STANDARDIZATION DRIVES QUALITY AND EFFICIENCY IN VEHICLE DIAGNOSTICS

Interview with Prof. Dr.-Ing. Goß

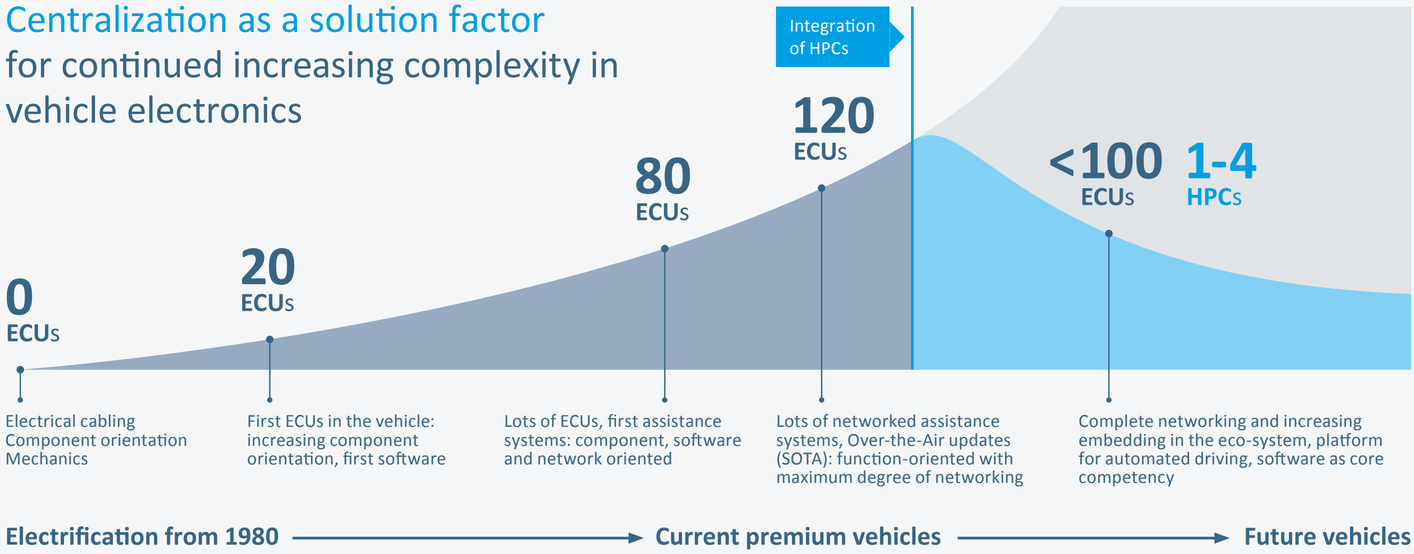
- Current developments in vehicle electronics
- Impacts on the standardization of diagnostics
- Standard vs. proprietary

Mobility behavior is changing faster than ever before. While smart functions and increased driving comfort have long been the norm, politics and society are demanding solutions for safe, sustainable and environmentally-friendly mobility. With this in mind, two fields of innovation are particularly important: electric and alternative drives as well as increasing digitalization and automated driving. Vehicles are therefore becoming increasingly smarter and more efficient, requiring greater computing power as a result. As E/E systems become more complex, so too do the on-board communication requirements in relation to higher bandwidths, shorter latency periods and error-free data transmission.

The secure, efficient and cost-effective networking of the individual electronic systems is thus becoming ever more important. In addition to this, rising energy and material costs are placing the entire automotive industry under pressure, meaning that the optimization of cost and revenue structures across the entire vehicle life cycle take top priority now more than ever.

The sector’s response to these developments is standardization, with areas displaying little scope for differentiation being standardized.

