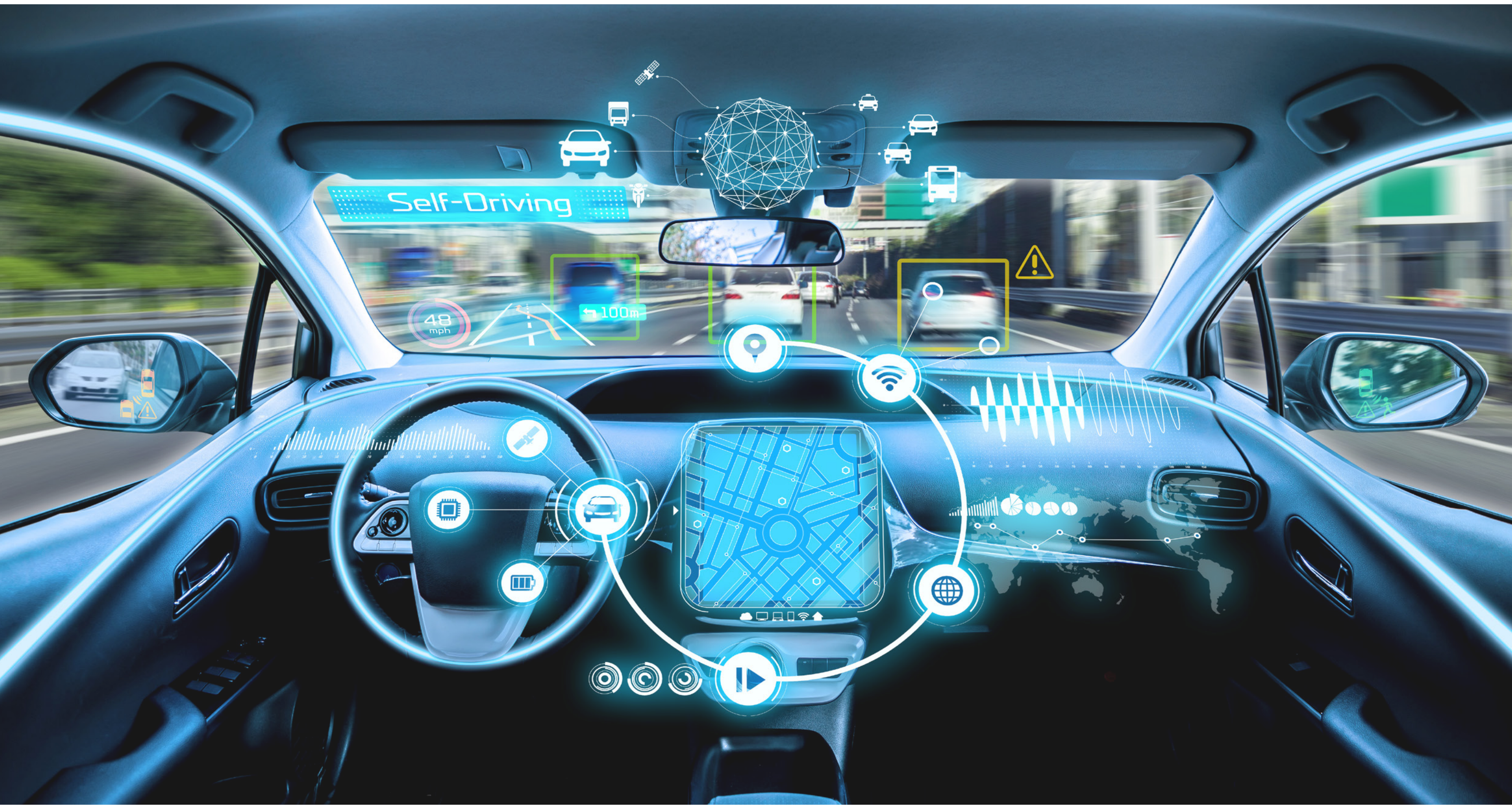
Test procedure

Quality checks for complex infotainment and driver assistance components

Modern vehicles are networked high-tech systems that combine driver information, entertainment and connectivity. Expectations regarding design, functionality and security are growing rapidly, especially in virtual cockpits.
However, increasing complexity requires new, efficient development approaches.



