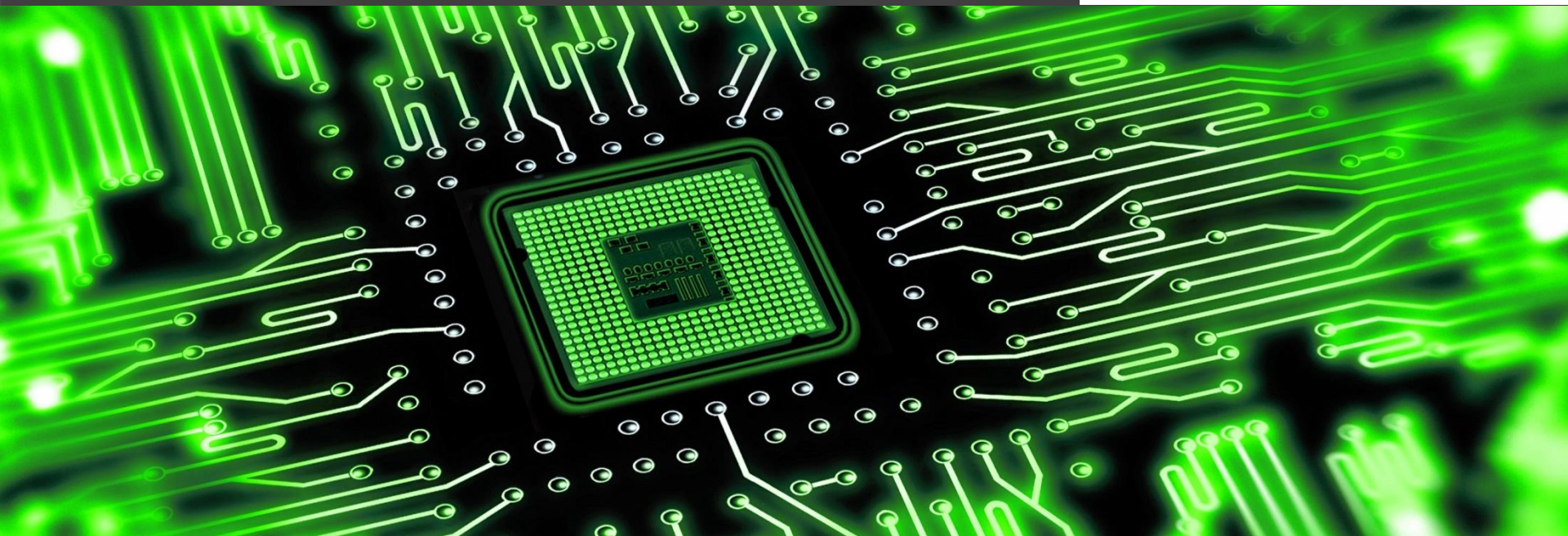


Software integration challenge multi-core – experience from real world projects



Elektrobit

Rudolf Grave
17.06.2015



Agenda

- About EB Automotive
- Motivation
- Constraints for mapping functions to cores
- AUTOSAR & MultiCore & Safety
- Summary & Outlook



EB: Software and Services



Infotainment

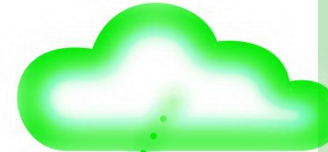
Connected navigation software

- HMI tools for in-dash, digital instrument clusters and head-up displays
- Global software integration and engineering services



Connected

- Connected experiences around urbanization and electrification
- Online diagnostics
- Software and content updates



In-Car Infrastructure

- EB tresos – integrated software and tools, based on AUTOSAR standards
- **Solutions for: operating systems, middleware, dependable communication**
- **Solutions for high integrity systems: reliability, functional safety and security**
- Test & simulation



Driver Assistance

- Software development for driver assistance functions
- Electronic horizon and test drive recording solutions
- Driver assistance algorithms and functions



