SAAB RDS

TECHNOLOGY ENABLER

Solutions for the Automotive Industry

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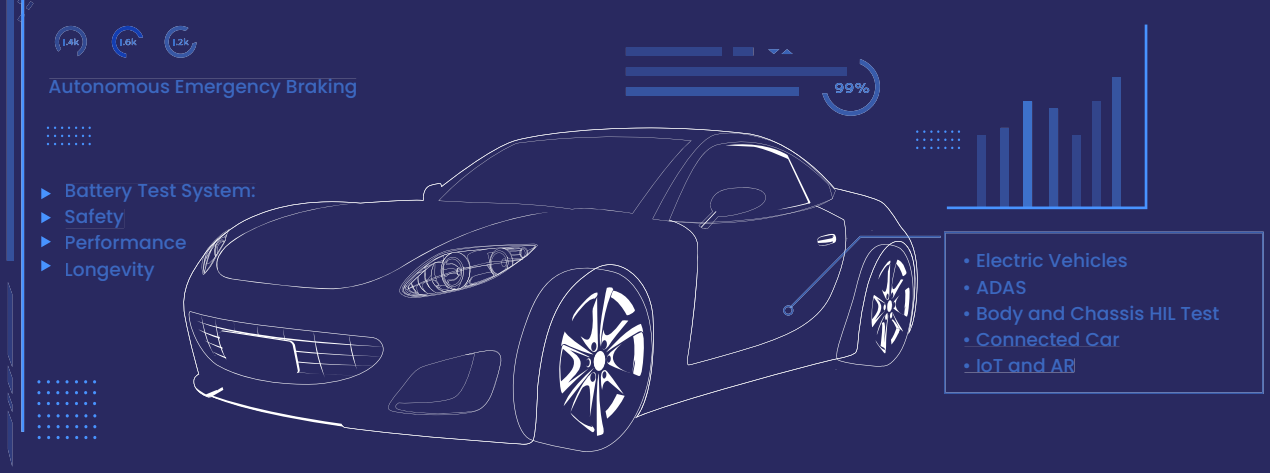


Local automotive production is booming in many areas of the world, imposing a harsh competition to the traditional players. In order to stand out, the highest-quality manufacturing processes need to be observed, including testing throughout all phases of the automotive design and production.

What can we do for you?

We will work with you to define your application needs and provide the best set of integrated technologies to reach your goals.

We provide automotive solutions and easily reconfigurable test systems that connect data from all phases of the product cycle, delivering analytics and insights that optimize performance, while having the flexibility to adapt to future requirement changes.

In addition, we provide solutions such as augmented reality, computer-aided design, or product lifecycle management that enable digital transformation in the automotive industry, and which are paving the way for the future of mobility.

- Electric Vehicle Battery Production Test
- ADAS and Autonomous Vehicle Test
- Body and Chassis HIL Test
- Connected Car: Infotainment and V2X
- IoT and AR

Customer Examples:

ALIARO SAAB RDS TECHNOLOGY ENABLER

Our partner, ALIARO is a global specialist that has delivered modular and future-proof test solutions to over 500 customers.

Efficient and Reusable Test Solution

The Challenge:
the customer needed to implement a commercial off-the-shelf (COTS) solution for multiple EE architectures within their group. Test objects must be available to change on regular basis and run simultaneously on the same system.

The Solution:
We delivered a re-configurable solution based on PXI and SLSC based on the xMove architecture with re-configurable interface boxes and replaceable load units for customized setups. All systems are configured through NI Software tool chain and accessible through the customers ecosystem.

Supporting Verification of Multiple Vehicle Types +30 Test Systems

The Challenge:
the customer needed to implement a commercial off-the-shelf (COTS) solution to support complete vehicle integration HIL lab that needed to support multi-domain verification. System had to be able to emulate all sensors and actuators normally connected to the ECUs. System shall be capable of running dynamic models simulating the behavior of all connected ECUs and simulated models.

The Solution:
We delivered a distributed hardware-in-the-loop systems based on PXI and EtherCAT. The Mechanical solution are customized to fulfill their requirements to handle external loads. The real-time application and test execution application were developed in LabVIEW and enabled the HIL operator to fully plan and execute automated testing on dedicated rigs using a customized UI Soft Panel.

