Diagnostics from a Distance
Interactive Diagnostics for Vehicles Worldwide

Vehicle diagnostics is an important tool for quickly and efficiently localizing and correcting faulty behavior of individual vehicle components. In certain rare cases, however, it may not be possible to find the cause of the error locally without the support of an expert. This expert can now access the vehicle directly and interactively – even without having to be on site locally – using remote diagnostics, and can then examine the vehicle and systematically determine the cause of a problem.

Sweden, -20 °C, snowfall. A test driver conducts a test drive on a frozen lake covered with snow. During a braking maneuver in a curve, he notices some unusual vehicle behavior. He suspects that the cause lies in the brake system. After additional trials, the experienced test driver quickly recognizes that the behavior only occurs under very special conditions.

Although the test driver is very familiar with the vehicle, a precise analysis by a system developer is necessary. Only the system developer has the necessary background knowledge needed to quickly and comprehensively find the cause of this behavior. However, it is very rare for this engineer to be available locally to read out key vehicle data and drive actuators for test purposes using vehicle diagnostics. With remote diagnostics, the expert can now access the vehicle despite the long distance from it, without having to quickly travel to Sweden.

Use Cases
Easy remote access to a vehicle or its components by experts is not only helpful during test drives. OEMs and suppliers can also benefit from remote diagnostics to diagnose their systems at later production startup.

And even in the service shop situations sometimes occur, in which it is essential to get the advice of an expert. In some cases, this is the only way to accomplish a quick and cost-efficient repair when an unpredictable and complex problem exists.

Diagnostics with Different Focal Points
Effective vehicle diagnostics is a key factor for achieving a high level of customer satisfaction with regard to the duration, cost and success of repairs.

It is an indispensable tool, which accompanies the vehicle over its entire life cycle – from development to production and finally customer service. Very different requirements are set in the various life phases, which must be considered in the development of diagnostics. During vehicle development, a deeper look into the ECU and more extensive interventions are needed. In production, diagnostics is used for the "OK / Not OK" test. In customer service, guided troubleshooting helps to localize errors without requiring very

special knowledge, and it can be used later to easily verify the success of a service repair.

As consequence the diagnostic testers – differ considerably based on these very different requirements – with regard to their user control concepts, level of detail and access capabilities. Accordingly, a service shop tester only makes a part of the diagnostics implemented in the ECU available, while other parts are reserved for development or production. However, if an unexpected problem now occurs in the field, the experts may sometimes require access to precisely these development-specific information or functions.

Data Protection

However, the general distribution of all diagnostic data with the customer service tester is not a solution either, because this would also make undesirable and very wide-ranging system interventions possible, interventions that should actually be reserved for just a small group of experts. Therefore, the data and functions are handled confidentially and are only accessible to a small group of users. This also makes it more difficult for unauthorized third parties to gain access to information on how functions of individual systems are implemented or to manipulate them. Therefore, precisely those parts of diagnostics are selected for the customer service tester that are needed for use cases in the service shop – user operation is made as simple as possible, and unintentional operating errors are prevented.

Interactive Remote Diagnostics

Using interactive remote diagnostics, the difficulty of physical separation of the expert from the vehicle is circumvented. Experts can access the vehicle as though they were present locally, and they can contribute their expert knowl-

edge in this process. The service shop employee can execute supportive actions – such as activating the brake pedal – while the expert reads out measurement values and precisely observes the behavior of relevant vehicle components. If vehicle conditions permit, it is even possible for the expert to have access to actuators from a distance. The expert can use further actions to confirm initial suspicions of a reason that could explain the observed behavior, or else exclude it as a cause, and can thereby effectively determine the cause of a problem.

For our test driver in Sweden mentioned above, this means that the expert neither has to quickly travel to Sweden nor is it necessary to send the development diagnostic data to the test driver for attempting to resolve the problem on his own – under the guidance of the expert. It is also unnecessary to reproduce the problem after returning from Sweden, if it is possible to study the matter right away locally. This is especially important if the specific environmental conditions have an effect on the observed behavior.

