



Infotainment – First Time in an Autosar Environment

It is Infotainment that is one of the blank areas on the Autosar map. Only at the end of 2009, the Autosar consortium will decide on whether and when Infotainment is addressed in Autosar. However, this month, OpenSynergy will introduce the first 100% Autosar-conform integration of an open-standard Infotainment platform for vehicle applications. This modular system can also be used without infotainment components. It can also integrate existing complex non-Autosar-conform functions.

1 Introduction

At present, the development of automotive electronics is dominated by two trends: The introduction of Autosar in series production as basis for conventional and new software functions and an increasing influence of entertainment electronics on the customers' expectations. Likewise, the market demands vehicles that are economically priced and environmentally sound on the one hand, but nevertheless equipped with many functions on the other hand.

For all the success Autosar can exhibit, unfortunately some essential problems remain unsolved. This standard can be used for typical vehicle functions, but with infotainment and connectivity it just excludes those areas that are extremely driven by the entertainment industry and telecommunications and in which innovations are most directly and strongly perceivable to customers. It is OpenSynergy's vision to connect both of these worlds safely and reliably by data technology.

2 Specifications for an Autosar-conform Operating System

Starting from the above mentioned basic conditions, OpenSynergy designed a versatile automotive-specific operating system named "COQOS", **Figure 1**. The objective was not only to create a sort of gateway between infotainment and vehicle but allowing the coexistence of vehicle and infotainment functions on a single control unit.

As the result, an operating system is now available that uses the power of advanced processors that are more and more employed in infotainment equipment also for automotive functions. Positive accompaniment: the number of control units in a vehicle is reduced. Such an operating system should meet following requirements:

- architecture and processes are 100 % Autosar-conform
- relevant automotive standards are met
- open infotainment system interfaces and connectivity
- software development cycle is drastically reduced thanks to the platform approach especially in the fields infotainment and connectivity

- number of control units are reduced while the functionality grows
- maximum openness and future-proofness
- maximum reusability and scalability
- flexibility thanks to a modular approach.

In principle, there are different requirements in the non-functional area between both worlds, Autosar and Infotainment. Above all, there are differences in the requirements on functional and remote security, time behaviour, system stability and resource demand. Consequently, an in-depth knowledge both of Autosar and also of telecommunications and consumer electronics is needed for the implementation of this concept. Virtualisation is the crucial basis of "COQOS". This is a technology that evolved to become a trend also in these industries in the last year. The objective of virtualisation is to combine or distribute different resources of a single computer. In the case of "COQOS", resources of a control unit are to be distributed between infotainment and connectivity on the one hand and Autosar applications on the other hand based on a cost-effective system-on-chip. When doing so, the aim is to safely exclude any interaction of both software worlds so that the specific requirements from the automotive industry regarding maximum safety and security as well as rapid start-up behaviour are met under all circumstances. Certainly, in addition to self-defined new requirements on the operating system, there are also known requirements such as on/off behaviour and the capability of diagnostics.

Thanks to virtualisation, the need for additional system resources is very low.

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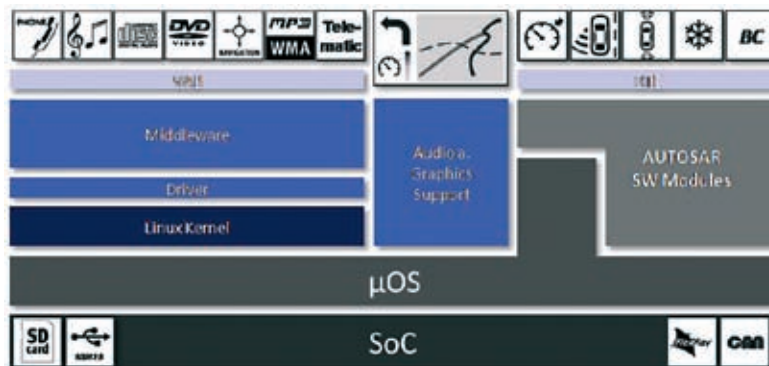