Electric Vehicle Test

Every automaker in the world is focusing on developing the best Electric Vehicle (EV). The key to innovation in this field is testing EV batteries, inverters, and chargers, and the key to a successful test is for it to be done earlier in the design process.

Electric Vehicle Battery Test System

We work with leading global companies like NI to deliver a Battery Test System that is designed to respond to rapidly changing test requirements, pressing timelines, and limited resources. The BTS is built on a flexible system architecture, with a hardware abstraction layer for adding devices, system simulation to validate test sequences with equipment models, and enterprise data and systems management tools for large scale deployments.

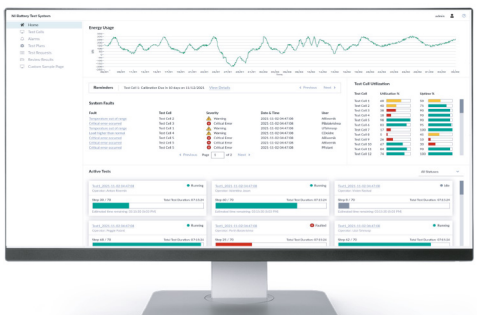
Battery Pack and Module Test Challenges

The battery pack is the single most costly component in Electric Vehicles (EV) and has the largest impact on design and performance (size, weight, acceleration, range, charge time, and vehicle life). EV battery teams must validate their design against requirements for:

Safety: The battery must be safe under all specified operating conditions.

Performance: The battery must meet performance design goals such as charge time, peak energy transfer rates, and thermal stability over its lifetime.

Longevity: The battery must maintain a certain capacity over a number of cycles defined by expected usage behavior and vehicle life.



THE BATTERY TEST SYSTEM SOFTWARE PROVIDES A UNIFIED SOFTWARE EXPERIENCE TO CONNECT THE BATTERY TEST WORKFLOW FROM HARDWARE TO FACILITY.

Advantages

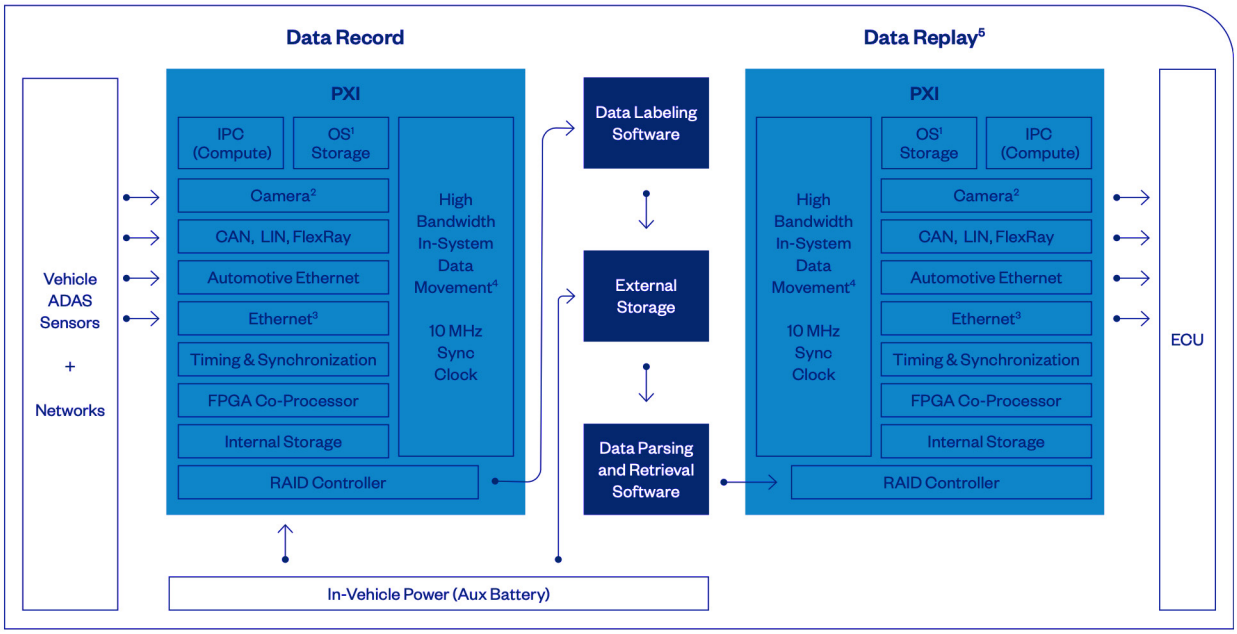
- Reduce Test Development and Configuration Times: Out-of-the-box functionality and a system architecture that effectively scales and adapts from single test cells to large scale, distributed battery test labs.
- Increase Test Efficiency: Enterprise-level software with data, system, and facility management capability to optimize OpEx, improve test cell utilization, and reduce overall CO2 footprint

