

SWAP - Design of an AUTOSAR Open Laboratory Test Bench

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ABSTRACT

This article describes an AUTOSAR testbench that will be evaluated by the SWAP (SoftWare Automotive Platform) project. It presents the functionality as well as the expected use of the platform.

SWAP is a Swedish research initiative whose goal is to increase AUTOSAR competence throughout the design of an AUTOSAR compliant test bench. The test bench will be provided in an open laboratory where an AUTOSAR Version 3.0 (4.0 is planned)-compliant basic software, including applications, necessary tools and hardware, e.g. ECUs and communication bus, will be made available.

The test bench will hopefully be useful for a broad range of applied research and product development projects. Also, SWAP will manage AUTOSAR seminars for increasing the know-how for interested users.

SWAP will also provide a basis for establishing and increasing knowledge in the area of adapting AUTOSAR to the emerging functional safety standard ISO WD 26262.

INTRODUCTION

The use of software in automotive applications has increased enormously during the last few years, and with this the complexity of automotive software has also

increased. It has been obvious for some time that this increase in complexity cannot continue without a standardized and controlled approach to handle this complexity. This is especially important since safety is an increasing area which puts requirements on how software should be developed in order to be "safe".

There have been several research initiatives that have addressed the coming situation and identified the requirements to design robust and reliable systems on systems and components. X-By-Wire [1], for example, is one of the better-known research projects that have addressed requirements for safety-critical applications, and it has been a useful starting point for many other projects. Other similar projects in the automotive domain have addressed issues concerning the underlying services required by automotive applications, such as reliable and deterministic communication, fault and error containment regions, real-time operating systems, and time and memory partitioning. However, these projects have focused on a specific aspect of automotive embedded software. There are few projects endeavoring to address the entire software platform (middleware including operating systems), which is needed to execute and support all different automotive applications.

AUTOSAR [2] is a major approach to solve the growing complexity of software development and integration. Most major vehicle manufacturers, their suppliers as well

as tool vendors have committed themselves to this de-facto standard, the new platform paradigm.

Traditionally, new paradigms change the way of thinking and acting in a dramatic way. AUTOSAR is, following this reasoning, certainly to be regarded as a paradigm shift, since it requires a multi-level approach to a novel way of thinking, in terms of business, designing systems, applications and platform software. The new paradigm includes concepts such as time and memory partitioning, as well as real integrated systems with applications running on more than two ECUs which require new and complex mechanisms to guarantee consistency and timing, even in the presence of errors.

As is common with paradigm shifts, those who are incapable of understanding the new situation and not investing in the new field are usually left behind, and in the end risk going out of business. Given this scenario, it is important to address AUTOSAR and the effects it will bring on your company's business without delay. However, it is not only the software platform itself that needs to be addressed, but the entire AUTOSAR framework. This includes everything from development tools, processes and guidelines, AUTOSAR basic software design and application software, as well as suitable hardware and communication protocols. This is done in SWAP: the SoftWare Automotive Platform.

SWAP is a project initiated by a handful of automotive suppliers in Sweden that will focus on providing enablers for smaller companies to stay tuned to the new situation. This article is a short summary of the project proposal and expected outcome.

The reason behind this article is that we believe that companies can benefit from the knowledge of existing research and development platforms. We believe they can initiate new research projects, products and introduce professionals to each other. Furthermore one goal of the SWAP project is to gather more stakeholders and get them involved in the project.

Another reason for publishing this article is that we believe the SWAP project is unique. It is, to our knowledge, the first project to partially assess a design in accordance with ISO WD 26262 [3], using specifications produced by AUTOSAR. ISO 26262 is an automotive-oriented functional safety standard similar to IEC 61508 [4]. Furthermore, we see the need to analyze AUTOSAR Release 3.0, and we expect to report back experiences from a practitioner's view something that, to our knowledge, has not been done yet.

This article is organized as follows. First, we present the supplier situation with respect to AUTOSAR and then the SWAP project itself, why it is needed and how it is organized. Subsequently, we present the SWAP Open Laboratory, SOL. Then, we present some related work, followed by future work and conclusions.

THE SITUATION FOR SUPPLIERS

Traditionally, automotive OEMs often have their own in-house standards and solution to problems and challenges in vehicle development and vehicle systems. In this setting, it was (and is) possible for small and local suppliers to present solutions and components addressing the OEM-specific problems and challenges.

Conditions will change with AUTOSAR. Since automotive OEMs will have more or less the same basic E/E system, they will to a larger extent be facing the same problems and challenges. This also means that suppliers will be able to present their solutions and components not only to one specific OEM but to all OEMs. That is, the playground for automotive suppliers will be more global.