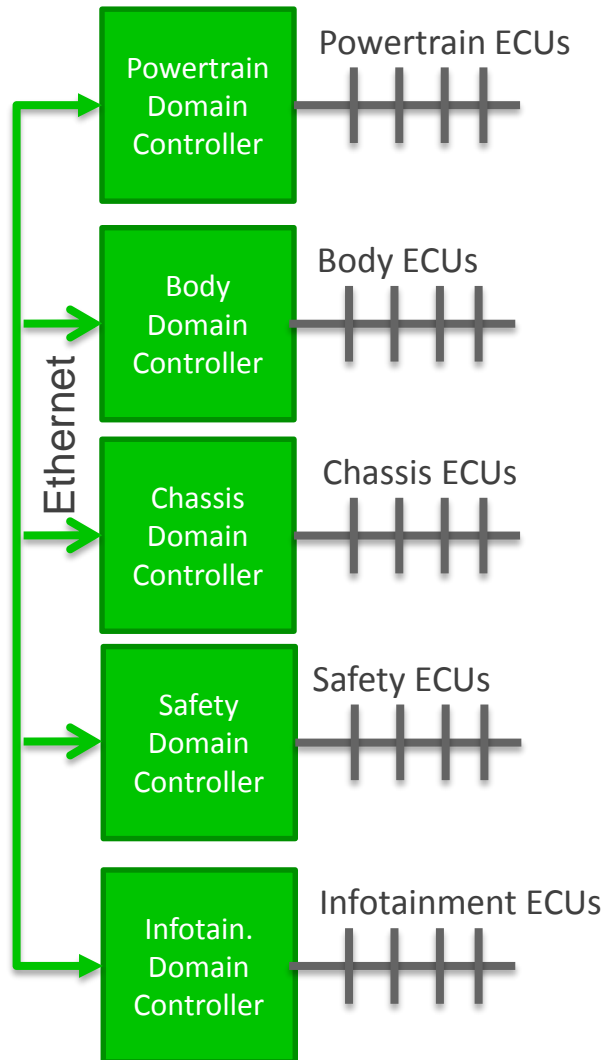
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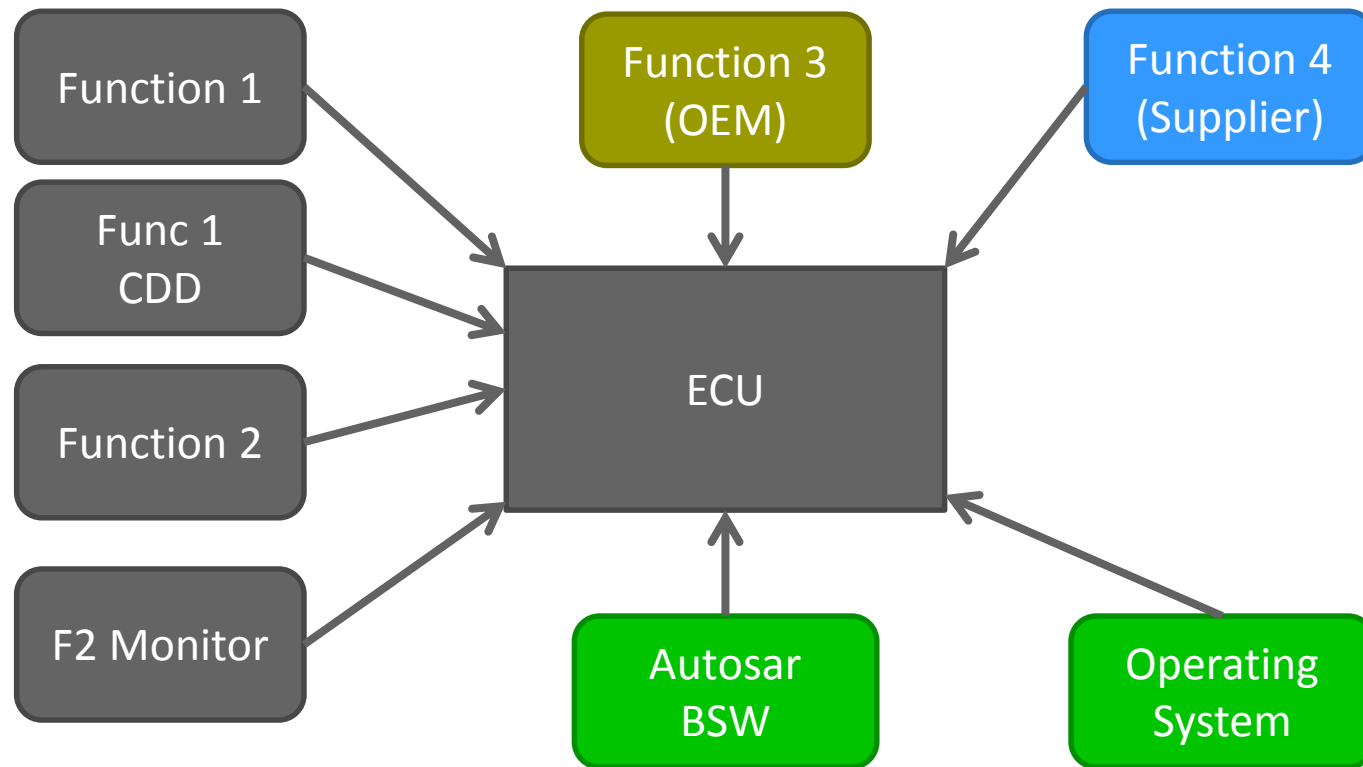
Next generation of ECUs



- Domain Controller will be huge multi-core systems
 - ECU independent function
 - Connected to Actuator / Sensor ECUs
 - Reloadable functions
 - Connected with Automotive Ethernet
- Domain ECUs will be „small“ multi-core or single core systems
 - Hard real time
 - I/O handling
 - Safety functions
- Motivation for change current E/E architecture
 - Updatable ECUs
 - Dynamic Systems
 - Security



Motivation



Agenda

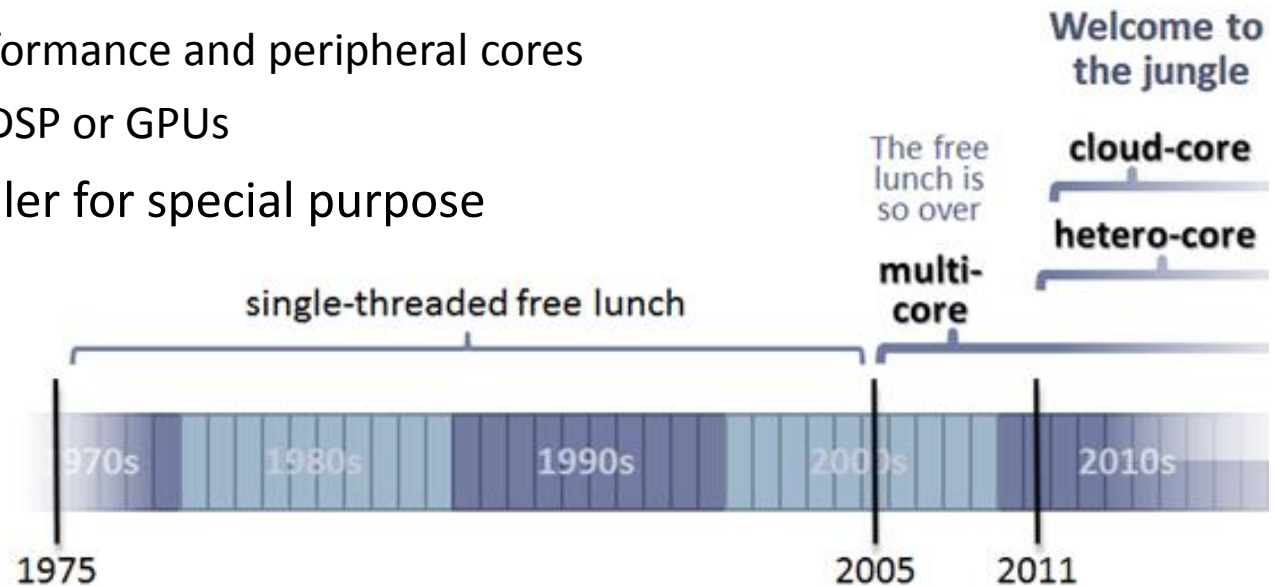
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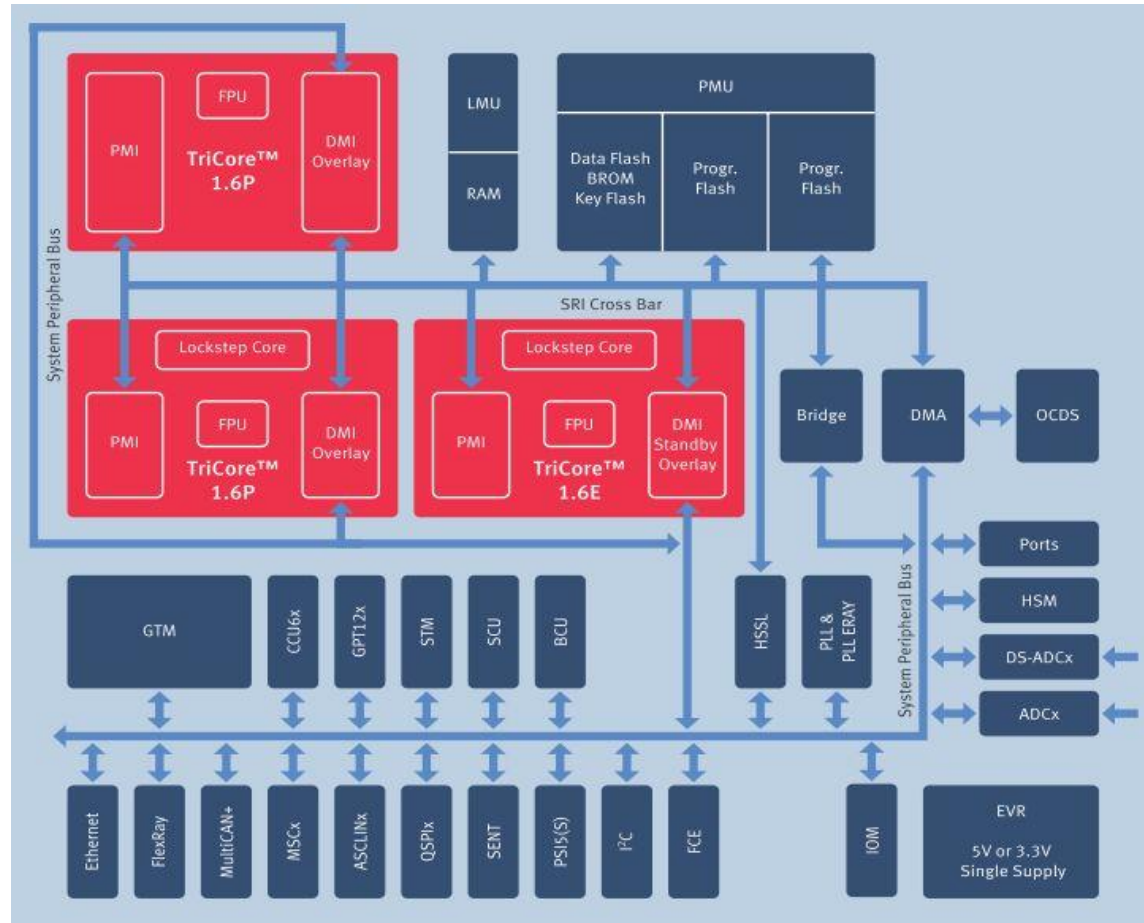
„Welcome to the jungle!“ (Herb Sutter)

