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Integration Opportunities in Automotive Infotainment Systems

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agenda

- (brief) Evidence company profile
- trends in integrated automotive electronics
- some details on ERIKA Enterprise
- SCHED_DEADLINE in Infotainment systems
- conclusions

Evidence

company profile

the company

Founded in 2002 as spin-off company of the
Real-Time Systems Lab at Scuola Superiore S.Anna

~20 qualified people with an average age of 34 years

10+ years of experience in academic and industrial projects

One third of the company has a PhD degree

Our Mission:
design and development software for small electronic devices

products and services

ERIKA ENTERPRISE RT DRUID

open source OSEK/VDX RTOS and IDE

E4 CODER

simulation and code generation tool
based on open-source tools

EVELIN

BSP/SDK for Embedded Linux systems
Custom drivers

application development
on various platforms



Let’s start!

The basic idea…

Automotive embedded systems changed over time

- 1985 – Isolated embedded architectures
- 1995 – Distributed architectures over CAN bus
- 2005 – Integrated architectures based on AUTOSAR
- 2015 – Distributed architectures based on Multicore AUTOSAR + Infotainment solutions

What's next?

…is cost reduction

- 2025 – Distributed architectures …
  …with small number of nodes

Need to:

- Integrate applications from different sources → AUTOSAR components
- Integrate applications with heterogenenous timing requirements → schedulability analysis
- Integrate applications with different safety levels → mixed criticality, mem. protection

… but then…

- Integrate applications with different semantics → ???

A static world…

- Static allocation of resources, Static software architecture, control
- No dynamic allocation of memory
- Hard realtime, safety critical
- Limited HW resources

Compared with a dynamic world:

- Infotainment has relaxed real-time constraints
- Works on Linux-based systems (or similar)
- GUI, Network, Graphical libraries, standard applications
- iPhone/Android integration, App stores

the “dynamic” side: Linux in infotainment

Many new infotainment systems on car are based on Linux and Android

Automotive Grade Linux - http://www.linuxfoundation.org

Tizen - https://www.tizen.org

Genivi - http://www.genivi.org/

ok, Linux is there… but…

How can we implement the static part of the application integrating it with Linux?

Objectives:

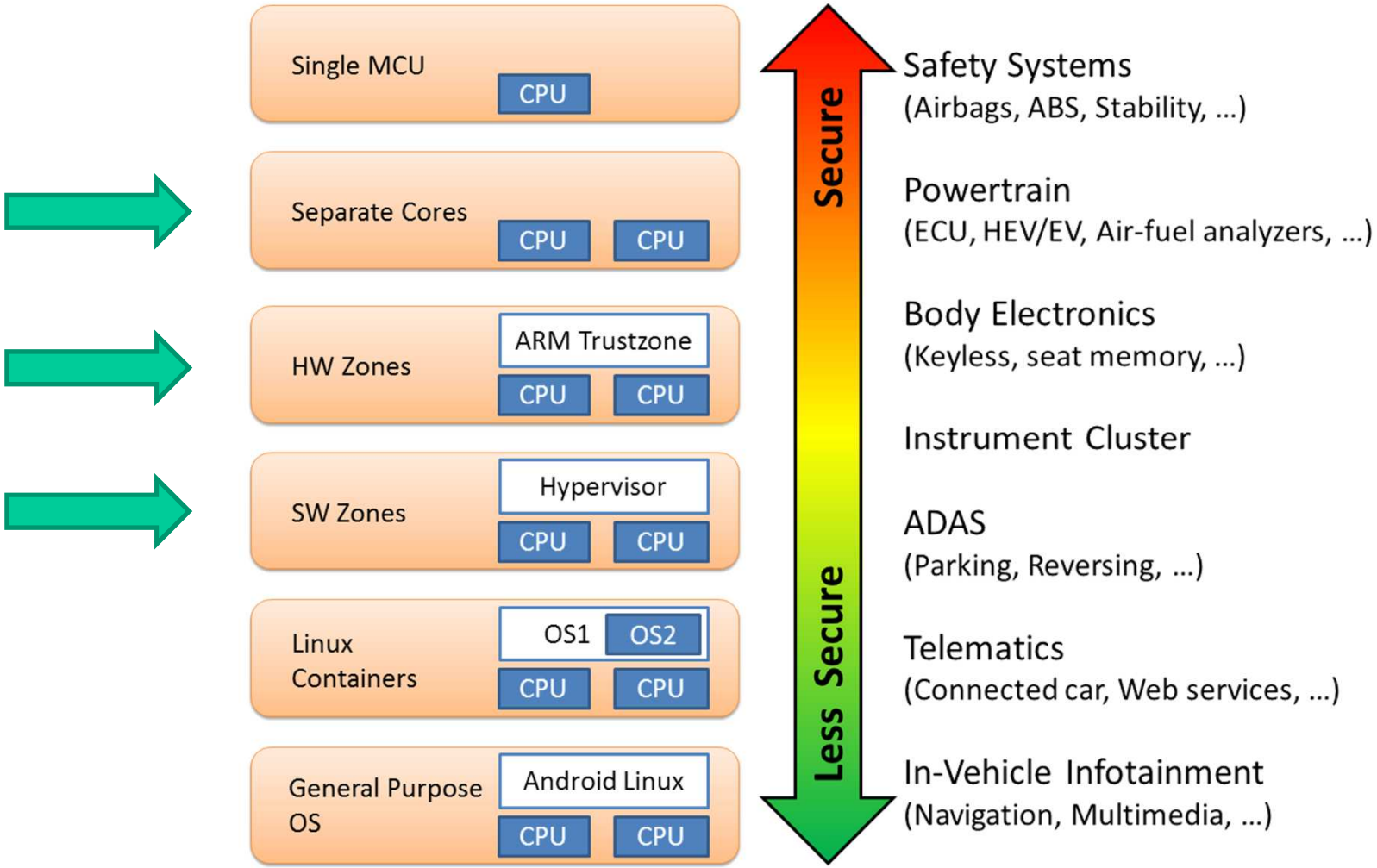
- a complete open-source solution
  - ERIKA Enterprise as the underlying automotive RTOS
- integrate Linux with ERIKA preserving real-time performance
  - interrupt latency
  - fast boot
  - response time and scheduling algorithms

