my own

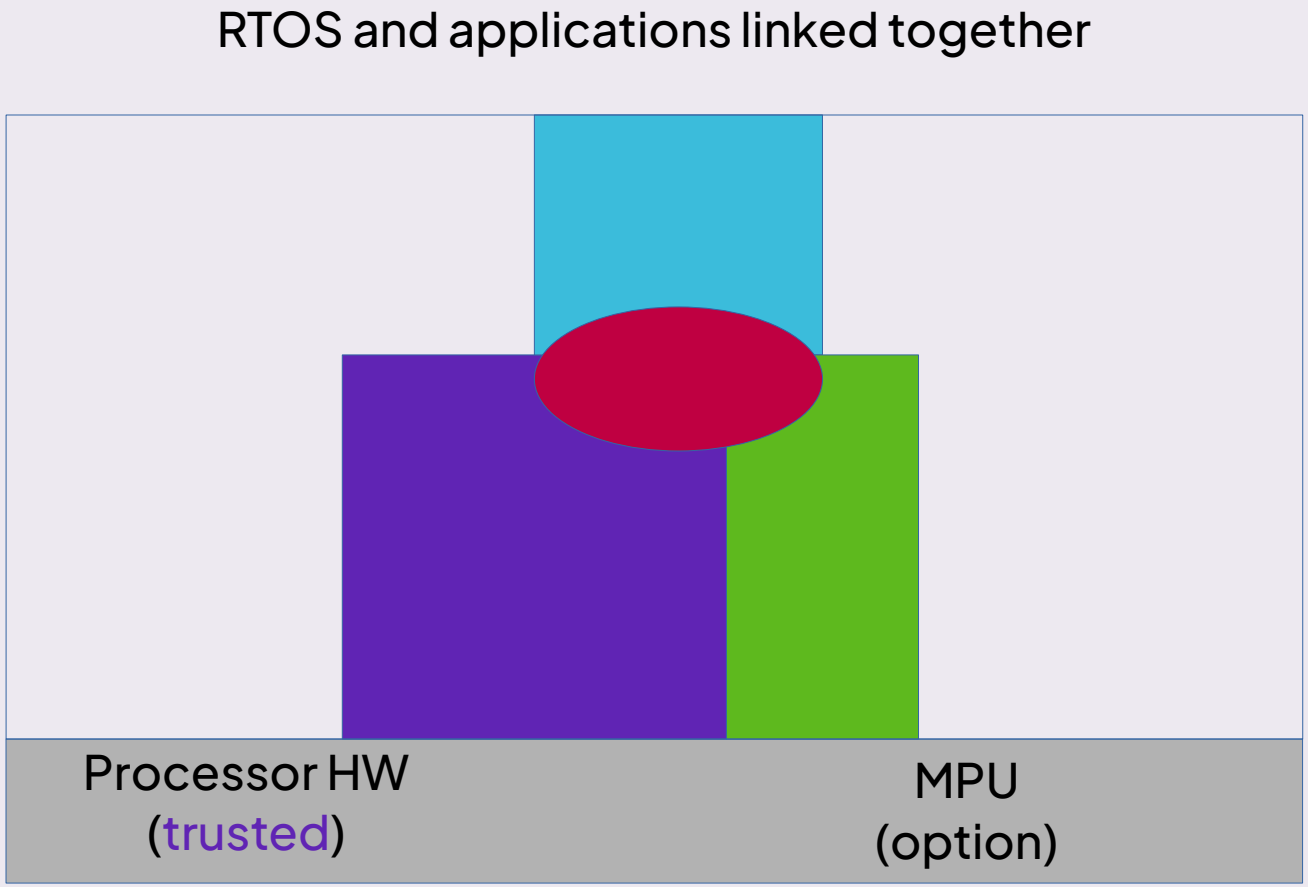
HISTORY (KIND OF…)

- Whom do you trust?
  - In “generic” PCs
  - In embedded

HISTORY: Generic PC: WHOM do you trust?



HISTORY: An embedded system: WHOM do you trust?



- Simple applications
- Rely on heavy debugging
- Application is trusted because no other choice

