



The Convergence of Automotive and Aerospace Testing

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NER Automotive Business Development Manager

Agenda

Megatrends

- Electrification
- Connectivity
- Sensor Fusion

Test in the V

- Model Based Test
- Distributed Test Architectures

Open Standards & Interoperability

- ISO26262
- ASAM XIL
- FMI
- SLSC



Our Customers



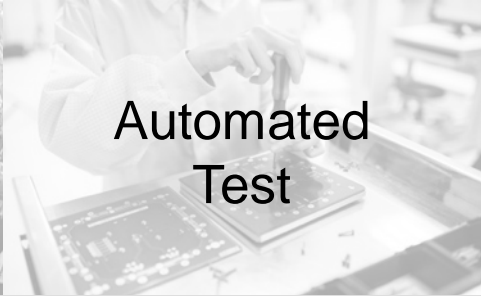
Cameras,
Industrial
Protocols

Industrial Machinery



Radar

Aerospace and Defense



Automated
Test

Electronics and
Semiconductor



Modularity,
Performance

Academic and Research



RF Protocols
(i.e. GPS,
Bluetooth)

Wireless



Ruggedness,
Telemetry

Transportation and
Heavy Equipment



Automotive

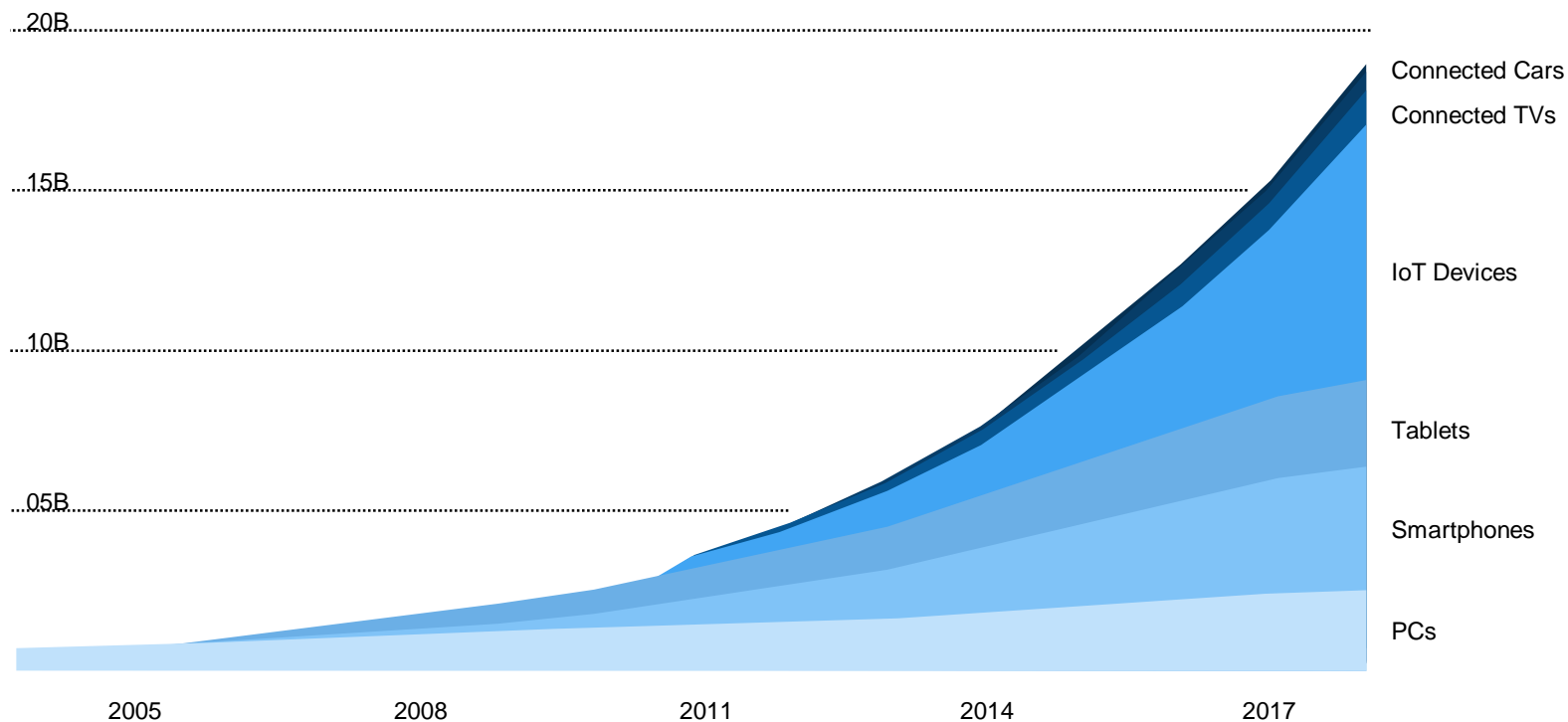


Storage and
Inverter
Testing

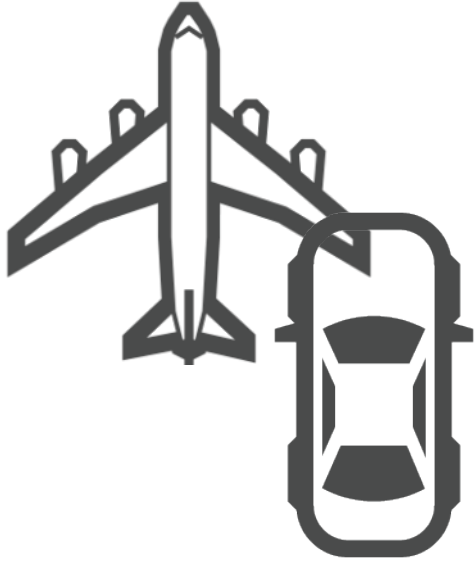
Energy

Megatrends

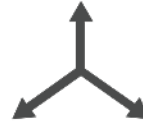
The Big Bang of Smart Devices



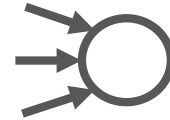
Convergence of Aerospace and Automotive Testing