- Automotive microcontroller follow IT systems with 5-8 years delay
- Appearing microcontroller
 - Different CPUs on one architecture
 - Combination of performance and peripheral cores
 - Combinations with DSP or GPUs
- Special microcontroller for special purpose



http://herbsutter.files.wordpress.com/2011/12/image_thumb22.png?w=640&h=304

Example: Infineon AURIX TC27x



Two lockstep cores

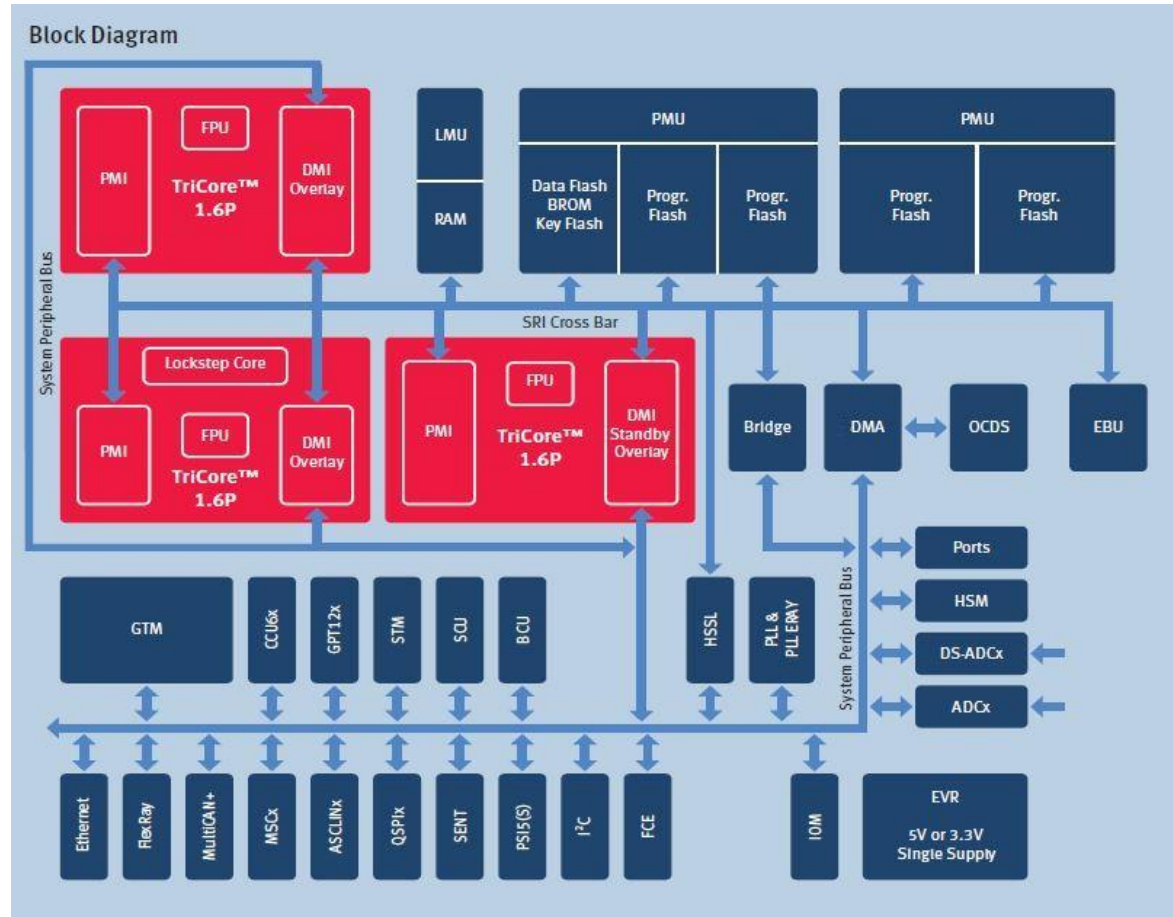
- 1.6E
- 1.6P

One non-lockstep core

- 1.6P

Source: <http://www.infineon.com/export/sites/default/media/products/Microcontrollers/32bit/BlockDiagram-TC27xT.png>

