

AUTOSAR Goes Off-road

Automotive standard expanding to include agricultural and construction vehicles

A decade after its introduction, the AUTOSAR standard is finding its way into agricultural and construction vehicles. For cost and quality reasons, this makes sense – but equipment manufacturers should plan carefully.

AUTOSAR is writing history. Only twelve years after it was introduced, AUTOSAR (Automotive Open System Architecture)¹ has become one of the most influential standards in the automotive industry. And with good reason: AUTOSAR-compliant software functions are interchangeable, independent of software and hardware providers, and reusable. Now, the most recent release has hit the unpaved road and has off-highway vehicles in its sights. While the first agricultural and construction vehicle OEMs are already using the standard, others are deliberating about what advantages AUTOSAR might bring them.

A successful standard

Nearly 180 companies worldwide have joined the AUTOSAR development partnership to further refine and use the standard for software architecture, application interfaces, and methodologies for configuring and generating ECU software. At the core is the AUTOSAR layer model (diagram), which makes it possible to implement software components from various providers spanning many product generations, independent of the underlying hardware.

Key challenges for agricultural and construction vehicles

A number of factors need to be considered before AUTOSAR can be

used in the off-highway vehicle sector. In principle, ECUs for cars, agricultural equipment, and construction vehicles are similar, since they use the same microcontroller families. But there are some differences, too:

- Due to the lower number of units produced, the development costs per ECU are higher in the off-highway vehicle sector; this is often compensated for by the reuse of hardware and software designs based on “generic” ECUs.
- Vehicle manufacturers primarily develop software in-house. Only the board support packages come from Tier 1 suppliers.
- The wide range of implements that can be attached to these vehicles makes them even more varied – and increases the number of different variants of software functions. So a flexible software architecture and system configuration is required.
- Solutions must adhere to industry-specific standards such as J1939, ISOBUS, Profibus, and CANOpen communication protocols, as well as ISO 25119 “Functional Safety for Tractors and Machinery for Agriculture and Forestry”².

Although there are differences, automakers and agricultural and construction vehicle manufacturers do share one key requirement: in the interest of quality and efficiency,

they all want to reuse as many software components as possible. AUTOSAR software architecture offers the perfect framework for this because it fulfills both application-specific tasks. For example control of individual devices, and system services such as network management. This allows OEMs to concentrate on the development of system and software functions that add value for end customers while sourcing and implementing commercially available standard software.

Requirements for functional safety

This modularity presents risks to functional safety. Faults in sourced modules could disrupt safety-related functions; this is something that must be ruled out before software modules from different sources are integrated. This is where ISO standard 25119 is helpful. It defines a set of measures that ensure faults remain isolated locally, for instance through software partitioning. Meanwhile multi-core systems, scheduling, and watchdog mechanisms safeguard communication between ECUs and software components.

AUTOSAR supports the ISO 25119 measures through its own software partitioning mechanism. Its use is particularly recommended for uni-