Electrification



Connectivity



Sensor Fusion

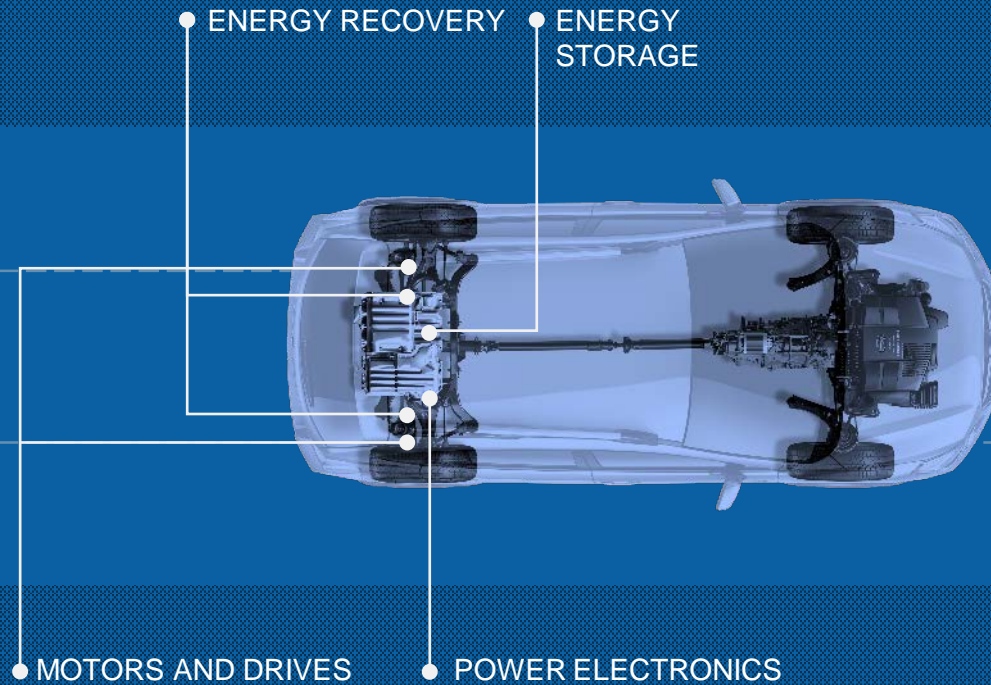


Embedded Software

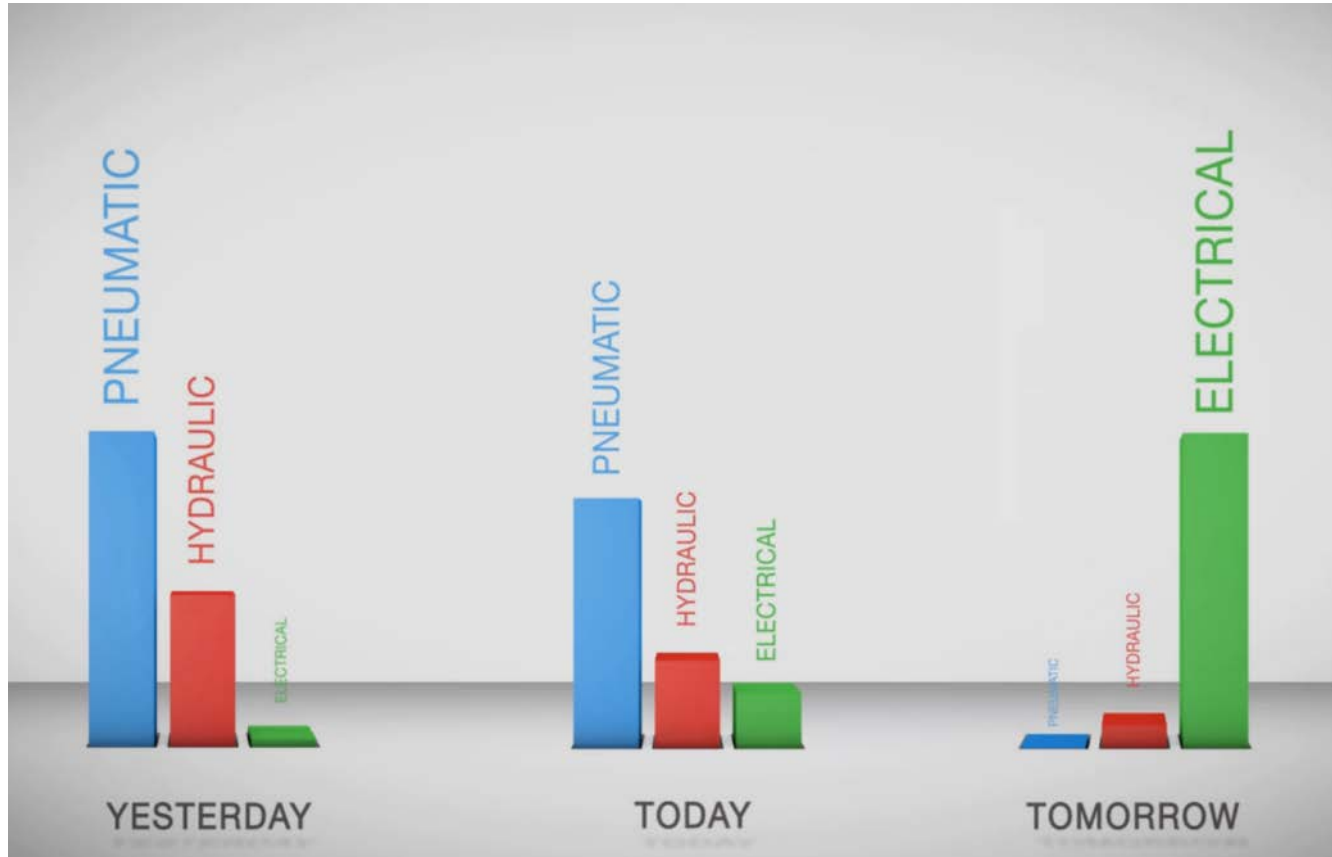


Functional Safety

Vehicle Electrification



Aerospace Electrification



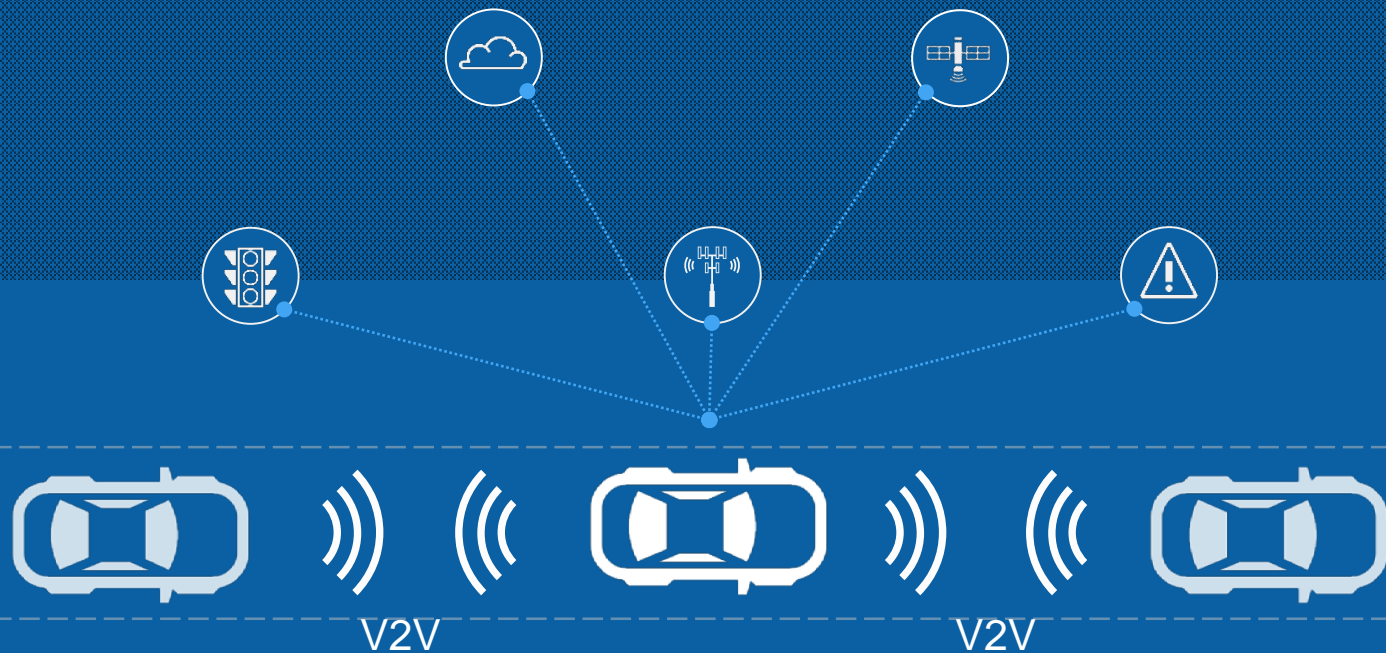
- + RELIABILITY
- MAINTENANCE
- + AVAILABILITY
- VOLUME
- + PAYLOAD
- ENERGY
- FUEL



“By adopting FPGA-based simulation using the NI hardware and software platforms, we achieved the simulation speed and model fidelity required for verification of an electric motor ECU. We reduced test time to 1/20 of the estimated time for equivalent testing on a dynamometer.”

—Mr. Tomohiro Morita, Subaru

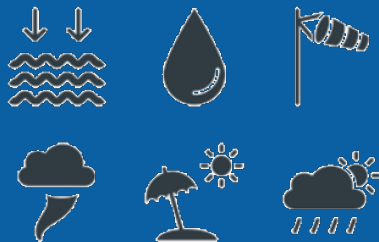
Vehicle Connectivity



Connectivity

Pilot

Live weather and situational awareness updates



Maintenance

Just in time maintenance enabled by real-time aircraft status



Passenger

Entertainment, PED connectivity, and flight status updates





Technische Hochschule
Ingolstadt

CARISSMA - Center of Automotive Research on Integrated Safety Systems and Measurement Area

" We have chosen the NI USRP RIO as a solution for our V2X protocol analyzer due to its openness. This is a mandatory property for enabling research. Moreover, a fruitful research cooperation has been established with our new research partner S.E.A., based on the contacts provided by NI ."