Example: Infineon AURIX TC29x



One lockstep cores

- 1.6P

Two non-lockstep core

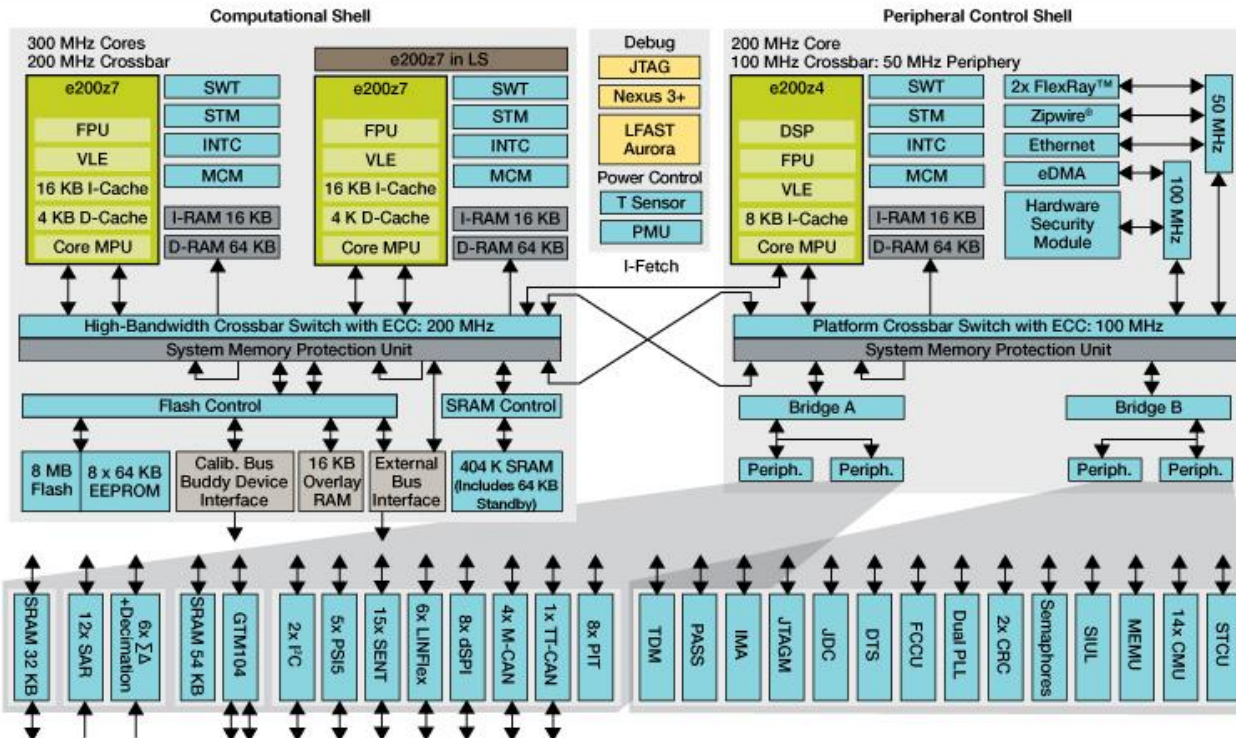
- 1.6P
- 1.6P

Source: http://www.infineon.com/export/sites/default/media/products/Microcontrollers/32bit/TC29xT_Block_Diagram.JPG

Example: Freescale MPC5777M



MPC5777M Block Diagram



Source: http://cache.freescale.com/files/graphic/block_diagram/products/microcontrollers/AUT-P27692_MPC5777M_BDTN.jpg

Two computational core

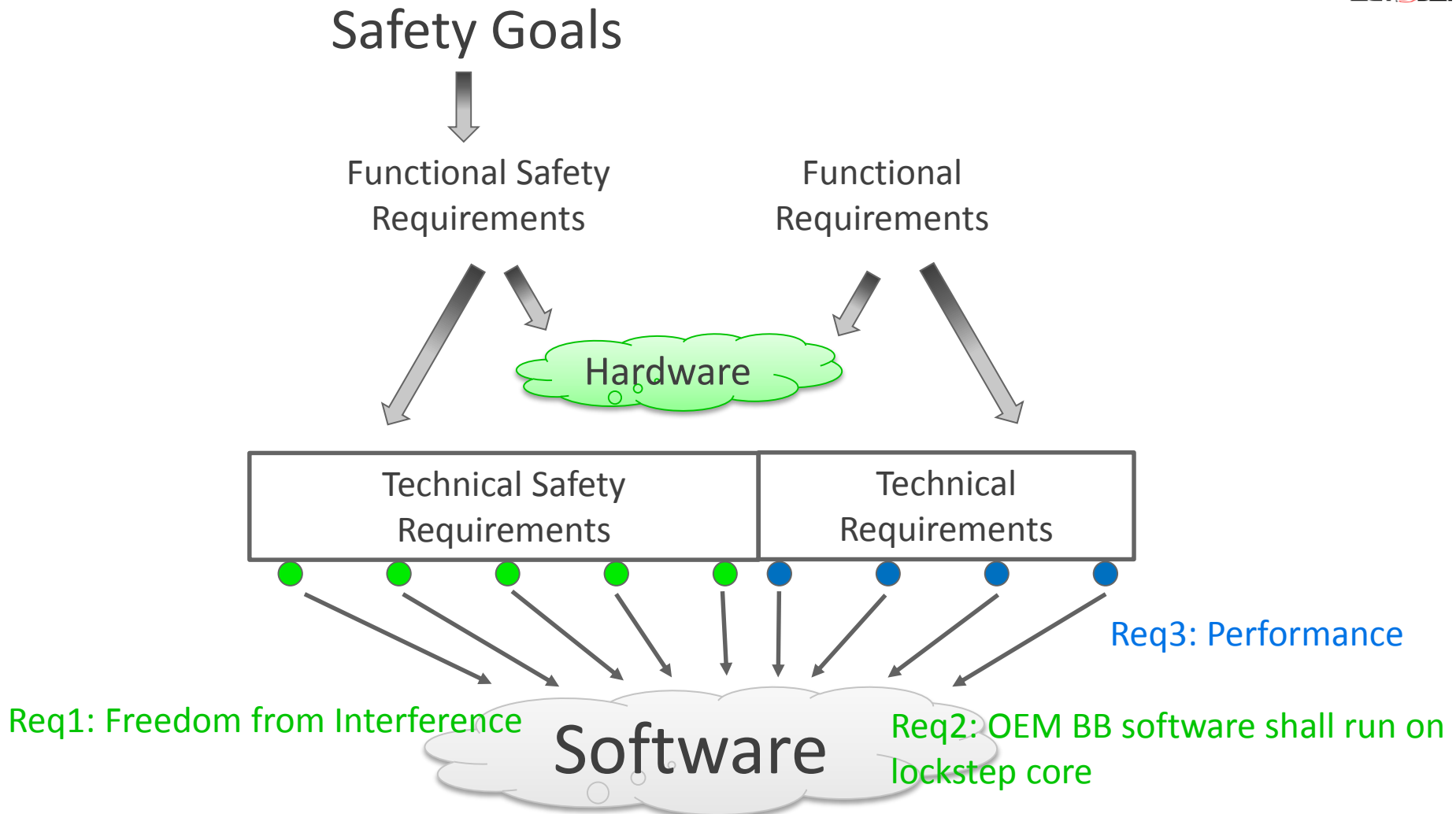
- e200z7 (lockstep)
- e200z7

One peripheral core

- e200z4



Constraint: Safety Goals





Freedom from interference (ISO 26262)

