Generic Support for ARM TrustZone

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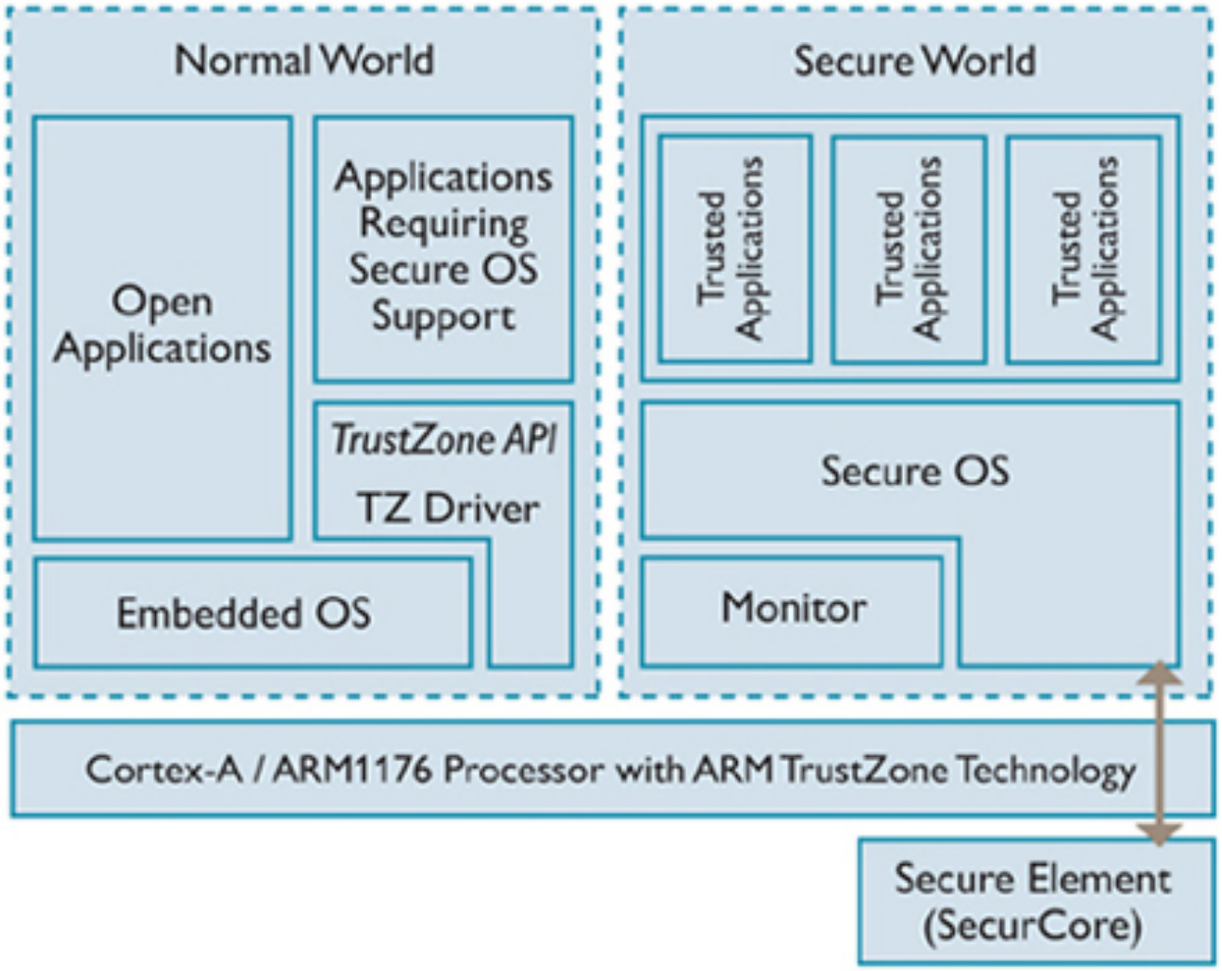
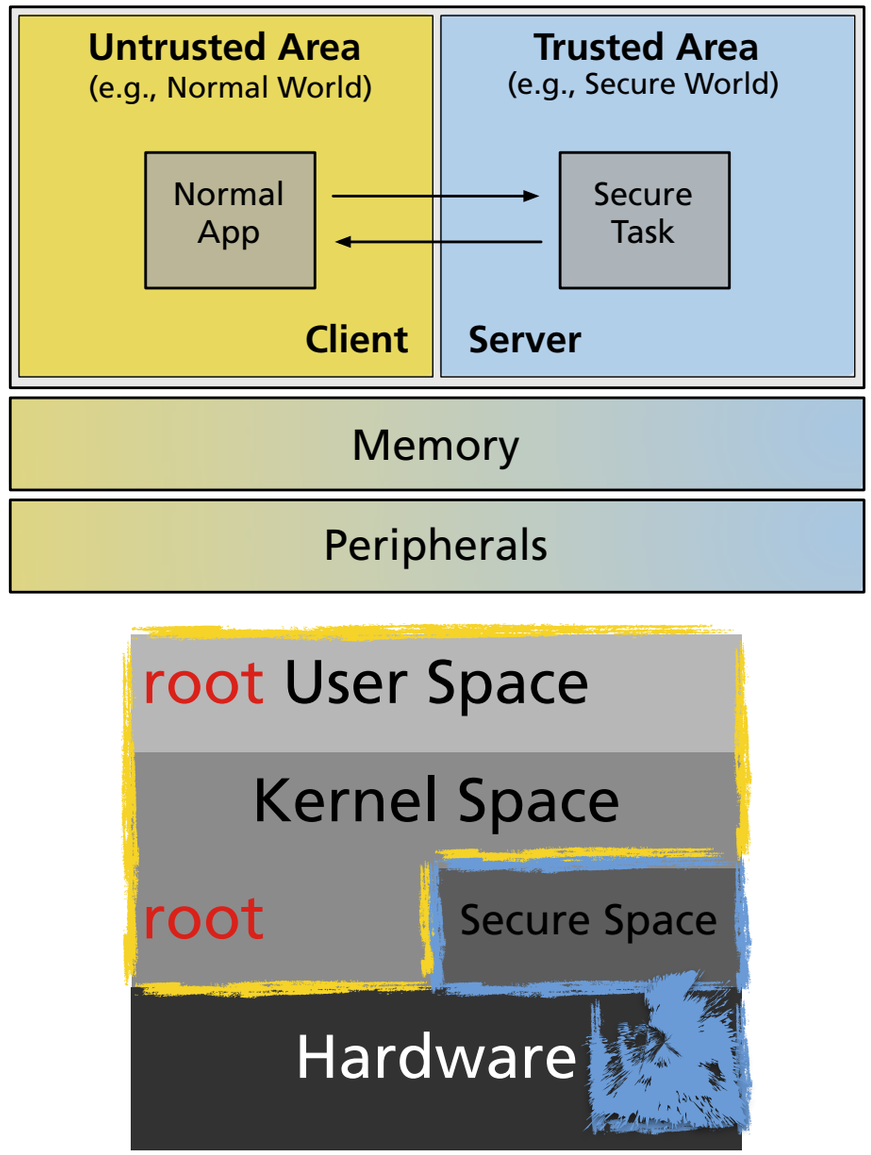
What is TrustZone?