Centralization as a solution factor for continued increasing complexity in vehicle electronics

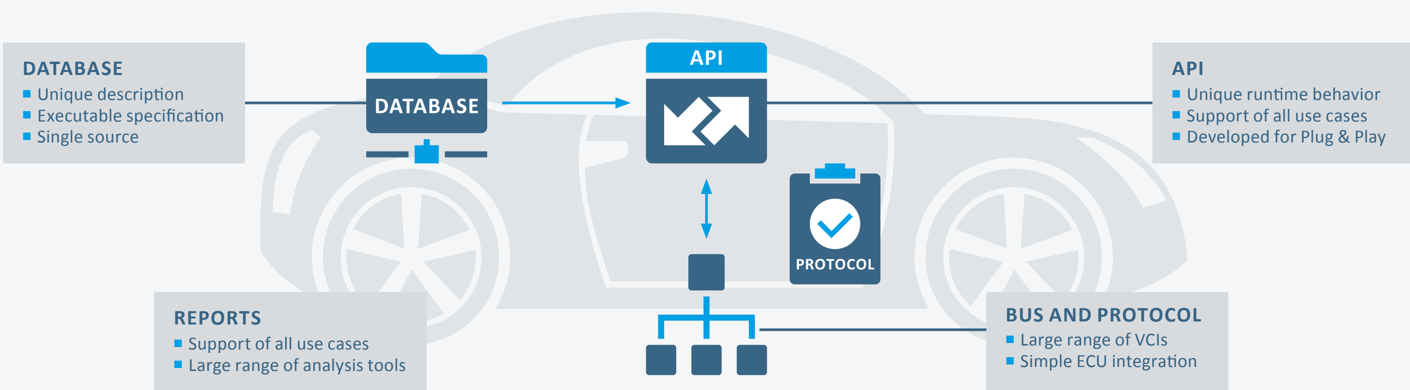


STANDARDIZATION IN VEHICLE DIAGNOSTICS – FOCUS ON QUALITY, EFFICIENCY AND PROTECTING INVESTMENTS

The use of standards in areas not relevant to competition offers numerous benefits across the entire vehicle life cycle. One of the main advantages of standardizing vehicle diagnostics is much shorter engineering times, in particular through the development of a central diagnostics database (standard: ODX ISO 22901-1, Open Diagnostic Data Exchange). The possibility of reusing data once created in engineering, manufacturing and service, combined with the availability of tools from different manufacturers which are all based on the same data format and have standardized interfaces, greatly simplifies the existing and very often heterogeneous world. It provides an opportunity to set up diagnostic tools on a modular basis throughout the company, which in turn facilitates a high level of recyclability of the individual components in different business sectors. For example, thanks to suitable interfaces, the diagnostics hardware (VCI, Vehicle Communication Interface) is largely interchangeable and can be obtained from different manufacturers for specific applications: e.g. high performance interfaces for manufacturing and low-cost interfaces for after-sales. The overlying diagnostic runtime system can also be purchased from different manufacturers according to performance, standard compliance, flexibility and cost requirements. Standardization therefore makes it possible to reduce unit costs considerably.

To achieve overarching interoperability and secure our customers' investments, we at Softing Automotive systematically rely on recognized, international standards. As an active member of the major standardization committees in the field of automotive electronics, such as ASAM, SAE and ISO, we help shape the future of technology. Our customers therefore benefit directly from the effects of standardization.

Advantages of standardization



CURRENT DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRY AND THEIR IMPACTS ON THE STANDARDIZATION OF VEHICLE DIAGNOSTICS

Prof. Dr.-Ing.
Stefan Goß

Professor at Ostfalia University of Applied Sciences and Head of the Institute for Vehicle System and Service Technologies

We talked to Prof. Dr.-Ing. Stefan Goß about the current developments in the automotive industry and their impacts on standardization, in particular with regard to vehicle diagnostics. Dr. Goß is a Professor at Ostfalia University of Applied Sciences in Wolfenbüttel (Wolfsburg site) and Head of the Institute for Vehicle System and Service Technologies. In addition to the basics of electrical engineering and electronics, he also teaches vehicle diagnostics, automotive expertise and document management and security. Dr. Goß previously spent a number of years working in the private sector, including with a major German vehicle manufacturer. Today, alongside his professorship, he also works as a freelance automotive engineering consultant, experiencing at first-hand how different departments have to deal with new technologies. Dr. Goß believes that one of the greatest challenges facing the E/E architecture at present lies in the new bus systems, and in particular the transition to Ethernet on the physical layer. Debate in the sector is ongoing as to whether the transition to Ethernet will also extend to optical bus systems, and Dr. Goß has a clear opinion on the matter:

