



Automobiles and  
Light Commercial Vehicles



## AUTOSAR – Automotive Open System Architecture

“Cooperate on standards, compete on implementation.”

Alessandra Mitidieri C.

11 dicembre 2008

## Agenda



- AUTOSAR History
- Partnership Structure and Members
- AUTOSAR Main Topics and Benefits
- AUTOSAR Architecture
- Present status
- Future plans and developments
- AUTOSAR in FGA

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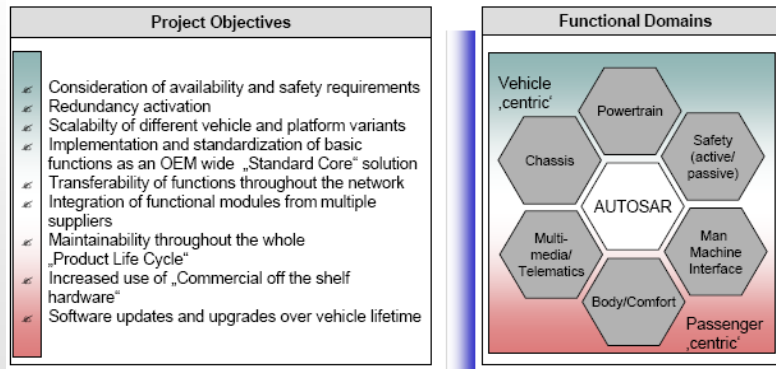
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## About AUTOSAR



**AUTOSAR (AUTomotive Open System ARchitecture)** is an open and standardized automotive software architecture, jointly developed by automobile manufacturers, suppliers and tool developers.

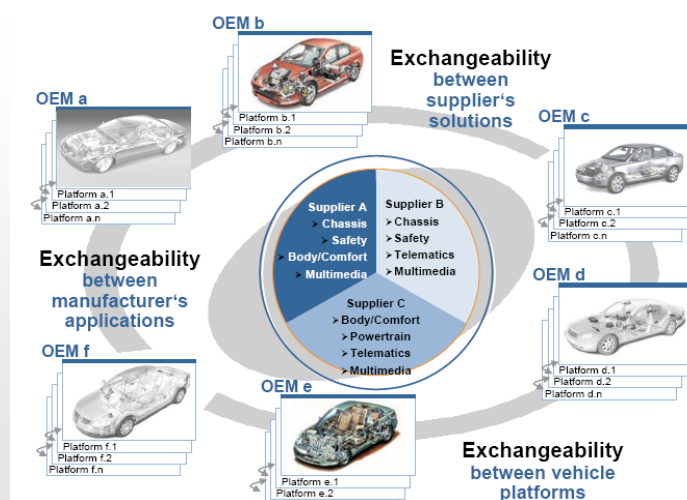


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## Exchangeability and Reuse of Software Components



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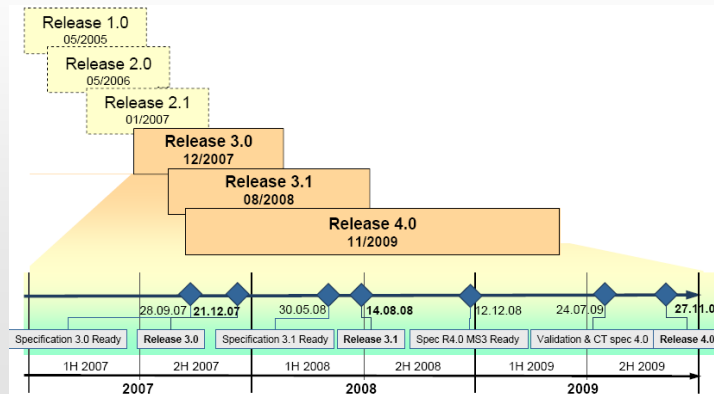
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## AUTOSAR History



**July, 2003** - After an initial discussion on the common challenge and objectives (Aug. 2002) the partnership between the Core Partners was formally signed off. The Core partners were initially BMW, Bosch, Continental, DaimlerChrysler, Volkswagen and Siemens VDO then joined by Ford Motor Company (Nov. 2003), P.S.A. and Toyota (Dec. 2003) and General Motors (Nov. 2004).