In software partitioning system the freedom from interference argument between software component shall claim that:

- Shared resources are only used by one partition or a appropriate mechanisms are implemented
- Software partitioning is supported by hardware mechanism e.g. MPU
- Software mechanism ensuring FFI are implemented on highest level

Spatial FFI

“The data used by a one element shall not be changed by a another element. In particular, it shall not be changed by a non-safety related element.”

Temporal FFI

“One element shall not cause another element to function incorrectly by taking too high a share of the available processor execution time, or by blocking execution of the other element by locking a shared resource”

Exchange of information

“Exchange of information shall be defined as transport of data between software elements or hardware. (e.g. messages between ECUs or cores, data from non-volatile memory)”

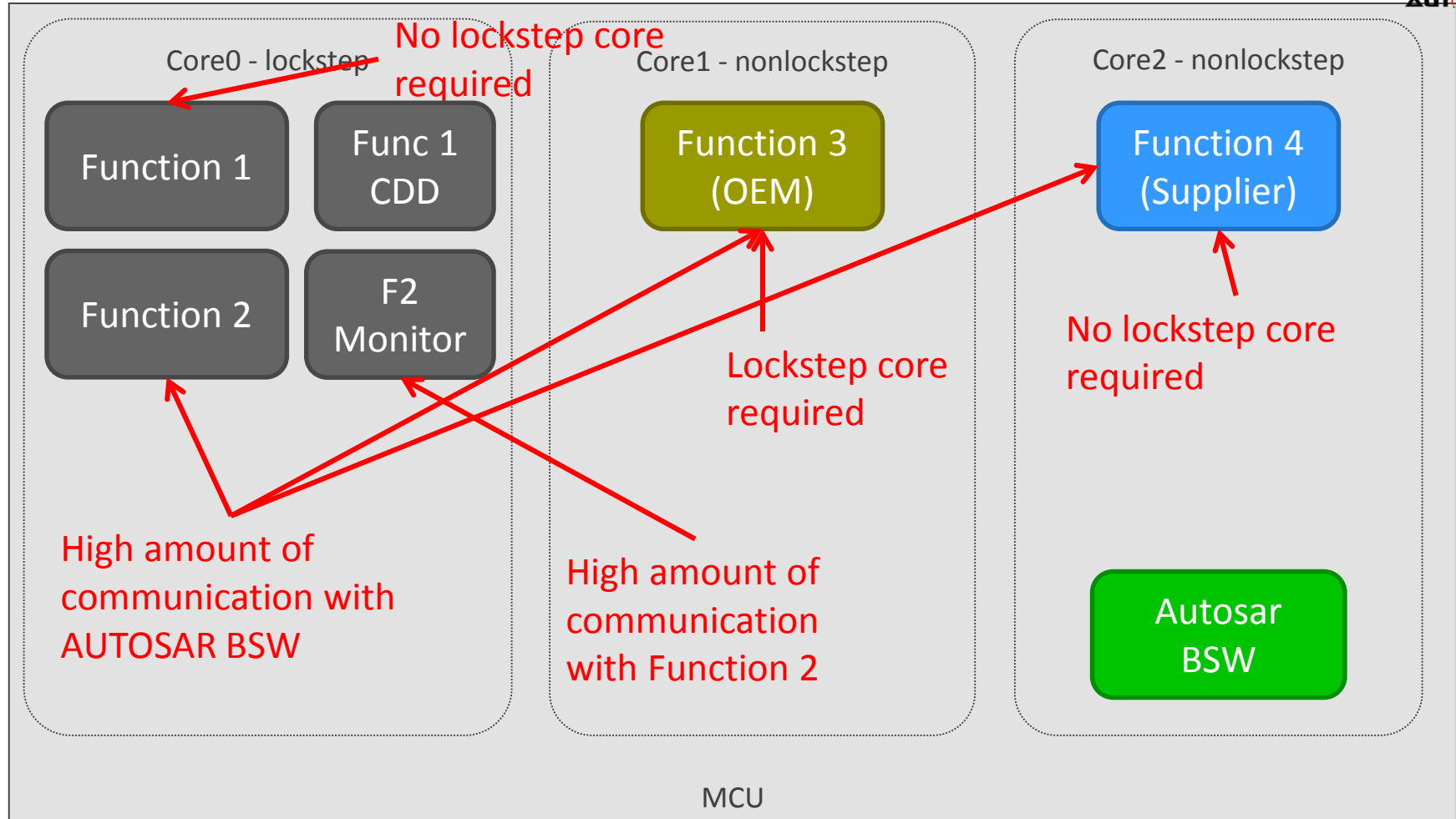


Functional Constraints

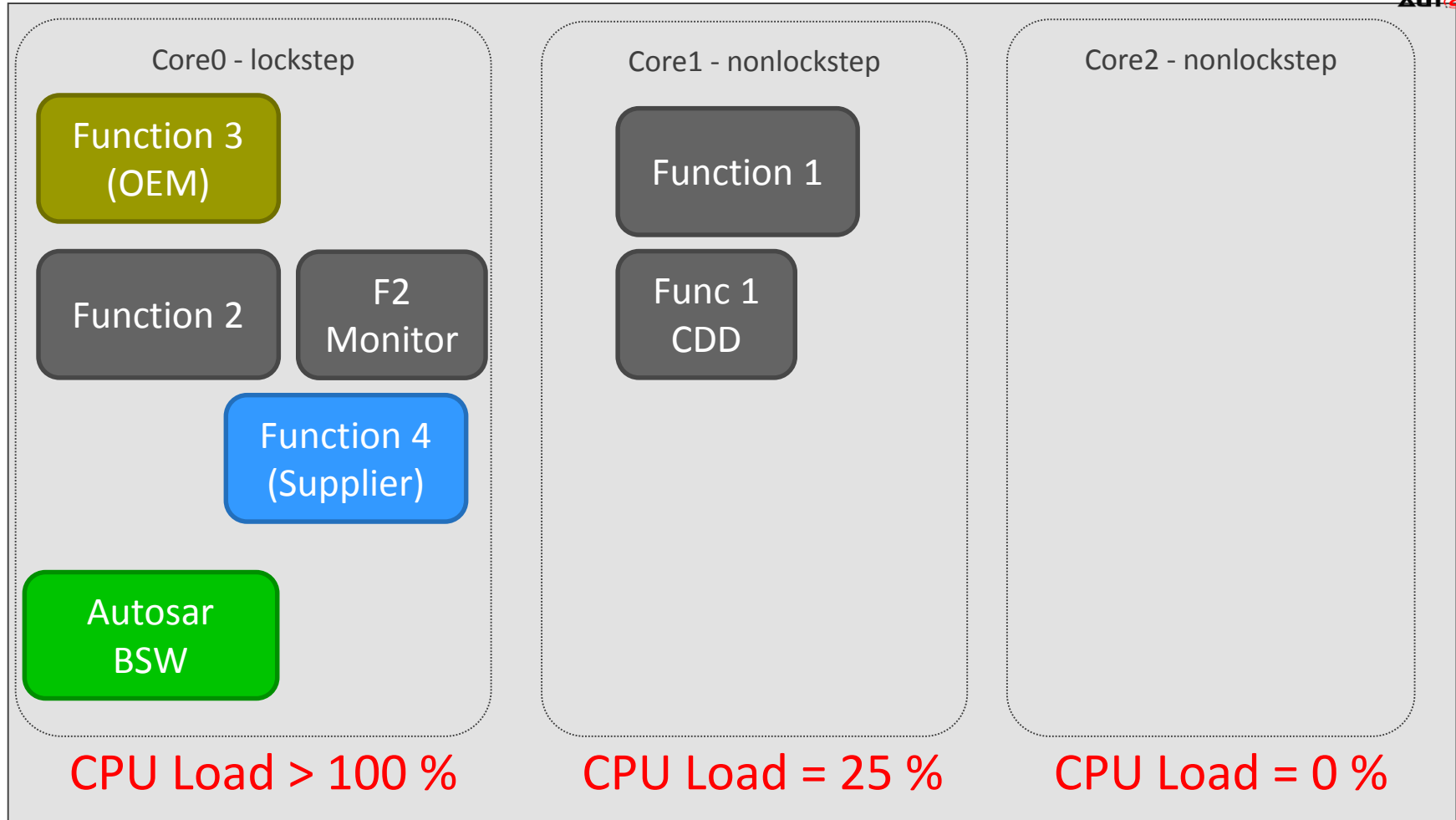
- AUTOSAR basic software < v. 4.0.3 can't be distributed on cores
- Reuse of legacy software
- Functional requirements
 - Response times
 - CPU load requirements
 - Startup times
 - Delay in Inter-Core, Inter-processor communication
- Access to peripherals



First idea: Group according to supplier



Next idea



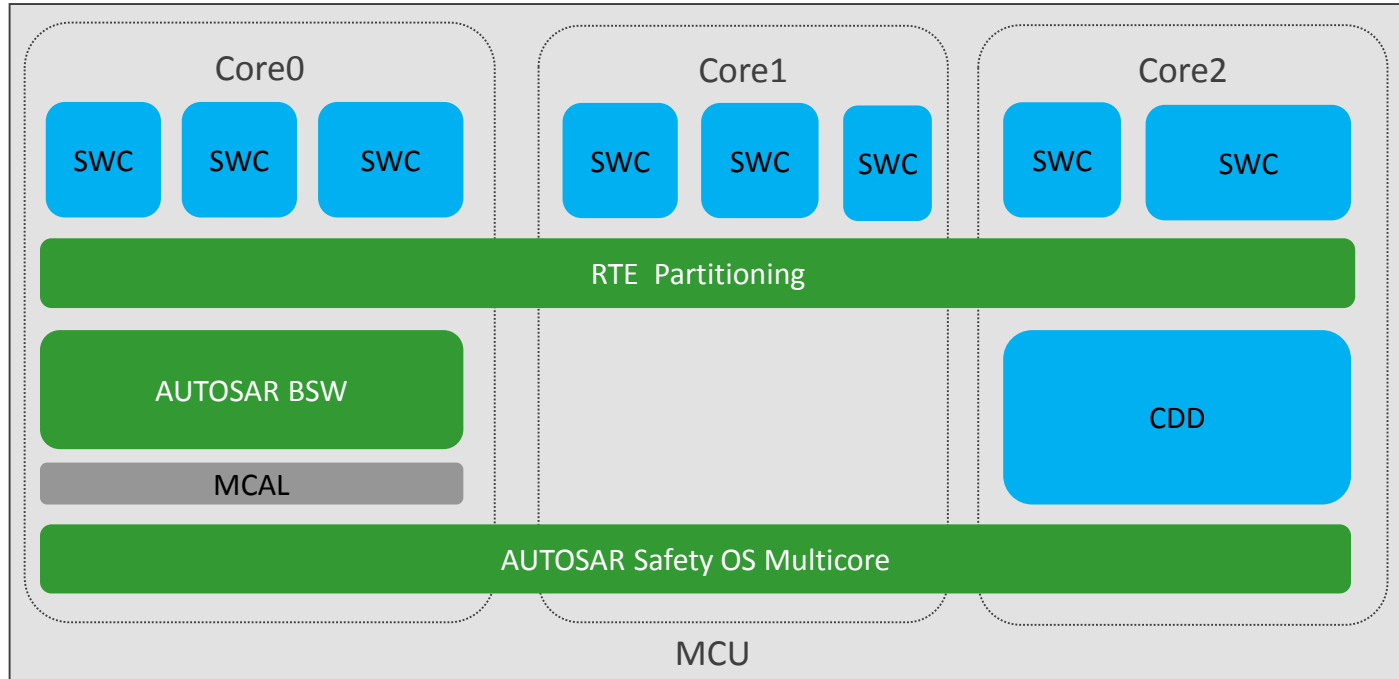
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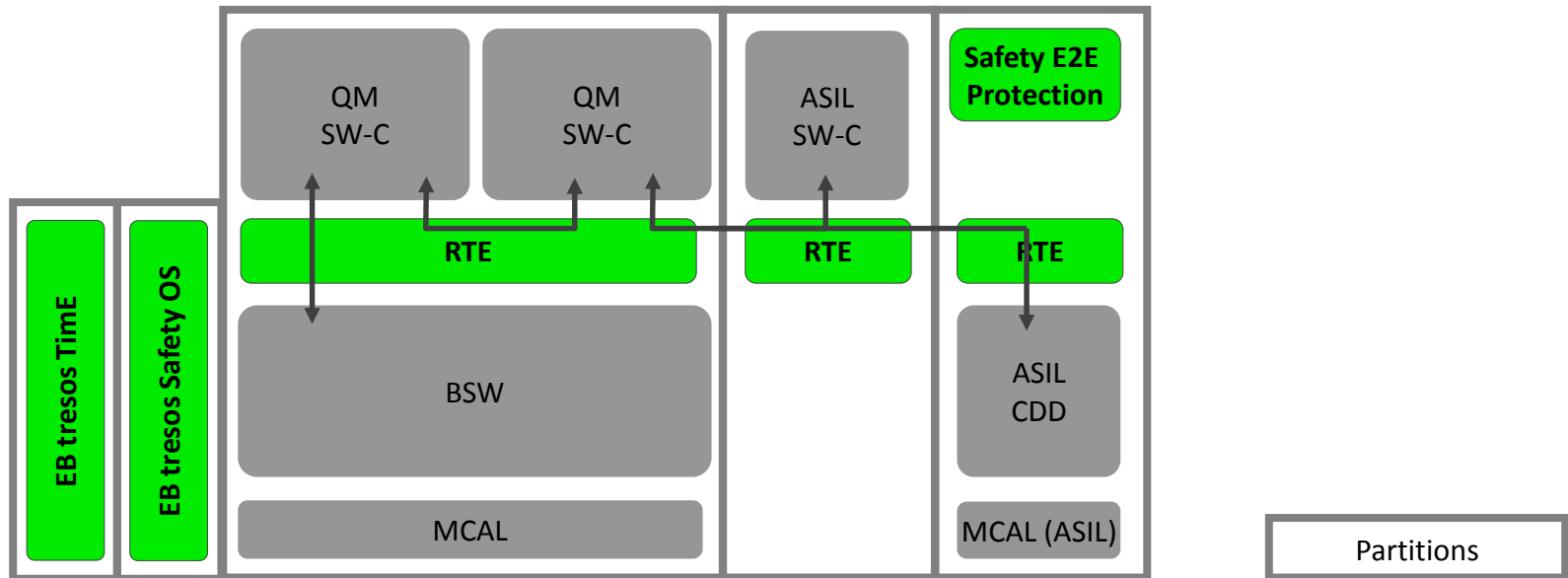
AUTOSAR 4.0 – MultiCore