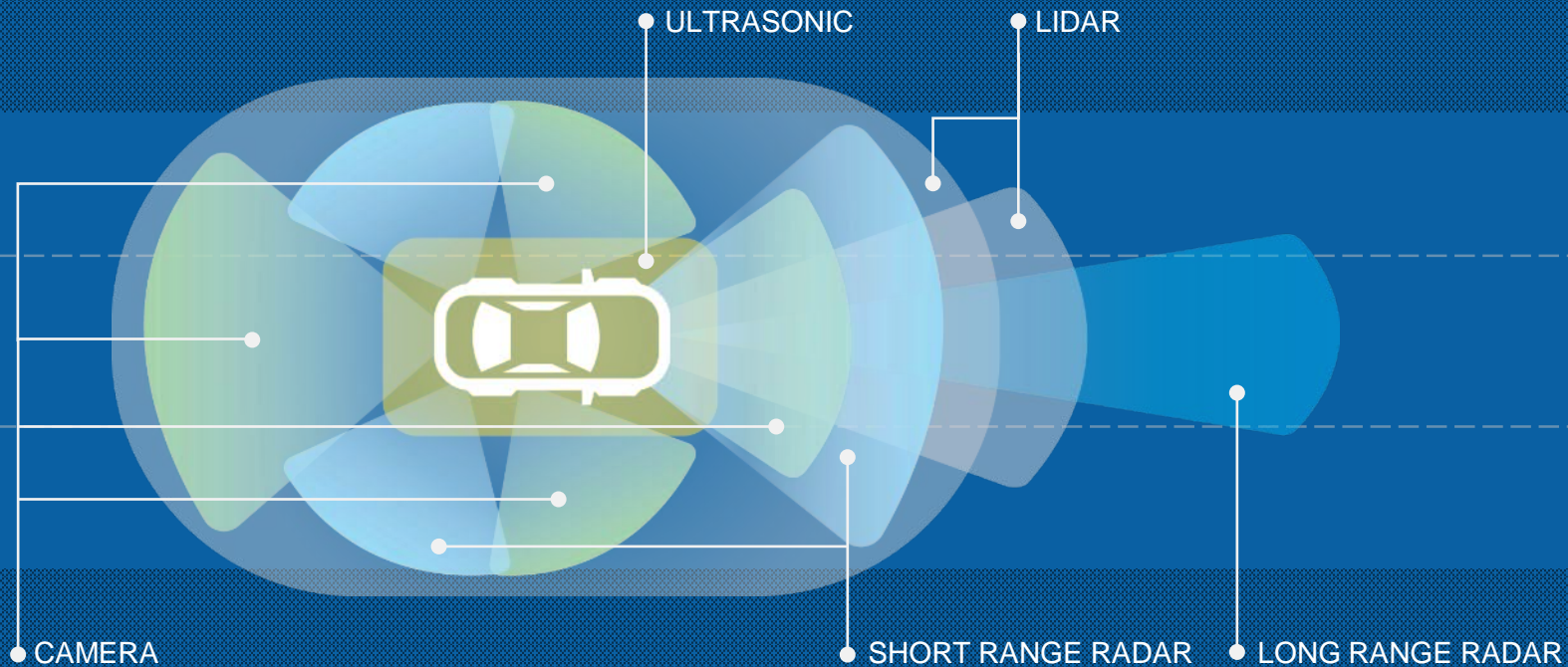
— Dr. Christian Facchi,
Academic Director of the THI

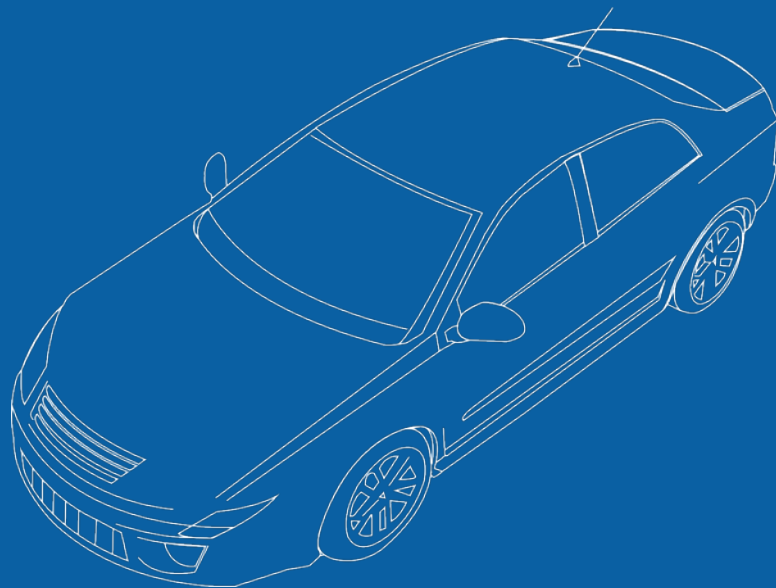
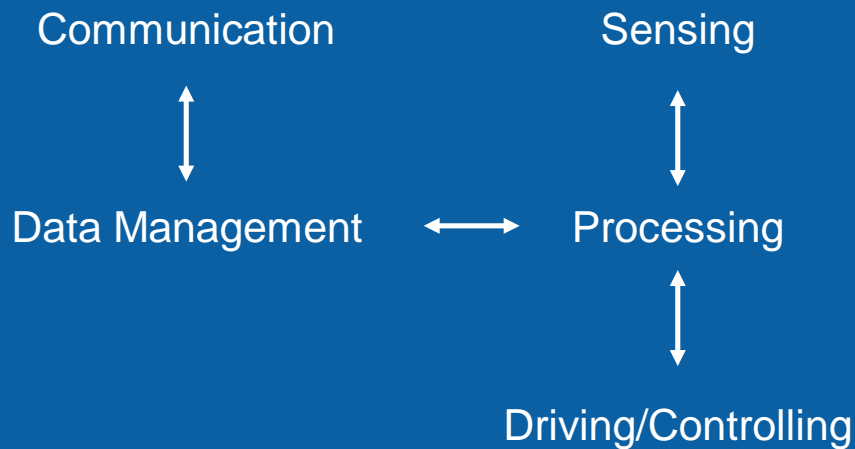
Research Centre, Ingolstadt, Germany