BTS Components

COMPONENT	DETAIL
Core Rack	24U, 19" equipment rack with UPS, internal power and network distribution, and emergency power-off circuitry
0 -60 VDC Output	Redundant supply circuits on DUT
CAN Outputs	Interface with additional test hardware or DUTs
RS232 or RS485	Interface with temperature chambers, chillers, cyclers, or other test hardware
GPIB	Interface with temperature chambers, chillers, cyclers, or other test hardware
Cell Voltage	Direct measurement of individual, stacked cell voltages in a module (up to 250V)
Module Voltage	Direct measurement of individual module voltages in a pack (up to 600V)
Local Temperature	Rack-based thermocouple measurement
Remote Temperature	In-chamber thermocouple measurement
Digital I /O	DI/DO/PWM options for ECU signal emulation
HVIL Monitoring	DI/PWM analog options for monitoring an existing High Voltage Interlock Loop
Relay Output	Controlling a High Voltage Interlock Loop

ADAS and Autonomous Vehicle Test As advanced driver assistance systems (ADAS) and autonomous vehicles (AVs) introduce new technology into vehicles, they need adaptable, future-proof test systems. Our global partners offer a software-connected toolchain to automotive test that covers Data Record, Data Replay, Hardware - and Software-in-the-Loop, all the way up to Sensor Fusion and Sensor characterization and manufacturing test applications to address today's and tomorrow's ADAS and Autonomous Driving (AD) technology.

- Data record for ADAS and AD: Record sensor and ground truth data during road testing to verify sensor capabilities and train ADAS and autonomous vehicle (AV) algorithms. Address all needs across the test process: synchronization, changing requirements, high data volumes, integrated system.