- AUTOSAR BSW runs on one core
- Safety OS MultiCore and Rte provides the ability to distribute AUTOSAR Software Components (SWC) to different cores



Singlecore Safety architecture



EB tresos Safety products enable

- mix of QM and Safety Software (also different ASIL level)
- integration of Black-Box Software (independent from ASIL-Level)

Os Applications

OS application

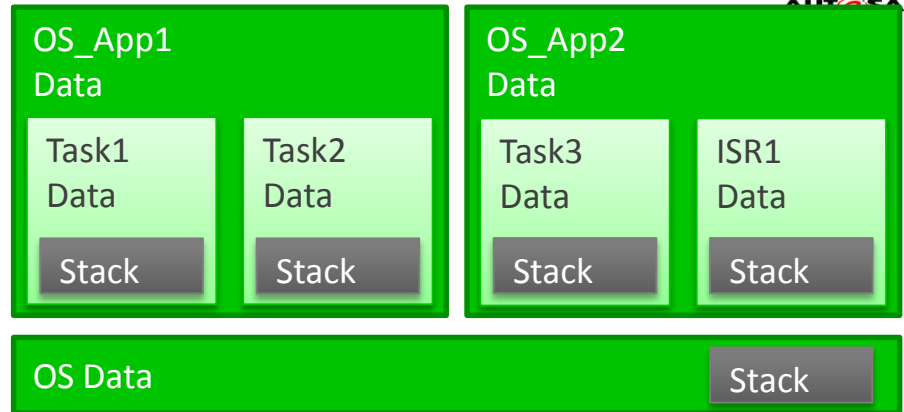
- Group of OS elements (ISRs, tasks, events, alarms,...)

Safety OS

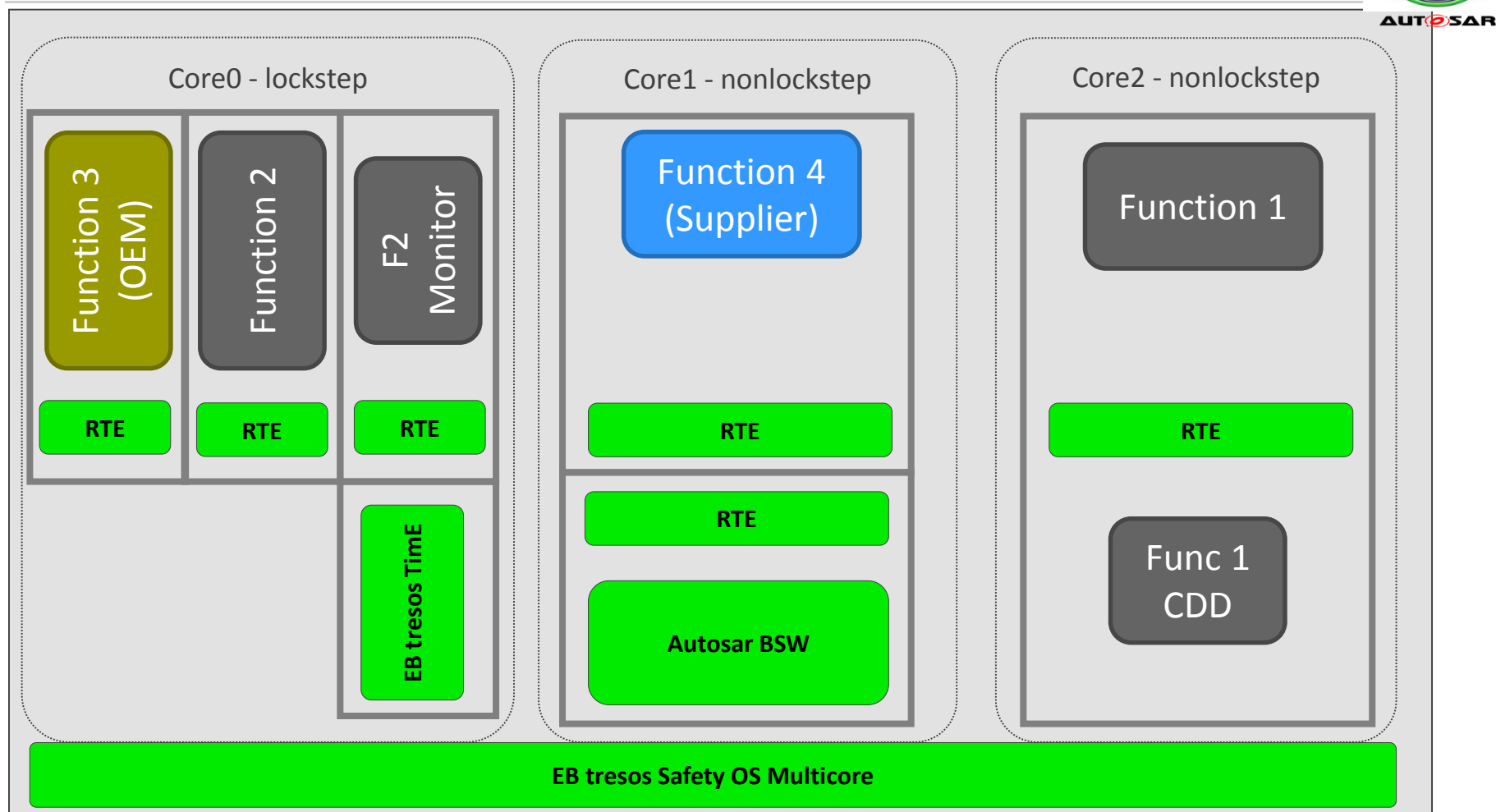
- OS Applications are used to realize memory partition

