

# Early Migration creates Opportunities for Innovations

## Mix of Individual Software and AUTOSAR Components in Vehicle Electronics

ECU development in the motor vehicle is evolving rapidly. This article sheds light on one important aspect: The introduction of standardized basic software defined by the AUTOSAR development partnership. If AUTOSAR software components are added to the overall architecture in a stepwise and differentiated manner, this assures quality enhancements.



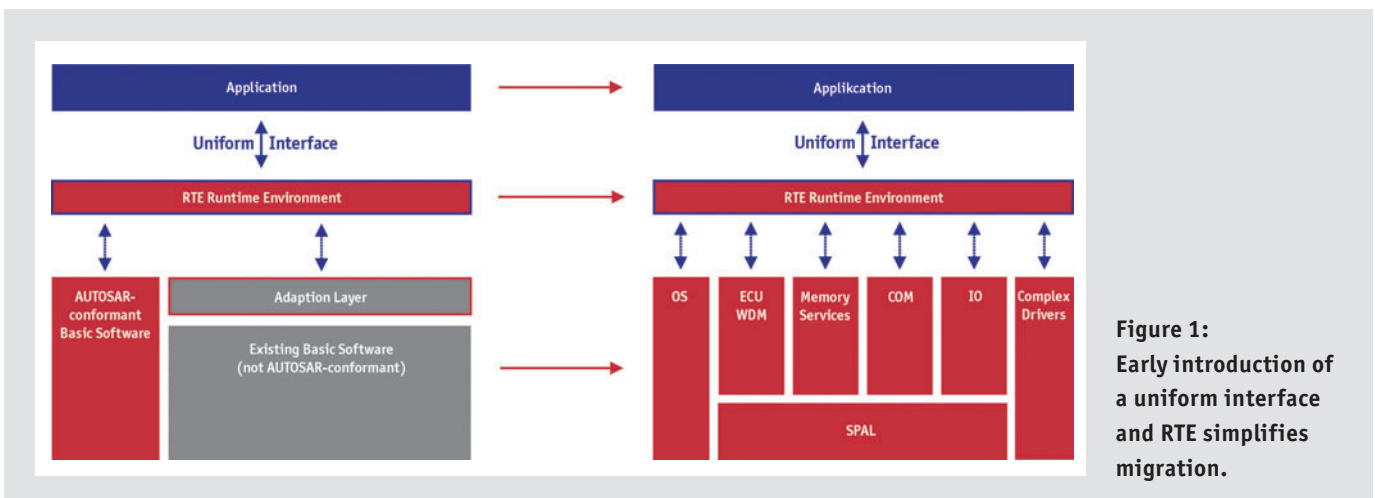
At the beginning of 2007, the AUTOSAR development partnership defined, in its Release 2.1, a practice-tested software architecture that is used as a foundation for developing reusable applications. With publication of these specifications, in the future it will be possible for all companies belonging to the AUTOSAR development partnership to develop AUTOSAR-conformant components. However, its practical implementation is not trivial. The transition from individual software to standard software has to be well-planned and is certainly only conceivable if a stepwise approach is taken. The AUTOSAR philosophy and description language create a diverse environment for using standardized software. In practice, this may be a mixed installation of AUTOSAR and non-AUTOSAR components or an integration of basic software for specific platforms by a number of different software suppliers. For both types of implementation, it is necessary to clarify and define the relevant constraints from various perspectives.

### Vehicle perspective

From the OEM perspective, basic platforms, technological platforms, etc. are being developed, from which the next generations of cars will be derived. The underlying goal here is to integrate one and the same ECU in many vehicles and thereby reduce costs. At the same time, the quality and the stability of the vehicle electronics should be improved. This results in a dilemma between the imperatives of a newly introduced technology and the stability of the product.

### Architectural perspective

From the point of view of an ECU individual software components are discernible. At the same time, two contradictory approaches are being followed with regard to the base software of today's ECUs. On the one hand, many OEMs require specific software components or at least they specify them. On the other hand, control module producers are striving internally to always use the same architecture for a control module platform. Added to this is the fact that the degree of standardization of the software is not as comprehensive as



described by AUTOSAR. The goal here is to apply a standard to software that does not serve the purpose of competitive differentiation, thereby creating space for new innovations. Optimally, low investment costs would be incurred by new tools, since those tools already in service can for the most part be reused.

