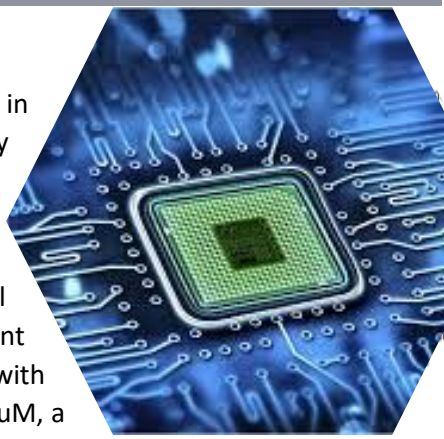
Bringing the Power of Multiple Virtual Machines to Embedded Systems

Challenge & Solutions



Embedded systems are virtually everywhere. From cell phones and ATMs to onboard avionics in spacecraft, these special-purpose computing systems housed in devices and hardware they control are essential for modern life. Multicore platforms, which are run by integrated circuits with more than one central processing unit, represent the future of embedded systems. However, they haven't reached their potential in these systems because some functions, including the use of shared resources, interfere with critical applications that allow optimal functioning of the platforms. Mixed-criticality systems, in which applications with different criticality levels are executed in the same hardware platform, can overcome this problem with partitioned systems in the multicore platform using virtualization techniques. Adapting XtratuM, a hypervisor that supports multiple virtual machines on a single computer and is specially designed for real-time embedded systems, the MCS-MX project demonstrated such a mixed-criticality system for space-and-avionics applications on multicore platforms. The team used the integrated modular avionics (IMA) software architecture for multi-core platforms and XtratuM as a partitioning kernel. XtratuM also provided full-virtualization techniques, which create virtual computers in the hardware, to limit the use of shared resources by non-critical partitions. This solution, which supports the execution of several isolated partitions with different levels of criticality, can boost the role virtualization is playing in the avionics, automotive and other sectors. Using XtratuM, software that allows physical devices to share resources with virtual machines, the MCS-XM project developed a feedback-control technique that controls execution of critical tasks, which helps pave the way for higher performing, multicore embedded systems. Many sectors would benefit from limiting interference from other cores in a transparent way.

EuroCPS Support

Thales Research & Technology (TRT) provided the platform on which XtratuM was adapted to space and avionics uses and the application that validated the results. It also shared its expertise in predictability issues related to multicore architectures, notably in avionics use cases, such as flight-management systems.

Digital Skills

FENTISS: XtratuM hypervisor improvements, feedback controllers for mixed-criticality systems.

Thales Research & Technology (TRT): Avionics CPS system, avionics demonstrator (flight-control simulator) adapted to TRT's platform based on a PowerPC T2081.

Company

FentISS is a technology company experienced in partitioned systems, for real-time and critical embedded applications.(SP)
http://www.fentiss.com

11 employees

Partners: Thales TRT (FR)

Since 2010
as a spin-off UPV and the Instituto de Automática e Informática Industrial (AI2)

Impact/What's next

Removing barriers for multicore platforms to become the dominant computing hardware for embedded systems creates a large business opportunity for FentISS. The improvements of XtratuM stemming from this project create immediate business opportunities in the space and avionics sectors. With XtratuM's certification expected this year, the company expects a 10 percent increase in staff, and forecasts annual sales growth of 15 percent for the next three years, to more than €725,000 by 2020. Longer-term, FentISS will certify the hypervisor for the renewable energy and railway sectors, as it removes major roadblocks for multicore processors to increase the functionality of embedded systems