**December, 2004** – FGA became AUTOSAR Premium Member



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## AUTOSAR website



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## Partnership Structure



### Core Partners (OEM & Tier 1 Supplier)

- Organizational control
- Technical contributions
- Administrative control
- Definition of external Information (web-release, clearance, etc.)
- Leadership of Working Groups
- Involvement in Working Groups

### Premium Members

- Leadership of Working Groups
- Involvement in Working Groups
- Technical contributions
- Access to current information

### Associate Members

- Access to finalized documents
- Utilization of AUTOSAR standard

### Support Roles

- Development Members
- Attendees

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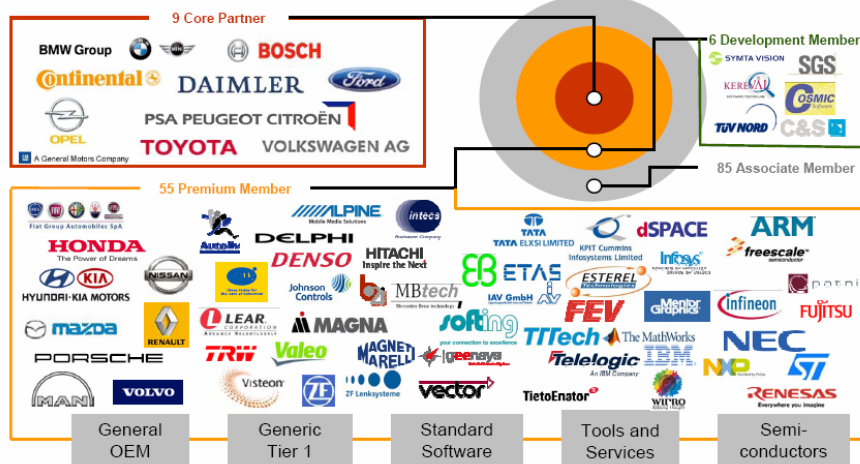
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## Core Partners and Members



Status: 10th October 2008

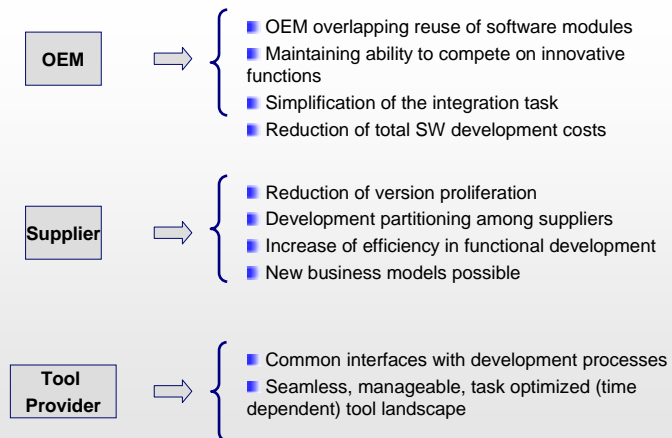


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## AUTOSAR Benefits



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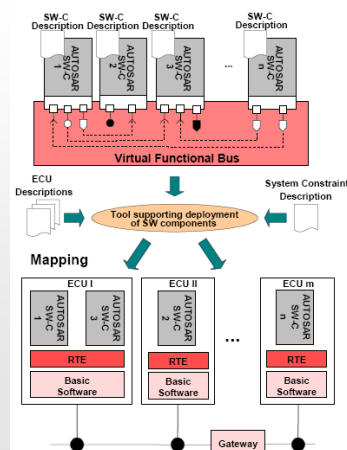
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## Basic AUTOSAR Approach



Following the AUTOSAR Methodology, the E/E architecture is derived from the formal description of software and hardware components.



Functional software is described formally in terms of "Software Components" (SW-Cs).

Using „Software Component Descriptions“ as input, the „Virtual Functional Bus“ validates the interaction of all components and interfaces before software implementation.

Mapping of "Software Components" to ECUs.

