

AUTomotive Open System ARchitecture

**-
An industry-wide initiative
to manage the complexity
of emerging Automotive
E/E-Architectures**

Development partnership with:

**BMW Group
Bosch
Continental
DaimlerChrysler
Ford Motor Company
PSA Peugeot Citroën
Siemens VDO
Toyota Motor Corporation
Volkswagen AG**

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1. Introduction

The current automotive electric/electronic (E/E) architecture landscape is characterized by proprietary solutions that seldom allow the exchange of applications between both automotive OEMs and their suppliers. However the exponential growth in functional scope will require an increase re-use even across OEMs and suppliers.

In the past, the automotive industry had to react response on major technological advances in order to address such challenges. Recent examples include the transition from analog to digital bus systems and the introduction of deterministic technologies.

A technological breakthrough is required in order to control the complexity of contemporary E/E architecture that is being driven by the introduction of innovative vehicle applications and increased passenger and legal requirements.

This need is particularly effective for high-end, luxury vehicle manufacturers and their leading Tier 1 suppliers who are facing with often-conflicting requirements from

- Legal enforcement – key items include environmental aspects and safety requirements
- Passenger convenience and service requirements from the comfort and entertainment functional domains
- Driver assistance and dynamic drive aspects - key items include detection and suppression of critical dynamic vehicle states and navigation in high-density traffic surroundings.

Motivations for change

Motivations for change are

- Management of E/E complexity associated with growth in functional scope
- Flexibility for product modification, upgrade and update
- Scalability of solutions within and across product lines
- Improved quality and reliability of E/E systems

Leading OEMs (BMW Group, DaimlerChrysler, Ford Motor Company, PSA Peugeot Citroën, Toyota Motor Corporation, Volkswagen AG) and Tier 1 suppliers (Bosch, Continental, Siemens VDO), having recognized this to be an industry-wide challenge, have now decided to work together. Their common objective is to create a basis for industry collaboration on basic functions and interfaces while providing a standardized platform on which an efficient competition on innovative functions is enabled.

(see Figure 1)

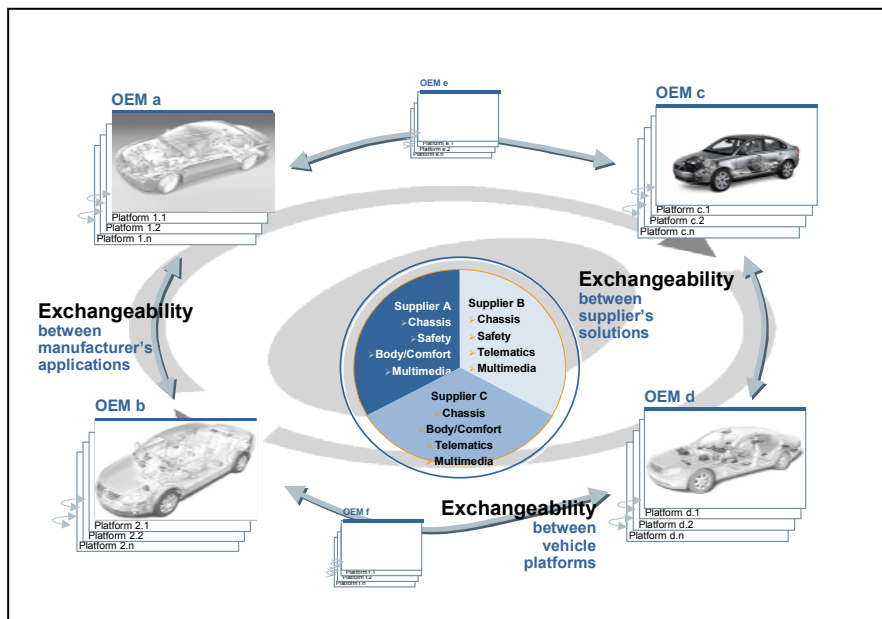


Figure 1: AUTOSAR Target of Exchangeability of functions between OEM and suppliers

AUTOSAR Partnership and standard

A development partnership called **Automotive Open System Architecture (AUTOSAR)** has recently been formed. The AUTOSAR standard will serve as a platform upon which future vehicle applications will be implemented and will also serve to minimize the current barriers between functional domains. Its scope encompasses Powertrain, Chassis, Safety (active and passive), Multimedia/Telematics, Body/Comfort and Man Machine Interface functional domains. Applied to all previously cited functional domains, primary objectives (see Figure 2) are