ni.com

Sensor Fusion Enables Environment-Awareness





https://en.wikipedia.org/wiki/Autonomous_car

An autonomous car (also known as automated, uncrewed, computer-piloted, driverless, self-driving and robotic) is a ground vehicle capable of sensing its environment, navigating, and fulfilling the main transportation capabilities of a traditional car without human interaction.

Support Driver

Assist Driver

Replace Driver



Passive Functional
Support

Active
Assist

Fully
Autonomous

Dashboard
Headlights
Backup camera
Distance sensors
Lane sensing, warning

Parking assist
ABS and Traction Control
Cruise control
Emergency braking
Stability control

Automated powertrain
and steering
GPS routing and
rerouting
Collision avoidance
No human assistance

Sensor Fusion



Weather Information



Synthesized
Information
Display



Combined Vision
Systems



Pilot Awareness
Recognition





Audi

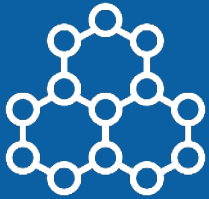


Copyright Audi

“The combination of the industry’s widest bandwidth and low-latency software-designed instrument allowed us to discover our automotive radar sensors as never before, and even allowed us to identify problems very early in the design phase that were previously impossible to catch. With the VST and FPGA programmable by LabVIEW, we were able to rapidly emulate a wide range of diverse scenarios, thus influencing safety and reliability aspects in autonomous driving.”

—Niels Koch, Component Owner of Radar Systems, Audi AG

Challenges of Modern Test



INCREASING
COMPLEXITY



CHANGING
REQUIREMENTS



LACK OF
MANPOWER



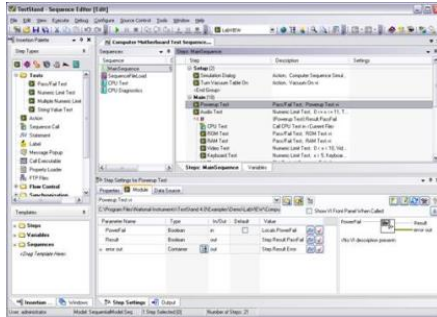
UNREALISTIC
SCHEDULES



Your product is guilty until proven innocent

—A functional safety certification authority for aero application

Safety-Critical Systems



What are the safety risks?

- Safety assessment
- Probability and impact of failure
- Criticality/ASIL level

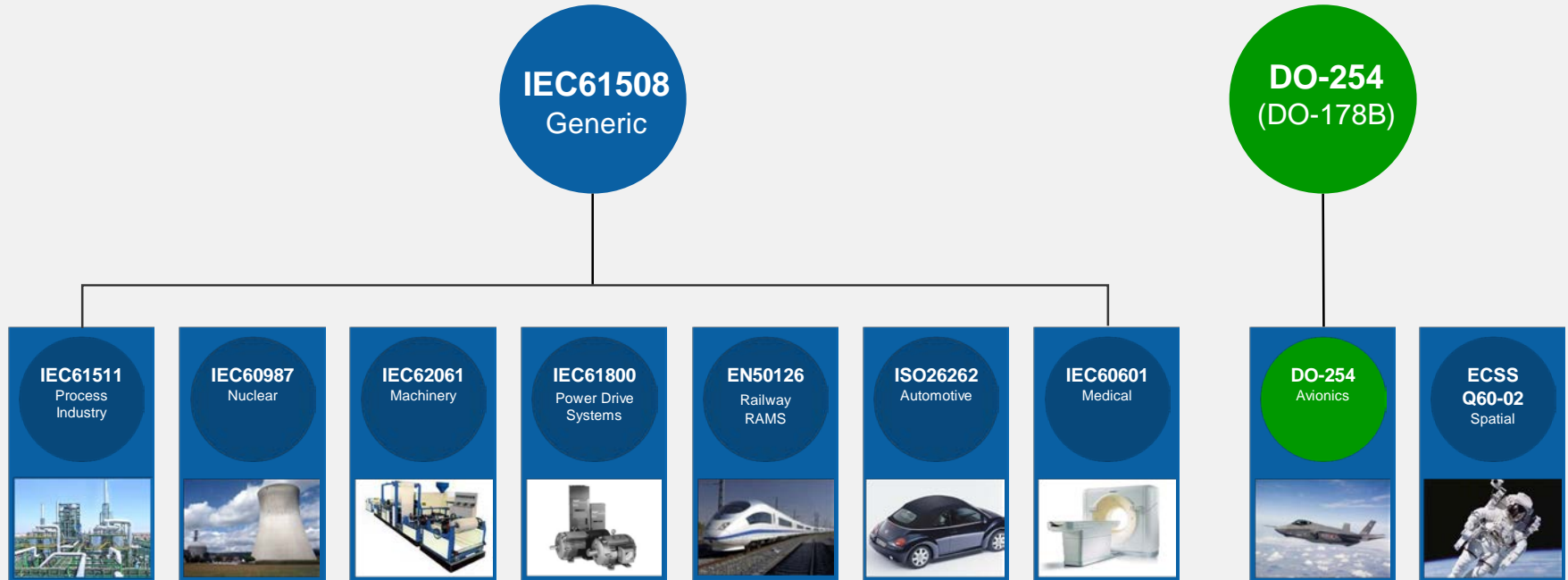
Have you mitigated risks?

