

Advantages of the Frontloading ECU Diagnostics

Jochen Retter, Business Development Manager, and Uwe Schmidts, Marketing Coordinator, Diagnostics Product Line, Vector Informatik.

Diagnostic functionality is typically implemented very late in the development cycle of an Electronic Control Unit (ECU). Suitably configured diagnostic test systems are usually not available until shortly before production start-up. An informal never-ending requirement phase further aggravates this situation. This article describes a frontloading approach which overcomes these problems.

In an environment of continuous increases in complexity, diagnostics is becoming more and more important in the motor vehicle. Diagnostic functions should be implemented early on, and in parallel to functional development. Yet, they are often added very late in the development cycle of an ECU. Appropriately parameterised diagnostic test systems are usually not available until shortly before production start-up. These facts, and the common misinterpretation of product and requirement specifications, often lead to unfavourable long-term economic consequences, intense workload and a high occurrence of last-minute changes. The OEM defines, in one or more specifications, its requirements for an ECU. In the diagnostics area, the ECU-specific specification usually references international standards and a general diagnostic specification for all ECUs of a specific vehicle model. Unfortunately, the latitude for interpretation of these standards and specifications is considerable. The solution of Vector Informatik consists in formalising Requirements Management and filling in the gaps between the customer specification and the requirement specification using OEM-specific templates; and implementing diagnostic requirements in a XML database. With this approach (Frontloading), the total effort required to implement the diagnostic protocol can be reduced by a factor of 6 to 7. This creates a win-win situation for both suppliers and OEMs.

Universal diagnostics

The supplier initially works out a diagnostic requirement specification, in which he describes from his perspective how it will implement the requirements. This second perspective and the room for differing interpretations make it necessary to conduct a costly coordination phase. This generally occurs too late. In some cases, it does not happen at all or only when a failure occurs after the ECU has already reached the test bench or been installed in the vehicle. Another negative aspect is the higher priority given to the development of new functions compared to the implementation of diagnostic functionalities. Consequently, in practise one finds high work intensity, changes with broad impact and a high occurrence of last-minute changes. The solution is distribution across reusable diagnostic components. Diagnostic features are classified as general diagnostic

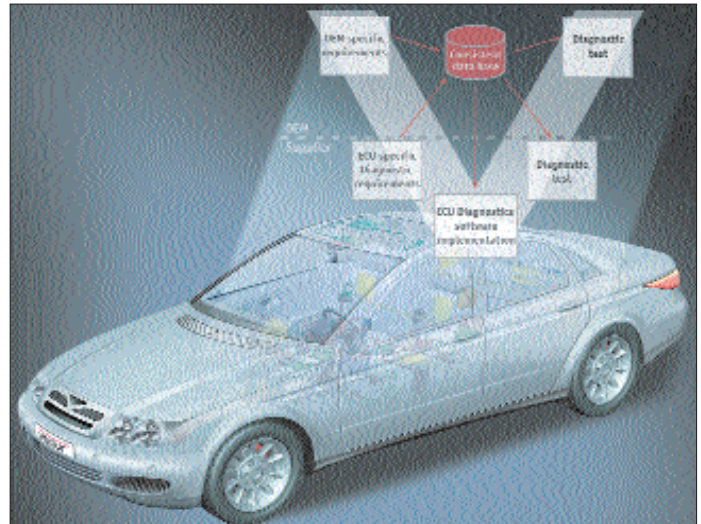


Figure 1: ECU diagnostics need a consistent data base

data applicable to all ECUs (ECU Identification for example), ECU-specific diagnostic data, underlying diagnostic protocol and ECU-specific diagnostic algorithms. This approach can substantially eliminate time-dependencies, and the first three parts of a diagnostic solution can be prepared before submission of a bid. The motor vehicle OEM highly values having the general diagnostic features in a vehicle implemented from one ECU supplier to the next. The OEM would also like for the specific diagnostic data of an ECU type (dashboard, lighting, etc.) from different suppliers to be as similar as possible. The supplier would like to implement its ECU-specific diagnostic features as consistently as possible across all OEMs. OEM-specific requirements with regard to

diagnostic protocol and data counteract this desire. How can a solution be worked out that makes Frontloading possible, results in time and cost savings and creates a win-win situation for all participants?