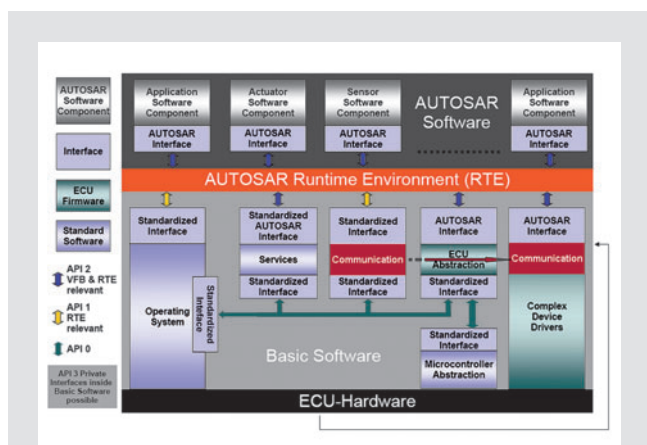
### Clear migration strategy as factor in success

When these two perspectives are applied to a decision on introducing AUTOSAR, it makes sense to select a multistage approach.

#### Stage I – Set up the architecture and expand:

The first step is to compare the existing custom software and the AUTOSAR architecture. After analyzing overlaps and integration potentials, a decision is made regarding which modules will be preserved and which ones can be replaced by standard software. At this stage it is recommended that a separating layer be introduced between application software and base software as well as a standardized interface. The so-called Runtime Environment (RTE) serves as the link for the necessary data exchange, and as a buffer with defined interface it enables modular programming without dependencies. This is how AUTOSAR components can be integrated without making additional changes to the custom and application software. The custom software is linked to the system architecture via an Adaptation Layer to enable data exchange with the AUTOSAR components via the RTE; see Figure 1.

To minimize cost and effort and arrive at an optimal overall solution, it is helpful at this point to integrate the custom software in the configuration tools.



**Figure 2:**  
Integration of custom software in the AUTOSAR architecture.

#### Stage II - Replace:

Non-AUTOSAR components can now be replaced gradually by AUTOSAR components without putting the overall architecture at risk or requiring reprogramming of other modules. The goal here is to set up an AUTOSAR architecture and use the appropriate tools. Initiated in individual ECUs, in the end the entire vehicle is conceptualized with AUTOSAR software, starting with system design and ending with integration.

#### Using the AUTOSAR architecture in designing new ECUs

As implied in Figure 2, essential parts of the individual software can also be reused in the framework of an AUTOSAR architecture. They are then linked to the application via an adaptation layer as a complex device driver.

An overlap matrix shows the portions in which AUTOSAR software can be introduced without great risk. Primarily, the memory section and the IO hardware abstraction can be migrated smoothly. Cluster memory management in particular has very clear and easy-to-use interfaces that enable its early migration to new ECUs.

In communication and diagnostics, on the other hand, there are considerable overlaps between proprietary vehicle software and the standard modules of the AUTOSAR basic software. In the interest of stability in the vehicle, a more conservative approach is required here. Many OEMs utilize platform ECUs, in which existing software modules are transferred to new vehicle models. One implication is that the network and communications strategy cannot be changed over the short term. In the case of an immediate migration, ECU calibration and off-board diagnostics would also need to be adapted, which in practice would lead to significant problems.

Therefore, the simplest path is to use the existing communication stack in the AUTOSAR environment too. This stack can be linked to the RTE via an adaptation layer.

Vector has the necessary expertise in this area and can propose the right solutions for creating such mixed architectures or supply them to the customer. For example, the familiar XCP protocol can be integrated in a migration architecture so that existing measurement and calibration tools such as CANape can be used.

The described approach is not a pure top-down approach, since at many points AUTOSAR software can even be integrated on lower hardware-related layers. Its modular structure and defined interfaces help in implementing the standard software on the SPAL level without affecting the upper layers. This offers an enormous advantage with regard to reuse.

Vector Informatik utilizes the concept of Product Clustering here. Based on AUTOSAR specifications, the products offered range over a number of layers and provide total solutions for memory, commu-

nication, diagnostic and system areas. These are independently functioning areas, some of which can also be implemented without AUTOSAR architecture. Cluster memory for example can be integrated quickly and easily in many ECU applications; see Figure 3.

