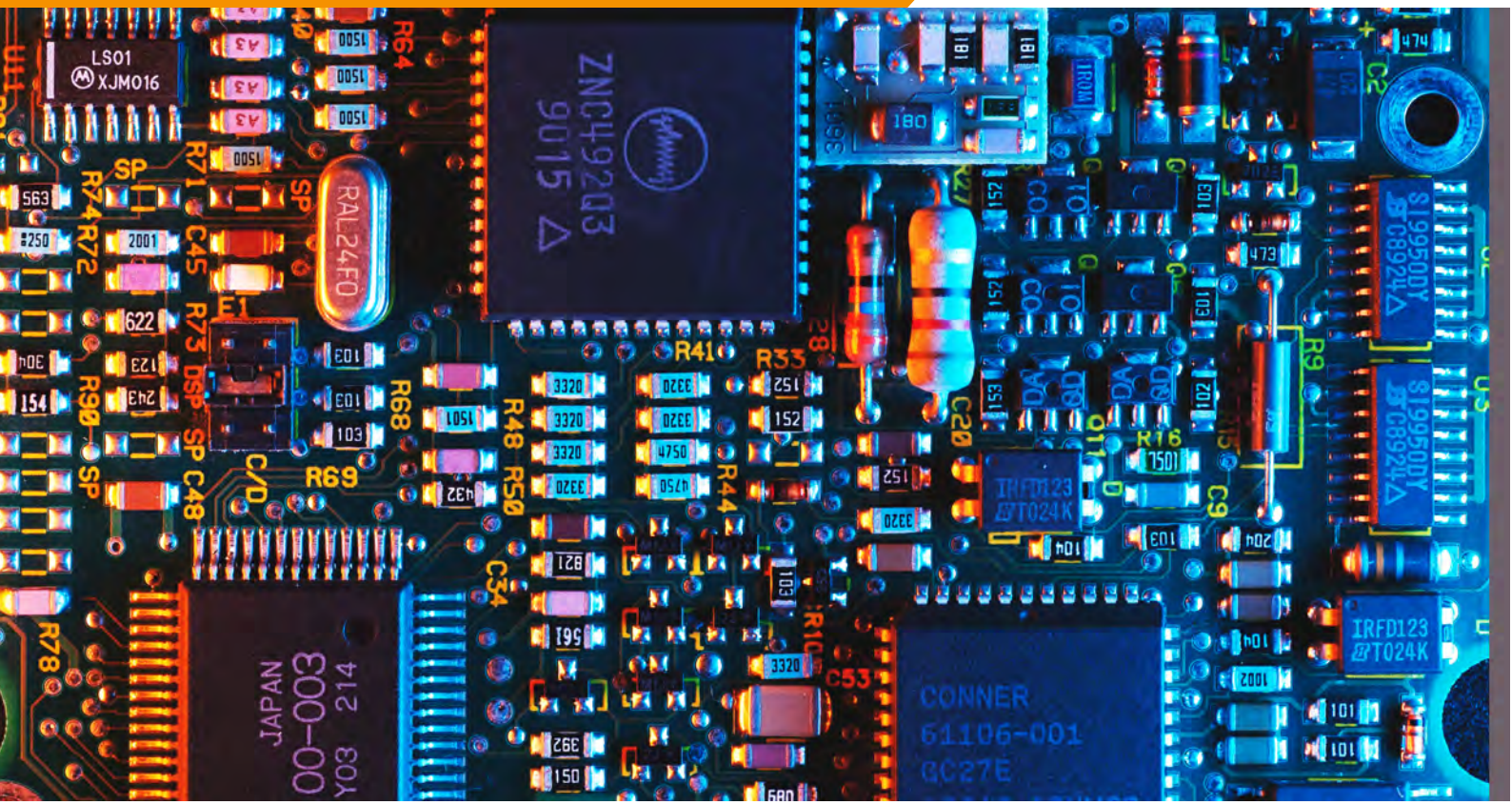


Jailhouse Hypervisor

The ideal solution for homogeneous and heterogeneous multi-core architectures with embedded and real-time requirements. Benefits:

- ✓ **True Separation:** Independent and hardware protected operation of host and guests
- ✓ **Minimal Footprint:** Minimalist design, no unnecessary software support
- ✓ **Real-Time Support:** No impact on timing behavior
- ✓ **Secure IPC:** Shared memory areas protected by hardware, access only for authorized processes
- ✓ **Supervisory:** Guest systems supervisable and restartable
- ✓ **High Security:** Secure boot, chain of trust, rights management, IOMMU support and many more

Modern SoCs are growing increasingly complex and diverse. On the one hand, this shows the trend of consolidating many embedded system functions in one hardware, on the other hand, it also reflects the increased requirements in terms of security and safety. In addition to homogeneous solutions (i.e., n-CPUs of the same architecture, such as x86), more and more heterogeneous multi-core CPUs are entering the embedded market. Different CPU architectures and programmable logic (FPGA) are combined to offer optimal solutions for different requirements. High-performance ARM Cortex-A processors, combined with GPUs and video processors, are used for GUI/HMI interfaces, while ARM Cortex-R Cores could handle safety-critical tasks, for instance. An FPGA can offload compute-intensive or highly time-critical workloads from the CPUs. This allows you to keep proprietary or confidential parts of your design off-board from third parties.