- **Consideration of availability and safety requirements**
- **Redundancy design and activation.** Redundant activation is the ability to internally activate redundant functionalities.
- **Scalability** to different vehicle and platform variants
- **Implementation and standardization of basic system functions as an OEM wide “Standard Core“ solution.** Initial focus for the integration of basic system functions and technologies are:
 - Bus Technologies (MOST, FlexRay, CAN, LIN, ...)
 - Operating Systems (OSEK/time, ...)
 - Communication Layer, OSEK/COM, OSEK fault tolerance, API*
 - HW Abstraction Layer
 - Middleware/ Interfaces – APIs
 - Standard Library Functions (CRC checksum, Cast Operations, Simple mathematical functions, ...)
- **Transferability of functions throughout network.** It will be possible to map functions and functional networks to different control nodes in the system, almost independently from the associated hardware.
- **Integration of functional modules from multiple suppliers**

- **Maintainability** throughout the whole “Product Life Cycle“
- **Increased use of “Commercial off the shelf hardware“**
- **Software updates and upgrades** over vehicle lifetime

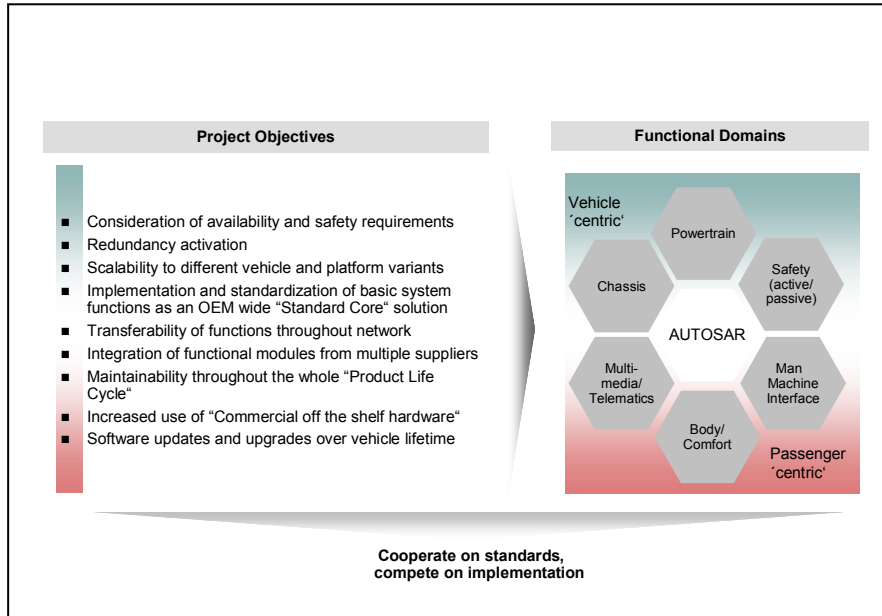


Figure 2: AUTOSAR high level project objectives

2. Description

Overview

To achieve the technical goals modularity, scalability, transferability and re-usability of functions AUTOSAR will provide a common software infrastructure for automotive systems of all vehicle domains based on standardized interfaces.

AUTOSAR standard encompasses:

- Standardization of different APIs to separate the AUTOSAR SW layers
- Facilitate encapsulation of functional SW-components
- Definition of the data types of the SW-components to be AUTOSAR compliant
- Identify basic SW modules of the SW infrastructure and standardize their interfaces

A schematic view of AUTOSAR SW layers are shown in Figure 3.