„I believe that in the coming years and decades, we will continue to use copper in vehicles and not fiber optics. The repair processes for fiber optic cable systems in the workshops require specific competences, for example compliance with bending and buckling radii. Unlike the fiber optics that can be found in houses, this poses an entirely different challenge in vehicles, especially with regard to the worldwide after-sales activity which has to be able to deal with the technology. There are nevertheless also major challenges with regard to copper, due to technical developments, such as higher frequencies. In training, this is precisely what we are gearing our lectures and laboratories to.“

„HPCs are Scalable Drivers in Vehicle Electronics“

As the level of innovation in new vehicles increases, so does the complexity of the E/E systems and thus the requirements for onboard communication, with a need for high performance computers in vehicles. Vehicle manufacturers are nevertheless unable, at present, to provide the suppliers with a guarantee that they will have the necessary computing power at all times. We asked Dr. Goß how he sees the future development of high-performance computers (HPCs):

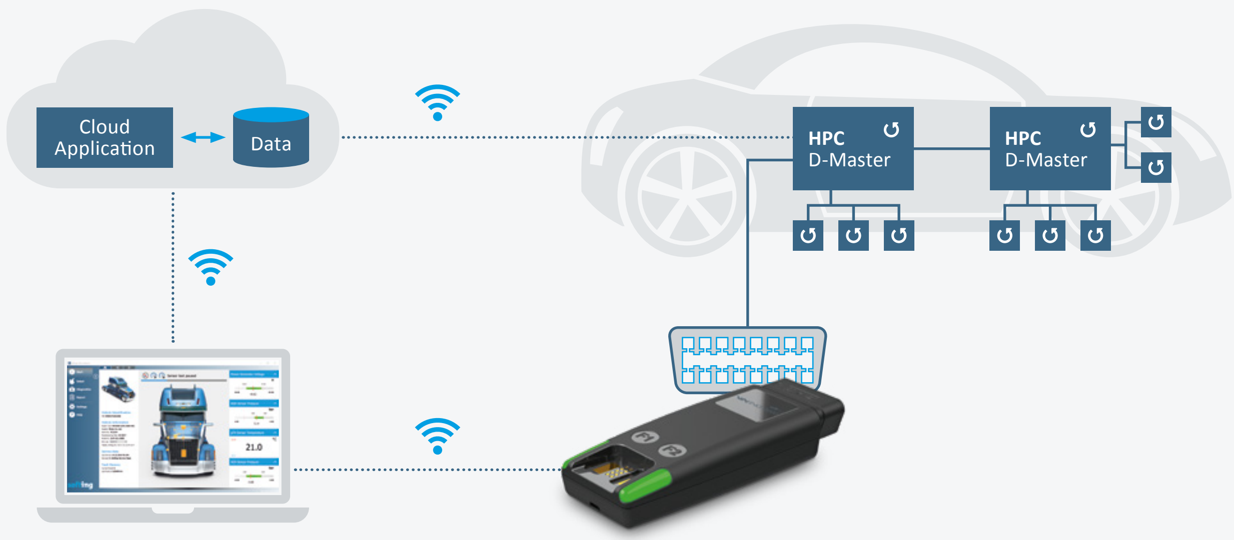
„Even in 20 years, cars will not consist of three high-performance computers and a couple of simple sensors. A key reason for this is not even technical, but simply the multiple supplier strategy of vehicle manufacturers. Today, negotiations are taking place at the hardware level. I cannot imagine the purchase of software components from a wide variety of manufacturers being condensed to two or three HPCs. There will therefore still be decentralized components and architectures. These will very probably make do with fewer control units and look different than they do at present.“

In the industry, we are currently observing a trend towards incorporating everything into high-performance computers, thereby reducing weight and saving on materials, in particular copper. Among other things, this calls on the use of wireless technologies for control units to communicate with the HPCs. Dr. Goß is nevertheless somewhat skeptical with regard to the associated euphoria:

„Through the safety requirements of ISO 26262 relating to functional safety, this current hype will give way to a phase of "sobering up". In 20 years' time, we will still need things like CAN and LIN. The key argument is the good relationship between data rates, safety and costs. The HPC approach remains undisputed, but not everything should be incorporated wholesale into the HPCs.“

Diagnostics in transition – centralized computing power

For every main vehicle function, there is an electronic control unit, ECU. Every ECU monitors its environment – what is referred to as self-diagnostics. The ECUs are connected to one another via bus systems – generally via a central gateway that is also connected to the OBD jack. A repair shop employee can thus connect an external tester in which algorithms read data from the ECUs and combine it to create meaningful repair instructions. Autonomous driving nevertheless requires much greater computing power in the vehicle than can currently be provided via present-day ECUs. Consequently, at least two high-performance computers (HPCs) – for reasons of redundancy – will be incorporated into the vehicle.



