



Linux and AUTOSAR

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Brief Introduction to OpenSynergy

OpenSynergy is a software company bringing innovative technologies into embedded automotive applications.

OpenSynergy's main product is COQOS:
A standards-based automotive software-platform that brings together automotive technology and technology from consumer electronics.

COQOS
the core

Challenge in automotive 1: Integration

The functionality of the „Head-Unit“, „Communication Box“, „Mobile Device Integration“ and even „Instrument Cluster“ and „Driver Assistance Systems“ must be closely integrated.



Can the instrument cluster be a 2nd display of the head-unit?



Will open communication channels endanger vehicle systems?



Can driver-assistance systems run on the same processor?

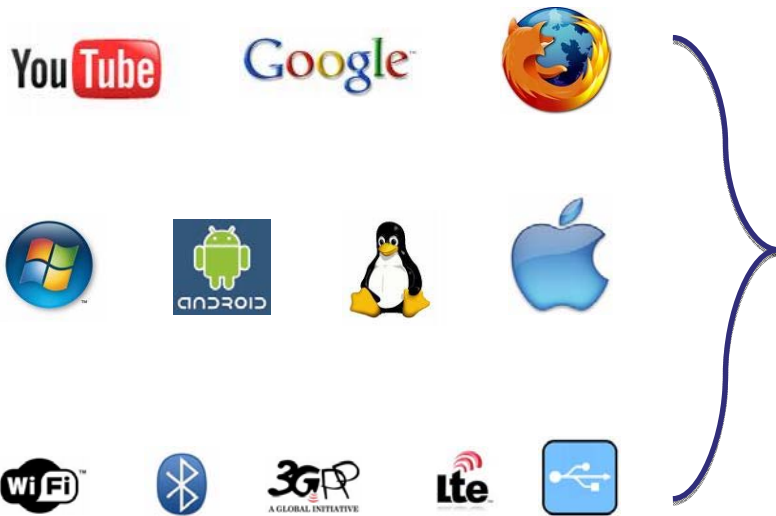
How can compatibility with mobile devices be ensured?



Challenge in automotive 2: Consumer electronics

Consumer electronics

Automotive



?

Driver assistance

Body control

Chassis control

Comfort electronic

AUTOSAR

FlexRay™

CAN
Controller Area Network

Some limitations of AUTOSAR

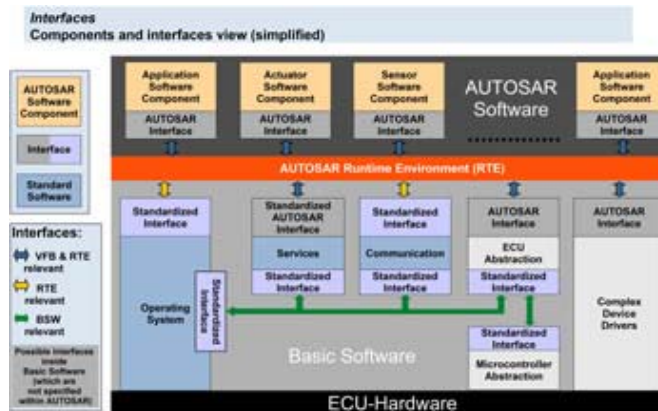
AUTOSAR was not designed to handle specific issues that come up in infotainment systems, driver assistance systems or HMI-oriented devices.

Some examples of the issues that come up:

No mechanisms to output complex graphics



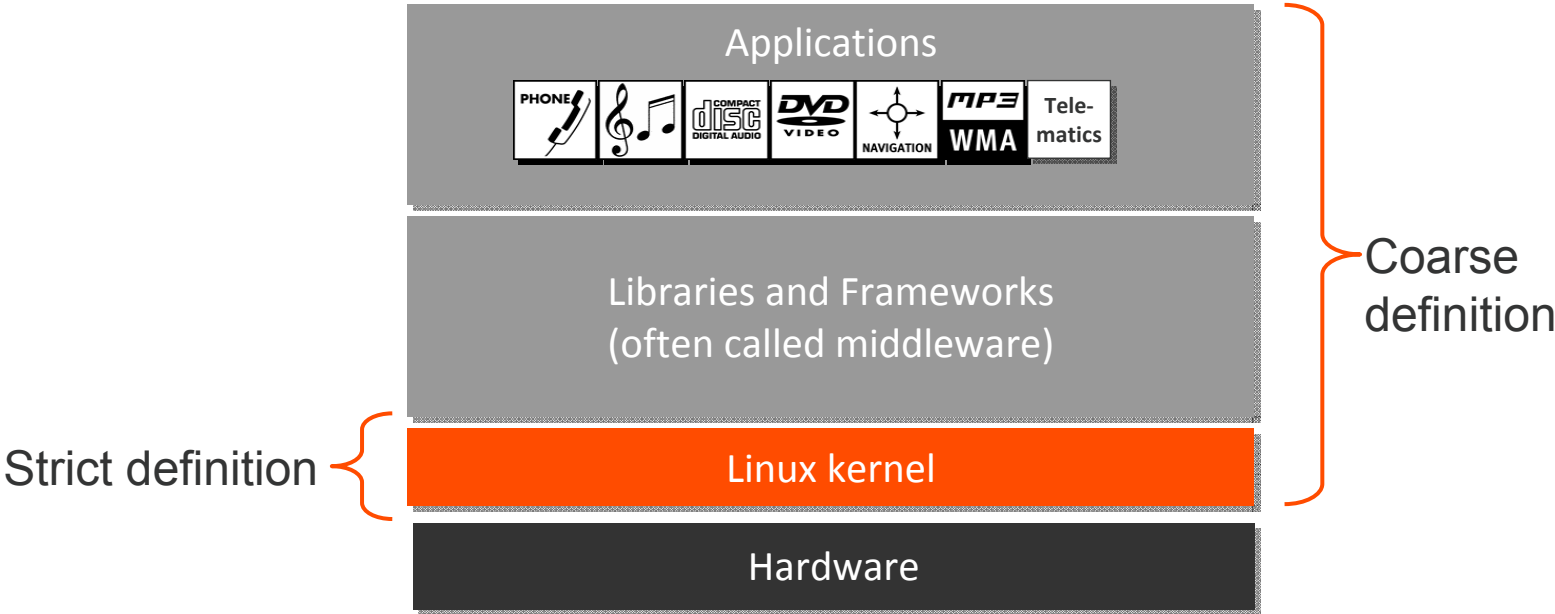
No communication mechanisms for audio or video streams



Not designed to easily run existing complex communication stacks (e.g. full IP stack, Bluetooth,...)

No good mechanisms for image Processing algorithms to process Large amounts of data efficiently.

What is Linux?



Where is Linux? Who uses Linux?



[servers]



[tv]



[phones]

“Every single person in the modern world every day. Everyone who searches Google, picks up a phone and uses telecommunication infrastructure, watches a new television, use a new camera, makes a call on many modern cell phones, trades a stock on a major exchange, watches a weather forecast generated on a supercomputer, logs into Facebook, navigates via air traffic control systems, buys a netbook computer, checks out at a cash register, withdraws cash at an ATM machine, fires up a quick-boot desktop (even those with Windows), or uses one of many medical devices; the list goes on and on.”

Jim Zemlin, the executive director of [The Linux Foundation](http://www.linuxfoundation.org)

Where does Linux come from?

- **Eco - System**

- 4910 developers
- 532 companies: Top contributors: Red Hat, IBM, Novell, Intel, Oracle, Parallels, Fujitsu, Analog Devices, Renesas, SGI, Movial, Sun, HP, Freescale, Marvel, Montavista, AMD, Nokia

- **Who funds Linux?**

- 75% is developed by commercial developers - 25% is developed by private or unknown developers
- These companies know they can achieve business goals better when using, supporting and developing Linux because they share significant effort between each other.

- **Value of Linux**

Linux Foundation estimates that it would take **\$10.8 billion** to develop the Linux distribution Fedora 9 by traditional proprietary means in year 2008 dollars.