Whether it's safety-critical information, simple control commands or multimedia functions: tasks that were previously performed in vehicles by numerous specific individual components are now being handled by high-performance computing units that process bundled vehicle and user information and open up new possibilities in human-machine interaction. Conventional vehicle bus systems interact with multiple sensors or cameras with high-resolution displays, which are used for various applications ranging from connectivity to entertainment (Figure 1).

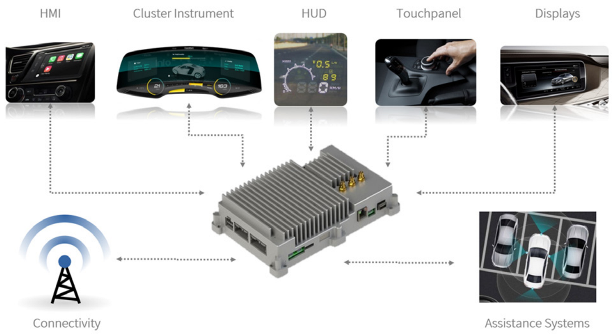


Figure 1: Multidimensional systems for vehicle control, such as the components for infotainment shown here, require test systems tailored to specific requirements. © GÖPEL electronic

This multidimensionality, coupled with high quality and safety standards, calls for needs-based test systems with powerful hardware and software architecture. In order to meet the demands and expectations of end users, but also to ensure their confidence in the vehicles, car manufacturers and suppliers must comprehensively test all installed systems for functionality, precision and performance. In addition, the test systems and test procedures must be continuously developed. Testing is carried out in realistic simulations with authentic environmental parameters, combining functional and application tests with long-term and environmental tests in various scenarios.

While functional tests check the extent to which a system meets functional requirements, application tests analyse and evaluate the software used to implement specific requirements – making its quality measurable. Long-term and environmental tests build on these test methods and are carried out under specified environmental conditions, for example simulated temperature conditions, fine dust pollution or mechanical stress. These comprehensive tests ensure that the systems meet the highest quality standards and can withstand the demanding conditions of real-world operation.

Designing flexible and scalable test environments

To ensure that the relevant test scenarios meet the desired requirements and generate differentiated signals and environmental conditions realistically, many hardware and software components are required. Test environments must therefore be designed to be flexible and scalable. Only then can testers respond easily to future extensions or adjustments to increasing requirements and changing needs. Modern, bundled control units have numerous functions and systems that can be assigned to different areas (Figure 2).
Bus systems ensure data exchange between the control units in the vehicle, for example for the transmission of control information and status messages.
The multimedia area is closely linked to the further development of digital cockpits. In particular, it encompasses the transmission of image and audio

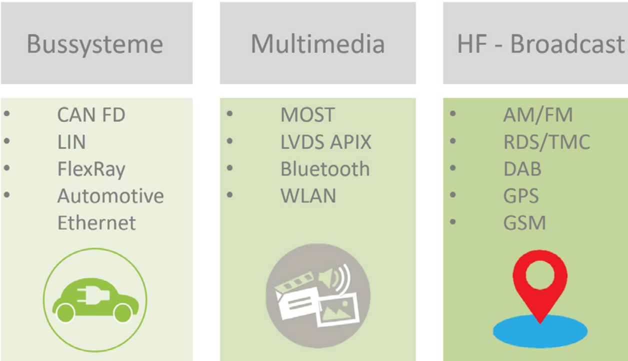


Figure 2: The functions and systems of bundled control units can be assigned to different areas of vehicle control. © GÖPEL electronic