For the most part, we talked to Dr. Goß about HPCs in passenger cars, but we are also interested in his opinion with regard to trucks and mobile working machinery. According to the expert, HPCs will play an even more important role in this domain:

„At the automotive engineering faculty, we see the need for high-performance computers in the fields of agricultural and ship technology with their high requirements. To a certain extent, agricultural machines are already fully-autonomous when driving in the fields. Every effort should be made to share experiences and competences with these pioneering industries. Ensuring the scalability of HPCs in these fields would make good technical and economic sense. That is why we have created a new slogan for our faculty: Shaping the mobility of tomorrow.“

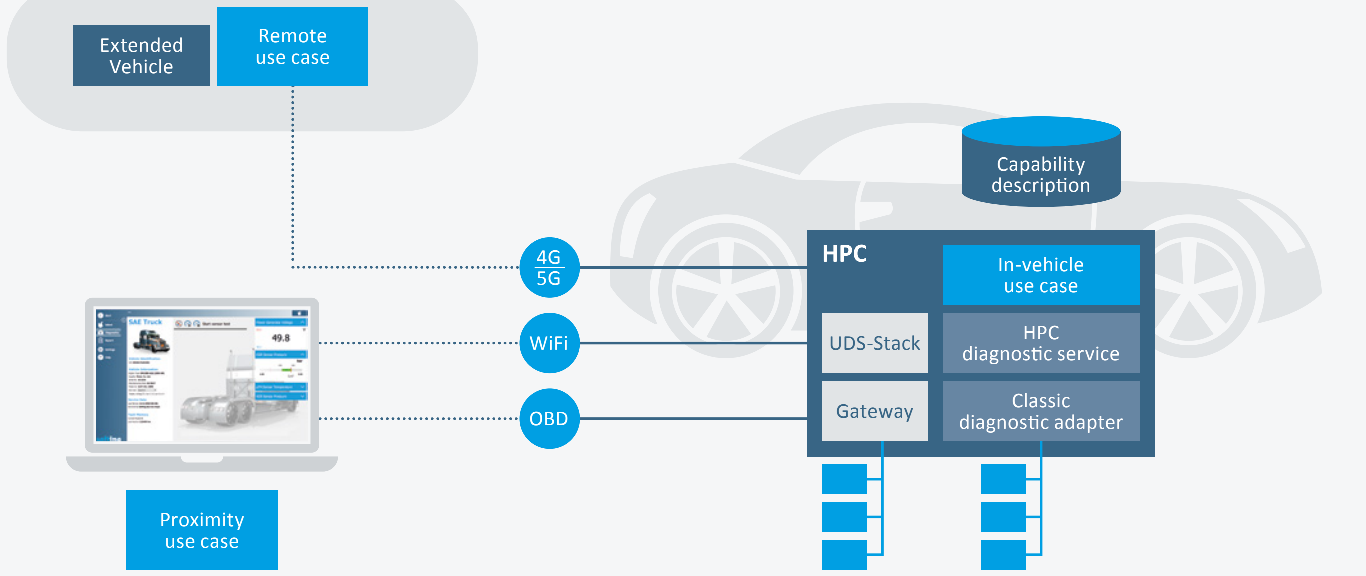
„SOVD will Become the Future Diagnostics Standard“

The more efficient vehicles fitted with HPCs bring with them major progress, while presenting the automotive industry as a whole with new challenges. This is also true of diagnostics. The UDS diagnostic communication protocol (ISO 14229, Unified Diagnostic Services), for example, will no longer be sufficient in the future. The use of a new SOVD standard (Service-Oriented Vehicle Diagnostics), defined by ASAM e.V., will be necessary both for repair shops and for remote diagnostics. SOVD defines an interface that facilitates vehicle diagnostics in the repair shop directly on the vehicle (proximity), via remote access (remote) or as a tester directly in the vehicle (in-vehicle). To simplify standardization and subsequent implementations, as many existing mechanisms and standards should be used as possible (e.g. TCP/IP).