Figure 1: "COQOS" architecture

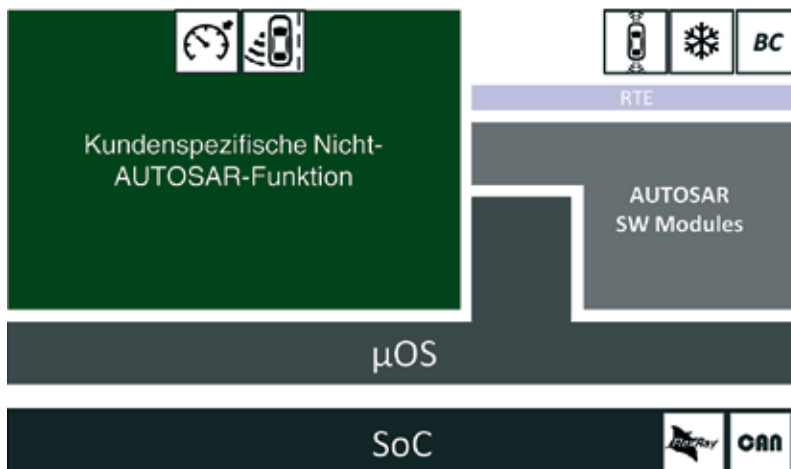
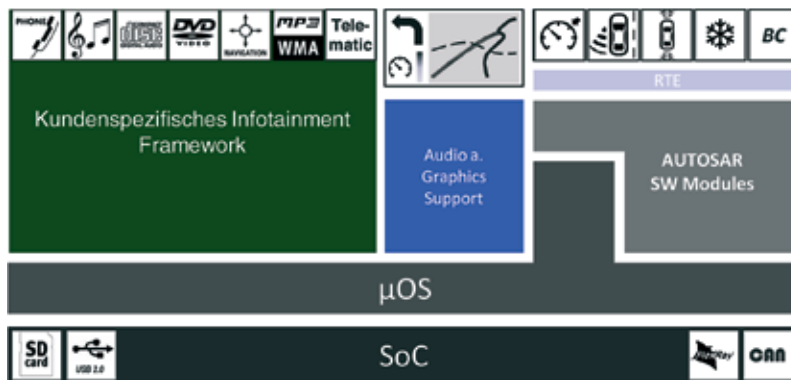
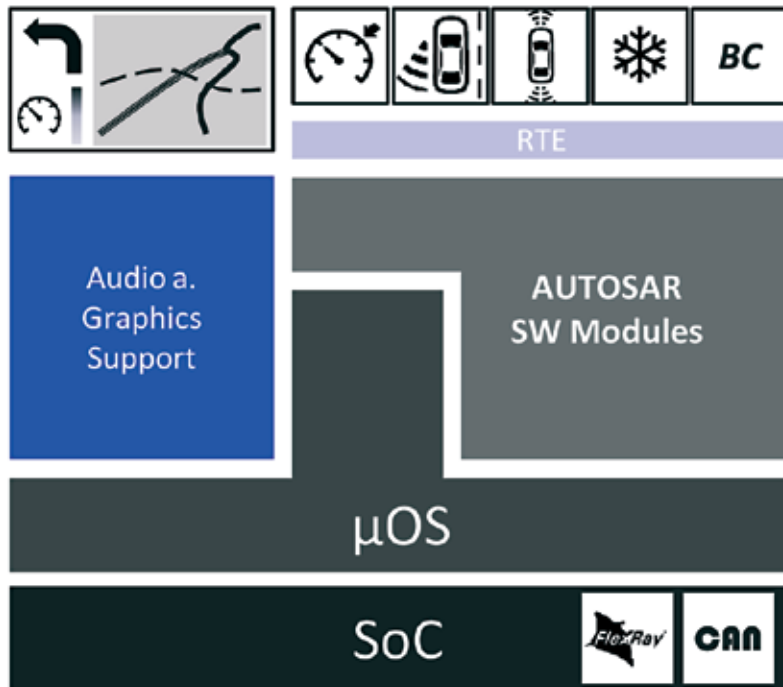


Figure 2: Example of “QOCOS” application scenarios (top down): Autosar basis software with HMI adapter, infotainment system with customer-specific Framework and migration solution for proprietary and Autosar applications

To meet all requirements Autosar modules needed for the relevant application are combined with a Micro Operating System that also provides a virtualisation layer.