MultiCore

- OS Applications are used for
 - Task to core mapping
 - ISR to core mapping



Multicore Safety architecture





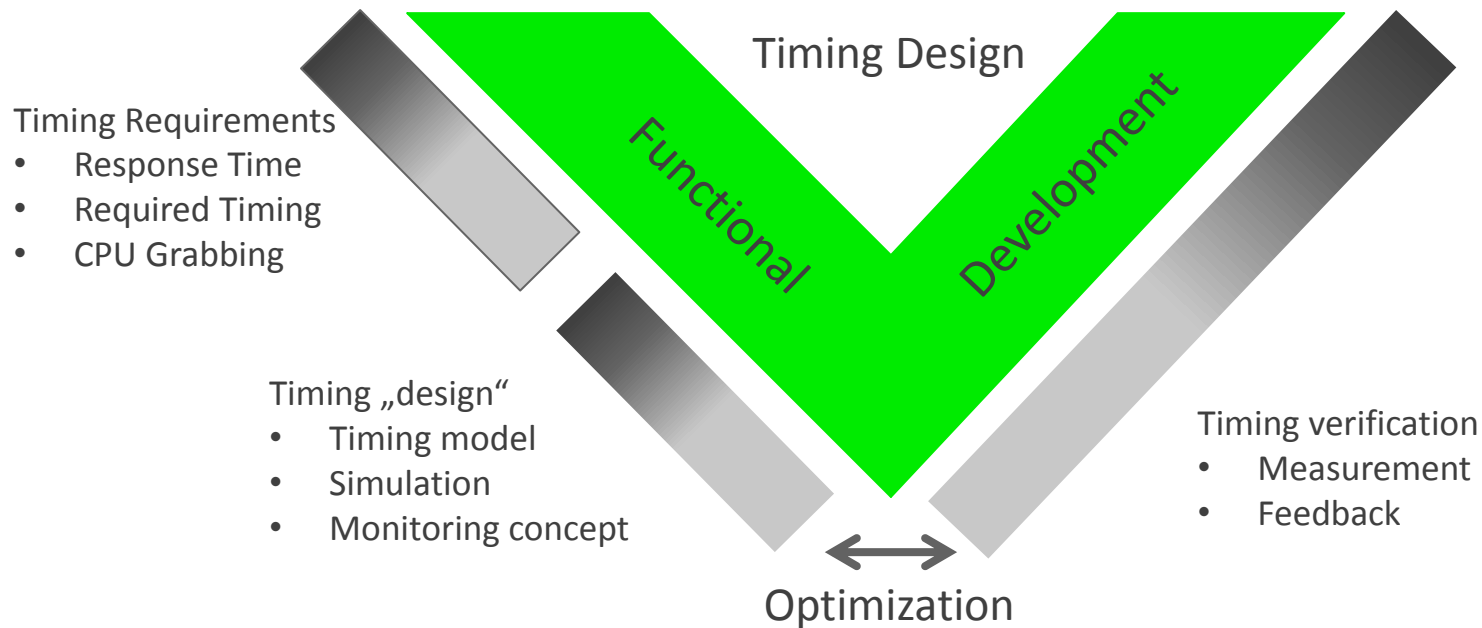
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Summary:

Software Architecture and early verification is the key to success

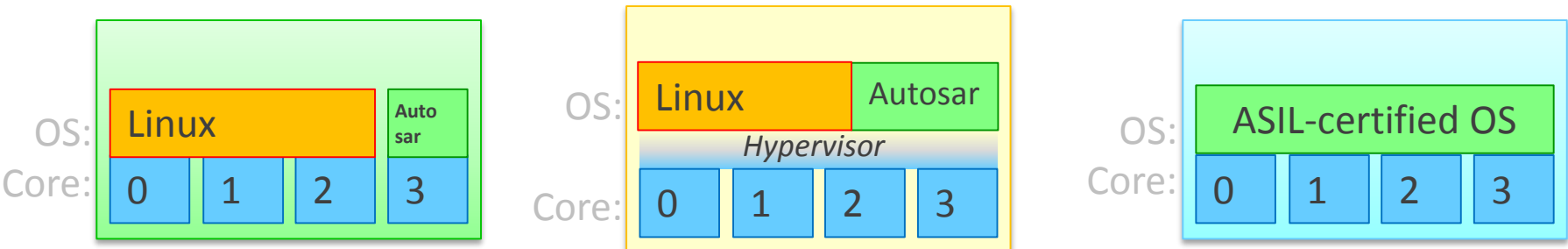


- Connect experts from functional development and infrastructure (Operating system and RTE)
- Functional expert can concentrate on algorithm
- Integration expert can concentrate on OS, RTE, Safety and performance



Outlook – “Reading the Crystal Ball”

- Multi-core systems are becoming a reality now and allow further consolidation of more functions on fewer ECUs
- Software system integration capabilities are key to success:
 - Taming the rising complexity
 - Building dependable, high-integrity systems
- Dynamic (service-oriented), dependable and high-integrity system architectures are required for future vehicles, e.g. autonomous driving.
@EB you can evaluate / order such systems today (or soon) 😊
- Mixed operating system will come



Contact us!



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