Automotive uses Open Source / Linux solutions



Linux-based Technologie is already used in automotive embedded devices today



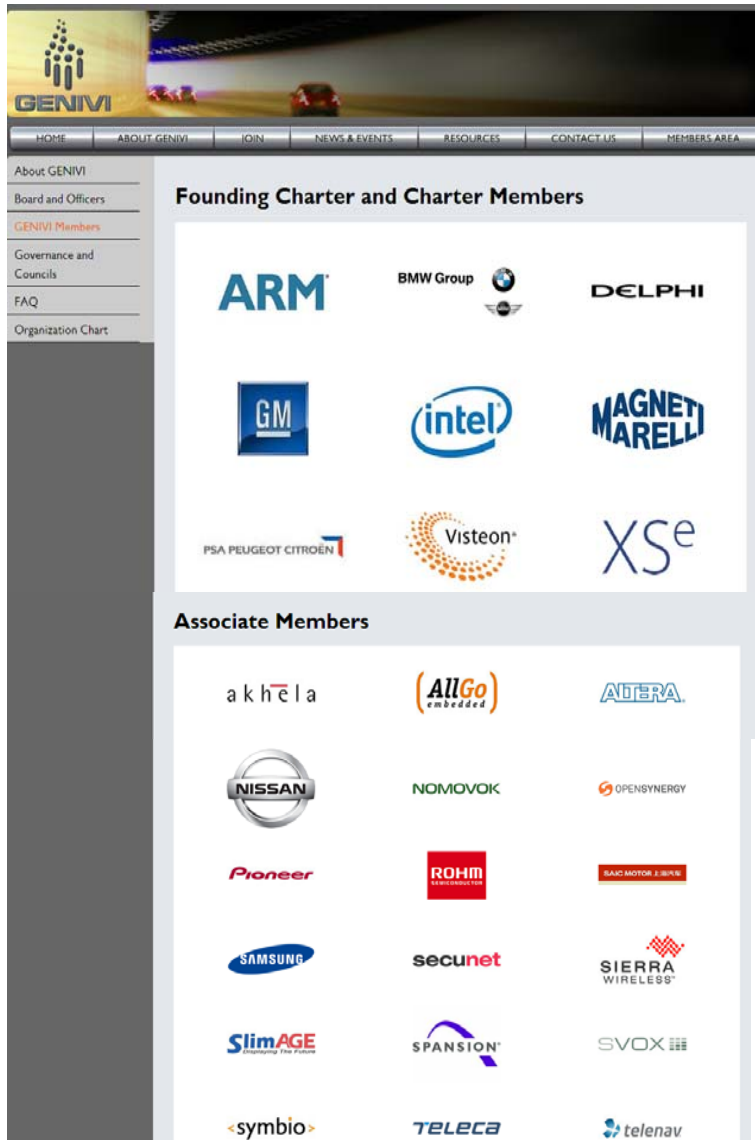
- Excitement about „Apps“
- Large Tier1 offers Head-Unit based on Android
- Chinese OEM sells cars with Android Head-Unit



New automotive industry alliance



GenIVI



Growing quickly... almost 100 members...

- GenIVI wants to make Linux automotive compatible
- GenIVI wants to point out GenIVI compatible solutions within Linux
- GenIVI wants to develop additional components that are missing

Challenges

Start-up Times

(„Fast boot“)

- On the network
- Early Applications



MeeGo



Integration into the Vehicle

AUTOSAR-Compliance

Security:

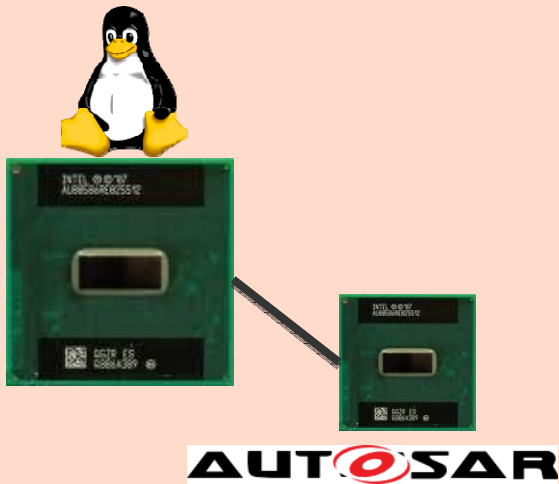
Firewall
between vehicle
domains

Reliability:

- Diagnostics
- Software Updates
- Test

Architectural Options

Multiple Chips



- Often used today
- Increased BOM-cost
- Limited flexibility

OR

Rely on Linux



Improved Versions of Linux or modified Versions of Linux could be better at satisfying the automotive requirements

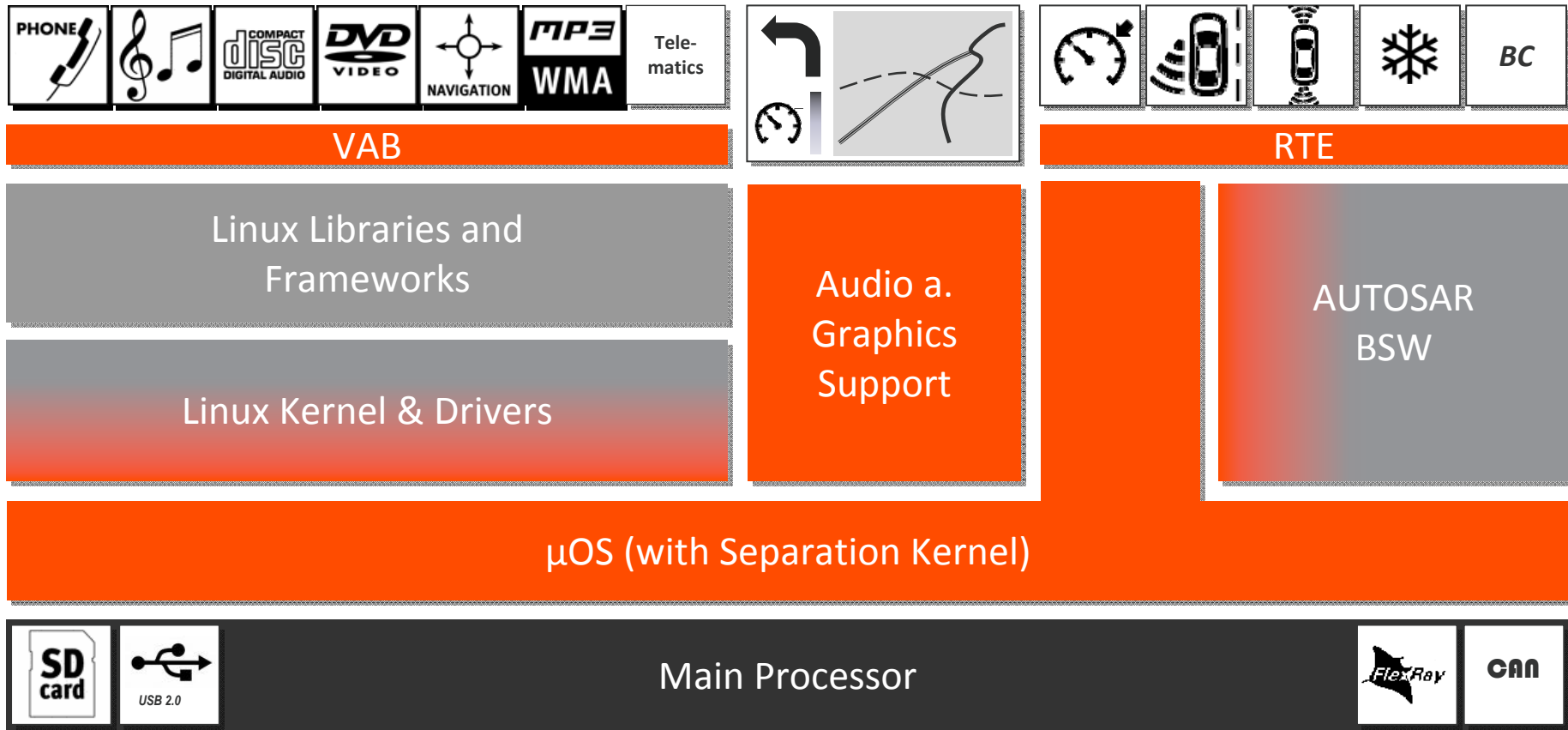
OR