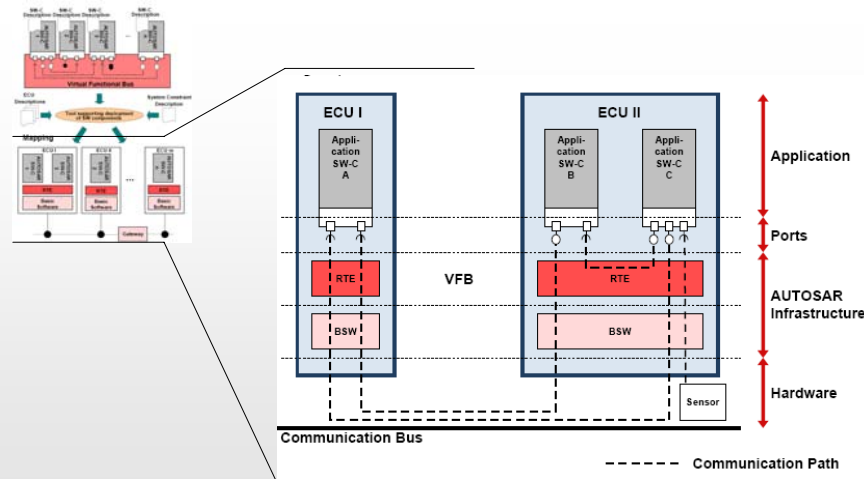
The AUTOSAR Methodology supports the generation of an E/E architecture.

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## Intra- and Inter-ECU Communication