Hypervisor and Realtime

Virtualization is a powerful approach to implement mixed-criticality systems by integrating software components of varying criticality levels. This objective can be achieved with the help of a hypervisor. And here Jailhouse enters the playing field. It is a partitioning hypervisor based on Linux and is configuring CPU and device virtualization features of the hardware in a way that none of these virtual machines, called “cells” here, can interfere with each other in an unacceptable way.

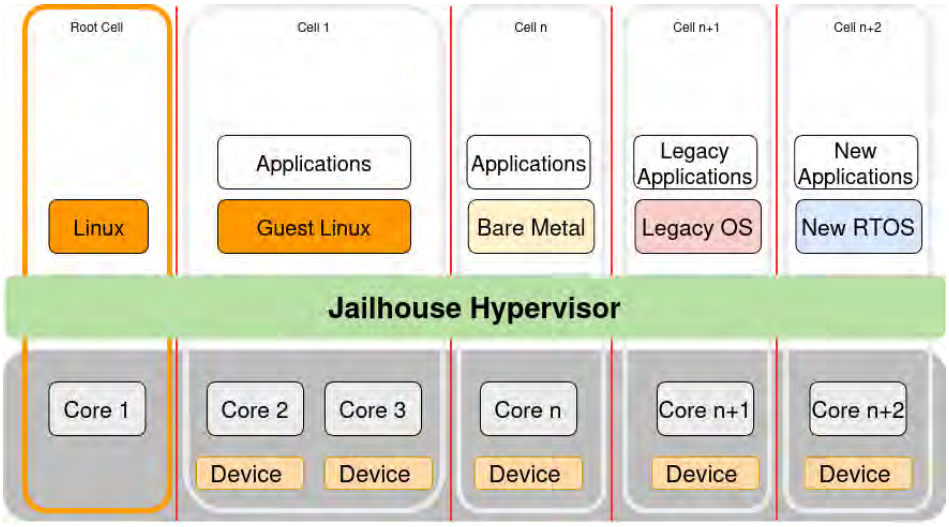


Figure 1: Jailhouse Consolidation

Jailhouse does, unlike other full-featured hypervisors, not support overcommitment of resources like CPUs, RAM or I/O devices. It performs no scheduling and only virtualizes the resources in software that are essential for a platform and cannot be partitioned in hardware. Jailhouse prioritizes simplicity over feature richness. Real-time performance in the guest is virtually unchanged, with overhead typically below 3 µs. Jailhouse allows any combination of Linux, other operating systems like Zephyr and bare metal applications. Flexible assignments to CPUs and devices is possible. Jailhouse makes it easy to consolidate existing solutions on a SoC, as illustrated in Figure 1.

Intercore Communication

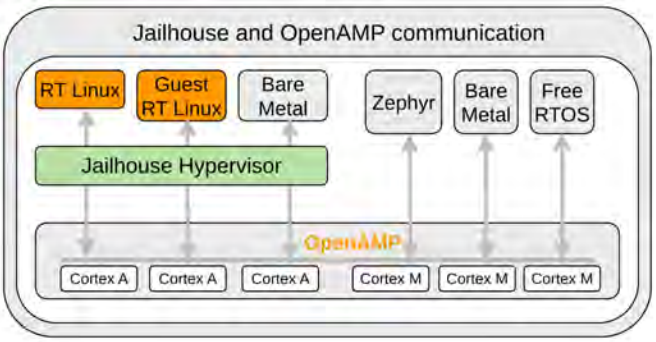


Figure 2: openAMP Communication

Communication between the individual CPUs of any asymmetric multiprocessor design is a challenging task. The open-source OpenAMP framework simplifies this by enabling communication between individual CPUs. Even for bare metal applications corresponding libraries are available. Figure 2 shows an example.

Linutronix Solutions

- Linutronix offers complete support for heterogeneous multi-core CPUs
- openAMP Framework for communication between the subsystems
- Jailhouse as hypervisor implementation
- Based on our Linux solution IGLOS, the operating system can optionally be created as a security hardened variant
- IGLOS also supports containerization for individual applications
- (OTA) Update options are available on request, either as a redundant system or with an update kernel. Also available as a solution with signed updates to ensure system security

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