In the discussion focusing on high-performance computers in vehicles, the issue of self-diagnostics is often raised. Despite SOVD, it is also unrealistic to envisage the repair shop outsourcing diagnostics completely to the vehicle in the future because a sensor is generally only installed in the vehicle for values required for the actual driving function. If, for the purposes of repairs, readings are required that the vehicle itself cannot generate, they must be taken on-site by a mechatronics engineer using a measuring instrument. According to Dr. Goß, the picture is nevertheless different for error-finding procedures, which are based on standard processes:

SOVD – Service-Oriented Vehicle Diagnostics

- Support for use cases: diagnostics beside the vehicle, remote diagnostics and in-vehicle diagnostics
- Basic diagnostics system in the vehicle, including the system diagnostics of the HPC
- Implicit support of UDS diagnostics for transfer control units
- Offline description of diagnostic capabilities for authoring systems



„SOVD Leads to a Rescaling of the Diagnostics Applications“

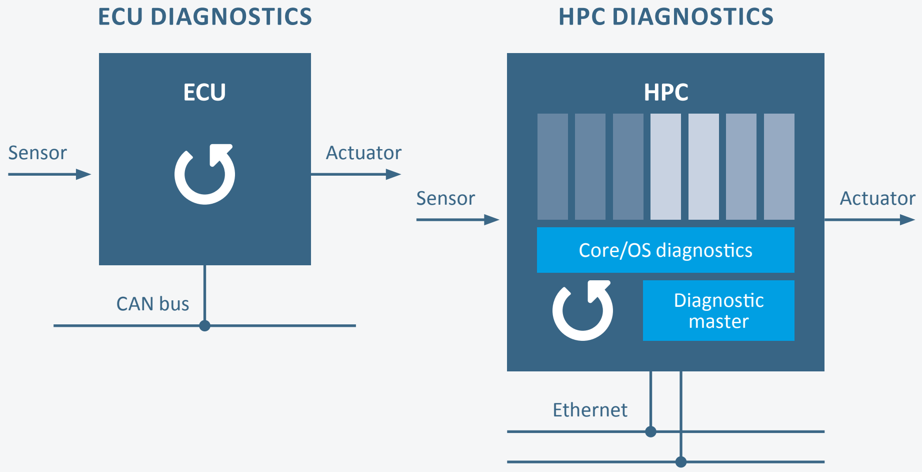
„If the specific vehicle data is available in the vehicle, the fault-finding process can also be conducted remotely via ‘Request and Response’ by means of outsourced diagnostics in the vehicle. Today, a tester has to be proficient in diagnostics for a wide range of vehicles, whereas a tester in the vehicle need only deal with the diagnostics data for the vehicle in question. This will simplify diagnostics. However, it will not be reduced to a browser function as expert knowledge or downstream processes often still play a role. On the other hand, the topic of SOVD requires another form of cooperation between diagnostic tester developers and engineers as well as vehicle manufacturers. Requirements management for the next generation of diagnostic testers must be coordinated precisely and shaping this coordination represents a huge opportunity for all those involved.“

Today, SOVD is still a matter for the future that needs to prove its worth. Ultimately, standardization is always linked to political or techno-economic goals. Current trends offer potential for further standardization. We asked Dr. Goß what would still need to be standardized for things to be better in the future:

„In the field of automated driving, or in other words if, in case of doubt, a driver can or must take over the driving functions after a certain reaction time, I certainly expect more standards to be developed for the purposes of comprehensible homologation and type approval. Those who are genuinely responsible for granting operating licenses and homologations will lay down additional major requirements with regard to standardization with a view to making provision for uniform, trustworthy type tests and approvals. I am expecting certain influences here. One of the major drivers is bound to be vehicle self-diagnostics.