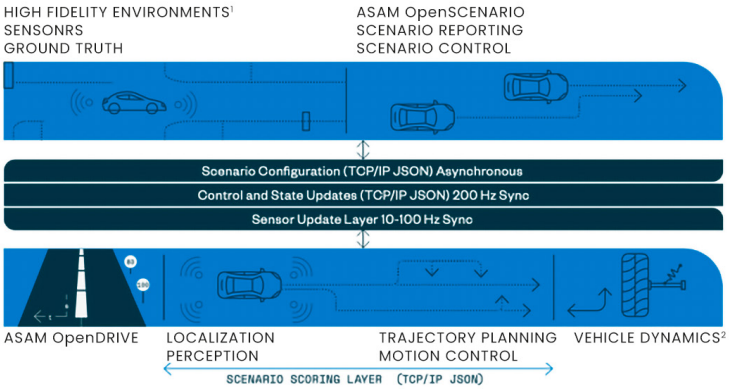


Block Diagram for Data Record Applications

KEY SPECIFICATIONS

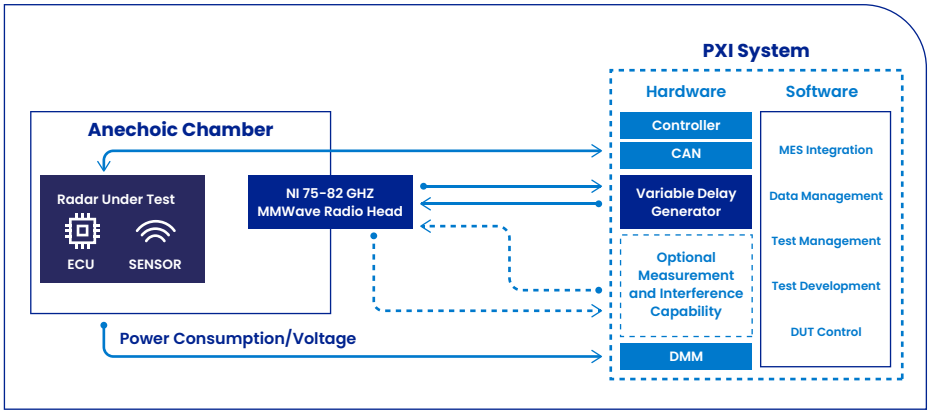
Maximum Data Rate	6 GB/s (up to 15 GB/s using multiple storage devices)
Storage Capacity	Up to 200+ TB (through Seagate Lyve Mobile and third-party storage options)
Synchronization	<1 µs
Camera Interfaces	FDP-LINK, GMSL, GigE, Ethernet, USB
Vehicle Networks Support	Automotive Ethernet, FlexRay, CAN FD, LIN
Radar, Lidar, Ultrasonics Support	Through Vehicle Networks and Ethernet
Ethernet Devices	Up to 40 Gbit Ethernet
Operating Voltage Range	9 VDC to 30 VDC
Application Software	Data Record AD-High-performance Data Movement and Data Synchronization Software
Supported File Formats	MDF4, TDMS, KITTI, Parquet, and other via file conversion and pluh-ins
Data Labeling	Pre-Labeling Tool by Konrad Technologies interfacing with Data Record AD via gRPC API
Digital Twin Creation	Convert recorded data into simulated scenarios through Real-to-Virtual technology

- Software-in-the-Loop for Ultra-High Fidelity Perception Simulation and Test: Customers changing needs puts tremendous pressure on automotive businesses to launch new vehicles within short durations of time. This makes it mandatory to have a wide-ranging virtualsimulation and vigorous validation process to provide best in class ride and handling performance of vehicles. Physical testing of prototypes is the most time-consuming activity, so there is a need of front loading to substitute these requirements at the initial stage of the development cycle. Software-in- the-Loop (SIL) is one typical method to achieve this, but the infinite perception use cases, the complex workflow, and the gaps in modeling and simulation technology make it challenging to succeed.



- Leverage NI monoDrive Simulator AD (based on Unreal Engine—the world's most advanced real-time 3D creation tool) for ultra-high fidelity scenario generation and resulting sensor information for perception and planning system validation.
- Allows to Integrate and execute physics-based, high-fidelity sensor models (lidar, radar, camera, RPM, GPS, IMU).
- Connects with third-party environmental simulation and modeling tools like Ansys VRXPERIENCE, CARLA, IPG CarMaker, VIRES VTD, Simcenter Prescan, SCANeR, etc.

- 4 GHz Automotive Radar Test: Safety and ADAS features like autonomous emergency braking (AEB) or rear cross traffic alert (RCTA) rely on radars to function properly. As automotive radars evolve to have 4 GHz of bandwidth, testing becomes more challenging since more test coverage is needed for both parametric and simulation test.



- The 4 GHz Vehicle Radar Test System (VRTS) performs highly repeatable and accurate radar obstacle simulation and parametric measurements in parallel to reduce test time.
- Modular, flexible, and capable of addressing all validation and production test and measurement needs.