### Support by tools

An important pillar in the introduction of AUTOSAR relates to the tools. They must be able to operate the AUTOSAR interfaces, yet they must remain open to integration of third-party components. Above all, configuration tools should be able to master this challenge and also support the user in validation of the system configuration.

The tool world servicing AUTOSAR can be subdivided into three categories: Design, configuration and test/simulation. Above all, suitable test instruments are an essential component for successful development. An ECU operates as a part of a whole. Checking for and assuring consistency in the overall system requires a high-performance simulation tool. Vector Informatik GmbH has come to grips with these requirements and can make a contribution to the success of AUTOSAR with its comprehensive tool solutions such as the DaVinci Tool Suite, MICROSAR Configuration Suite and CANoe. Support in the context of project work and consultation complement the products offered.

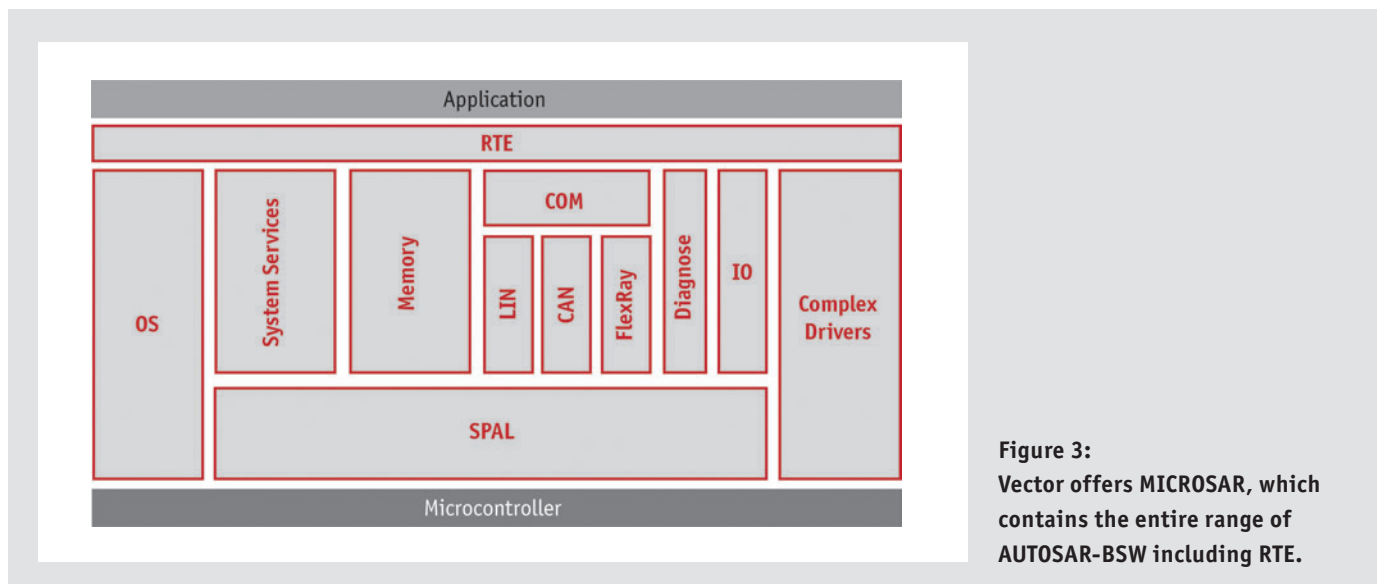
### Summary

When considered from different points of view, a stepwise introduction of the standard components defined by the AUTOSAR development partnership into an individual company's software architecture appears to be the correct path. This approach guarantees quality and consistency. Proper tools support this process. Gradual migration instead of an immediate total conversion leads to an overall AUTOSAR solution in the vehicle that minimizes risks. Vector's expertise and many years of experience lend support to this process.



#### Peter Schiekofer

(Graduate Engineer) has been employed at Vector since May 2006. He manages Vector's Regensburg subsidiary and is responsible for advanced technical development of AUTOSAR solutions. As an active working participant on Working Packages WP 1.1.2 and WP 20 of the AUTOSAR Development Partnership he is directly involved with the new technology.  
Tel. +49-941/20865-101,  
Fax +49-941/20865-111,  
E-mail:  
peter.schiekofer@vector-informatik.de



**Figure 3:** Vector offers MICROSAR, which contains the entire range of AUTOSAR-BSW including RTE.