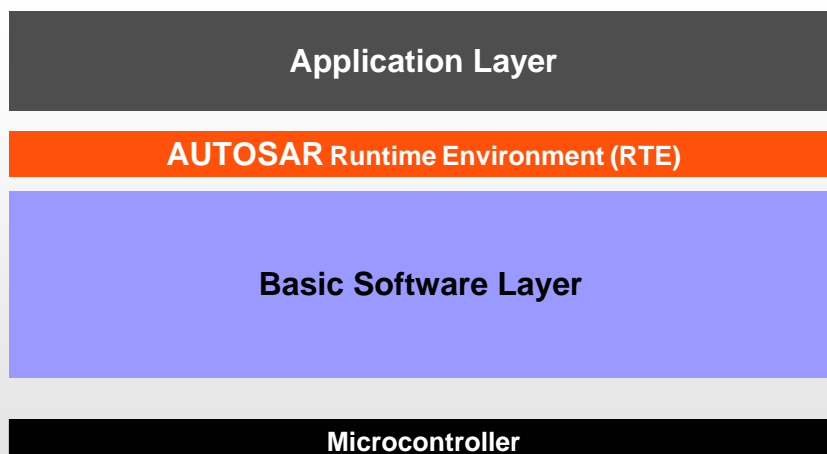


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## AUTOSAR Architecture

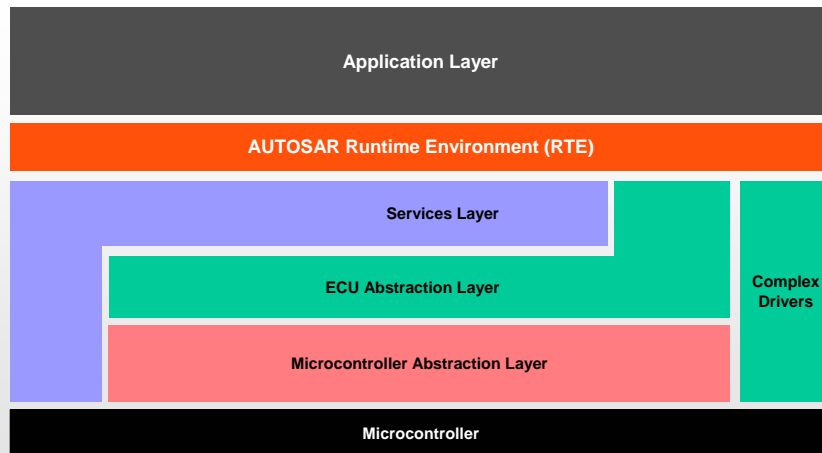


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## AUTOSAR Architecture

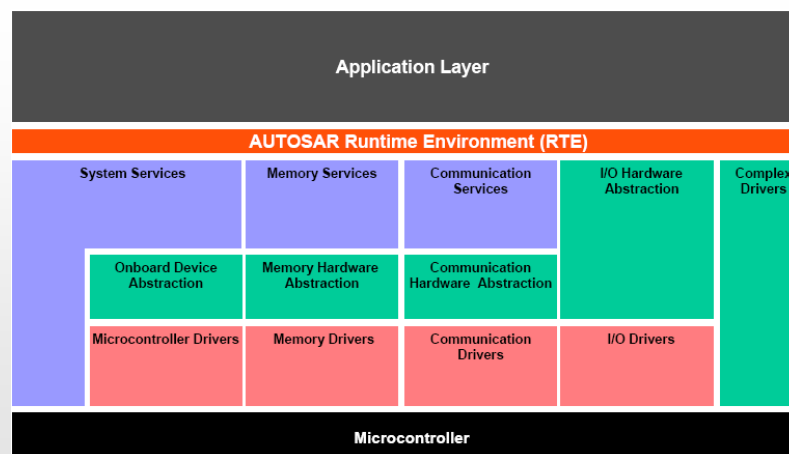


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## AUTOSAR Architecture



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## Microcontroller Abstraction Layer



The **Microcontroller Abstraction Layer** is the lowest software layer of the Basic Software. It contains internal drivers, which are software modules with direct access to the  $\mu$ C internal peripherals and memory mapped  $\mu$ C external devices.

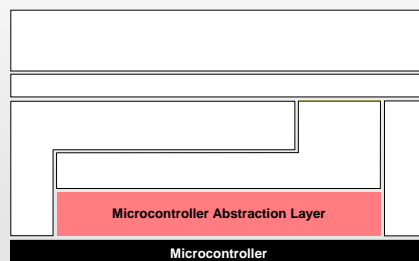
**Task:**

Make higher software layers independent of  $\mu$ C

**Properties:**

Implementation:  $\mu$ C dependent

Upper Interface: standardizable and  $\mu$ C independent



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## ECU Abstraction Layer



The **ECU Abstraction Layer** interfaces the drivers of the Microcontroller Abstraction Layer. It also contains drivers for external devices. It offers an API for access to peripherals and devices regardless of their location ( $\mu$ C internal/external) and their connection to the  $\mu$ C (port pins, type of interface)

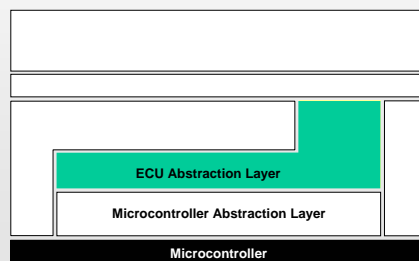
**Task:**

Make higher software layers independent of ECU hardware layout

**Properties:**

Implementation:  $\mu$ C independent, ECU hardware dependent

Upper Interface:  $\mu$ C and ECU hardware independent, dependent on signal type



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## Services Layer



The **Services Layer** is the highest layer of the Basic Software which also applies for its relevance for the application software: while access to I/O signals is covered by the ECU Abstraction Layer, the Services Layer offers

- Operating system functionality
- Vehicle network communication and management services
- Memory services (NVRAM management)
- Diagnostic Services (including UDS communication, error memory and fault treatment)
- ECU state management

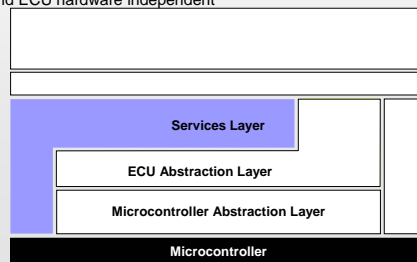
### Task:

Provide basic services for application and basic software modules.

### Properties:

Implementation: partly  $\mu$ C, ECU hardware and application specific

Upper Interface:  $\mu$ C and ECU hardware independent



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## RTE



The **RTE** is a layer providing communication services to the application software (AUTOSAR Software Components and/or AUTOSAR Sensor/Actuator components).