- Safety development processes
- Requirements-based V&V
- Normal range and robust testing

Can we trust your product?

- Reliability analyses
- Safety documentation
- Safety certification

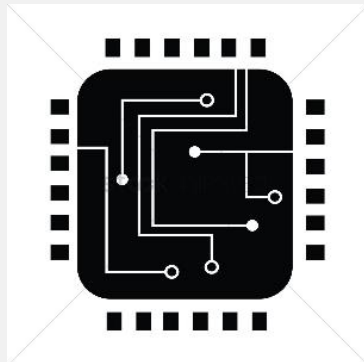
Certification Landscape



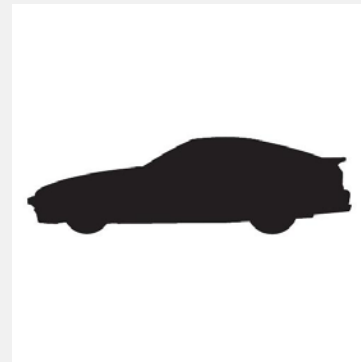
Look to Existing Functional Safety Standards



DO-178
DO-254



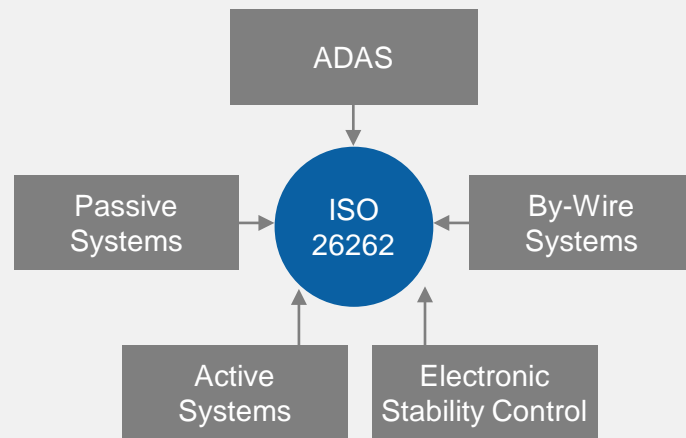
IEC 61508



ISO 26262

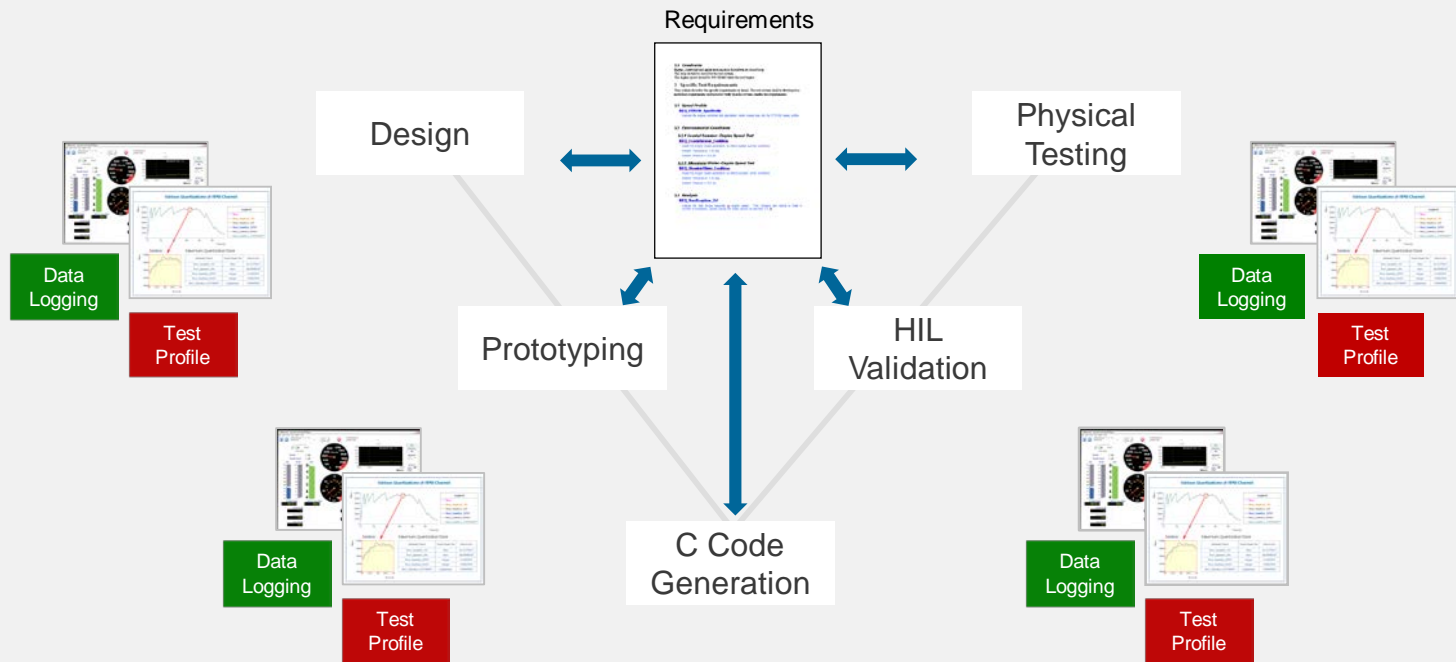
ISO 26262

- An adaptation of IEC 61508 to fit specific needs of the automotive industry
- Provides guidance to avoid risk in creating safety-critical systems
- Regulates critical testing processes
- **Risk = Probability x Impact**

