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REUSABILITY OF BASIC SOFTWARE

One of the goals of the Autosar [1] consortium is to develop a cross-OEM standard for "basic software" in vehicles. Use of the same software components by different automobile makers will generate synergy effects. However, not all conditions have been met in order to make use of all synergy effects.

As a result of the ongoing standardisation in various Autosar releases, ❶, a number of different versions of the standard have been used since its initial introduction. Depending on the SOP schedule, automakers selected the most recent version of the time. Initial isolated series projects started with Release 2.1, while a larger number of projects implemented Autosar release 3.0 and 3.1.

Release 4.0 offers many new features, ❷. These include concepts related to functional safety, multi-core, partial networking, etc. The version has met with highly positive response, and BMW and Volvo are already using it for their next vehicle projects. Other OEMs who want to introduce Autosar in their companies for the first time are interested in Release 4. Autosar release 3.2, which is used primarily by two large German OEMs, Daimler and Audi, will be available in parallel for some time to come, however.

Autosar users are now facing the question of which version of the standard to choose. Will they have to work with different release versions of the same standard for different OEMs?

As a supplier of basic software, Elektrobit (EB) [2] asked itself precisely this question. In close cooperation with the OEMs, a decision was finally reached to have the basic software operate on the basis of the status of specifications for Autosar 4.0. Accordingly, the new features of Autosar 4.0 will be supported in the product version EB tresos AutoCore 6, ❸.

At the same time, however, EB also supports series projects based on Autosar 3.2. A special compatibility mode has been developed for this purpose: Software components developed for Autosar 3.2 interfaces also work with Autosar 4.0. The same basic software version can thus support two different versions of Autosar. Configuration files (known as the system description) that the OEM distributes to the suppliers will continue to be used pursuant to the different Autosar versions implemented. The configuration tools for both versions must be imported for this purpose, ❹.

EB clearly sees Autosar 4.0 as the standard for the future. The specially developed compatibility mode for Autosar 3.2 could turn the sought-after cross-OEM

AUTOSAR 4.0 – AND NOW? CHALLENGES AND SOLUTION APPROACHES TO USE

The new version of the defined standard for electronics development in the automobile industry, Autosar 4.0, encompasses a wide range of standardised basic software modules and libraries. The advantages of the Autosar concept are obvious: standardisation makes it possible to reuse software components and more easily gain control of the increasing complexity in automotive electronics. But what is the situation in reality? This article of Elektrobit provides insight into the current status of Autosar 4.0 and describes relevant aspects with which Autosar users find themselves confronted.

solution into reality much quicker than expected. However, full reusage of the basic software and tapping of all synergy effects will require even broader agreement among automobile manufacturers.

OEM-SPECIFIC ADDITIONS

Prior to Autosar release 4.0, the standardised Autosar software modules were only partially integrated into a basic software stack used in a series project. Various automobile manufacturers had certain enhancements to some of the basic software modules. Reasons for this included the specification status of the module being inadequate or a lack of certain features needed by the OEM. The Autosar standard served only as a basis in each case, however. The final basic software stack consisted of a mixture of standardised and OEM-specific basic software modules.

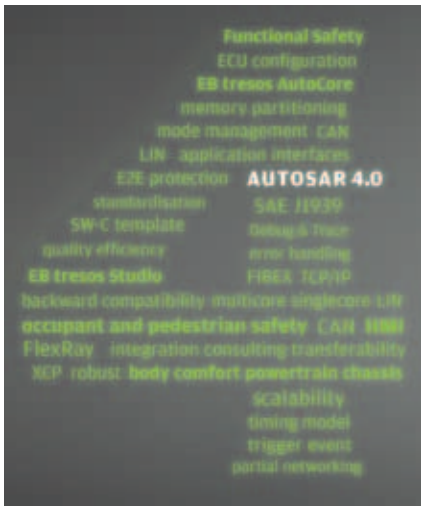
With Autosar 4.0, the industry has come a significant step closer to the goal of implementing only standardised modules within the basic software stacks and thereby achieving the planned Autosar synergy effects. This means the days of OEM-specific modules could soon be numbered. BMW was the first OEM to prove that basic software can function without manufacturer-specific components. Additional automakers such as Volvo are already following.