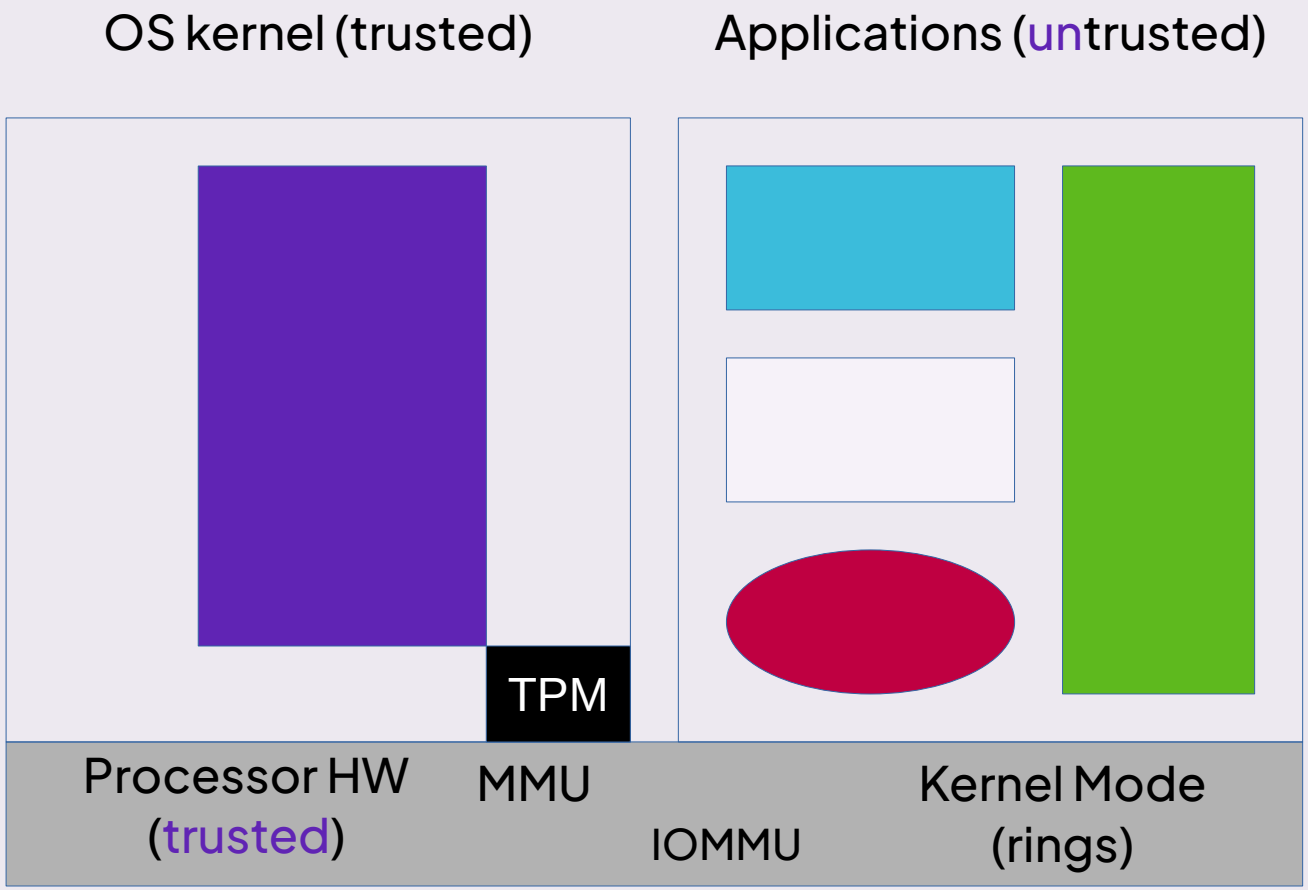
SECURE BOOT SITUATION

- Multiple issues
- If malicious software runs (at the system level), can overwrite everything

DEFINITIONS 1

- TPM (Trusted Platform Module) – a security cryptoprocessor and a standard
  - Showed up in the news around 2007
  - Can be a separate chip, part of a chip, firmware, or software
  - Main expected use was system integrity, but includes a random number generator, can accelerate crypto algorithms
  - For more information see:
    - https://lwn.net/Articles/674751/
    - https://wiki.archlinux.org/title/Trusted_Platform_Module

A PC with a TPM: WHOM do you trust?

