



## The Engine and Fuels of Modern Vehicle Diagnostics: Standardized Runtime System with ODX and OTX

**In the past, the lack of standards led to high costs and increasingly became a stumbling block to ever faster engineering cycles. Today, diagnostic data and sequences for standard-based systems in Engineering, Manufacturing and After-Sales Service only have to be created once. They can then be reused again and again by anyone involved throughout the entire vehicle life cycle. There are very definite advantages to vehicle diagnostics being covered completely with a holistic approach.**

Until just a few years ago, vehicle manufacturers put a lot of time and effort into developing and maintaining their own proprietary systems for vehicle diagnostics, either themselves or in collaboration with system partners. These systems worked with non-standardized data formats to describe diagnostic data and sequences which were usually not ma-

chine-readable (e.g. Word, PDF). The relevant data thus had to be entered again and again for the different tools used throughout the life cycle of a vehicle. This repeated manual input in Engineering, Manufacturing and After-Sales Service was both time-consuming and prone to errors. It was also virtually impossible for suppliers to reuse vehicle

data, tool chains and engineering processes based on these for different manufacturers. And exchanging data in cooperation projects involving different manufacturers was a major problem. The lack of standards led to high costs, was a stumbling block to ever faster engineering cycles and resulted in considerable dependencies on individual tool

manufacturers. Collaboration ultimately became possible when new legal requirements demanded a standardized data format for supplying independent repair shops and dealers, and when manufacturers came to the conclusion that it is not the basic diagnostic technologies that determine competitive edge anyway. All the major vehicle manufacturers worldwide, together with their suppliers, then worked on specifying and implementing a range of international standards.

### Important Standards

- ISO 22901-1/  
ASAM MCD-2D (ODX)
- ISO 22900-2 (D-PDU API)
- ISO 22900-3/ASAM MCD-3D
- ISO 13209 (OTX)
- ISO 13400 (DoIP)
- ISO 14229 (UDS)
- ISO 15031 (OBD)
- ISO 27145 (WWH-OBD)
- SAE J1939
- SAE J2534 (Pass-Thru)

### Standardized Diagnostic Runtime System

A standardized diagnostic runtime system, the ISO MVCI server, is a central element in vehicle diagnostics, effectively the "engine". It makes it possible to use vehicle interfaces from different manufacturers and exchange them at will. The necessary "fuel" in this diagnostic runtime system is ODX. This is an XML-based, machine-readable data format for specifying and exchanging diagnostic data. It is independent of the bus protocols used and comprises not only the vehicle- and ECU-specific diagnostic

functions ("services") but also configuration and flash data. All ECU variants, based on a standard variant, are included. Redundancies are avoided with the use of libraries, inheritance and references.

The actual applications (created by the users themselves or simply one of the many tools available on the market) use the methods made available at the application interface. This means that they can be created without there being any need for users to have special knowledge of communication protocols or services and that they are independent of vehicle interfaces and the protocols used. ECU and vehicle information is accessed using the conversion methods, service and data type descriptions contained in the ODX database. It is also possible to address a request to all ECUs of a functional group with comprehensive functionality, such as for example OBD.

But in vehicle diagnostics, not only individual services but also a large number of diagnostic and test sequences are required over and over again throughout the entire life cycle. Examples of these are:

- Start-up routines for ECUs (seat adjustment, ventilation/air conditioning, matrix LED light and many more)
- Reading out the fault memory including the environmental conditions
- Flash programming with previous ECU identification and security access

These more complex sequences including possible user interaction cannot be described using ODX. This gap in vehicle diagnostics was closed by OTX as the second "fuel". OTX, too, is a standardized XML format which can be run directly over an additional OTX runtime based on

the diagnostic runtime system. Unlike the Java jobs used to date, OTX is process-safe long term (test sequences must still be able to work in a repair shop tester after 20 years with the operating system relevant at the time!).

### In use worldwide

The standardized diagnostic runtime system as well as the two data formats ODX and OTX are now accepted worldwide as state of the art. The major vehicle manufacturers all over the world are at different stages of replacing the previous proprietary systems: The process has already been completed in Germany, but is still in progress in Asia. In the rest of Europe, ODX data is being imported into the existing systems or tools as a first step. In North America, individual OEMs are very active.

Due to the process improvements and the associated potential savings, however, more and more small and middle-sized vehicle manufacturers are opting for standard-based solutions. As part of the necessary changes, diagnostic data for new vehicles is now only being created in ODX format. There are various strategies for dealing with the existing diagnostic data of current vehicles which is available in proprietary formats. Vehicle manufacturers can define the number of interim steps and the entire duration of the changeover to suit their individual requirements and processes.

### Universally reusable

The use of ODX and OTX has made a completely new way of working possible: For the very first time, the Engineering, Manufacturing and After-Sales Service Departments as well as all suppliers can always use the same database for their different tools. This is also true of cooperation projects between different vehicle manufacturers and the compli-

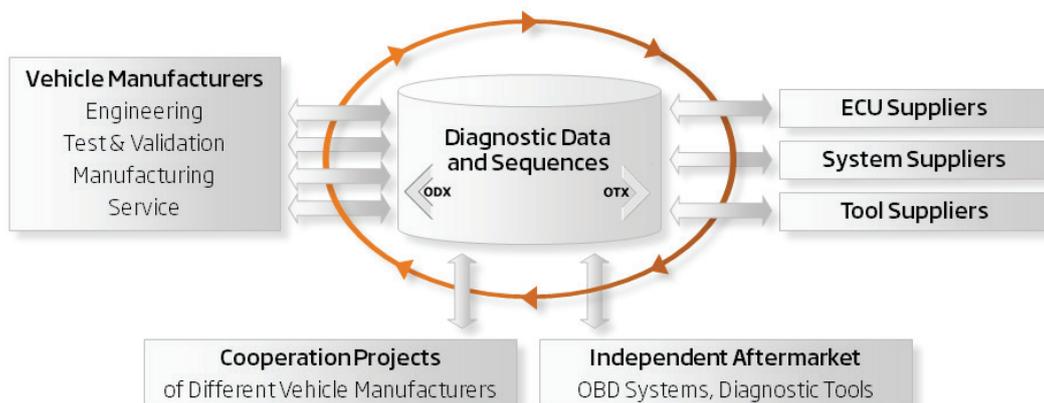


Figure 1: Continuous reusability of diagnostic data and sequences

ance with legal stipulations.