The status of the Autosar 4.0 specifications is mature so that the basic software modules can be used directly in a series project. However, new modules have to be viewed from a more differentiated perspective. For example, the use of TCP/IP communication in the Autosar environment still requires a number of additions to the current status of Autosar 4.0 specifications. In a few cases, additions have also been made to the specifications of existing modules. All of these changes are dealt with in "Requests for Changes" (RfCs) and published in revisions. So far there have been three revisions of Autosar 4.0, the fourth revision is planned for December 2012.

The challenge for Autosar users in series projects is now to take into account all current changes in the revisions as well as the RfCs currently under discussion. It is possible, for example, that certain changes in the basic software are required on a specific integration date by the OEM before the corresponding RfCs are approved in an Autosar revision.

As a basic software supplier, EB therefore regards it as absolutely necessary to

❶ Autosar Roadmap



❷ Features of Autosar

work as closely as possible with automobile manufacturers during series introduction in order to evaluate the open RfCs for the respective integration dates. For Autosar users, this means at minimum that they have to expect updates in the basic software between OEM integration dates. However, Autosar users can delegate most of the consideration of exact details in the specification changes to the basic software supplier.

FUNCTIONAL SAFETY

Autosar 4.0 integrates new concepts into the standard that are absolutely essential for the use of applications critical to safety. Among other things, these concepts include memory partitioning and end-to-end communication protection (E2E protection).

Memory partitioning helps in the use of application software both critical and non-critical to safety on one and the same control device. After all, in order to reduce the number of control devices in the vehicle, manufacturers want to integrate many different software components into one control device. If the software components are of varying relevance to safety and therefore have different Asil levels (automotive safety integrity level), the ISO/DIS 262626 standard stipulates that the highest of these Asil levels is effective for all components. That would require a great deal of effort and expense in development since all components would have to be developed pursuant to the highest Asil level. Memory partitioning is a key stepping stone on the path to reducing these development expenditures and cutting development costs. The partitioned memory areas help limit the prorogation of errors within set boundaries. In order to ensure reliable communication between software components, the new Autosar release also offers E2E protection. It identifies errors in both the software and the hardware. The protection mechanisms offered include the option of assigning a serial number or a checksum for a cyclical redundancy check (CRC) to signals.

The specified concepts in Autosar 4.0 enable support of functional safety requirements. However, when selecting a corresponding implementation, Autosar users are well advised to make sure that it is not just flexible but efficient and robust as well.

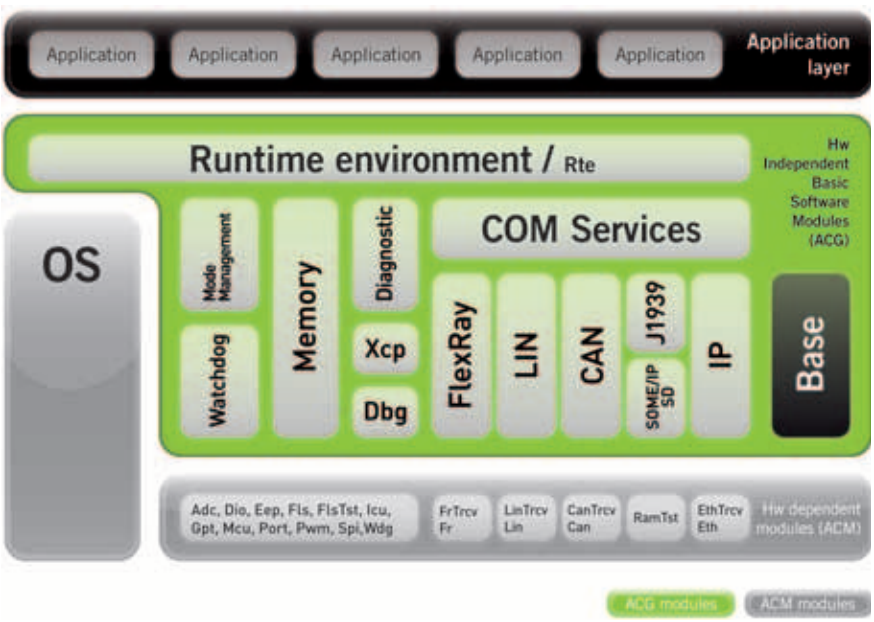
One approach to realisation of memory partitioning, for example, is to call an additional software function, known as a memory protection checker, at the appropriate points in time. However, this software function does require additional function calls, resources and run time. Above all else, it is highly complex and difficult to prove that this verification software cannot itself be influenced by another, faulty application software.