ARM TrustZone Architecture



ARM TrustZone Spaces

Architecture: http://www.arm.com/products/processors/technologies/trustzone/index.php

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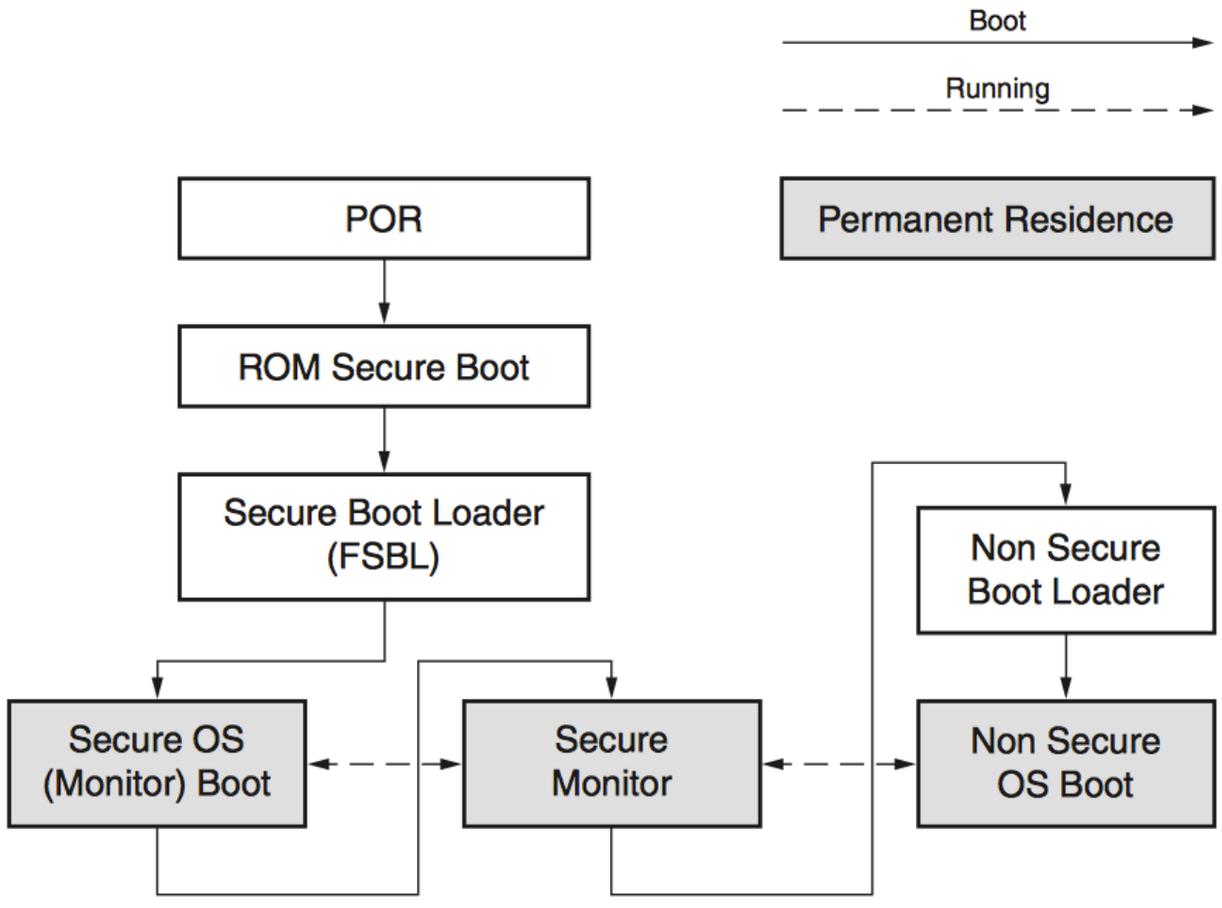
What is TrustZone?



