

ANALYZING INDIVIDUAL
SOFTWARE COMPONENTS INSTEAD
OF ENTIRE ECUS

Early Testing of AUTOSAR Components

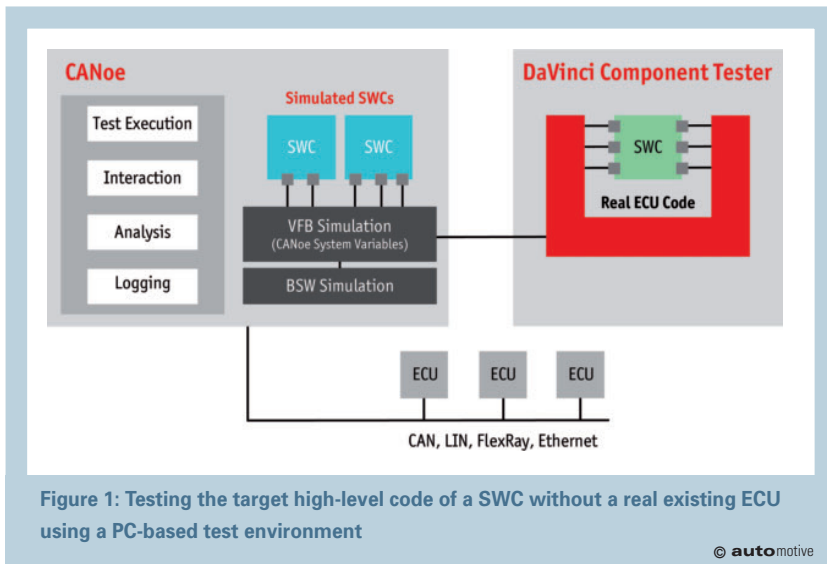
Software components and the Virtual Functional Bus of AUTOSAR define a new layer in the application software. This layer enables testing of individual software components and the communication between them. This article explains how you can test parts of the application even during early development phases and thereby simplifying the later integration of the software components.

AUTOSAR is becoming increasingly important to the entire ECU design process. The AUTOSAR methodology and its description formats have become the current state-of-the-art method for specifying the in-vehicle software architecture. Key AUTOSAR concepts are "Software Components" (SWCs), "Runtime Environment" (RTE) and the "Virtual Functional Bus" (VFB), as well as interfaces specified and standardized in AUTOSAR.

On the one hand test tools for analyzing and checking ECUs must understand the AUTOSAR interfaces and read-in the description formats. But, on the other hand the new component layer within the software architecture is increasing diversification and allows certain time independence in ECU development. This requires analyzing and testing of individual SWCs or groups of SWCs instead of entire ECUs. Thus module and integration tests on this component layer are necessary for an individual ECU.

Description of the Network Communication

In the AUTOSAR design methodology, bus communication is transparent as a central basic service for the application and is therefore also transparent to the SWCs; which is defined in the higher-level AUTOSAR system description. This description is derived from the distribution of SWCs to the ECUs and from the interface ports of the SWCs. In testing an AUTOSAR ECU, the test tool must know the communication so that it can interpret the signals in the messages. Until now, communication databases have been read-in using the FIBEX or DBC exchange format. The process of converting the "AUTOSAR System Description" into these formats is time-consuming and error-prone. That is why the system description is read-in directly into CANoe since version 7.2, significantly improving the user friendliness of the analysis and testing tool from Vector.



Testing individual software components instead of entire ECUs

AUTOSAR methodology offers finer granularity of the software units under test. Instead of testing entire ECUs or parts of ECUs, in the future SWCs will be tested either individually or in combination. Real ECUs are tested using a remaining-bus simulation to simulate the non-real ECUs. Comparable to this method, in the future the SWCs will be executed in a runtime environment and tested with simulation of the remaining SWCs.

Use of the DaVinci Component Tester as a SWC runtime environment is advisable in early development phases, in which no real ECUs are available as a runtime environment. The DaVinci Component Tester provides a PC-based runtime environment for the real ECU code of one or more SWCs. CANoe uses an emulated VFB to interface the SWC to bus communication, inputs and outputs (I/O) and to a model-based simulation of other SWCs. The VFB in CANoe consists of system variables for each SWC port and, if applicable, routing of these variables to or from the bus or the I/O. The DaVinci Component Tester connects these CANoe system variables to the ports of the real SWC code (**Figure 1**) using an RTE emulation.

Familiar CANoe test functionality is used to test real ECUs, the ECU's target C-code of a SWC and completely simulated SWCs (MATLAB model / CAPL code), including automatic generation of a test report.

Communication analysis between software components

For integration tests of the SWCs on an ECU, the test tool requires a powerful interface to analyze internal ECU communication between the SWCs via the RTE. In the implementation planned for CANoe, no distinction is made

of whether the SWCs under test are SWCs in a real ECU or whether they are simulated SWCs on the PC. Just as the internally emulated VFB is mapped by system variables, RTE signals in the ECU are also accessed by system variables. In the future, these RTE signals might be acquired by a measurement over XCP-on-FlexRay. However, high-resolution traces require very high throughput in logging the internal ECU signals. That is why in the future the ECU and CANoe test environment will also be interconnected via a JTAG or Nexus Debug interface (**Figure 2**).

This will let users read-in or adjust internal signals of the RTE or basic software (BSW) in CANoe – quickly and with high data throughput.

Summary and Outlook

Today, it's just as simple and feasible to test and analyze AUTOSAR software components as it was to test and analyze an entire ECU previously and indeed in all phases of development – from fully simulated SWCs via partially simulated systems or the production code of an SWC to an entire AUTOSAR ECU. One future consequence is that interfaces to the test system will no longer be just real interfaces on the outside of the ECU; instead, they are more likely to be virtual interfaces within the ECU.



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