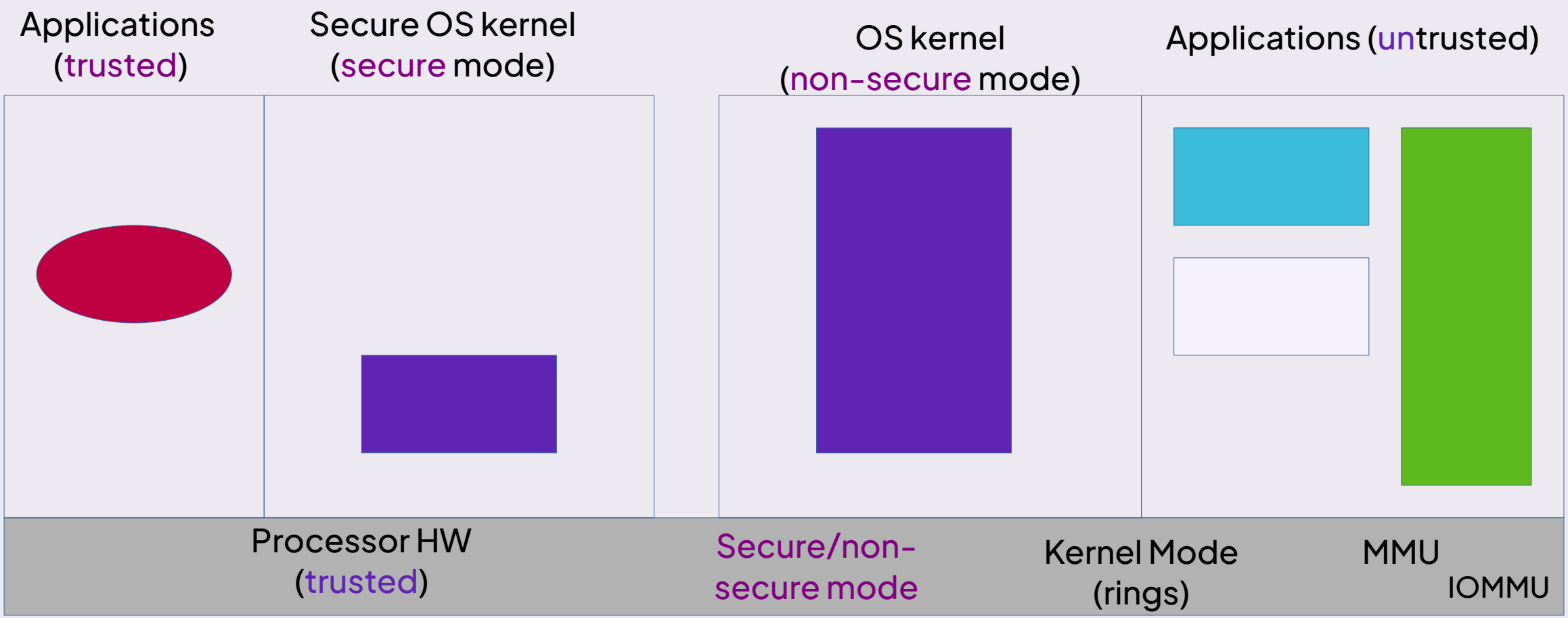


- TPM can encrypt/decrypt keys (binding)
- TPM has no DMA access → can't read memory

DEFINITIONS 2

- TEE (Trusted Execution Environment) – a part of a processor, protects loaded code and data (integrity and confidentiality). Different implementations exist
  - *Also a GlobalPlatform specification and API (License required to view the specification)*
- OP-TEE (Open Portable Trusted Execution Environment) – an Open Source implementation of TEE, mostly for ARM TrustZone

A platform with an ARM-style TEE: WHOM do you trust?



TPM/TEE

- Similarities
  - Contain crypto accelerators
- Differences
  - TPM is typically a separate chip, TEE is a inside of a chip
  - TPM is hard-coded, TEE can run applications
  - TPM has small storage, TEE has bigger storage

DEFINITIONS 3

- TF-A (Trusted Firmware-A) – a reference firmware for ARM v7 and v8 “A” platforms
  - Works next to OPTEE
  - For more information see:
    - https://trustedfirmware-a.readthedocs.io/en/latest/
- TF-M (Trusted Firmware-M) – similar, for the “M” platforms

DEFINITIONS 4

- Intel SGX (Software Guard Extensions) – a possibility to create a specific memory region (enclave)
  - Only code from the enclave can read/write it
  - Including the OS kernel
  - The memory may be encrypted
  - For more information see:
    - https://lwn.net/Articles/786487/
    - https://lwn.net/Articles/798748/

DEFINITIONS 5

- AMD SEV (Secure Encrypted Virtualization) – an extension to virtualization, adds encrypted memory for a virtual machine (VM)
  - Keys handled by the firmware
  - The host can't access the memory space
  - For more information see:
    - https://www.kernel.org/doc/html/latest/virt/kvm/amd-memory-encryption.html
    - https://www.amd.com/system/files/TechDocs/55766_SEV-KM_API_Specification.pdf

TEE / Intel SGX / AMD SEV

- Similarities
  - All can be used to create TEE-like designs
- Differences
  - SGX/SEV designed to separate VMs
  - SGX/SEV do not add a separate crypto accelerator

SECURE BOOT FOR ONIRO (work in progress)

- Aiming at unification
- UEFI boot for x86 and EBBR for ARM
  - EBBR uses simplified UEFI
- Behind the scenes:
  - OP-TEE to store UEFI variables (work from Linaro)
- Complete root of trust up to the enclaved applications possible :)

LINKS

- Websites:
  - https://oniroproject.org/
  - https://projects.eclipse.org/projects/oniro
- Source code:
  - https://booting.oniroproject.org/

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