Partitioning & Virtualization

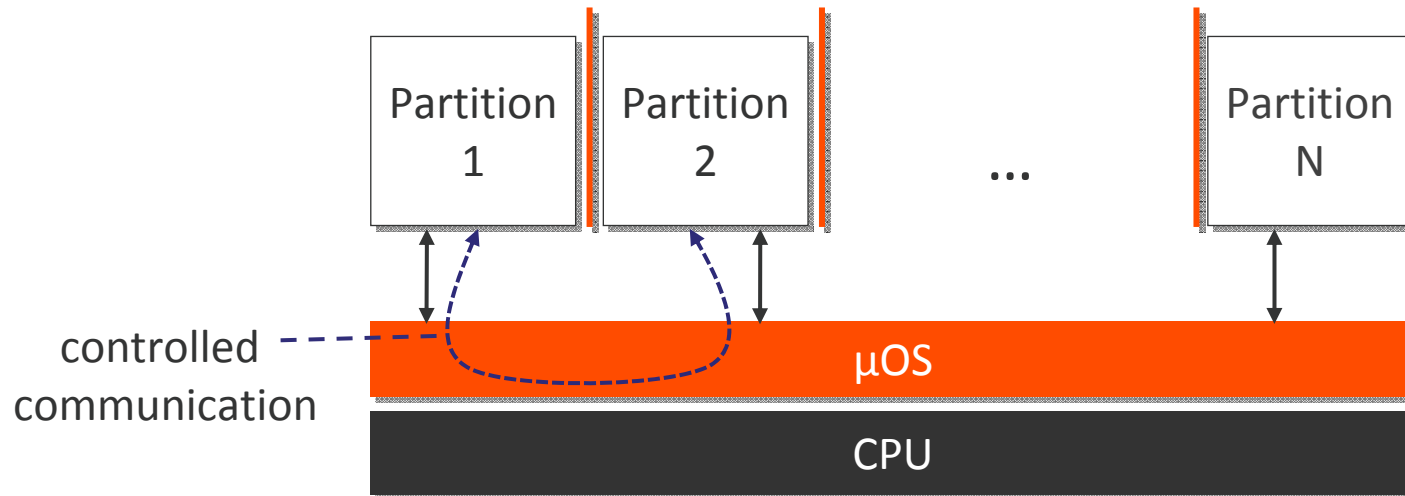


- Micro-Kernel Partitions Processor
 - AUTOSAR runs independently from Linux
 - Linux runs „virtualized“

Solution based on Separation & Virtualization



Key Technology 1: “Separation Kernel “



The Micro-Operating-System separates the processor into „partitions“:

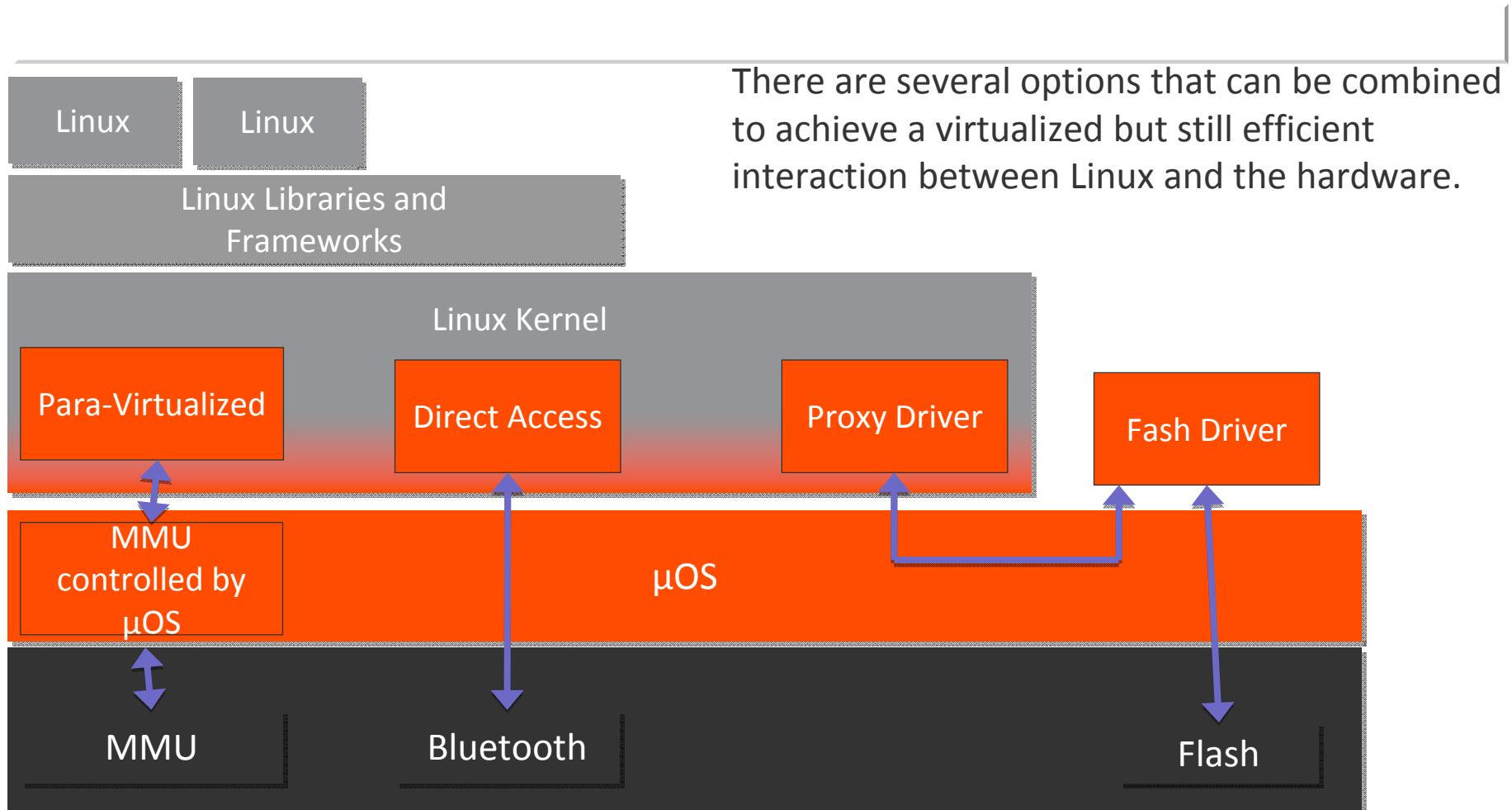
- The μ OS ensures proper separation (execution time and memory)
- The μ OS provides communication mechanisms between the partitions

Technology already used successfully in:

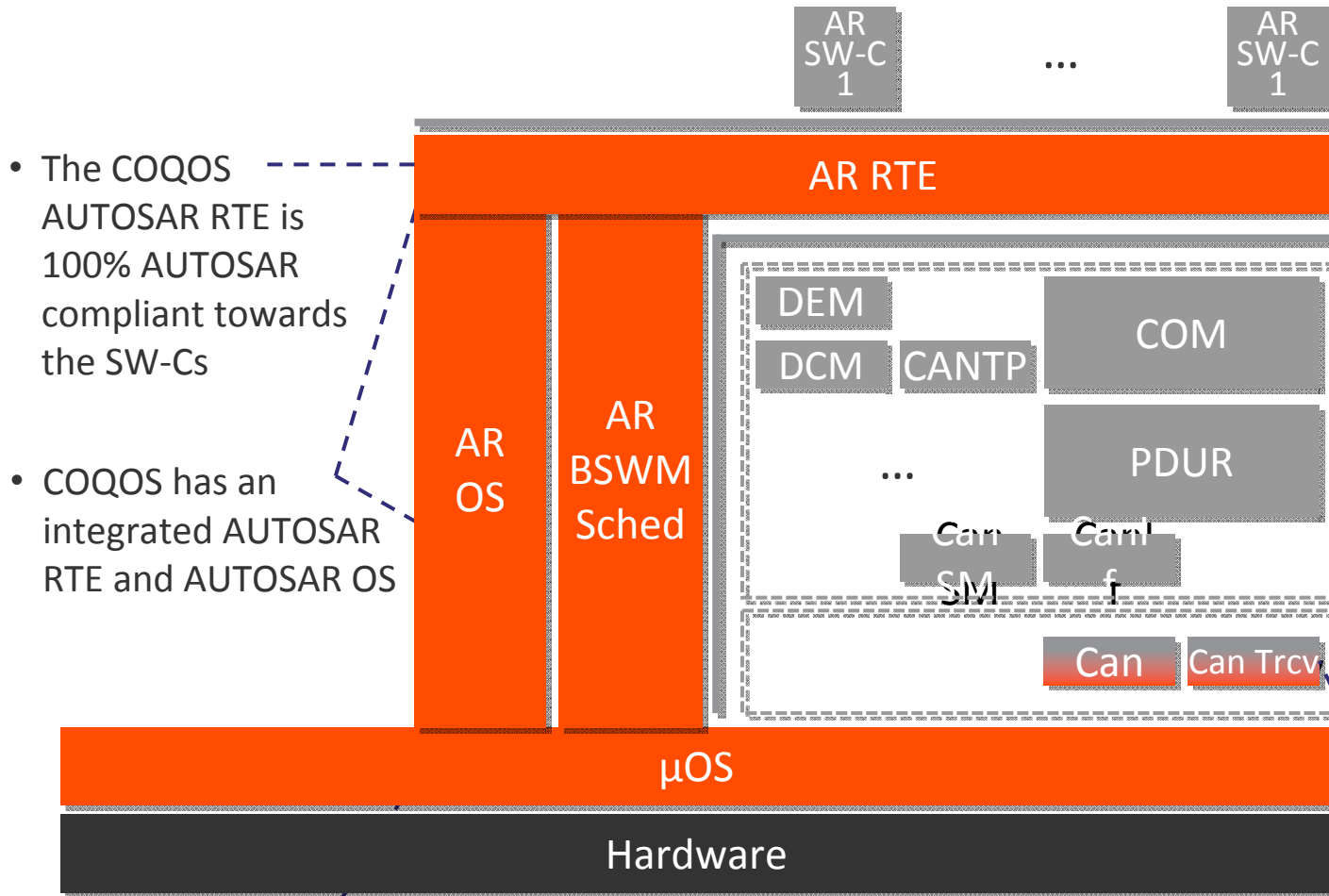
- Safety-critical applications: e.g. “IMA: Integrated Modular Avionics”
- Security-critical applications

Key Technology 2: “Virtualization”

Virtualization means that the full operating systems (like Linux or Windows) do not have direct access to all of the hardware.



Details on AUTOSAR Integration



- The COQOS AUTOSAR RTE is 100% AUTOSAR compliant towards the SW-Cs

- COQOS has an integrated AUTOSAR RTE and AUTOSAR OS

- The COQOS AUTOSAR OS runs directly on the μOS

- BSW from other vendors can be integrated without modifications. This has been done successfully for the Vector Informatik BSW.

- Because of the presence of the μOS, the SPAL layer needs to be ported.

Long-term vision, foundations laid today

COQOS makes it possible to optimize and rethink the electronics architecture:

- Reduce the number of processors
- Take advantage of the powerful computing power of high-end processors
- Allow optimized distribution of applications



COQOS

Secondary „Instrument Cluster“ Processor

COQOS (or other AUTOSAR solution)

„Domain Controller“



Third-Party „Applets“

Infotainment Applications

AUTOSAR Applications

COQOS

Powerful „Head-Unit“ Processor

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