Consulting is helpful

In consulting services provided before the bidding process, the OEM requirements are determined from standards and specifications, and their precise implementation is defined. This information is then converted to a machine-readable diagnostic XML-template. The entire diagnostic protocol and the general diagnostic requirements and data for a specific vehicle model are already described in this diagnostic template. The template also defines how the supplier should map

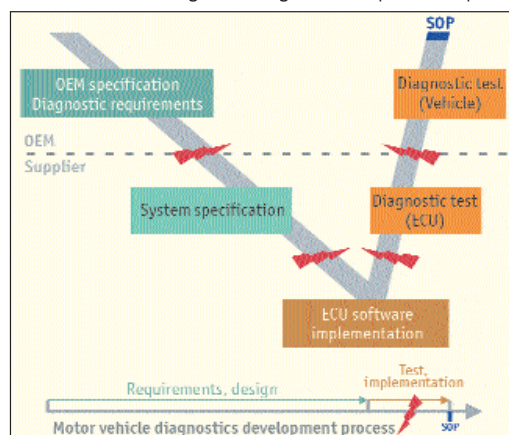


Figure 2: Conventional diagnostic development process that addresses problems arising between individual process steps

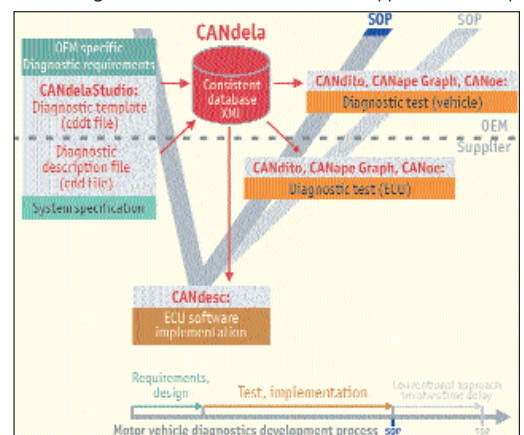


Figure 3: Diagnostic development process with Frontloading

Process in Developing

ECU-specific diagnostic requirements to the diagnostic protocol and how diagnostic data should be described for the customer. Practical implementation consists of a tool-driven data input process, automated source code generation and automated data support for test systems. The discussion of what should be implemented and how is only handled once representatively for all ECUs, and it is saved in a formalised template using the Vector Tool CANdelaStudio. The template is refined by adding ECU-specific diagnostic data. As the template is expanded further, the supplier only enters functional descriptions and diagnostic data to be sent to the test system. This approach eliminates misinterpretations of the requirements and implementation specifications. Both requirements and implementation specifications are replaced by a common specification document that evolves over the course of the development phase and describes requirements and their implementation.

Short development time

Because of the clear description of requirements and their implementation in the template, the step to implementation is easy. An effective C-code generator can be developed which maps the requirements unambiguously to ECU code. The CANdesc C-code generator generates OEM-specific diagnostic software components for the ECU. Just a short time after the project is started, the supplier can deliver an ECU that contains the entire diagnostic protocol and the general basic features of the diagnostic system. Both the OEM and the supplier have the capability of immediately developing or configuring their diagnostic test systems. Diagnostic algorithms relevant to the manufacturing process can be simulated ahead of time, or they can be tested in the ECU (for example with the software tools CANoe, CANape Graph and CANdito). As a result, the entire development model can be fully executed about 6 to 18 months earlier than by the conventional method. This succeeds because of the massive shift in development efforts toward the beginning of the product creation process (Frontloading). Suitable templates are prepared for each of the

various car manufacturers, so that the ECU supplier can concentrate on his ECU-specific data and algorithms. Reuse of these diagnostic features for different OEMs or for related ECU products is facilitated by the separation of ECU-specific

information from the car manufacturer-specific template. This approach permits Frontloading in the development process, enhances product quality, creates a win-win situation for all participants and leads to massive time and cost savings.

**VECTOR
INFORMATIK GMBH,**
Tel+49-711-806700
Fax+49-711-80670111

 enter 12696 at
www.epn-online.com