quick look at ERIKA Enterprise

http://erika.tuxfamily.org

- ERIKA Enterprise is an OSEK/VDX certified RTOS
- ERIKA Enterprise implements an API inspired by the AUTOSAR OS API
- offers a suitable open-source license allowing the static linking of closed source code
- Typical footprint around 2-4KB Flash
- Used by several automotive/white goods companies

Integration at different levels…



Original source: Mentor Graphics,
Automotive Linux Conference Oct 2013

Current (and future) solutions

We worked on different directions:

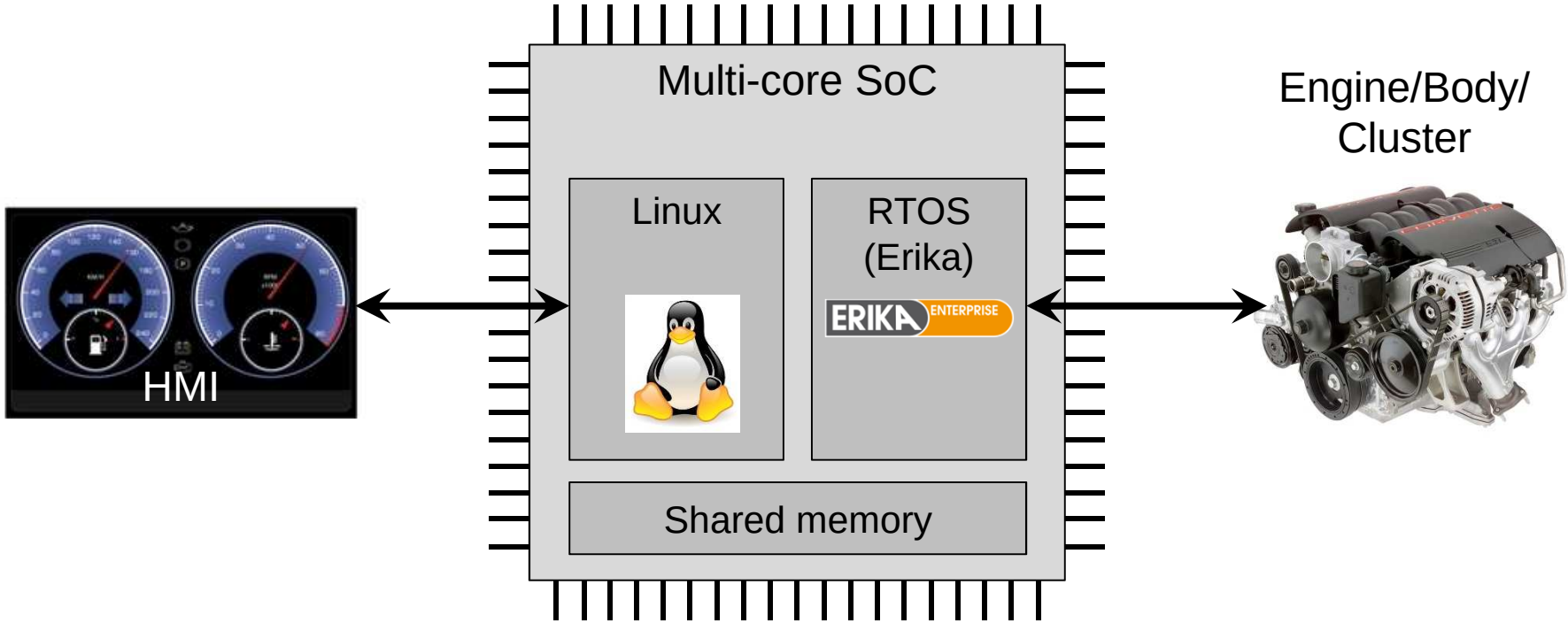
Available as a demo:

- Linux + ERIKA on SMP cores (iMX6)
- Linux + ERIKA on top of the XEN Hypervisor (as domU)

Linux + ERIKA on SMP multicores

Real-time and quality of service for IVI systems without hypervisor!

- ERIKA running on one core
- Linux on the second core



conclusions – open question…

Can SCHED_DEADLINE be used to schedule Hypervisor domains, or application subsets creating a timing isolation that allows to safely simplify the integration of different real-time/non-realtime applications on the same machine?

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