

Advanced multicore solution for ECUs

Benefits

- Optimized for efficient multicore utilization
- Enables mixed-criticality system partitions
- Scalable for zonal and domain master nodes
- Multicore enabled gateway functionality

Features

- Standard AUTOSAR multicore components
- Multicore ECU start up and application scheduling
- Application and basic software multicore partitioning and Inter OS Application Communication
- Performance and safety use cases of partitioned and core distributed basic software services
- Multicore distributable communication stacks for signal and service based communication
- Multicore mode management, watchdog, diagnostics, cryptography, memory services

Advanced ECU design with AUTOSAR software and tooling

Capital® VSTAR™ is Siemens' implementation of the AUTOSAR standard. It is a complete offering with tools and software to meet all ECU platform needs from ECU extract updates to software platform configuration.

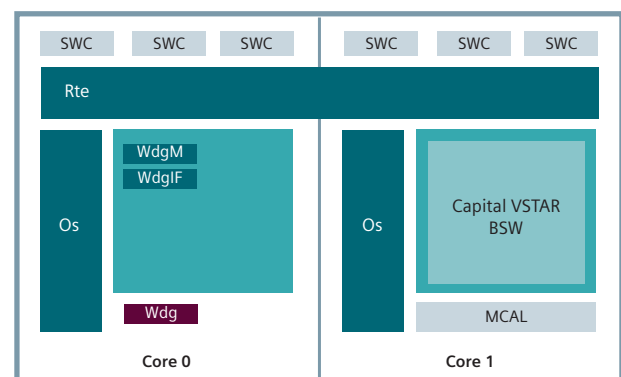
The multicore challenge

Most of the inventions and customer functions of modern vehicles are implemented by software on electrical control units (ECUs). Those functions are steadily increasing and demanding more and more computation resources. Electrical and electronic (E/E) architectures are challenged to manage the increase of ECUs, distribution of functionality and the related costs in bill of material and weight of the wire harness. An approach to overcome those challenges include using multicore enabled solutions which provide efficient and safe utilization of computational resources. This comes with the need for well-planned allocation of vehicle functions on multicore enabled ECUs, their partitions and CPU cores.

AUTOSAR multicore features

The standard AUTOSAR components of Capital VSTAR and their use cases are developed and optimized to be deployed in the latest homogeneous and heterogeneous multicore environments. AUTOSAR basic software offers a strong baseline for multicore ECU deployments:

- **Operating System (Os)** provides an abstraction layer for a standardized interface to higher software layers. It provides scheduling mechanisms, multicore partitioning of applications and the Inter Os Application Communication between those.
- **Run Time Environment (Rte)** is located between the application and the basic software. It utilizes the Os mechanisms in an efficient way to provide application software components basic software services and abstracts the underlying platform.



Basic software separation

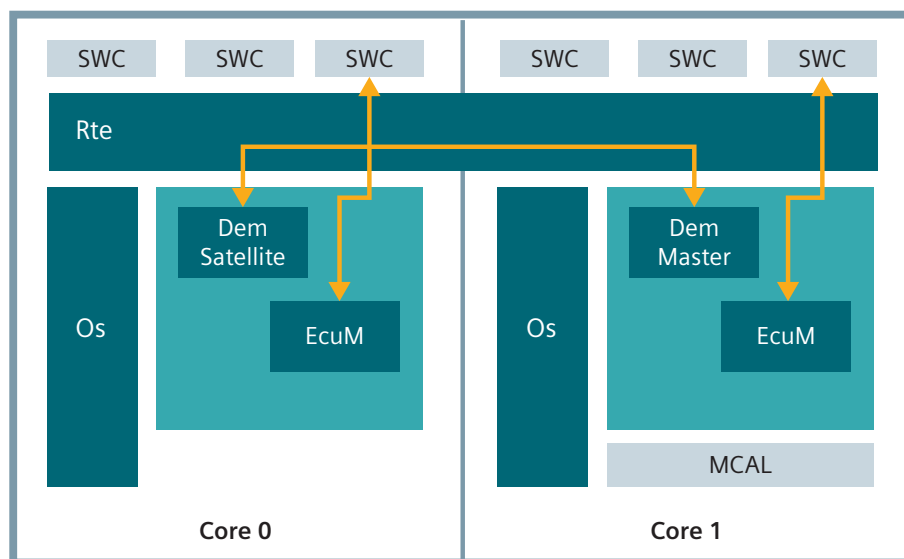
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- **ECU State Manager (EcuM) and Basic Software Mode Manager (BswM)**, provide multicore startup and shutdown scenarios and taking a central role in driver/basic software initialization as well as managing vehicle modes throughout the partitions of the multicore system.
- **Diagnostic Communication Manager (Dcm), Diagnostic Error Manager (Dem) and Function Inhibition Manager (FiM)**, are providing the application with monitoring and diagnostic capability that could affect vehicle function execution partitioned throughout the CPU cores.
- **Watchdog stack (WdgM, WdgIf, Wdg)** supervises the execution of software and gives periodic health reports.

Multicore optimizations

Siemens Digital Industries Software expands its multicore offering with non AUTOSAR specified features. Below only a small extract of what is included:

- **Network communication stack distribution:** Capital VSTAR's communication stack supports the distribution of different bus types such as CAN-FD and Ethernet on different CPU cores. Advanced communication use cases such as service oriented and secured messages create high communication load and can be managed by utilizing multiple cores.
- **Multicore signal gateway:** Zone based nodes need to have the ability and flexibility to gateway information on the highest communication layers. The multicore enabled communication and Protocol Data Unit Router module support gateway use cases between different bus technologies like Ethernet and CAN-FD, even if they are allocated on different cores.



Diagnostic Master/Satellite and core dependent branching ECU State Manager

- **Basic software stretch:** Service module sets are stretched over multiple partitions in order to provide same functionality of the module in the respective partitions. Modules share internal memory or can apply Master-Satellite concept to facilitate cross partition communication techniques. Frequency of cross partition communication is reduced by deep knowledge of the stack and analysis of its internal interactions and sequences. Optimized use cases as well as efficient use of lite Spin-Locks, IOC, TrustedFunctions, OsEvents and scheduling improves responsiveness and CPU load distribution.
- **Basic software separation:** Partitioning fitted to separation of different functionalities, e.g. the watchdog stack or a group of basic software can be completely moved to a separate partition. Separated basic software could have (by configuration) no direct connection to other parts to enable the customer in their safety argumentation and goals.
- **Run Time Environment:** Provides together with the Operating system vendor specific options that enable efficient data transfer or calls between Runnables in interpartition/-core and intrapartition/-core use cases, without risking safety in the system.
- **Operating System:** Provides together with the Run Time Environment vendor specific options that enable efficient Inter Os Application data transfer or optimized synchronizations mechanisms options like Light Spinlocks to leverage the full potential of target specific multicore support.

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