The RTE is the implementation of the Virtual Functional Bus (VFB) concepts. It realizes the communication between software-components (SWCs) and between SWC and basic software (BSW) modules.

Above the RTE the software architecture style changes from "layered" to "component style". The AUTOSAR Software Components communicate with other components (inter and/or intra ECU) and/or services via the RTE.

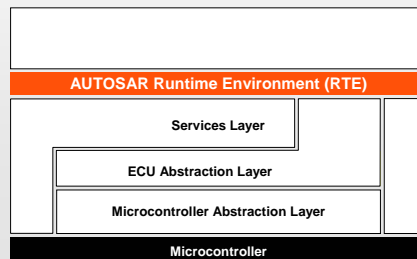
### Task:

Make AUTOSAR Software Components independent from the mapping to a specific ECU

### Properties:

Implementation: ECU and application specific (generated individually for each ECU)

Upper Interface: completely ECU independent

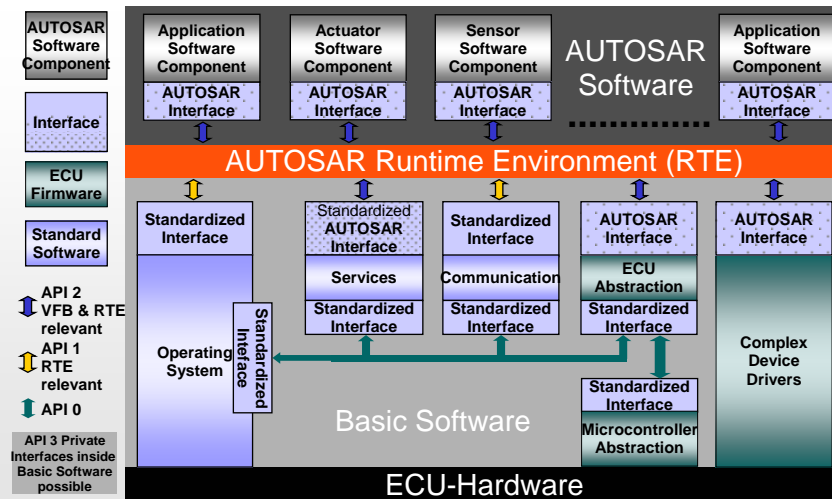


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## AUTOSAR Architecture: Standard Interfaces



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## AUTOSAR – Validation



- **Release 1.0 and 2.0** have been validated developing two validators, mainly focused on BSW.
- The approach for BSW validation was focusing on:
  - Exchangeability of implementations from different implementers
  - Check of interoperability of the modules in the stack (does the APIs fit together?)
  - Check whether the specifications are unambiguous
- **Releases 2.1, 3.0 and 3.1** have been validated by each implementer.
- **Release 4.0:** the results of the validation are expected to be incorporated into the Release 4.0

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## AUTOSAR – Validation Results



- AUTOSAR **harmonizes** already existing basic software solutions and **closes gaps** for a seamless basic software architecture.
- AUTOSAR aims at finding the **best solution for each requirement** and not finding the highest common multiple.
- The **decomposition** of the AUTOSAR layered architecture into some 50 modules has proven to be **functional** and **complete**.
- The **AUTOSAR 2.0 specifications** for the modules of the layered architecture have been **successfully implemented and integrated**.

## Next Steps: AUTOSAR release 4.0 (Nov. 2009)



### Architecture

- Architectural improvement in terms of error handling and multicore support
- Communication stack evolution related to FlexRay and diagnostic over Ethernet.
- Support for functional safety.
- Functional enhancement of BSW mode managers.
- Quality improvement developing conformance tests specifications and applying validation.