Generally speaking, diagnostic data and fundamental sequences are created by the ECU suppliers based on OEM-specific templates and authoring guidelines. ODX and OTX can be used both for the specification and for the documentation, and reused and extended over and over again throughout the vehicle's life cycle. Both the number of faults and the time involved are thus reduced with every step as verified data is already available and an increasing number of test sequences is available all the time. Additional variants can be added at any time.

### Extended diagnostic runtime system

Softing's Diagnostic Tool Set product family is based on an extended diagnostic runtime system. This is shown in orange in Figure 2. It implements the latest automotive standards, whereby full compliance and performance are verified in comprehensive tests in accordance with the ASAM test suite.

In addition to the ISO MVCI server with support for both ODX 2.2.0 and ODX 2.0.1, it contains a completely integrated OTX runtime. The integration offers additional advantages, such as:

- Holistic project and library management for individual ECUs, vehicles or model ranges
- Release of diagnostic and test sequences for certain approval states of diagnostic data
- Safeguarding of expertise and protection against unauthorized changes because both encrypted ODX and OTX runtime data can be run
- Fully comprehensive support for the MVCI server, OTX runtime and the entire data management from one source

The D-PDU API software, contained in Softing's extended diagnostic runtime system, supports EDIC, CAN and SAE J2534 (PassThru) vehicle interfaces from Softing and other manufacturers as well as ISO 13400 Diagnostics over Internet Protocol (DoIP). Furthermore, the simultaneous, parallel use of different D-PDU APIs and (if required multi-channel) vehicle interfaces from any manufacturer is enabled. This is how 100 interfaces of the samtec HS family could be operated in parallel with high performance with over 100x 60 services per second on an

endurance test bench of a major Tier1 supplier.

The system supports several processor platforms and different operating systems: x86, x64, ARM as well as Windows, Linux and Android. The low resource requirements mean it can be used on smartphones and embedded systems, such as the Raspberry Pi.

### Conclusion

It is only together that ODX and OTX cover the entire spectrum of vehicle diagnostics and thus protect investments long term thanks to international standardization. Diagnostic data and test sequences only have to be created and maintained once and can be reused as many times as required by everyone involved at any time without any problem over the vehicle's entire life cycle. The overall data quality increases firstly because problems and faults are now both discovered and remedied at an earlier stage than they used to be and secondly due to the native system support of ECU variants. There are already considerably fewer communication problems during the development process. In Manufacturing, the use of a

standardized diagnostic runtime system leads to considerably reduced initial setup times for new models. The high performance and the support of Ethernet make the constantly increasing amounts of data in flash programming manageable. As service testers are also based on the same system as used in Engineering and Manufacturing, completely verified diagnostic data and test sequences can be used for their functions.

The diagnostic runtime system as the "engine" and the two data formats ODX and OTX as the "fuels" of vehicle diagnostics are being used by more and more vehicle manufacturers all over the world to master the challenges presented by the continuously increasing complexity and the ever faster product cycles. It is particularly advantageous if the runtime system used and the tools deployed seamlessly integrate ODX and OTX, thus covering holistically the entire vehicle diagnostics process.

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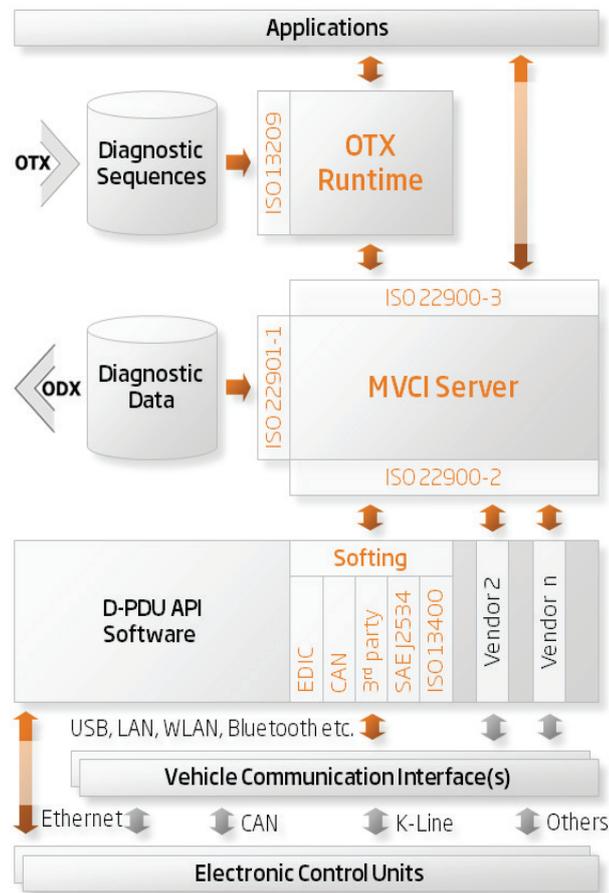


Figure 2: Vehicle diagnostics with extended diagnostic runtime system