Diagnosis of complex subsystems

Standards can be very helpful in integrating complex electronic subsystems into an existing diagnostic system. In fact, the dissemination of these standards is still relatively limited.

The following procedure model of Sontheim Industrie Elektronik is intended to illustrate how the interests of both OEMs and suppliers can be safeguarded.

The complexity of commercial vehicles in the agricultural and construction industries is increasing all the time in order to meet the ever more demanding technical requirements. As complexity increases, so does the number of electronic control functions within the machines. This poses an ever-increasing challenge for service technicians to ensure the support of the machines throughout their entire life cycle. One way to make this task easier is to develop a diagnostic tool that is able to combine all diagnostic sub-functions of the most diverse subsystems and make them usable (readable).

Standardized communication

To achieve these goals, standardized communication data and interfaces must be used. These include, among others, D-PDU-API, ODX and OTX. These standard communication interfaces are simple and modular, as shown in Figure 1. The D-PDU-API is a generic software interface that provides "plug-and-play" functionality for various communication protocols. This interface connects the diagnostic information of the different protocols collected to a standard D server. The server then uses information based on the found data descriptions in the ODX files and provides "translated"

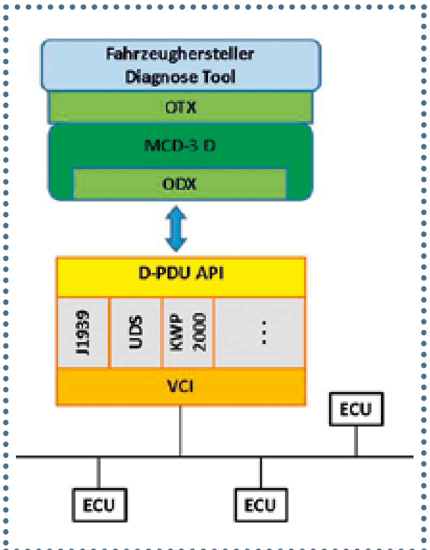

Figure 1: Communication structure with unified formats and intersections.

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information to the diagnostic application.The ODX files contain the interpretation of the diagnostic data from the various ECUs. Finally, OTX files are used in the last step to link the raw data to the diagnostic application. OTX is an XML-based exchange format for diagnostic test sequences.

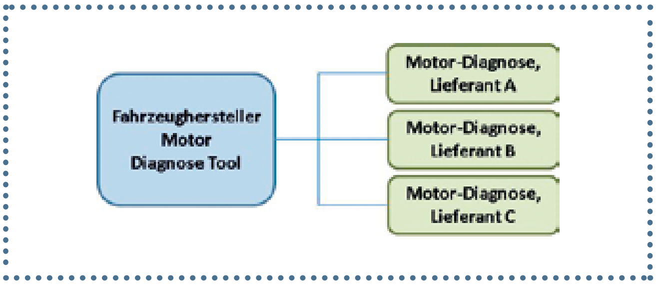

Figure 2: Use case 1, a diagnostic tool for different engines.

Best Case Scenario

To illustrate this methodology, the communication structure refers to a use case that corresponds to a real situation often faced by vehicle manufacturers. In this example, a vehicle manufacturer receives a subsystem from different suppliers. For example, the vehicle manufacturer needs engines from different suppliers for different vehicles it produces.

The manufacturer's goal is to create a diagnostic tool for this subsystem, as shown in Figure 2. The "best case" solution for diagnostic integration has occurred when the engine suppliers deliver the appropriate OTX and ODX files for their engine ECUs. These files are stored in libraries as part of the overall diagnostic software architecture and can be retrieved whenever needed. This solution is illustrated in Figure 3.

Real World Case

In the "real world", suppliers do not always provide ODX and OTX files. This can have several reasons. Often suppliers do not use these formats in order not to give the machine manufacturer access to their proprietary knowledge. Instead, they use their own proprietary

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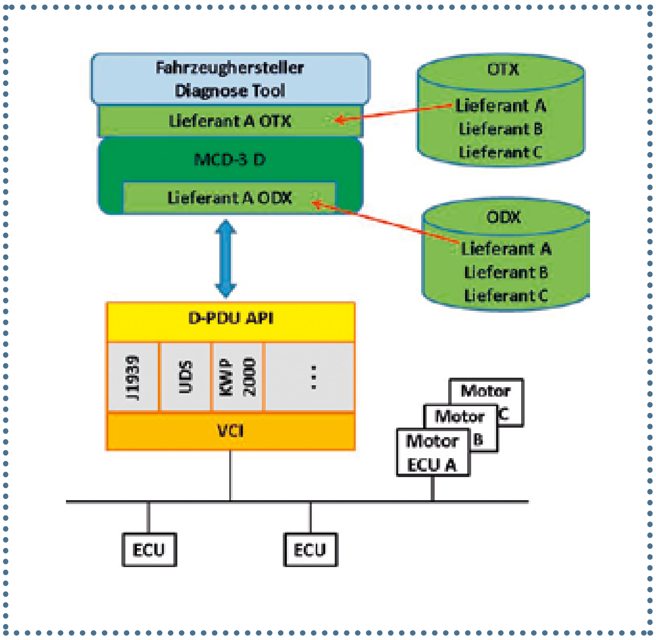

Figure 3: "Best case" solution for use case 1.

Figure 4: Illustration of the "real world" solution for application case 2.

transmission protocol DLLs, but these are not supported by the D-PDU API. Furthermore, suppliers can also use otherwise specified communication formats such as RS232 instead of CAN.

Suppliers are naturally also interested in maintaining the quality of their subsystems and their corresponding diagnostics. By using standards, suppliers fear that the machine manufacturers will develop diagnostic systems that are not compatible with their quality standards. By integrating a licensing mechanism into the communication DLLs, the supplier can ensure here that only certain trained personnel can maintain the subsystem in the vehicle.

Regardless of the reason why suppliers do not provide ODX and OTX files, the task of subsystem integration is made more difficult. The solution involves the vehicle manufacturer building ODX files based on the supplier's data descriptions and by developing "wrappers" or special interfaces that allow both proprietary and non-standard communication formats to connect to standard protocols such as UDS. Hard-coded into the "wrappers" is information about the test routines that can be used with the built-in UDS function routine control.

To demonstrate this methodology, the previously shown use case was modified by two additional engine controllers communicating with proprietary protocol DLLs and one engine controller communicating via a serial interface. The solution for this use case 2 is shown in Figure 4.

The ODX files are created by the vehicle manufacturer based on the data descriptions of the various engine suppliers. A "wrapper" is created for the RS232 interface as well as for each proprietary DLL protocol. In addition, licenses and user level management mechanisms are integrated into the wrapper. This enables suppliers to set licensing options that help ensure the quality standards of their subsystem. Thus, the supplier can only issue licenses to people after they have completed an appropriate training program provided by the supplier.

Conclusion

The actual key to the integration of a wide variety of sub-functions in a diagnostic tool is the use of standardized communication interfaces and uniform methods for describing diagnostic information. Standards create a modular architecture that can be adapted to different situations. The machine manufacturer can thus combine subsystems from different suppliers in one diagnostic application. Not only can the manufacturer work much more easily with this system, it is also robust and future-proof. Suppliers also profit from such modular architectures, because it allows them to protect their know-how and also offers proven and secure technologies. In addition, appropriate licensing and user management mechanisms are integrated to ensure quality standards. ■ (oe)

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