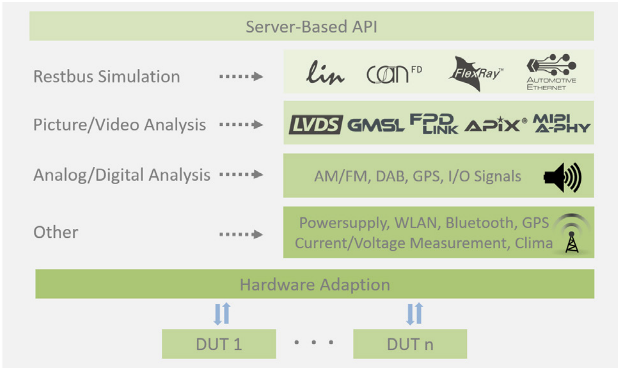


Figure 3: Schematic diagram of an infotainment test system that can also be adapted for future device generations. © GÖPEL electronic

streams between the main control units, but also the processing of camera data and display content that visualises important information and instructions for the driver. Equally relevant is wireless communication and networking with mobile devices in the vehicle. Another key area is RF broadcast for the reception of audio signals and communication between the vehicle and the outside world. All of the areas mentioned are technically highly sophisticated and have been developing rapidly for years. New functions such as augmented reality head-up displays (AR-HUD) and over-the-air communication (OTA) make the further development and adaptation of specific hardware, including specified test organisation, essential.

Recommended: Modular hardware concept

To ensure that the test environment is as adaptable as possible and can be used as a scalable solution, a modular hardware concept is recommended. This can be adapted to individual test requirements and scaled according to the resources and number of test items. The foundation for such a system should essentially consist of 19-inch components that can be variably combined in a system. This not only takes the latest requirements into account, but also keeps open the option of modifying test systems for prospective device generations. Signals to be taken into account such as GPS, AM, FM or DAB can be fed into the system separately via interfaces using dedicated generators (Figure 3). Communication controllers can be used for the required automotive bus systems.

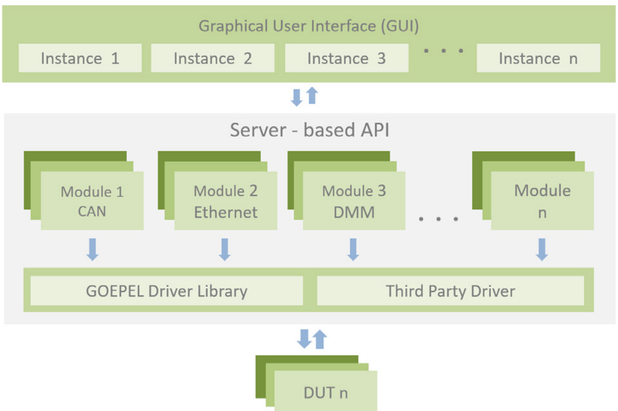


Figure 4: PXIe 6281 communication controller and PXIe 6222 VideoDragon from GÖPEL electronic with the respective supported standards. © GÖPEL electronic

The devices from GÖPEL electronic, for example, are based on the Series 6X hardware platform and implement the based on the AUTOSAR standard. The hardware platform is high-performance and the channel configuration is flexible. The controllers are available both as stand-alone devices and in the test system concept shown (Figure 4) as a PXIe card.

The flexible channel configuration includes not only the number of bus system interfaces, but also the various available automotive buses. Both CAN/FD and the LIN bus can be simulated for cost-effective networking of sub-buses. The FlexRay bus offers higher data rates and can also be used if deterministic transmission behaviour is required. In addition, the automotive Ethernet defined in the IEEE standards 100/1000Base-T1 and 10Base-T1S is also supported. Thanks to the point-to-point connection, it enables the transfer of large amounts of data at high bit rates between the high-performance computers in the vehicle. The transport and diagnostic protocols, network management and SecOC required in conjunction with the bus systems can be combined as software options.