KEY SPECIFICATIONS

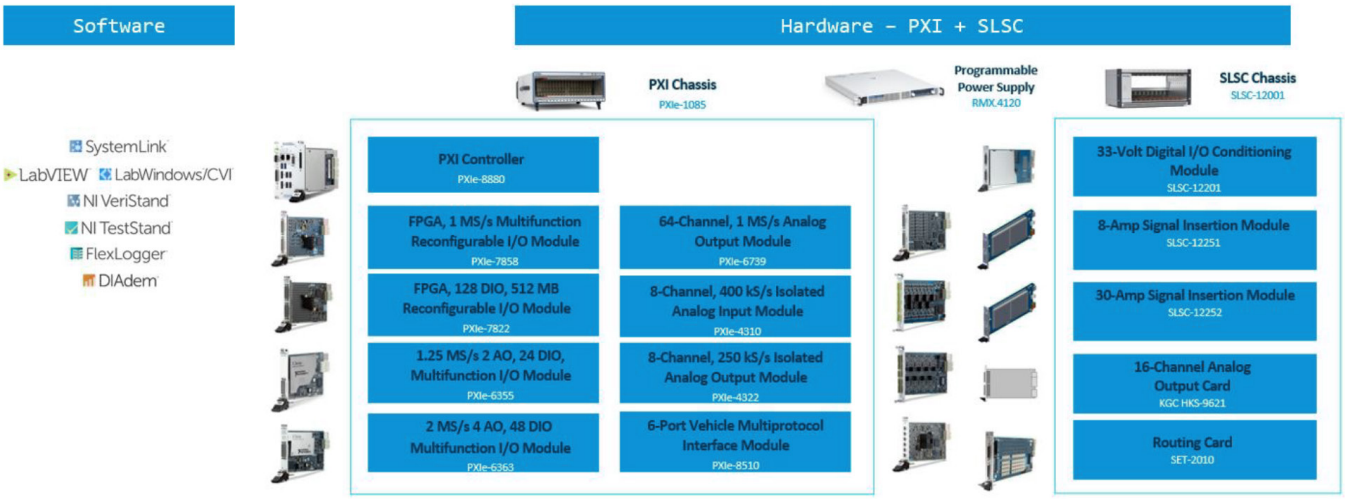
Maximum Data Rate	6 GB/s (up to 15 GB/s using multiple storage devices)
Storage Capacity	Up to 200+ TB (through Seagate Lyve Mobile and third-party storage options)
Synchronization	<1 µs
Camera Interfaces	FDP-LINK, GMSL, GigE, Ethernet, USB
Vehicle Networks Support	Automotive Ethernet, FlexRay, CAN FD, LIN

Body and Chassis HIL Test

As vehicles become increasingly connected, automated, and electrified, body and chassis systems are being transformed to maintain inter-functionality and meet user's changing demands. The complexity and number of electronic control units (ECUs) within vehicles continues to grow, together with the complexity of testing them.

Hardware-in-the-loop (HIL) simulation minimizes the testing cost and ensures reliability, reducing the need for costly real-world tests. It is also possible to maximize system reuse with a flexible test solution designed to be extended and customized to meet your changing requirements: you can test all body and chassis features such as active suspension and emergency steering, seat control, infotainment systems, and passive safety systems such as airbags or seat belts. This system is based on a custom PXI or NICompactRIO system with a broad range of modular I/O connected directly to the FPGA for high-speed deterministic execution.

The VeriStand software includes features to configure real-time I/O, import and simulate models, and automate real-time tests. You can reuse the system and extend and customize it to meet changing requirements.



Body and Chassis ECU HIL System Example.

System Components:

Software:

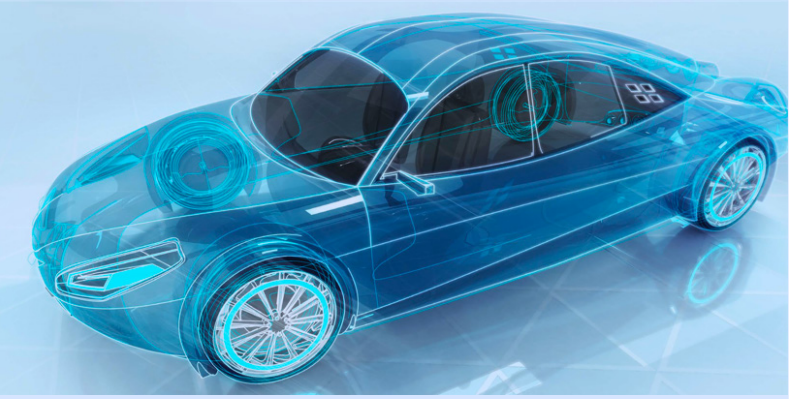
- DIAdem is a single software tool that you can use to quickly locate, load, visualize, analyze, and report measurement data collected during data acquisition and/or generated during simulations
- TestStand is a ready-to-run test management software designed to help you develop automated test and validation systems faster.
- VeriStand is a software environment for configuring real-time test and HIL applications
- Out of the box , you can build a multicore-ready real-time engine to execute tasks such as real-time stimulus generation, data acquisition for high-speed and conditioned measurements, and calculated channels and custom channel scaling