The second driver will be insurances, because conventional vehicle liability insurance will become less relevant as the vehicle is no longer steered by the driver. Product liability through the manufacturer will thus have greater significance. The safety of the technology must naturally also be scrutinized. Only when this has been deemed safe can product safety be achieved. Once this confirmation has been obtained, the type approval or operating license can be granted. In my opinion, this explanatory variable of how to check the technology will be accompanied by further standardizations in the medium term.“

In this respect, it will also be interesting if a duty to provide proof is introduced, and reliable records have to be kept as to whether the vehicle was driving in autonomous, fully-automated or partially-automated mode. Modern vehicles are now fitted with an event data recorder, the vehicle equivalent of a “black box”. Dr. Goß nevertheless believes this is insufficient for future challenges:



New diagnostic capabilities in HPCs

At least two new diagnostic tasks must be implemented in HPCs. The first is the system diagnostics of the HPC, which constantly monitors the function of the operating systems and the distribution of tasks to the different processor cores, while the second is a diagnostics master that consolidates the self-diagnostics at the functional level. Furthermore, each HPC also performs today's self-diagnostics. It monitors inputs and outputs as well as the significantly increased number of signals via the Ethernet connection to other HPCs.

„The current event data recorders are insufficient. To ensure the authenticity of what a recorder registers before and after a crash, appropriate measures are necessary. The aim should be for the data to be consulted unchanged to ensure that the triggers can be read and analyzed with complete integrity, ultimately pushing accident forensics – and thus standardization – to new levels."

„Standardization Facilitates Massive Efficiency Gains but Should not Lead to Overregulation"

Dr. Goß therefore shares our philosophy that standardization can be a driver of quality. To stick with the example of type testing, type approval and issuing an operating license, overall quality begins with the quality testing of the products, which generally consist of networked hardware and software. The safe clearance test to issue an operating license is a fundamental indication of how mass-produced products will later work in the market. Dr. Goß adds:

„If standards are then in place allowing those concerned to conduct the test as well as possible and to issue the operating license with the best possible conscience, then we have made good progress. It is here in particular that I see the direct and immediate link between quality and standards. I can especially see major advantages for the launch of new mass-produced products."

A huge improvement in quality has also been achieved in standardization committees in recent years in the fields of communication technology and data processing. There is a strong awareness of the need for standards, and competent people have been delegated by companies. Standards are made by people who have the relevant basic knowledge and long-standing experience and who, above all, know how to make standards and where standardization is meaningful for everyone concerned. Numerous OEMs and suppliers nevertheless call on their own technologies and, in doing so, hope to create a positive unique selling point. This also raises the question, however, of whether a proprietary solution promotes a unique selling point as an optional extension or attempts to undermine a standard in order to dominate the market. Dr. Goß recommends differentiating:

„I believe that the reasons for adopting a proprietary solution are a key basis for discussion. Is it a positive extension or is it really an attempt to gain market power? This distinction should always be kept in mind."

In our day-to-day business, we often see that people try to establish in-house solutions as "de facto standards" ahead of established standards. This raises the question of whether it is a good idea in the long run to be dependent on one provider. This is the case, for example, if you are dependent on a specific cable instead of using the existing standard. For end customers, this is less of a problem, but for vehicle manufacturers and suppliers, it results in a high level of dependency. One of the major advantages for our customers is that they are not dependent on our products. With regard to this, we asked Dr. Goß how he sees the future viability of proprietary solutions:

„Many firms attempt to make use of proprietary solutions that is detrimental to the market. But I am also concerned that there will be overregulation in the form of standards and regulations. Take this example: On the one hand, we have the ISO and the ISO standards. These are generally implementation independent. Alongside this, we have the United Nations Economic Commission for Europe, or UNECE, which has a major impact on the mobility industry through the ECE regulations. And then you have the legislators, both at the national and continental levels such as Europe, Asia or the US. So there are three strong influences competing with one another and which may even contradict one another. In short, we have the ISO, the UNECE and the legislators.

I am a founding member of ISO standard 20730, working on it right up to its publication. In the use cases described in this standard (e.g. reading the chassis number, etc.), it was standardized with bits and bytes. In these use cases, the protagonists requested that everything be made "mandatory". If the UNECE then comes along and demands that a specific standard be made mandatory for a specific technology, the European Union adopts this recommendation in a European regulation. And in one fell swoop, an entire ISO standard, for example ISO 20730, becomes legally binding. Often, not all the parties that prescribe them are capable of assessing the related technical and business impacts. If the parties affected, be they vehicle or tool manufacturers, then come forward and complain that it is quite simply not economically feasible, it is already too late. And that is why I advise caution. Over-standardization combined with overregulation is dangerous and would be detrimental to the necessary degree of freedom and creativity. Incidentally, in the case of ISO 20730 and following a lengthy discussion, only those use cases that were absolutely necessary were given the status of "mandatory"."

