Solution Brief

Accelerated Linux: Addressing Performance-Feature Trade-offs on Multicore Devices

Overview

- AMP solution for real-time Linux acceleration on symmetric, homogenous multicore devices
- Standard SMP Linux accelerated with a real-time executive
- Type 1 hypervisor provides clean and strong isolation
- Standard Linux/POSIX API
- Hardware platform independent
- Independent of number of cores, scales easily to different devices
- Flexible deployment, core assignment at boot time
- High determinism (low latency and low jitter)

Linux is not suited for real-time applications. So when the ecosystem and rich feature set of Linux is desired in combination with strict real-time requirements, Enea's Accelerated Linux provides a runtime without trade-offs between features and performance.

Real-Time Accelerated Linux

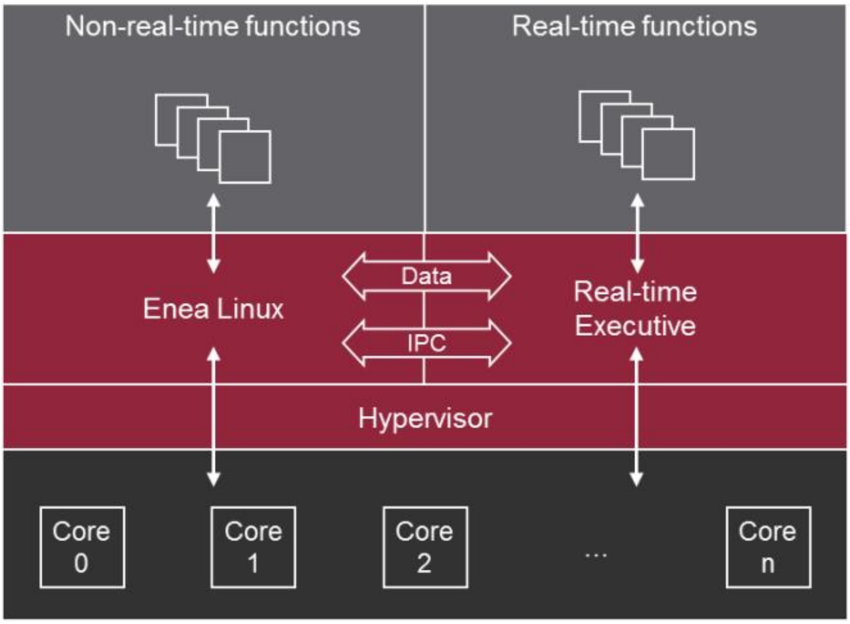
Enea's Accelerated Linux is enhanced with a real-time micro-kernel executive, capable of scaling linearly over multiple cores. The real-time executive and Linux kernel run side-by-side on a multicore processor, each in their own domain.

Less time-critical functions reside on the Linux side, and real-time critical functions run in the real-time domain, where the real-time executive provides a deterministic and POSIX compliant runtime.

Applications and processes in the two domains are connected through high-speed inter-process communication (IPC). The IPC mechanism allows processes in different domains to synchronize despite the isolation provided by the partitioning.

Big Data Transfer

Some applications rely on a high speed, high volume data transfer between real-time and Linux domains. This is typical when data has to be processed within a constrained time and then moved to Linux, or the other way around. This would typically be sensor applications or communication protocols. To support this, Accelerated Linux features functionality for Big Data Transfer through shared memory buffers. It implements a simple and easy-to-use API to allocate and transfer buffers.



Overview of the dual OS partitioning approach to enable real-time in Linux on multicore devices

Shared Resources

Enabled by fast zero-copy IPC between the Linux domain and the real-time domain, both partitions can share a number of services such as file system and debug channels as well as hardware resources. The ability to share resources allows better resource utilization.

Deployment Flexibility

Accelerated Linux provides complete flexibility on how a multi-core processor is partitioned between Linux and real-time domains. Cores can be assigned to either domain (Linux or real-time executive) at boot time, based on the needs for the application. This makes it possible to easily change the configuration to match new requirements or new hardware platforms.

No Black Boxes

Certain approaches to real-time in Linux create "black boxes" that cannot be debugged in the runtime environment. Enea's Accelerated Linux supports full debug and profiling capabilities of the real-time domain. This is enabled by a virtual point-to-point Ethernet connection between the two domains.

Ultra-thin Hypervisor

Accelerated Linux uses the open source Jailhouse hypervisor to partition the processor cores. It provides strong and clean isolation between the Linux domain and the real-time domain. Being ultra-thin, it enables direct hardware access to the real-time domain, providing native performance to the real-time executive. As a result, the hypervisor incurs almost no added latency.

Hardware Support

Accelerated Linux is adapted to ARMv8 and x86 homogenous multicore processors, including:

- Xilinx Zynq Ultrascale+
- Xilinx Zynq 70xx
- STM32MP
- Altera Stratix 10
- Intel Denverton
- NXP i.MX
- NXP LayerScape LS20XX
- TI Sitara
- NXP B4860
- Nvidia Tegra

Typical Use Cases

Accelerated Linux is intended for systems that require both high performance real-time as well as Linux.

Real-time + GUI

Many embedded devices are fitted with advanced graphics and Linux provides an abundance of components for graphical user interfaces. However, some require a true real-time environment. Typical applications include medical devices, industrial automation, and consumer electronics.

Sensors with High Data Volume

Advanced sensors often produce a continuous data stream that needs real-time processing. Typical applications include radar and lidar systems, vision control, and real-time image analysis.

Networking

Networking applications often require a Linux runtime for the higher layers in the protocol stack, while the lower layers require a strict real-time environment. A typical example is LTE/5G Radio Access Networks.

Evaluation

Contact Enea to request an evaluation or a demo of Accelerated Linux.

www.enea.com/accelerated-linux

ENEA

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