Hardware:

- CompactRIO is a rugged hardware design in a compact form factor that is ideal for most harsh environments as well as lab settings that require a small physical footprint.
- PXI: high channel count and density, the broadest availability of I/O, and the highest processing capability available.
- SLSC extends PXI and CompactRIO measurement hardware with high-power relays for signal switching, power loads, and additional inline signal conditioning capability

Top 5 HIL Trends
to Make Your Life Easier

Here are the top reasons why our platforms are well-suited for HIL simulation in automotive, off-road, and large machinery applications:



#1 Open Architecture

With chassis and body electronics evolving so quickly nowadays, sometimes the test technologies to evaluate them may not even exist yet. While it's impossible to completely future-proof any HIL system you create, using an open architecture makes it much easier to implement cutting- edge tools and adapt future features down the road.

Building an HIL test stand with an open architecture has significant advantages, allowing you to reconfigure software functionality when needed and plug in your own code into the system.

With VeriStand you can ccept models from The MathWorks, Inc. Simulink® software, SimulationX from ITI, Dymola from Dynasim, and many other modeling platforms without extra licensing fees.

#2 COTSTechnology

In order to test the latest chassis and BCM improvements, you can either build your own custom devices or look at what COTS options are available. Using off-the-shelf components makes life easier for everyone, especially when it comes to upgrading your system or buying replacement parts. The SLSC modules for switch, load, and signal conditioning bridge the gap between the data acquisition platform and the ECU, so you can create a completely COTS-based HIL architecture that tightly integrates and runs under the same software, resulting in cost and time savings.

#3 Deterministic Timing and Custom Protocols with FPGAs

Most HIL test systems run different nodes of computation, such as Windows, for the host computer and a real-time operating system for the controllers, and these nodes have varying amounts of processing time and jitter. If your test specifications require extremely deterministic processing times in the submicrosecond range you need customizable field-programmable gate arrays FPGAs are user -programmable chips that can bypass the operating system and perform the most deterministic, high- speed calculations. With NI technology, developers have complete access to the FPGA using LabVIEW graphical programming or VHDL code.

#4 RF Wireless Communication

With the mass movement towards intelligent vehicles and global connectivity, today's cars can come equipped with everything from keyless entry and Bluetooth integration to satellite radio and global navigation satellite systems (GNSS). New safety features on the market include advanced driver assistance systems (ADAS), LiDAR obstacle detection, and V2X communication. All of these different connectivity technologies require RF testing to verify and fine- tune proper operation.

HIL systems for these BCMs and embedded controllers may require RF measurement and generation for direct testing of RF functionality or embedded software synchronization and triggering. For example, an HIL system testing ADAS may involve receiving a radar signal, manipulating it to insert a simulated object (such as a deer on the road) using a vector signal transceiver, and sending it out to the chassis or body ECU to evaluate its response.

#5 Standardization with ASAM XIL

If you already have existing test equipment or software stacks from a mix of other suppliers, NI fully supports ASAM XIL, an automotive test API standard developed for model-in- the-loop (MIL), software-in-the-loop (SIL), and HIL applications. ASAM XIL is supported by major test automation providers, such as NI, dSPACE, ETAS, and Vector. That means if you're using one vendor's library of test automation scripts, you can use their software to talk to and control NI's open, modular hardware. And vice versa— NI's configuration-based softwarecan communicate with and run other vendors' ASAM-compliant hardware. Having this test API compatibility makes it easier for companies to try out new platforms and upgrade their test stands over time.

Connected Car

Infotainment and V2X Conformance Test: Infotainment systems and human machine interface (HMI) are key factors for consumers selecting a vehicle, and they make up for a big part of all sensors and ECUs in a car. Vehicle-to-Everything communications are transforming the automotive industry. In addition V2X interfaces must conform to communication standards (such as 4G/5G cellular connectivity or 3GPP standard) and RF regulations, so a test system must adapt to changing standards quickly. A flexible and scalable test system is needed to implement validation test of those systems in production.