A primary advantage of remote diagnostics, however, is that the expert can react immediately to measurement results, conduct additional measurements, modify parameters and address actuators. This interactive access capability also illustrates the significant difference between remote diagnostics and the approach of using a logger or onboard tester.

Remote Diagnostics with High Levels of Performance and Data Protection

The benefits of interactive remote diagnostics succeed or fail with the ability to process diagnostic inquiries at a high rate of speed and with low latency. The new Version 4.0 of the Indigo diagnostic tester from Vector **(Figure 1)** supports the interactive remote diagnostics described above.
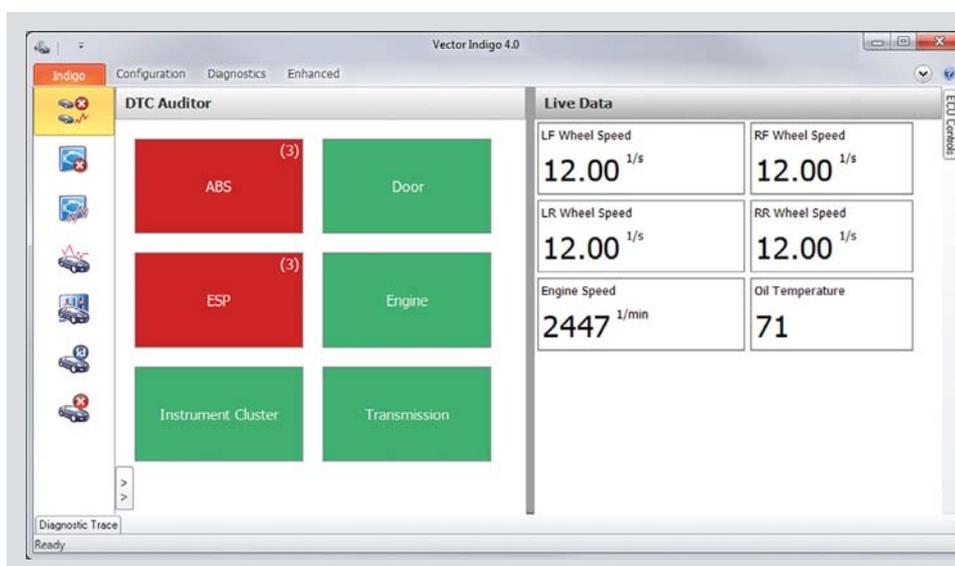
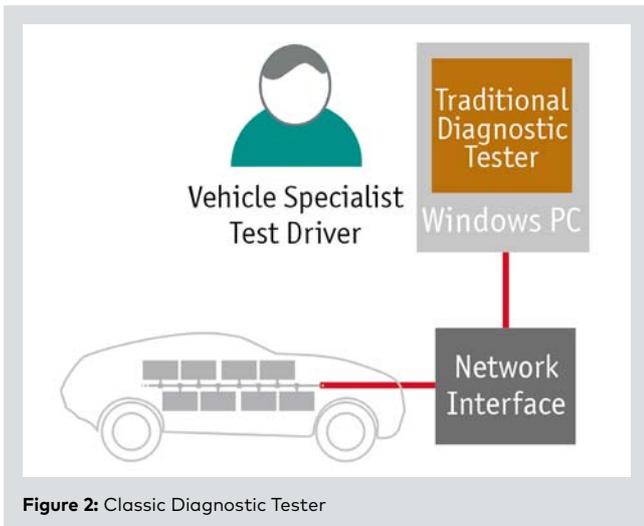**Figure 1:** Diagnostic tester Indigo: Fault Memory and Measurement

Figure 2: Classic Diagnostic Tester

To use remote diagnostics, it is sufficient to download the access point on the vehicle side and invite the experts to a diagnostic session with an ID and password. It is especially noteworthy that no changes need to be made to the vehicle for the test system to be immediately ready for use.