This Micro Operating System already provides basic mechanisms for a safe design of the overall system (such as memory and timing protection) and thus addresses both functional safety and also security against attacks.

Whereas the automotive world is defined to a great extent by Autosar, the infotainment world was relatively unaccounted for in previous systems. QNX is widely used in current systems.

But approaches based on Linux Embedded or Windows Automotive are in the discussion in the meantime. As a typical Embedded Operating System, QNX comes from the industrial area and requires high development expenses when it comes to the integration of consumer electronics functions. Windows and Linux come from entertainment electronics and thus provide all interfaces and technologies already used there such as WiFi or 3D graphics. However, huge development efforts are needed for the integration in the vehicle infrastructure. Each function developer in the automotive environment will have trouble with this. A new universal operating system has to connect existing infotainment operating systems with a standard-conform Autosar basis software. The advantages of existing systems are preserved by function distribution between the components involved:

- Autosar modules meet the specifications and thus they can be used for all automotive applications and provide a tool-based configurable RTE as function interface. Then, on top of the RTE, Autosar-conform applications can also be integrated as is usual, e.g. a parking sensor system.
- In the infotainment field, commercially available operating systems can be used. There is no need for special work to adapt them to the automotive environment. Functions can be implemented on existing application interfaces:
- As an additional module, “COQOS” contains a Micro Operating System that provides the virtualisation layer for the infotainment system and

even allows a safe and independent coexistence on a common hardware platform.

- Together with the Micro Operating System, the Autosar basis software also implements the gateway function, via which both the infotainment and also Autosar functions can exchange data with the other vehicle functions via common bus systems.

- In this way, required hardware components for the applications such as sensors are integrated in the system.

Through the design of the system architecture, i.e. connection of the Autosar modules with the Micro Operating System, the functional safety/security of automotive functions is ensured.

So, the assignment of system resources (available memory, processor time, etc.) occurs on the automotive side of the system, which serves as master. If a failure occurs in the infotainment system, the master can shut down and restart it in a controlled manner. Also the access to other resources such as bus systems or HMI is controlled from this side. In this way, also alarm messages from the different driver assistance functions, for example, can have priority access to a display available in the system and overwrite information from the infotainment system.

On the infotainment side, the first “COQOS” implementation will be based on Linux to provide easy access to the vehicle for an as wide as possible spectrum of function providers known from mobile telephones and consumer electronics. Moreover, Linux offers further advantages for development such as free accessibility of the source code and a variety of available development environments.

In future implementations, also the use of other infotainment operating systems will be possible on customer’s request, e.g. different Microsoft products.

Another requirement to an universal operating system is to support an as wide as possible hardware spectrum. The processor architecture selected for the specific application is crucial for this. The ARM architecture is widely used. Therefore, it is supported as standard. Porting to other architectures is possible with relatively little effort.

The key advantage arises when system-on-chip solutions based on single-core processors are used as in combina-

tion with “COQOS” these allow an optimal and cost-efficient system design.

3 Solution Examples for Current and Future Systems

OpenSynergy’s Autosar-conform operating system has been designed as a modular software kit and is based on multiple modules that can be used to realise a specific solution – see **Figure 2**. The three application scenarios below are among the most important:

- The use of the modular system is also possible without infotainment components. In contrast to other systems, “COQOS” as Autosar basis software according to Autosar 3.1 has additional security/safety mechanisms and provides a RTE that can be generated according to Autosar specifications as mentioned above. Therefore, the integration of applications can occur as planned using the development environment.
- The integration of existing complex non-Autosar-conform functions with Autosar is possible. During the evolution of Autosar, many automobile manufacturers have developed functions that cannot be adapted to the standard without further ado. Other functions were already developed conform to the standard and expect a RTE as system interface.