C-V2X Open Loop Test System

Fully autonomous mobility will need widespread connectivity according to many in the industry. C-V2X (Cellular Vehicle-to-Everything) for direct, network independent communication will be based on the 3GPP LTE-V or 802.11 based standards to meet this need. We work with our global network of partners to provide a system with the following characteristics:

- Test the functionality of a V2X Device with synchronized emulation of driving scenarios using predefined Day 1 use cases and customer-defined use cases also for high-load situations (congestion)
- Flexible software-defined radio V2X Open Loop test solution is future proof for current and developing standards such as 5G-NR
- Expandable to include RF measurements and closed loop HIL test for dynamic control/interactions with other traffic objects and sensors

Sample Configurations:

The NI + S.E.A C-V2X Open Loop Test system is configurable to allow for maximum scalability, cost efficiency, and deployment options. This flexibility is fully available for the customer. Extension modules are available for:

- Day 1 use case test catalog for immediate start of test execution with the turnkey test system
- Emulation of the V2X surrounding environment up to several hundred objects (congestion)
- GNSS signal simulation including physical distortions
- Emulation of the physical distortion of radio waves (channel emulation with 8 tabs)
- RF-compliance measurements in accordance with 3GPP
- Replay of real-world data logged in the field with S.E.A.'s V2X sniffer/logger systems

C-V2X Conformance Test System

V2X (Vehicle-to-Everything) communications will transform the mobility industry to improve the safety and efficiency of vehicles and autonomous systems.

For this application, V2X interfaces must conform to communication standards and RF-regulations such as 4G/5G cellular connectivity based on the 3GPP physical standard along with protocol, security, and other application standards from SAE, IEEE, and others.

Together with our partners we can offer the **First OmniAir OQTE Certified C-V2X Modular Bench Tester, enabling comprehensive C-V2X conformance testing**.

- Modular architecture expandable to HIL test or other test and measurement needs in a larger road/ traffic/ vehicle system
- Open-loop test and closed-loop test system turnkey solutions for functional and V2X application-level test, including dynamic control and interactions with other traffic objects, sensors, and ADASapplications
- Open system framework can include additional interface extensions like automotive Ethernet, cameras, and data management. This system can scale to an open-loop or closed-loop system for functional and application-level test, including dynamic control and interactions with other ADAS applications

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Body ECU HIL Test

Increasingly sophisticated and interconnected interior, infotainment, and advanced driver-assistance (ADAS) systems have expanded the number and complexity of body electronic control units (ECUs)—from active suspension, braking, and emergency steering to seat control and rearview mirror ECUs integrated with infotainment systems. When testing the embedded software on these ECUs, safety, availability, or cost considerations can make it impractical to perform the necessary validation tests using a complete system. Hardware-in-the-Loop (HIL) test methodology brings test earlier in the design cycle. Creating that tester on a software-defined platform makes for a flexible system that can adapt as ECU design and test requirements change.