With the implemented solution, the diagnostic data, test sequences and security algorithms remain within a protected environment – all control, interpretation and evaluation actions are performed on the expert's computer. A high level of data security is achieved in conjunction with end-to-end encoding.

In order to efficiently use full diagnostic capabilities efficiently, a number of technical measures are implemented to assure high bandwidth and low latency. This makes it possible to access vehicles with very short response times worldwide – even when transmitting large amounts of data.

By comparison, a classic diagnostic tester is connected directly to the vehicle via a network interface **(Figure 2)**. In this case, all necessary diagnostic data and the required diagnostic and module knowledge must be available locally. When using remote diagnostics in Indigo, the classic diagnostic tester is replaced by an access point. Together with the communication server on the Internet, it serves as a routing hub and routes diagnostic requests and responses between the vehicle and the actual diagnostic tester **(Figure 3)**. The actual diagnostic tester is located remotely at the location of the expert. Neither the diagnostic data nor the expert needs to be sent on a trip – and yet it is possible to access the vehicle directly.

Summary

By using interactive remote diagnostics, a system or diagnostics expert can connect to a vehicle anywhere in the world and examine errors locally and at the same time as they occur.

In this process, the expert does not need to rely on a locally available test system optimized for customer service, but can use an expert tool instead. Yet, the data required for diagnostics does not need to be distributed or transmitted – the data remains in the protected expert environment.

The interactive remote diagnostics offered by the Indigo diagnostic tester from Vector goes far beyond the static diagnostics of an onboard test system and also differs sig-
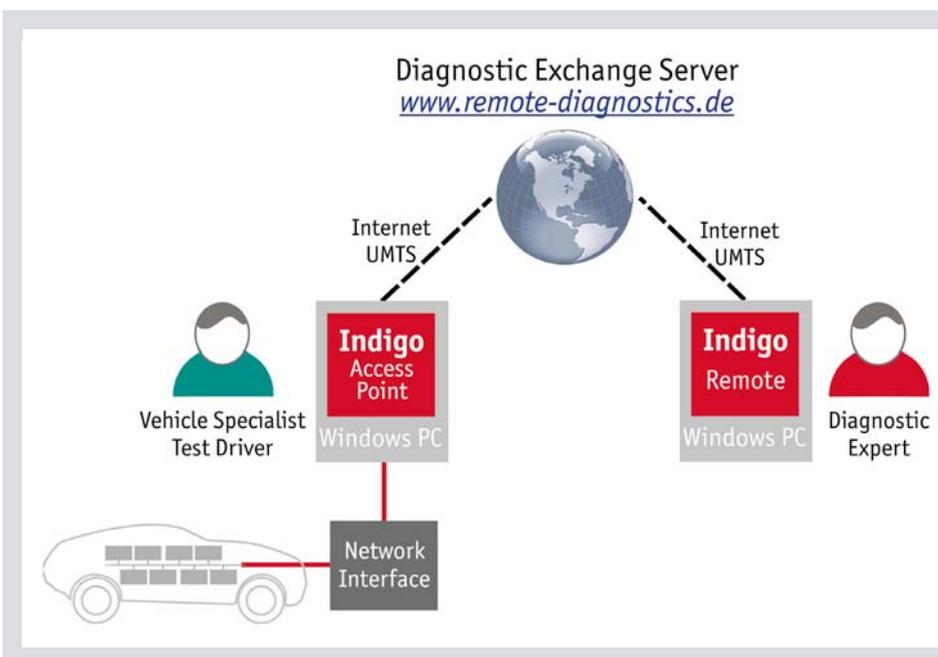

Figure 3: Concept of interactive remote diagnostics with Indigo

nificantly from a remote desktop approach with regard to data protection and performance.

The diagnostic tool makes it possible to study unexpected behavior on test drives over great distances, and it also significantly shortens repair times when unexpected problems occur in the service shop. In service shops, in particular, efficient third level support with remote diagnostics can reduce repair time and costs and deliver a high level of customer satisfaction.

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