The OpenAMP System Reference Project

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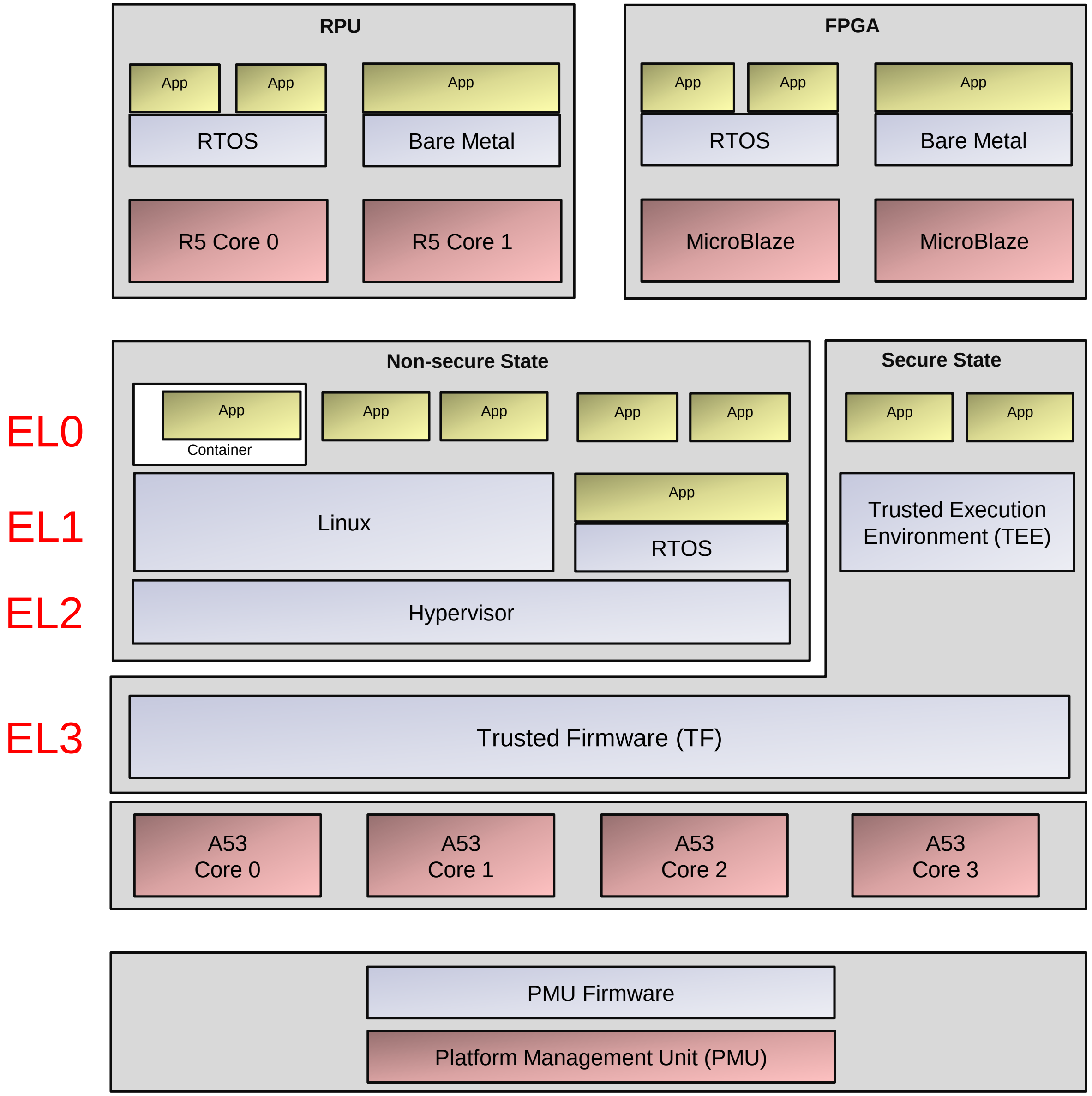
Recap: What is OpenAMP trying to solve?

Heterogeneous Embedded System

- Multiple core clusters
  - A53, R5, PMU, MicroBlaze
- Multiple Execution Levels (EL)
  - EL0 – User space – Linux apps, Containers, RTOS apps
  - EL1 – OS space – Linux kernel, RTOS + RTOS apps
  - EL2 – Hypervisor – Xen, …
  - EL3 – Firmware – Trusted Firmware
- Multiple Security Environments
  - TrustZone (TZ) – HW protecting resources (e.g. memory)
  - Trusted Execution Environment (TEE) – SEL1
- Multiple Operating Environments (OE)
  - Linux – including Android
  - Free and commercial RTOS's
    - FreeRTOS, Zephyr, VxWorks, Integrity, Nucleus, uC/OS, OSE, ThreadX
    - QNX/Neutrino, Sciopta, eT-kernel, Lynx, PikeOS, …
  - Bare metal (no OS) is common on smaller cores
  - Hypervisors – Xen, Jailhouse, commercial
  - Firmware/boot loaders – Trusted FW, PMU FW, uboot, …