Application Requirements

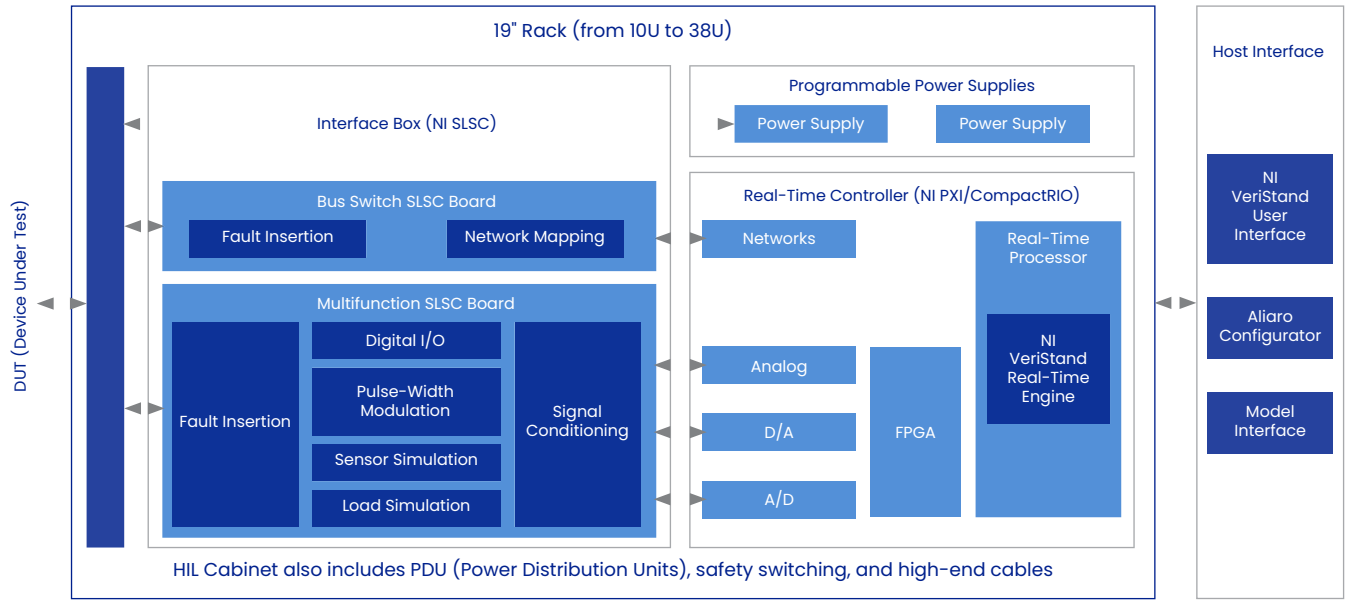
- Adapt to inevitable changes in signal lists and I/O requirements
- Conduct fault insertion and signal conditioning
- Integrate models, third-party devices, and toolkits to accurately simulate the full system

The Solution Advantages

- Minimize cost and ensure reliability with HIL test methodology, reducing the need for costly real-world tests
- Reduce test development time and enjoy quick startup with a turnkey system built with Aliaro's integration and NI's modular platform
- Maximize system reuse with a flexible tester designed to be extended and customized to meet your changing requirements

Our Partner's Solution: NI's and Aliaro's Tech

- If your ECU pinout changes, quickly reconfigure your system setup using Aliaro Configurator Software and the Aliaro AL- 1010 switch load signal conditioning (SLSC) module, which provides flexible I/O, signal conditioning, and switching capabilities on each channel, and fault injection on all pins.
- User-friendly model integration with NI VeriStand for sensor and actuation simulation, and I/O interfacing with NI PXI and CompactRIO hardware incorporating the latest Xilinx FPGA technology for µs-level, real-time, model-based simulation of power electronics actuation and sensors.
- Suitable for multi-vendor test environments with an open platform and support for ASAM XIL, CANoe, dSPACE ControlDesk, and a number of Python frameworks.



IOT and Augmented Reality

Automotive companies have been at the forefront of digital transformation as they race to deliver and define the future of mobility. A few key technologies are needed to ensure manufacturing processes are state-of-the-art for companies to stay competitive in the global automotive market:

Industrial Augmented reality.

- IoT and digital manufacturing
- Product Life-Cycle Management
- Computer-Aided Design

Augmented Reality also brings advantages in Car Repair and Service Instructions, as Ensuring customers are satisfied after purchase is critical, and providing exceptional service is key for OEMs.

There are two key areas in which AR is helping improve service efficiency challenges in automotive manufacturing:

- Reduce long service times and their associated costs: Before a technician can even begin servicing the vehicle, they need to diagnose the issue and locate the part—which is a difficult task as cars become more complex. 3D X-Ray Visualization Reduces Part Search Time as it transforms instructions into 3D X-ray visualization, which displays detailed, accurate 3D content on the physical car to show the inner components at scale.
- Complex 2D Instructions Complicate Service, while Visual Step-by-Step Guidance Simplifies this process, providing clear, in-context, visual content that guides less familiar technicians through repairs and maintenance—without requiring seasoned experts to step away from their own work to assist.

AR helps drive efficiency, increase FTFR, and improve the quality of repairs. The benefits of this solution boost customer trust, satisfaction, and retention over time, which is for OEMs in the competitive car manufacturing industry.

We partner with industry leader PTC to provide you with solutions to reach Operational Excellence in Manufacturing.

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