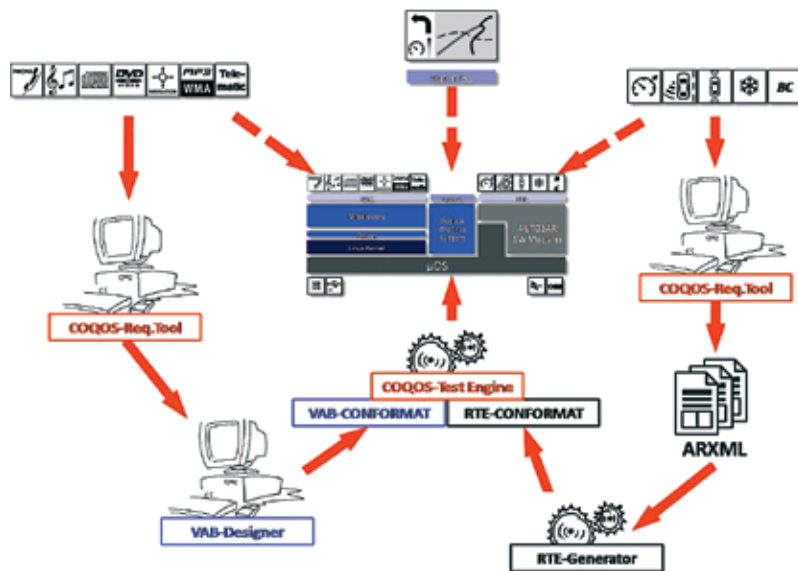


Figure 3: “QONFORMAT” development environment

If both functions are to be combined without starting a new development, two control units would have to be used and connected to each other via a suitable bus (typically CAN).

But “COQOS” allows this combination on a common single hardware unit because the non-Autosar function can be integrated on the virtualisation layer.

Infotainment in an Autosar environment is possible. “COQOS” combines two software systems having different non-functional requirements, separates them safely and enables a well-defined and controlled communication. The full potential of advanced embedded processors can be tapped.

By useful function assignment, it is possible to reduce the number of control units in the overall system.

Further solution approaches based on “COQOS” are worked out at the time being.

Thanks to the design of the development process, partitioning of software architecture and focus to quality, the system is designed for reusability. The integration of more and more new functions even within short development times is possible by stable application interfaces based on standards.

Across different vehicles, this system ensures a solid basis and allows paying attention to the essentials. That is the development of new exciting and affordable functions in next-generation vehicles.

4 Development Environment

The development environment is an essential frequently neglected part of complex software systems. It makes a crucial contribution to the mastery of the complexity in the development process and also to a well-aimed and exactly matched design of the software that is eventually integrated in a vehicle. Design requirements for the „COQOS“ environment were similar to that put on the operating system itself. The tools had to be modular, versatile and extendable and supported by a basis that is wide-spread on the market. Apart from easy configurability, especially the support of required development methods is also in the focus.

So, based on Java and Eclipse, the Autosar-defined methodology for the design of basis software was mapped in the tool chain. As the development environment should not only be used to develop Autosar software but also an infotainment platform the already intelligent approaches of Autosar have been advanced into this field.

The development environment is able to map both the different areas and also the required subfunctions.

With „QONFORMAT“, **Figure 3**, as the first module of a complete solution of the „COQOS“ development environment, a tool is available that can be used to verify the Autosar-conformity of basis software modules.

5 Prospect and Roadmap

The first release of „COQOS“ as universal automotive operating system will be finished in January 2009. In addition to a configurable RTE and basic Autosar-conform communication modules it will already provide a Linux-based framework as development basis for infotainment functions. According to the current plans, two further releases will follow at an interval of six months each adding further specific modules to the Autosar side.

In the infotainment field, the second release, which will be rolled out in late summer 2009, will first provide a virtual application bus VAB comparable with the RTE known from Autosar and support basic functionalities such as software update and diagnostics. The third

release, planned for spring 2010, will then support the full range of currently specified functions. Above all, a configurable firewall that will then provide maximum remote security is to be mentioned in this connection. Over this period, the development environment will be adjusted to the growing requirements of the system and supplemented by modules that are needed in any case.

So, in approximately 18 months, an operating system specifically designed for automobiles including the associated development environment will be available. It will be able to solve many of the problems known at the time being. It will allow tailor-made system architectures with a drastically reduced number of control units. Thanks to the separation of hardware and software, modular design and orientation to reusability, a system platform will then be available that allows the integration of new functions without increased risks within drastically reduced development times and thus helps to save costs and time in the development of advanced automobiles. ■



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