Standard Automotive Software Platform “AUTOSAR” and Microcontroller Driver MCAL Conforming to AUTOSAR Release 2.1

In collaboration with Elektrobit Corporation, FUJITSU has developed and released “MCAL,” a microcontroller driver conforming to Release 2.1 of AUTOSAR, which is a standard automotive software platform.

* AUTOSAR: Automotive Software Platform and Architecture
* MCAL: Microcontroller Abstraction Layer

Introduction

In recent years, the computerization of automobiles has been advancing rapidly. It is especially apparent in high-end automobiles, in which the number of ECUs (Electronic Control Units) has reached 100 or more per vehicle; approximately 50 ECUs are used even in popular, low-end cars. In concurrence, the number of required software programs is growing dramatically. High-end vehicles are said to have 10 to 15 million lines of C source code—this is a problem in terms of increased development man-hours.

There is also a strong demand for cost reduction, and efforts for ECU integration and software standardization are being advanced. By integrating ECUs, it will be possible to control applications that are conventionally controlled individually by multiple ECUs with only a few ECUs; this will also lead to a reduction in the number of hardware parts. Efforts are also being devoted to distributing and standardizing the software programs so that prior software assets can be utilized and the same operation can be executed by several different microcontrollers.

What is AUTOSAR?

Under such circumstances, AUTOSAR was established in July 2003 by DaimlerChrysler, BMW AG, Robert Bosch GmbH, and so forth to develop the software programs into parts and standardize them. Its activities are ongoing. FUJITSU participates in these activities as a premium member.

The AUTOSAR software platform was developed as a solution for the software demands in automotive systems; its automotive application is being examined by various OEM/ECU manufacturers. Since the parts that are dependent on microcontrollers can be masked by introducing AUTOSAR and using RTE and Basic Software (described later), it is possible to reuse the application software or to migrate it with simple processes. In this way, ECU manufacturers can develop without having to take into consideration the type or manufacturer of the microcontrollers.

Figure 1 presents the software configuration diagram.

AUTOSAR Software

AUTOSAR Software is an application software used to satisfy the functions of ECU systems. It exists on RTE I/F and can be used commonly by all hardware types. Furthermore, part of...
it can be used as “part” of a software program. Since the part relating to hardware is absorbed by BSW and is not dependent on the microcontroller, diversion becomes possible.

**RTE**  
**Run Time Environment**  
RTE is the middleware layer for the interface that connects AUTOSAR Software and AUTOSAR Basic Software. Exchanges between application software programs and BSW are executed via this RTE.

**BSW (Basic Software)**  
This is a hardware-independent middleware (though some parts of MCAL and OS are omitted). It is composed of a Service Layer, ECU Abstraction Layer, Microcontroller Abstraction Layer, and numerous software components.

**Service Layer**  
The Service Layer is the uppermost layer of Basic Software. It provides the application software with the following services:  
* Operating system service (OS)  
* Automobile network communications and management services  
* Memory service (NVRAM management)  
* Diagnosis service  
* ECU status control

**ECU Abstraction Layer**  
The ECU Abstraction Layer responds to the functions of the application software and connects to the Microcontroller Abstraction Layer. It also provides the APIs to operate the microcontrollers and devices, including the drivers of external devices.

**Microcontroller Abstraction Layer (MCAL)**  
The Microcontroller Abstraction Layer is a device driver that is positioned at the lowermost layer of the Basic Software. It can directly access the memory that is mapped with the peripheral and external devices inside the microcontroller. It is prepared to suit the interface for each microcontroller such as memory and register.

As an example, this section describes the operation outline of transmitting a CAN message.

Receiving the instruction from the application software, the instruction for CAN transmission is sent to BSW via RTE. When communication is executed, Communication Service provides automobile network communication and management service—this section determines how information is to be handled. Communication Hardware Abstraction analyzes how the received information is transmitted physically and MCAL makes an actual and direct access to the memory and transmits the information to the external destination. A similar operation is executed for memories, peripheral functions, and I/O.

**Status of AUTOSAR Support**

FUJITSU has been devoting efforts to support AUTOSAR for the MB91460 Series and is capable of providing MCAL. **Figure 2** presents the roadmap of the MB91460 Series. AUTOSAR Release 2.1 supports FlexRay as standard. It also supports our FlexRay microcontroller “MB91F465X” as well as “MB91F467D,” our microcontroller for dashboard control. Shipment of these products has already begun.

The MB91460 Series is composed of 32-bit microcontrollers with 100MHz (maximum) internal operation frequency; we have a lineup of 64- to 320-pin products. The target products include dashboard, BCM and audio, and gateway.
Strategic Partnership with Elektrobit

FUJITSU is under a strategic partnership contract with Elektrobit, a leading automotive software technology company. This enables us to keep up with the pace of AUTOSAR and to realize efficient and leading-edge product expansion and support by actively exchanging information. We are also jointly developing MCAL in conformity with this contract.

Since AUTOSAR can handle various software components as parts, it is possible for Company A to develop parts other than MCAL and Company B to develop MCAL so that they can be packaged. The problem here is the conformity between MCAL and the upper layer of BSW. At this point, we match all our software programs for the AUTOSAR package with Elektrobit so that we can provide an efficient execution environment.

Future Developments

Release 3.0 of AUTOSAR has already been issued, and Release 4.0 is to be issued in the near future. FUJITSU will continue actively discussing our future support in cooperation with our strategic partner Elektrobit.

Figure 2  Roadmap for 32-bit MCU MB91460 Series Supporting AUTOSAR