„Degrees of Freedom in Standardization Allow for Differentiation – Ultimately in Customer Satisfaction, Too"

Avoiding this situation is one of the reasons why Softing Automotive is involved in standardization committees, as this enables us to conduct discussions – for example concerning the definition of the SOVD standard – within a competent circle of experts before taking it to the ISO. While Dr. Goß is a keen advocate of standardization, he nevertheless stresses that there are also benefits to complementary proprietary solutions:

„In diagnostics, we differentiate between the exhaust tract, for which legislators have considerable influence and set guidelines right down to the last DTC, and the field of diagnostics for the non-exhaust tract. In light of the existing standards, the latter offers OEMs a high degree of freedom in implementing diagnostic options. Some vehicle manufacturers use this to provide repair shops with highly sophisticated offboard diagnostics mechanisms. They do this as customer satisfaction is strongly influenced by providing successful service and avoiding repeat repairs.

Beyond standards, however, functionalities in the field of diagnostics make sense as additions for fault finding (type and location of a fault). This allows a vehicle manufacturer to develop a competitive advantage that can have a positive impact on their product and on customer satisfaction. And that can, in principle, be seen in every diagnostic tool through the Block Exemption Regulation. In this case, the EU has rightly ensured that there are no constraints. However, legislators – and not even the standardization body – should not interfere in these proprietary extensions."

With SOVD, we defined an interface at ASAM that really only concerns the outermost interface and no longer the implementation. On the one hand, this means that manufacturers can implement proprietary solutions very simply on the vehicle behind the SOVD interface. This provides the necessary degree of freedom for OEMs. On the other hand, there are suppliers of HPCs and conventional ECUs. The SOVD interface allows them standardized implementation so that several manufacturers can be served efficiently. We asked Dr. Goß for his opinion:

„It is primarily the OEM-specific self-diagnostics in the vehicle that are affected by the fact that parts of the offboard diagnostics migrate into the vehicle with SOVD. If we have such a "partial" diagnostic tester on-board, vehicle manufacturers have greater freedom as to what they can make available externally in the responses. To this end, SOVD provides the shell for a standardized answer. But with regard to the content itself, the vehicle manufacturers' degree of freedom remains unchanged. I don't believe that vehicle manufacturers will want to start making their content less visible again, because the ODX data can already describe the diagnostic functionality – even of HPCs. I think that the EU will clearly demand that ODX data be sold – at non-discriminatory prices. In addition to the fact that SOVD provides a self-describing data format, the diagnostic content implemented must be presented transparently in one way or another. Perhaps through the sale of ODX data or similar documentation. In this respect, content will not be veiled and obscured again as it used to be "in the dark ages". The legislators will see to that."

„PoC Demonstrates the Possibility of Standards-Based ePTI Test Procedures"

The sale of data under the aegis of the legisaltor is an established procedure. In the course of the ePTI (electronic Periodic Technical Inspection), vehicle manufacturer data is collected by a central location and made available to the officially recognized expert as part of an inspection tool. In the future, a standard could describe the device-independent provision of ePTI test procedures for inspection tools.

ePTI – Electronic Periodic Technical Inspection (ISO 20730)

Due to the increase in electronic safety-relevant systems in vehicles, these must be examined in accordance with Directive EU/2014/45, Implementing Regulation EU/2019/621 and §29 of the national Road Traffic Act (StVZO), together with appendices as part of the main inspection. The inspection uses a vehicle interface. For this purpose, an appropriate device is required that controls the communication possibilities with the vehicle and provides a user interface for the officially recognized expert or inspector.