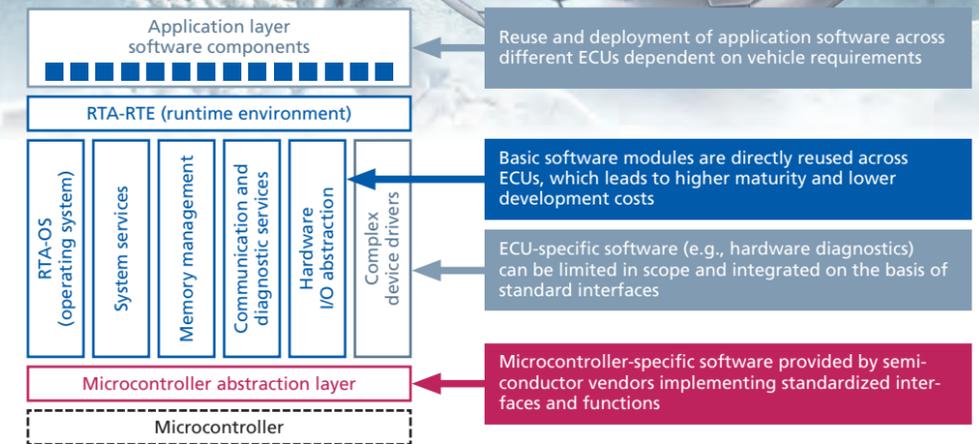
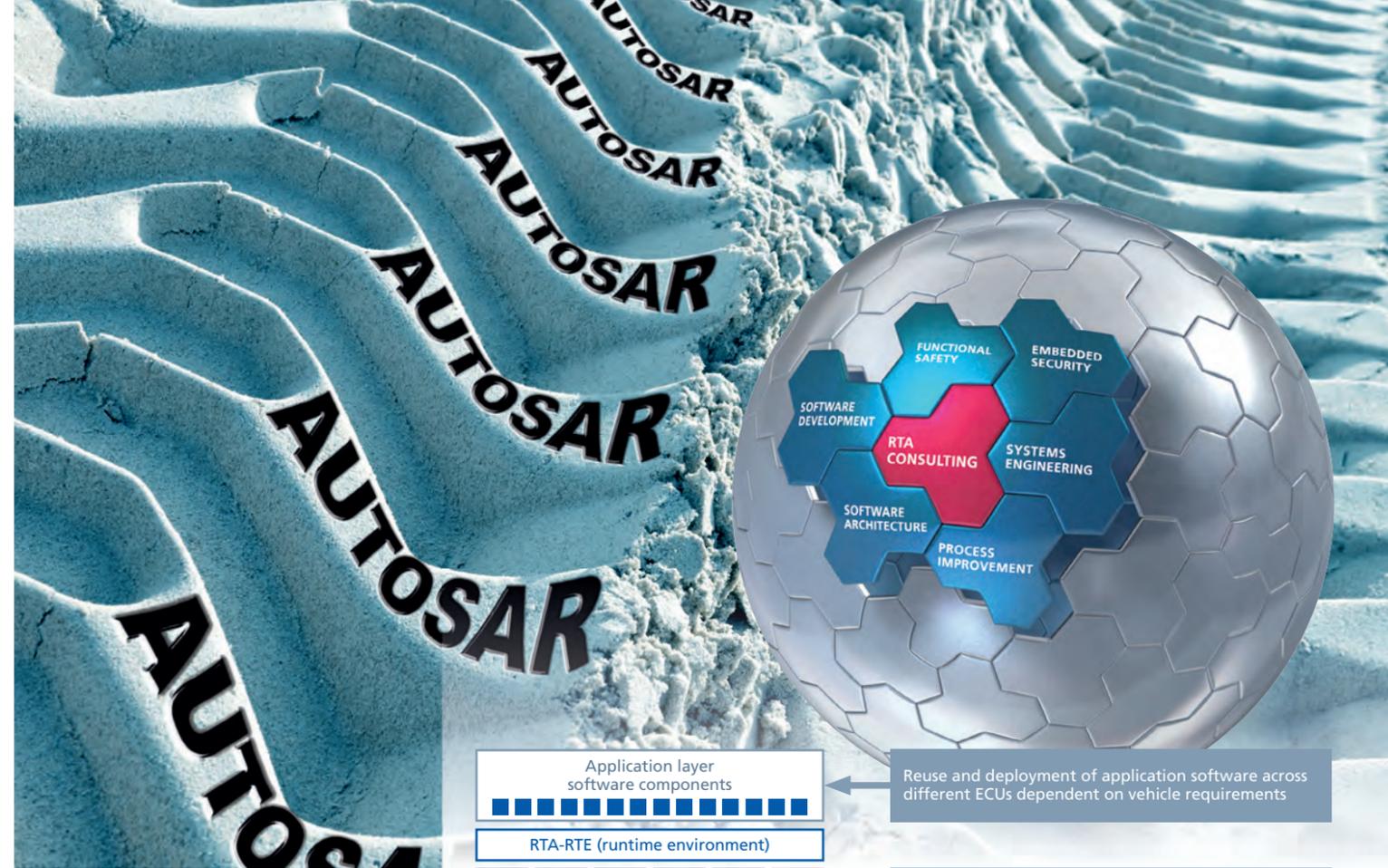


Diagram: Layer model of AUTOSAR's software architecture.

versal ECUs, which as a rule have been developed by a variety of partners and must fulfill the highest safety requirements. The standard provides the guiding principle, encourages an orientation on best practice during software development, and helps to detect faults at the hardware level.

Tools and processes as success factors

To make a success of applying AUTOSAR's safety measures, a well-thought-out development process is recommended that also considers available resources and budgets. In instances where these are limited and experience is lacking, expert advice is needed. The ETAS RTA (Real Time Architect) Solutions³ business area for developing customer-specific embedded software has experience in numerous off-highway and heavy-duty projects and offers comprehensive support for the migration to AUTOSAR.

Agricultural and construction vehicle manufacturers' plans to make use of standardized AUTOSAR software components and a corresponding development environment are justified on cost and quality grounds. Another reason is the COMASSO association⁴, which has several commercial vehicle OEMs – including Caterpillar, CNH Industrial, MAN, and Bosch Rexroth – as members, with high-quality series products as well as license-free reference implementations of many standard AUTOSAR components. This initia-

tive is of increasing interest in the off-highway vehicle segment.

Conclusion

AUTOSAR offers manufacturers of agricultural and construction vehicles great potential to flexibly develop high-quality embedded software. They can achieve tangible cost savings by reusing and acquiring mature software components. However, it is important to plan aspects of functional safety and organize the process chain in detail. ETAS can offer support for this in various ways.

Sources:
¹⁾ www.autosar.org
²⁾ ISO 25119, Functional Safety for Tractors and Machinery for Agriculture and Forestry – Safety-related parts of control systems, First edition 2010-06-01
³⁾ www.etas.com/en/products/solutions_real_time_applications.php
⁴⁾ www.comasso.org

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