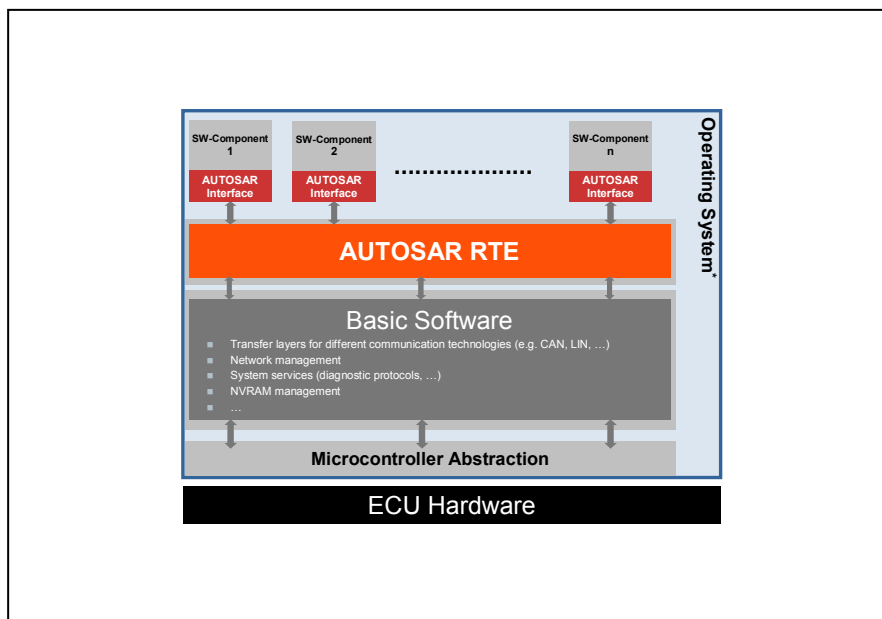


Figure 3: Schematic view of AUTOSAR software architecture

AUTOSAR will enable system-wide as well as configuration process optimization (e.g. partitioning and resource usage) and if required, allow for local optimization to meet the runtime requirements of specific devices and hardware constraints.

3. Benefits

The focus areas of this strategy are the modularity, configurability and transferability of SW modules and the standardization of their interfaces.

Functional transferability will enable the shift from proprietary to standard solutions resulting in the following benefits:

- Increased reuse of SW IP
- Increased design flexibility
- Clear design rules for integration
- Reduction of total SW development and service costs

Benefits for OEM:

- OEM overlapping reuse of non-competitive software modules
- Protection of innovation and competitive functions is in focus at OEM
- Later sharing of innovations is accessible (additional ROI)
- Focus on innovation/ functions
- Standardized certification

Benefits for Supplier:

- Reduction of version proliferation
- Development partitioning among suppliers
- Increase of efficiency in functional development
- New business models possible
- Preparation for upcoming increase in software volume

Benefits for tool provider:

- Common interfaces with development processes
- Seamless, manageable, task optimized (time dependent) tool landscape

Benefits for new market entrant:

- Transparent and defined interfaces enable new business models
- Clear contractual task allocation and outsourcing of Software-Implementation accessible

4. AUTOSAR Initiative

The AUTOSAR partners have been in active discussions since October 2002 and the partnership agreement was signed in July 2003. The partnership has adopted a three-tier membership structure that has been proven in similar initiatives. Each tier of the partnership has specific rights and duties that are outlined in appropriate agreements (See Figure 4).