Interface cards for image and video generation

Other areas of application that the test solution must cover include image and video generation for simulating display applications as well as the capture and analysis of camera streams. The central challenge here is also to cope with the diverse transmission standards and the ever-growing amounts of data. GÖPEL has developed its own interface cards based on the VideoDragon 6222. The VideoDragon combines both frame grabber and frame generator functions in a single device and supports the video standards FPD-Link II/III/IV, GMSL 2/3 and APIX 2/3 via various media interfaces. The integrated MIPI A-PHY interface is supported by DeSerializer from Valens Semiconductor. The MIPI A-PHY specification was developed specifically for Advanced Driver Assistance Systems (ADAS), Autonomous Driving Systems (ADS) and In-Vehicle Infotainment (IVI). For infotainment PCBA that interact with touch displays, the VideoDragon enables the capture of image data output by the control unit on the one hand, and the simulation of control data, such as embedded touch information on the other – without a physical display.

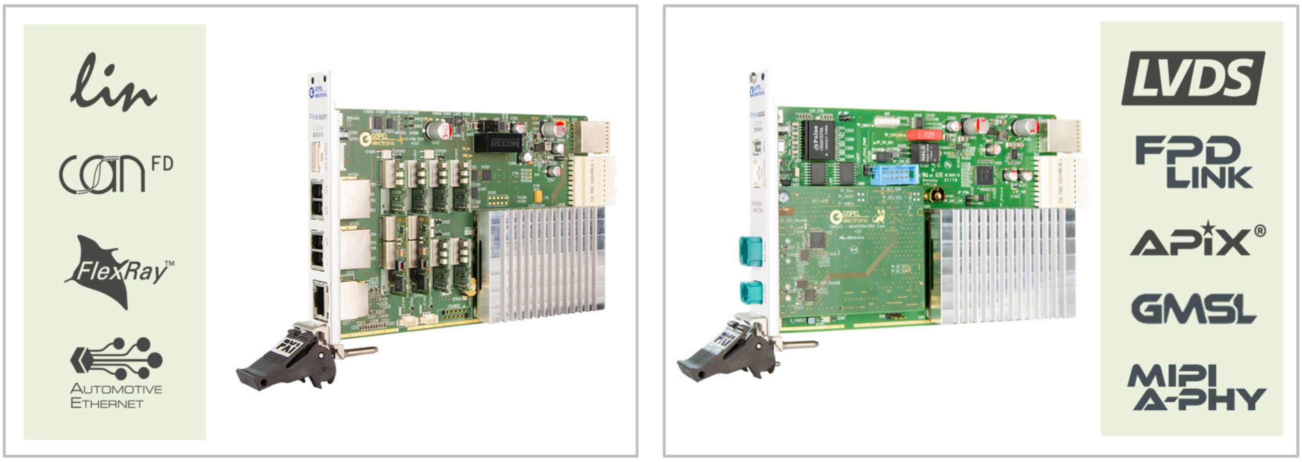


Figure 5: The server-based API for controlling the hardware implemented in the test solution supports the simultaneous processing of multiple requests. © GÖPEL electronic

This makes it possible to implement even complex touch sequences without any problems, which greatly facilitates software testing of the PCBA. Depending on the Ser-Des standard used, the various media interfaces available also support UART, I^{2}C and SPI or enable the simulation of bidirectional data streams. Conventional tasks such as generating and analysing analogue and digital signals can also be included and are implemented using selected generators or data acquisition hardware (DAQ).

Expandable with any software and hardware

A server-based API controls the hardware implemented in the test solution, which provides a comprehensive library. This includes both commands for executing functions and specific tests that are offered in conjunction with the integrated hardware. Thanks to the hardware abstraction layer (HAL), the API enables flexible control and can be extended for all software and hardware components – both for GÖPEL's own and third-party hardware. Its modular design facilitates adaptation to different test requirements and allows for easy expansion. A key advantage of API integration is the use of a user-friendly TCP/IP connection that can be seamlessly integrated into existing test software, higher-level test frameworks or the test sequencer from GÖPEL electronic. In addition, the server-based API supports the parallel processing of multiple requests, avoiding bottlenecks and ensu-