We asked Dr. Goß how he sees the relationship between ePTI, proprietary solutions and data trustees:

„For the overall architecture of offboard and remote diagnostics systems, proprietary solutions are a disadvantage if individual instances present themselves as independent data trustees following a business model. It is a shame that our free market economy is not fully driven in this approach. This is where I am trying to prove that it works. That is precisely why we created the Proof of Concept together with you at Softing and Volkswagen and demonstrated a manufacturer-independent implementation of ePTI procedures based on the ODX and OTX standards."

„Even Complex Functions can be Outsourced to the Cloud – For Example for Extended Vehicles"

Another trend is the Extended Vehicle. In the future, vehicles will have a permanent wireless connection to an external backend. And this would not simply be used to place an emergency call after a crash. Here is a simple example: A vehicle manufacturer has a voice recognition system for proper nouns, such as place names. When someone wants to navigate to a location, the driver specifies the destination by stating the name of the town, the street and the house number. The voice recognition system can be implemented using hardware and software in the vehicle or via the backend. That is exactly how it works when using Google Navigation on a smartphone. The route is not calculated on the smartphone but in a backend. That means that data and functions are outsourced and processed in the backed during the journey. For Extended Vehicles, there are already two ISO standards (ISO 20078 and ISO 20079), which are currently being promoted with regard to implementation.

In coming years, the topic of the Extended Vehicle will also have a major impact in its own diagnostics in connection with highly-automated and fully-automated driving, but also with SOVD.

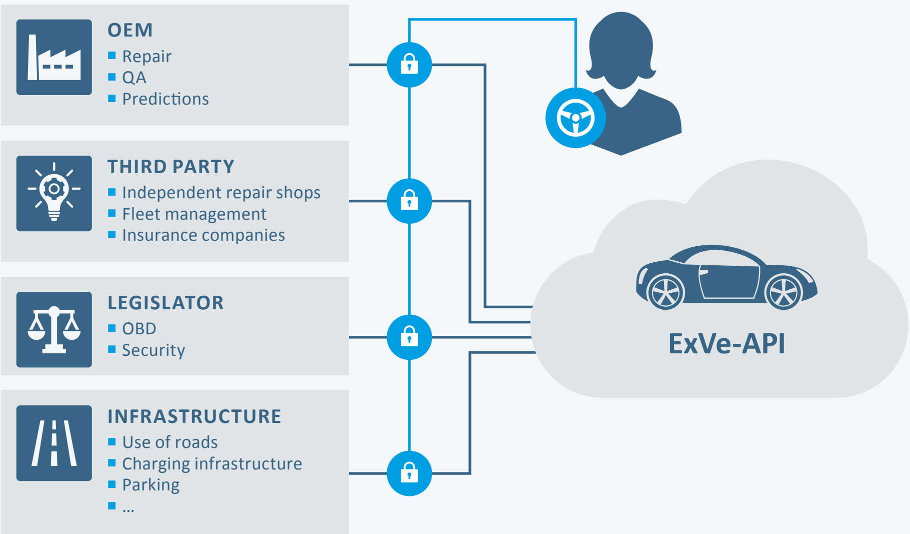
Dr. Goß recommends that the Extended Vehicle aspect should already be taken into account today when planning new diagnostics technologies and with regard to tool support for testing Extended Vehicles.

In addition to the advantages of complementary proprietary solutions, the use of standards in non-competition-relevant areas nevertheless offers numerous advantages across the entire vehicle life cycle, for example:

- increase in quality
- far shorter engineering times
- recyclability of data created
- much lower unit costs

We asked ourselves why vehicle manufacturers and suppliers might nevertheless use proprietary solutions. We agree with Dr. Goß and suspect that there is often insufficient awareness of the value of investing in diagnostics.

For decades, Softing Automotive has relied on the advantages of standardization. Dr. Goß too is convinced of the considerable savings potential of using standardized solutions. Standards must nevertheless incorporate backward-compatible scope for proprietary extensions in order to facilitate unique selling points for OEMs and other market players. Generally speaking, there are corresponding hardware and software libraries for standards, provided that they have been released.



Extended Vehicle (ExVe)

Accessing vehicle data remotely can already play a part in numerous value-added services. At present, however, proprietary solutions are provided which are often mutually exclusive, e.g. because they use dongles on the OBD jack. Standardized access via a cloud application in accordance with ISO 20078 offers different stakeholders access – under full access control by the vehicle owner. Softing's remote access technology makes it possible to create such solutions.

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