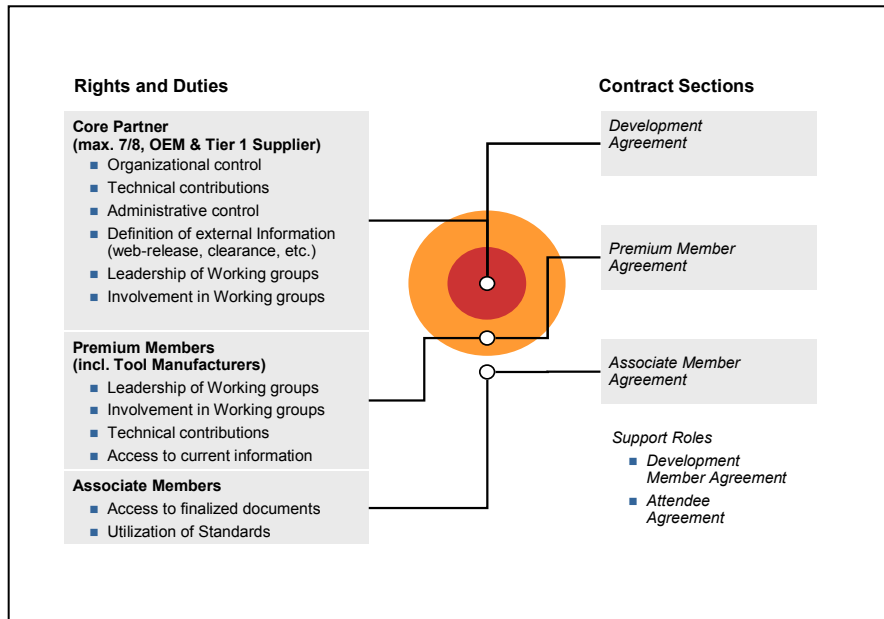


Figure 4: Three-tier membership structure of AUTOSAR

Core partners have organizational and administrative control, make technical contributions and determine the information to be distributed externally. Currently the core partners are BMW Group, Bosch, Continental, DaimlerChrysler, Ford Motor Company, PSA Peugeot Citroën, Siemens VDO, Toyota Motor Corporation, and Volkswagen AG. Strong interest has been shown by further leading OEMs to join as core partners and discussions to this end are ongoing.

Premium members participate in and can lead working groups, make technical contributions and have access to current information.

Associate members may use the standards and have access to finalized documents before release to public. The partnership will also welcome third parties to join as Development members or Attendees, both of whose participation is free of charge.

Development Member participates in and co-operates with the Partnership in one or more Working Groups in accordance with further instructions and guidelines from the Partnership.

Attendee contributes to the establishment of close connections between corporate research and development work undertaken by the Partnership and commercially independent, non-corporate research and development work represented by the Attendee and the institution which he represents.

5. Schedule

The admission process has been formally initiated from the 25. September 2003.

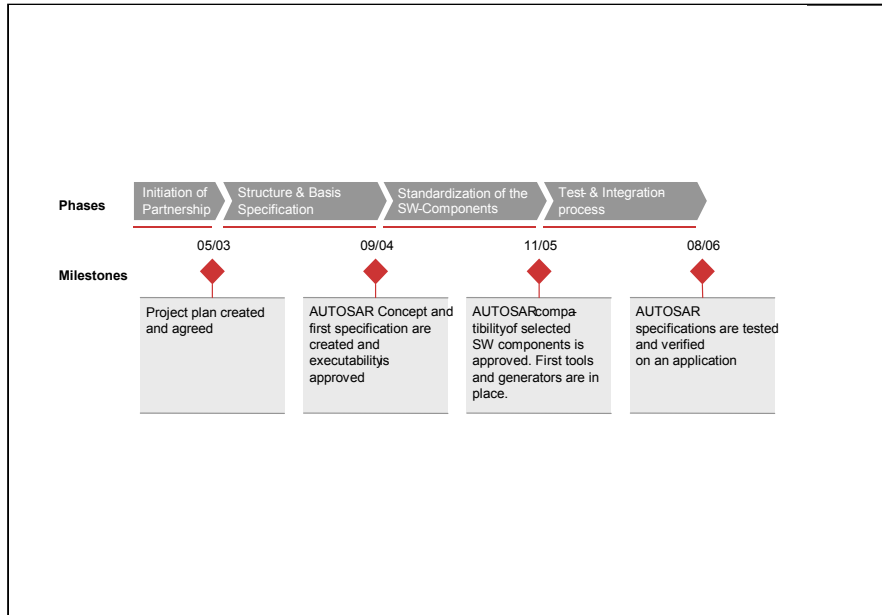


Figure 5: Timeline of AUTOSAR project

The project structure is divided into four sections. In the startup phase the partnership was initiated by setting up a detailed work plan and project management. Phase 2 is determined by the definition of interface specification and AUTOSAR concept harmonization. In Phase 3 focus is set on the standardization of the software components. The phase of testing and integration will finalize the development phase of the AUTOSAR standard.

6. Summary

The introduction of the AUTOSAR standard will place the future of E/E- development in automotive industry on a commonly accepted and stable basis. This will be the key element in order to cope with the functional and legal requirements in next generation vehicle architectures. In addition the increasing uptake of software solutions is placed on reliable design basis allowing for functional (re-) integration and concentration on the development of real new and novel functionalities. The standardization in AUTOSAR is mandatory in the automotive industry in order to secure market attractiveness.

7. References

Website

<http://www.autosar.org>

Publication

VDA Congress "Safety through Electronics", 20. - 21. March 2002, Stuttgart, Germany, Proceedings of the Technical Congress 2002, p. 267 - 276.