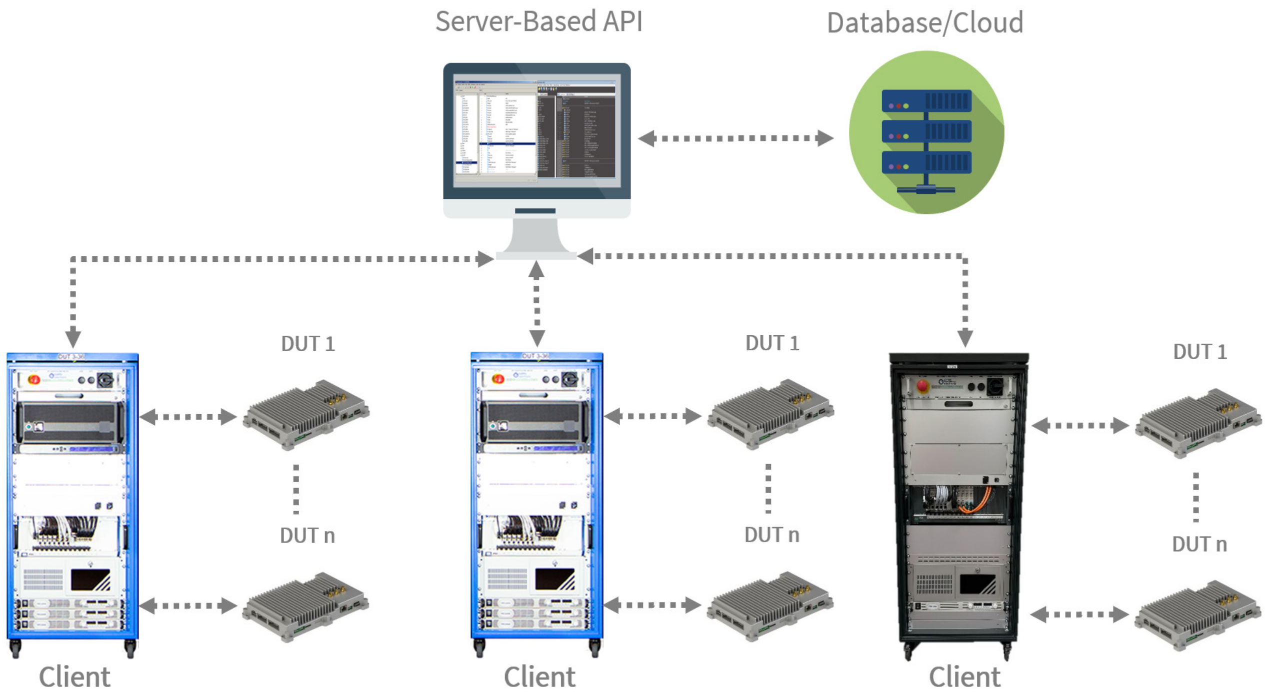


Figure 6: The API offers high scalability, so different test requirements and system sizes can be accommodated. © GÖPEL electronic

ring fast response times. Multiple test processes or different DUT tests can be executed simultaneously, which significantly increases efficiency (Figure 5). In addition, the API offers high scalability, allowing it to be flexibly adapted to different test requirements and system sizes. Measurement results are recorded and logged in a database, making them reliably raceable (Figure 6).

Conclusion

In future, sophisticated test solutions for the validation and quality assurance of multidimensional infotainment control units will be confronted with increasingly complex challenges in further development and test implementation.

A modern infotainment test solution relies on a powerful hardware and software architecture that can be flexibly adapted to the test object during the planning phase while also providing sufficient resources for future device generations. The server-based API developed ensures the necessary performance and flexibility to extend commands and easily implement functions that will be required later on.

Andreas Schmidt is an application engineer in the Network and Infotainment division at GÖPEL electronic. © GÖPEL electronic

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GÖPEL electronic

GÖPEL electronic GmbH
Goeschwitzer Str. 58/60
07745 Jena · Germany

ats.sales@goepel.com
www.goepel.com

+49 3641 · 6896 0
+49 3641 · 6896 944

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