In contrast to this, EB developed a special safety version of the operating system with strict separation of the application and operation system code. This ensures that the operating system core cannot be influenced by a faulty application. All memory protection administration now occurs in this safe operating system core. That makes it not only extremely robust, but efficient as well. No additional function calls are needed. What's more, this memory protection is highly configurable and can thus satisfy even the most difficult project requirements for memory partitioning.

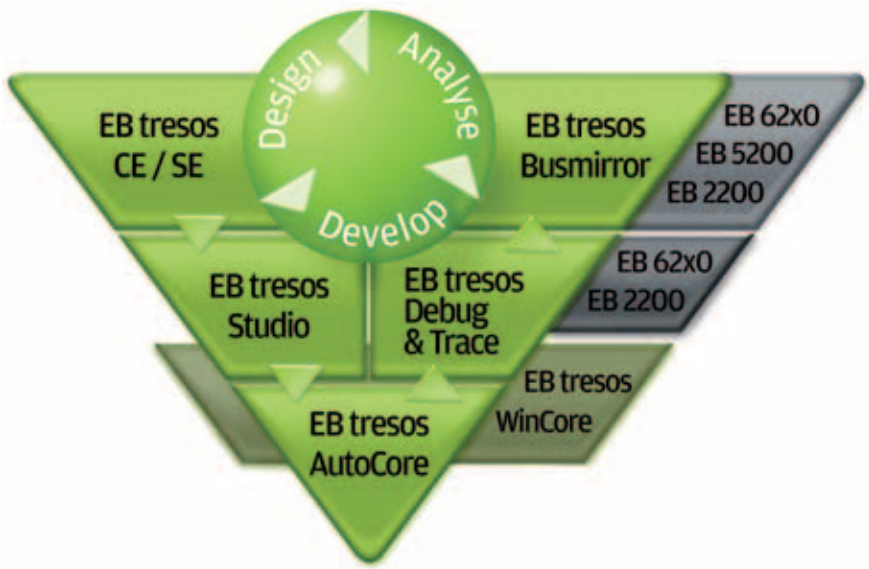
SELECTION OF THE HARDWARE PLATFORM

Ultimately, every Autosar user must also decide which hardware platform to use for his or her series project. But the necessary hardware-dependent Autosar MCAL (Microcontroller Abstraction Layer) modules and an appropriately ported operating system are not available for every new microcontroller derivative. In addition, the effort necessary for integration and qualification of a complete basic software stack on a hardware platform is usually underestimated.

Problems related to MCAL availability are still somewhat exacerbated due to the various Autosar versions. Virtual development platforms help to alleviate these difficulties. The clean separation of Autosar



❸ EB tresos AutoCore architecture



❹ EB tresos Autosar product portfolios

specifications into hardware-dependent and hardware-independent modules permits configuration and execution of the hardware-independent modules in a simulation environment. For example, several thousand parameters can already be configured in the Windows-based solution EB tresos WinCore and tested for functional correctness long before the target hardware or corresponding MCAL modules are available, ❺.