ARM TrustZone Secure Boot

Secure Boot: http://www.xilinx.com/support/documentation/user_guides/ug1019-zynq-trustzone.pdf

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What is TrustZone?

- Extra bit in the AMBA3 AXI Advanced Peripheral Bus (APB)
  - NS-bit: secure/non-secure
- Memory partitioning: secure and normal memory
  - Secure world memory assigned at boot-time
- Secure peripherals *on-the-fly*
  - Potentially any peripheral attached to the AXI-bus
  - In reality this is platform-specific
  - Typically: APB, SDIO, QSPI, USB, Ethernet, DMA, etc.
- A Trusted Execution Environment (TEE)
  - Execution environment separated by hardware
  - Different software stacks
  - Same processor as non-secure (normal) world (SMP & AMP)
  - Secure world triggered by a SMC call (secure monitor)

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TrustZone history

- TrustZone was introduced already in 2004
- It has been a very closed technology
  - Driven by Banking (e.g., Visa, Mastercard), DRM (e.g, Netflix), and other *offload* use cases (e.g., signing keys)
- Support for QEMU from 2013 (Johannes Winter), now Linaro has taken over (http://www.linaro.org/blog/core-dump/arm-trustzone-qemu/)
- Supported in Cortex-A processors
- Supported in development boards, disabled in commercial products
  - Fully supported: Xilinx Zynq, Nvidia Tegra 3, Freescale i.MX53, ARM Versatile Express, …

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TrustZone today

- Number of open source projects leveraging TrustZone in different platforms

TOPPERS
Toyohashi OPen Platform for Embedded Real-time Systems
SafeG
Real-Time Embedded Dual-OS System

GENODE
Operating System Framework

sierraware
open virtualization

NVIDIA
TLK

- Widely used API for user space applications

GLOBALPLATFORM™

- No low level API that can be used by kernel submodules (and reused to expose Global Platform's and others in user space) **yet**

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TrustZone today

- What I have:
  - open_session, close_session, write_secure, read_secure interface for the kernel (same as TPM device driver is implemented)
  - List of input / output arguments (arbitrary number)
    - Global Platform imposes 4 arguments
  - Ported Sierraware's Open Virtualization driver to implement this interface, also as a *char device.*
  - Modified Global Platform's user space interface to use the driver and do user space ABI unit testing
- What we should have in mind (coming for ARMv8)
  - ARM Trusted Firmware: ARM, Xilinx, Linaro, and others
  - SMC calling convention

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TrustZone discussion

- I want to push this mainstream for other people to:
  - Use TrustZone:
    - TPM use cases in ARM (MTPM) - IMA is a good example
    - Implement their own *secure system calls*
  - Port more drivers for other implementations
- Is open / close / read / write the right interface? Generic enough?
  - It is for my use cases but…
- Is it time to introduce *secure_read* and *secure_write* syscalls?
  - Would serve TPM, TrustZone, Secure Element (SE), Smart Card
- Common device list for *secure_processors*??
- Other things you might find interesting :)

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