AUTOSAR Enables Sharing of Automotive Embedded Software as Assets

Electronics becomes more widely used in automotive systems, such as power-train, safety functions, and infotainment. The transition from conventional mechanical and hydraulic systems to E/E architecture will never stop advancing in the future. While evolving electronics enrich the automotive functions, the number of man-hours required to develop the control software are higher than ever before, creating a significant burden on automobile manufacturers and suppliers. To deal with this situation, the open and standardized automotive software architecture AUTOSAR (AUTomotive Open System ARchitecture) was jointly developed by automobile manufacturers, suppliers, electronics manufacturers, semiconductor vendors, and software vendors, to aim enhancement of reuse of automotive embedded software as assets. AUTOSAR is a system that abstracts the differences in hardware, such as microcontrollers, and enables a standardization and reutilization of in-car application software assets, in short.

MICROSAR Selected at the Recommendation of European Automobile Manufacturer

AUTOSAR brings certain advantages on high efficiency on automotive software development. However, for manufacturers and suppliers using it for the first time, it’s not really easy to read through all the specifications and understand the full picture. It is also challenging to understand the detailed development activities. Alpine was among one of those car audio and navigation system companies struggling to go with AUTOSAR. Tomohiro Kusano (Alpine’s OEM Product Development Dept.) de-

AUTOSAR-compliant Development of an In-car Radio Product Using MICRO SAR for the European Market

Alpine Electronics, Inc. (“Alpine”), manufacturer of car audio and navigation systems, developed an AUTOSAR-compliant in-car radio product for a European automotive manufacturer for series production in 2013. Alpine completed development of AUTOSAR related software components for CAN, diagnostics and other functions within one year starting from October 2010 and then also completed development of other software components. By using MICRO SAR from Vector Japan Co., Ltd. (“Vector”) as the AUTOSAR platform and developing a proprietary wrapper that leveraged existing software assets, Alpine succeeded in its product development while meeting a tight schedule and high quality demands.
scribed the challenges. “We were asked to build an in-car radio for a European automobile manufacturer, and they specified as part of the RFQ that it must be developed in compliance with AUTOSAR Release 3.0. We had never developed any product using AUTOSAR, so it was our first time.” Also this particular in-car radio uses a Renesas SH2A microcontroller, with existing software assets based on µITRON (see Figure 2). Alpine immediately began work on introducing AUTOSAR. For the development infrastructure, the company selected MICROSAR, the AUTOSAR-based embedded software products developed by Vector. Kusano explained. “We selected MICROSAR because Vector is one of the suppliers recommended by the European automobile manufacturer and because we had worked with Vector in the past on CAN bus-related development.”

Next, Alpine consulted with Vector and gained an understanding of the functions realized by the basic software (BSW) of AUTOSAR. After analysis to extract minimum set of BSW regarding with required functionalities and possibility on combination of in-house solutions, Alpine contracted MICROSAR BSW modules. Alpine used MICROSAR SYS for its error reporting, communication management, and ECU state management, MICROSAR MEM for managing flash memory, and MICROSAR CAN and MICROSAR COM for its CAN control. They did not use any AUTOSAR runtime environment (RTE), because a large number of changes were expected in reuse of the existing software assets. Also, because the conventional µITRON-based operating system would be utilized, MICROSAR OS was not used. The entire configuration is shown in Figure 3. MCAL (Microcontroller Abstraction Layer), which abstracts the microcontroller hardware, was not supplied from the microcontroller vendor at the start of development, so it was developed at Alpine.

As mentioned above, Vector’s MICROSAR was chosen as the BSW modules. The Complex Drivers, which is highly depending on the vehicle variants, was provided by the automobile manufacturer. The software components (SW-C), which are equivalent to the application layer, were developed by Alpine using existing assets based on µITRON.
Leveraging Existing Assets with a Proprietary Wrapper without Using RTE

During actual development, the schedule became an initial issue. Kusano recalled the process. “We began development in October of 2010, but we had to provide the client with a prototype based on the evaluation board by February 2011, so we had to have big progress with AUTOSAR on a very tight schedule.” As a solution, training on the development flow of AUTOSAR, a BSW functional overview, and configuration of the MICROSAR environment and BSW were held at Alpine by instructors from Vector to improve the skills of the development leads. At the same time, development of MCAL was immediately started. Next, Alpine worked with Vector to implement an integration of products, starting with the MICROSAR BSW modules, Alpine-developed MCAL, and Complex Driver and CAN database (*.dbc) files that the client provided, and also combining EcuC (ECU configuration description), GENy and DaVinci Configurator Pro (both Vector’s configuration tools) (see Figure 4).

“The schedule leading up to the provision of the prototype was tight, and in the end, we went to Europe, where the automobile manufacturer is located, and worked together with Vector to accelerating integration and perform testing,” explained Kusano. These efforts were worthwhile, as the team successfully provided the prototype based on the evaluation board by February 2011, as requested by the client. They were also able to release a prototype which is based on the hardware for series production by April 2011. The AUTOSAR-related development work was nearly complete, and next, the weight shifted to development of the SW-C, which is the application layer. The SW-C, which is comprised of functions including the radio tuner and USB audio playback, follows the conventional architecture that interfaces with µTRON using the communication server named Virtual MOST and interfaces with the BSW modules using a specially developed wrapper without using the RTE (see Figure 5). Kusano explained. “The number of man-hours required to develop the wrapper was about five man-months, but that figure is smaller than it would have been if using the SW-C with an RTE.” After performing a series of tests, the team completed a bug-free version of the prototypes incorporating all functions in October 2011, and series production was started at the end of 2013.

Launching Product Development with AUTOSAR Release 4.0

Although increased man-hours is a typical concern with AUTOSAR-based development, Kusano revealed that there was no significant increase, with only two people (it became one at the final development stage) required for configuring MICROSAR BSW, while each did other development tasks in parallel, only three people (only in the initial development phase) required for integration work while they also did other tasks too, and only about five man-months required for wrapper development.

Kusano also revealed that he was quite satisfied with the quality of MICROSAR provided by Vector. “During the evaluation process, we discovered several problems, but they were mainly caused by incorrect settings, wrong use or problems caused by other tools. There was only one problem within MICROSAR itself. Moreover, all detailed inquiries..."
to Vector Japan were handled within 24 hours, and we were very pleased with their technical support.” Alpine has already started developing new products using AUTOSAR Release 4.0, with series production scheduled for 2016. “Introducing MICROSAR RTE that we skipped this time will be next challenge in our next product. We will work to develop new products with the continuous cooperation of Vector,” Kusano said.

Now, as AUTOSAR has been getting more mandated in RFQs of European automobile manufacturers, Alpine’s example of development with AUTOSAR by introducing MICROSAR for short turnaround and reduced man-hours will surely serve as an exemplary model for other suppliers provide products and services that best meet the needs of our customers.”

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Cover and Figure 1: Vector Japan
Figure 2-5: Alpine Electronics, Inc.

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Reviewing the Project

Tomohiro Kusano
OEM Product Development Dept.
ALPINE ELECTRONICS, INC.
“Thanks to the high-quality MICROSAR product and Vector’s support, we were able to meet the tight schedule and quality demands of our European automobile manufacturer client. AUTOSAR-compliant development will certainly become more important in the future, and we would like to leverage our experience and knowledge to other parts of the company and to new products.”

Tsuyoshi Sakurai
Embedded Software Dept. (PES)
Vector Japan Co., Ltd.
“The expertise of the Alpine engineers also helped us out. We were very happy that our AUTOSAR solution could efficiently contribute to their development. We will continue to