In general, it is advisable to keep the number of different hardware platforms as low as possible. Due to current development of Autosar specifications, Autosar modules will likely have to be updated several times even within one series project. As a result, expenditures for integration and qualification of each hardware platform may be incurred several times. One potential solution approach to keeping down costs for these necessary activities per project is cost distribution across several projects. This is possible for instance when several projects use the same hardware platform and basic software stacks already integrated can be used several times. Corresponding hardware platform strategies for Tier1 product lines or even across several product lines can thus lead to significant reduction of the integration and qualification costs incurred.

All in all, Release 4.0 provides a solid basis for coming a decisive step closer to reaching the set Autosar goals. Regarding the functional safety concepts introduced, particular attention should be paid to robust and efficient implementations. Unfortunately, users must currently cope with different Autosar releases and revisions and should therefore keep the number of hardware platforms as low as possible.

REFERENCES

[1] Autosar Development Partnership www.autosar.org

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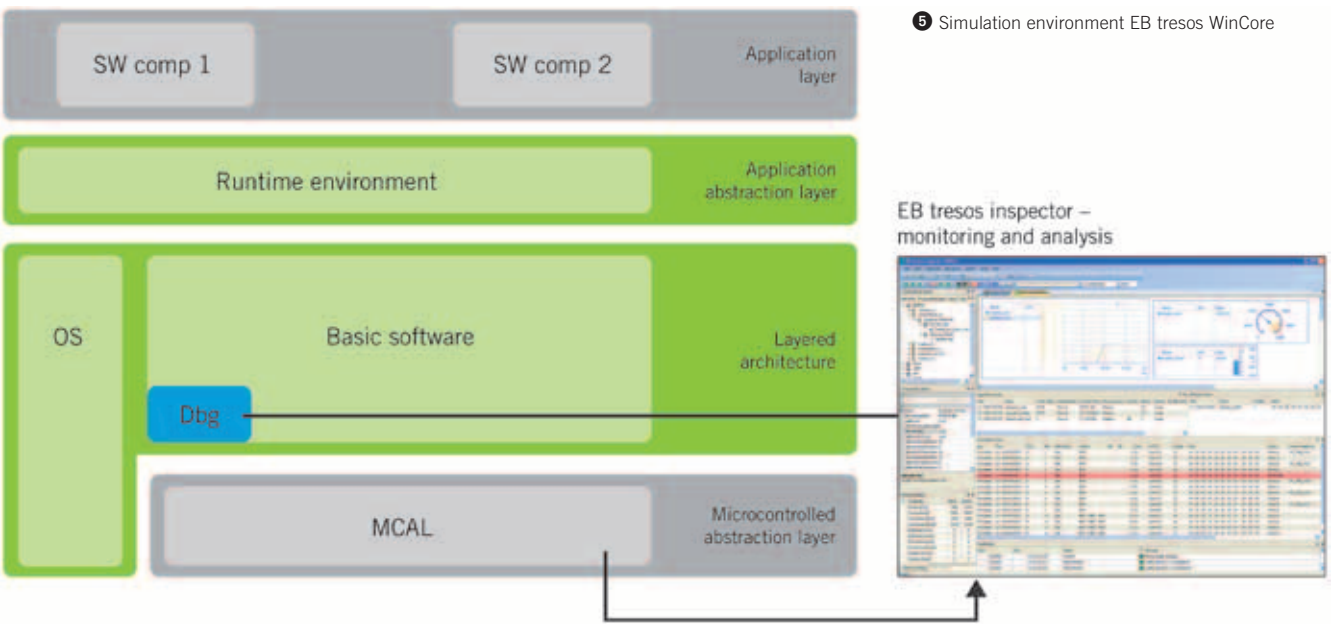

❺ Simulation environment EB tresos WinCore