Simplifying SW for Heterogenous Environments

- Today, most heterogeneous environments are cobbled together ad-hoc
  - Everybody coming up with their own shared memory scheme
- There is a need to standardize how environments interact
  - Configuring the environments
  - Managing (lifecycle) the environments
  - Passing messages between environments
  - Share resources between environments
  - Porting any OS using a standardized abstraction layer
- Open source implementation is fastest way to standardization
  - Especially if based on already existing open source projects

OpenAMP is a Linaro Community Project solving these kinds of problems

More information

- GitHub project
  - https://github.com/OpenAMP/
  - Also, Lopper lives at devicetree-org: https://github.com/devicetree-org/lopper
- OpenAMP Wiki
  - https://github.com/OpenAMP/open-amp/wiki
  - Notes from calls
  - Features being worked on & under consideration
- Community Project Website
  - https://www.openampproject.org/

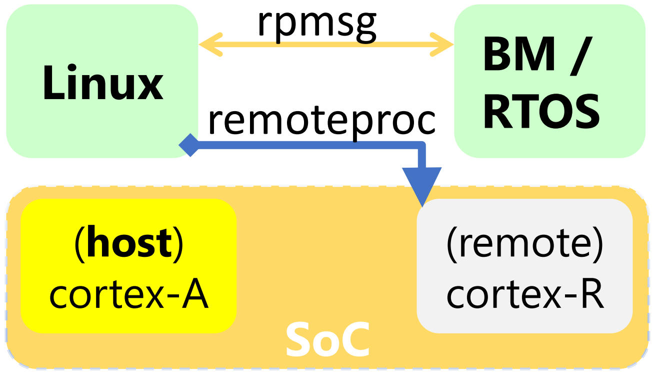
OpenAMP System Reference Project

OpenAMP System Reference Project

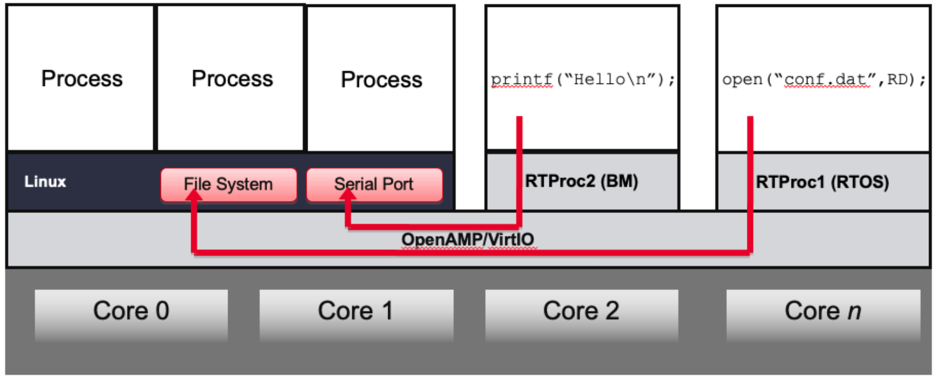
- Document and showcase OpenAMP technologies working together
  - Build, configuration, lifecycle management, messaging, higher level services
  - Crawl, walk, run – start with what we have today, then add more advanced features
- Multi-vendor targets
  - Start with QEMU, Xilinx and ST boards
- Build everything in open source
  - Without the need of vendor SDKs – Make it as similar as possible between vendors
    - Ok to use binaries for vendor specific first stage FW
  - Start with Yocto/Open Embedded for Linux, Zephyr/Bare Metal, OpenAMP, U-Boot, TF-A?
    - Eventually support other build systems and prebuilt binaries
- Simplify HW configuration and allocation
  - Start with today's manual configuration
  - Showcase System Device Trees and Lopper for a complete data driven configuration
    - Including FW, Linux, RTOS(es), XEN, etc.

OpenAMP System Reference Project

- Multiple lifecycle use cases and OS configurations
  - Start with Linux boots, dynamically starts RTOS/BM (from kernel and user space)
  - Add other use cases (static boot, RTOS-RTOS, RTOS-Linux)
  - Initially use Zephyr as RTOS
  - Later add support for proprietary RTOSes (VxWorks/Nucleus)
  - Later add hypervisor support (XEN)



- Demonstrate low-level messaging
  - Passing small and big buffers, zero-copy
  - Measure throughput and latency
- Demonstrate higher level interfaces through VirtIO
  - Filesystem -> Access Linux files from RTOS
  - Sockets -> Access network from RTOS
  - UART -> Access terminal from RTOS



https://github.com/OpenAMP/openamp-system-reference/wiki/

Thank You

Acronyms

- AMP: Aysmmetric Multi-Processing
- API: Application Programming Interface
- APU: Application Processor Unit
- EL: Execution Level
- FPGA: Field-Programmable Gate Array
- FuSa: Functional Safety
- HCI: Host Controller Interface
- IPC: Inter-Processor Communication
- LAVA: Linaro Automation & Validation Architecture
- MPSoC: Multi-Processing System-on-Chip
- OE: Operating Environment
- OS: Operating System
- PMU: Platform Management Unit
- RPU: Real-Time Processor Unit
- RTOS: Real-Time Operating System
- SEL: Secure Execution Level
- SoC: System-on-Chip
- TEE: Trusted Execution Environment
- TSC: Technical Steering Committee
- TZ: TrustZone
- WG: Working Group