A global scene brings with it both new benefits and new challenges. One major benefit is that the potential market for suppliers increases. Successful suppliers will therefore have the opportunity to expand on the international automotive scene. One major drawback is that the competition will be more stiff, as OEMs can pick and choose from a wider (global) range of suppliers.

Smaller suppliers, who often have no possibility of showcasing full-scale/production-scale solutions, will experience problems showing OEMs their skills and products unless they have access to or knowledge about AUTOSAR. Similar aspects could be noted for support expertise where a system is needed to provide a show-case application.

AUTOSAR

AUTOSAR is a consortium consisting of most major OEMs, and has an objective to provide software specifications that can simplify the design of future embedded systems. The aim is to establish and maintain an open standard for automotive E/E architecture that can serve as an infrastructure for the management of diverse functions such as body functionality and safety.

The goals of AUTOSAR include standardization of basic software so that it can be portable and scalable to different vehicle and platform variants. The concept includes transferability of functions throughout a network, integration of functional modules from multiple suppliers, consideration of availability and safety requirements, and redundancy activation.

A more in-depth description of the AUTOSAR architecture can be found at www.autosar.org. A brief overview is given in Figure 1.

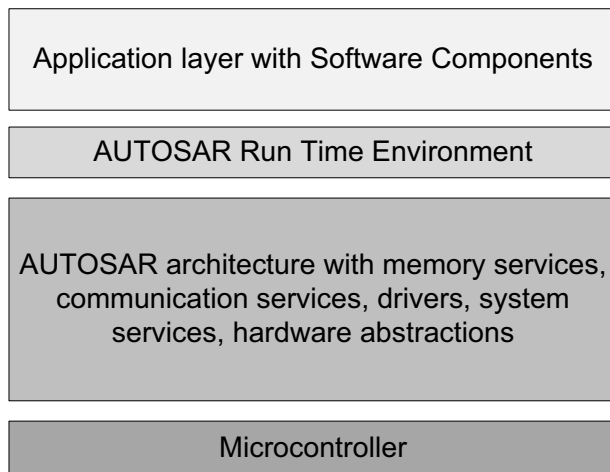


Figure 1 AUTOSAR architecture

SWAP PROJECT

Before SWAP was initiated it was reasoned that anyone wanting to could procure necessary AUTOSAR components from commercial players and set up their own AUTOSAR test bench at a reasonable cost. However, it turned out to be a more complex task than first thought to design or get hold of a useful test bench.

Not only was the cost discouraging, but also the technical status and level of the available products was insufficient. We found for example that one drawback of commercial products is their limited flexibility and openness, which we believe inhibits easy adaptation to the individual development needs and environments of developers.

Another drawback we found with currently available test benches is that they lag behind the specifications of AUTOSAR, as these are still evolving. Furthermore, they are not fully adapted to the AUTOSAR specifications, containing partially old software modules with just updated interfaces. At the time of this writing, Specification 3.0 is about to be released, but Release 4.0 is already in the pipe.

The major difficulty, however, was the missing capability to do all the necessary work within one company. This is natural, since it would require expert knowledge of a complete E/E system built on AUTOSAR with its applications, specific hardware needs, configuration and design tools, as well as safety expertise.

Thus the only reasonable alternative for procuring an AUTOSAR test bench was to investigate the neighbourhood for companies holding the necessary and complementing competence to design a professional test bench together, from hardware to application.

More than a year ago a handful of Swedish companies thus joined forces to increase their AUTOSAR knowledge and to produce a test bench based on AUTOSAR, with the intention to be open for development and research projects. With support from regional OEMs and VINNOVA, the Swedish Governmental Agency for Innovation Systems, funding was received to start the SWAP project. The project was officially started on the 3 of October at Mecel in Gothenburg, Sweden.

The final participants in the SWAP project have a well known, documented and strong position in the automotive area, and their experience and expertise is also well known outside Sweden. The partners have been involved in many research projects within the topic area, international projects as well as national ones [1],[5],[6],[7],[8] and [10]. Several academic and technical papers have been produced over the years, and we hope that SWAP will continue this tradition of contributions from Swedish projects to international research.

The following five companies and three OEMs make up the SWAP team: CONSAT (www.consat.se), ENEA (www.enea.se), Mecel (www.mecel.se), QRtech (www.qrtech.se); and Systemite (www.systemite.se). The involved OEMs are Volvo Car Corporation, AB Volvo (through Volvo Technology) and General Motors Europe (through Saab Automobile in Sweden).

The companies have specialists involved in

- System design
- Hardware design
- Communication aspects (protocols and topologies)
- Tools (design)
- Basic Software (AUTOSAR)
- Applications – Three domains
- Integration
- Verification and Validation
- Functional Safety and Dependability

ENEA will be dealing with operating systems, CONSAT with automotive applications, Mecel with basic software design, integration and safety aspects, QRtech with safety aspects, hardware design and communication and Systemite with system aspects and tools.