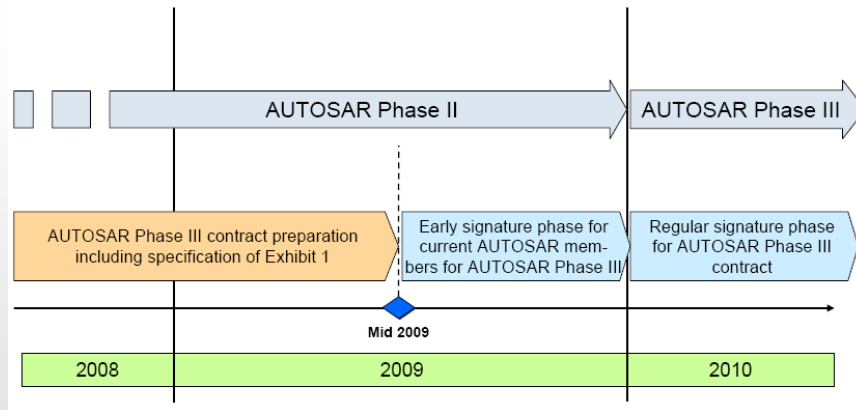
### Application level: Continuous development in the 5 different domains

- Body and comfort
- Powertrain
- Chassis control
- Occupants and pedestrian safety
- MM / T / HMI

### Methodology and templates enhancement

- Timing specification
- Variant handling

## Next Steps: Time plan of AUTOSAR phase III



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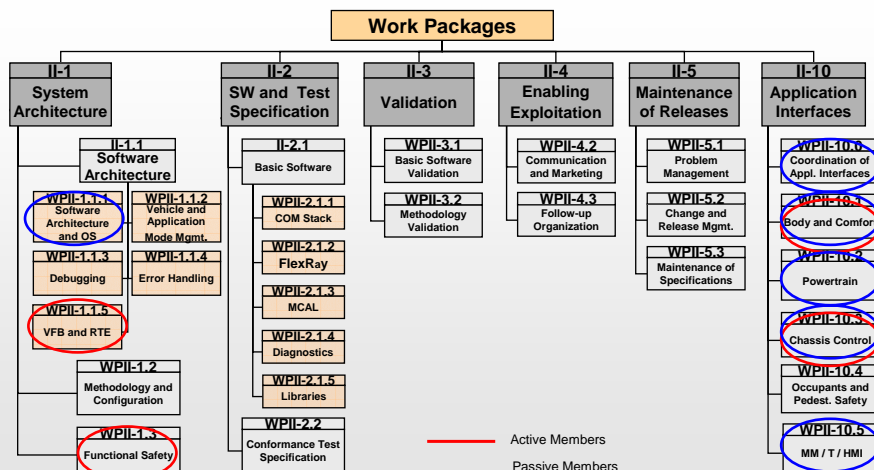
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## FGA in AUTOSAR Consortium



FGA starts working in AUTOSAR consortium as Premium Member at the end of 2004 with 10 active and passive members in some Work Packages.



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## FGA AUTOSAR Strategy



### Application Software

30%



- SWC's "in-house" development in Body Electronics, Infotainment, Climate Control and Chassy environment.
- SWC's reuse and standardization in many car projects

+

### Basic Software

70%



- Management of some BSW stacks:
  - ✦ Communication
  - ✦ Diagnosis
- Centralized development of cited SWC's stacks
- Centralized distribution of cited SWC's stacks
- Optimization of validation phases
- 100% AUTOSAR compatibility for some ECU Suppliers

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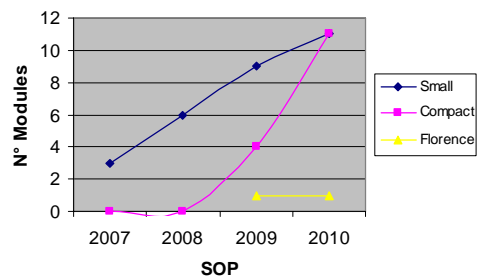
## AUTOSAR: Application SW development



### "AUTOSAR Body Computer" Project

- 6 SW modules nowadays in production, including "Alfa D.N.A." e "Stop&Start"
- 11 SW modules in production "fully operational" (2010)
- 14 SW modules involved on 3 architectures
- 81% of application software developed by FGA "fully operational"
- 100% reuse of software deliberato
- 80% minimum reuse in different cars

### Body Computer - FGA Software Modules



### Future developments on different systems/environments

- 3 modules in Chassis Control Systems environment
- Instrument Panel Cluster: an enquiry is going on with Suppliers
- Climate Control System: possible synergy with already developed SW modules by Interiors

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# Thank you!

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