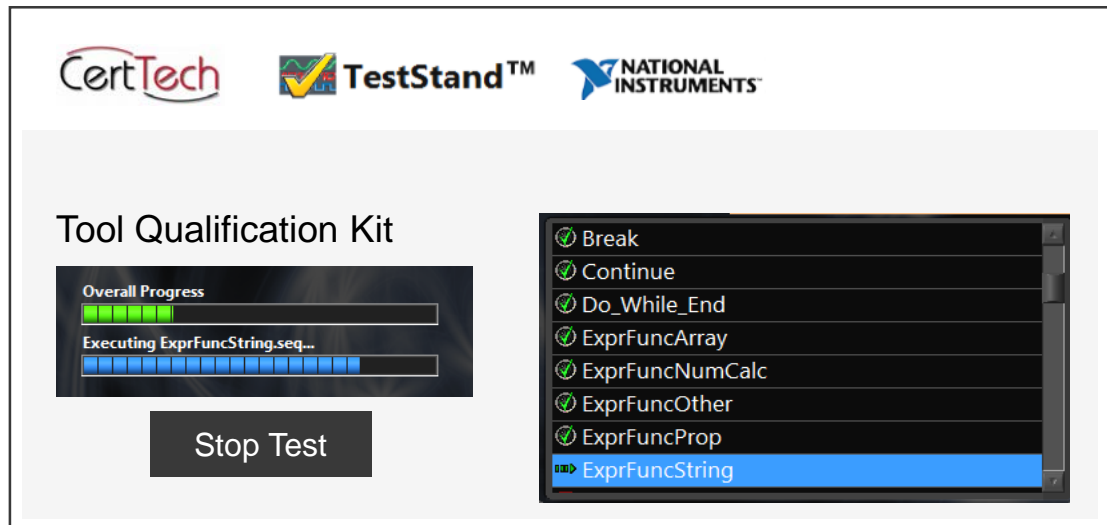


Consistency and Efficiency Throughout the Process

Test components automatically re-usable across all testing applications



NI TestStand™ Tool Qualification Kit



DO-254
ISO 26262

DO-178 B/C
IEC 62304

- Automotive
- Aerospace
- Rail
- Medical
- Energy

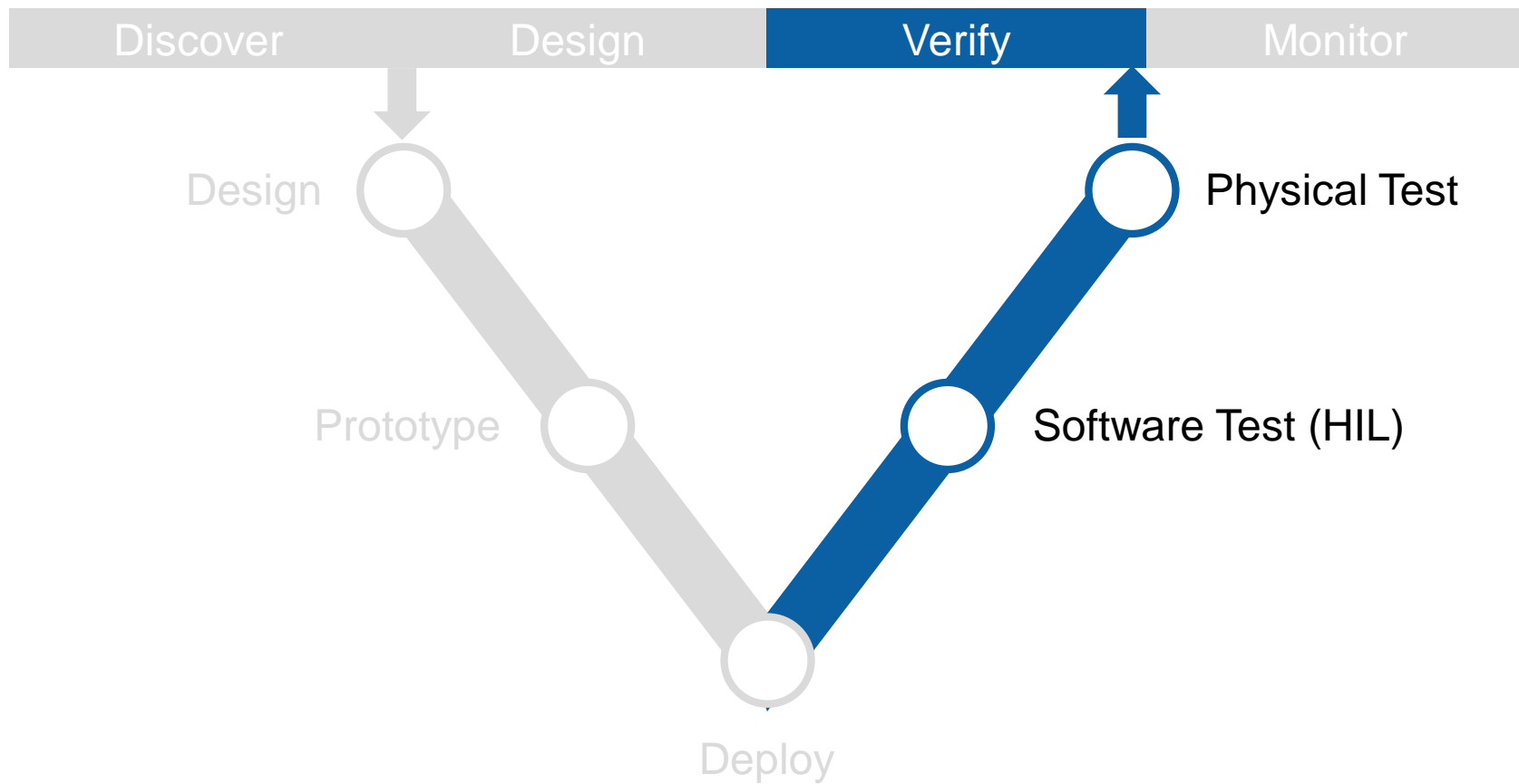
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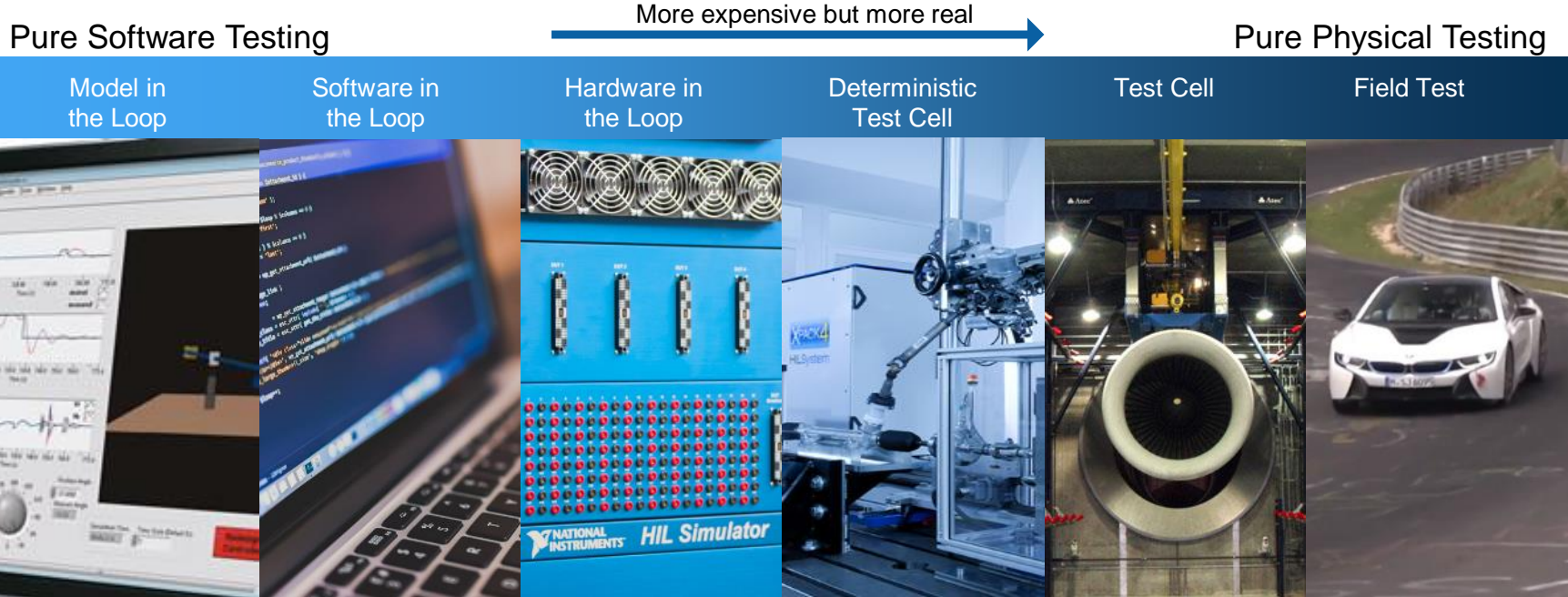


Some Functions and Interfaces are Difficult to Test
Example – ADAS, Cyber-security

Validation & Verification Test



The Continuum of Verification Testing



Aim: to confidently test earlier in product development

Types of Real-World Scenarios

Mission Critical

- Adult Pedestrians
- Minor Pedestrians
- Animals
- Group/Individual



Static

- Buildings
- Road signs, infrastructure
- Traffic Regulators
- Trees
- Environmental effects

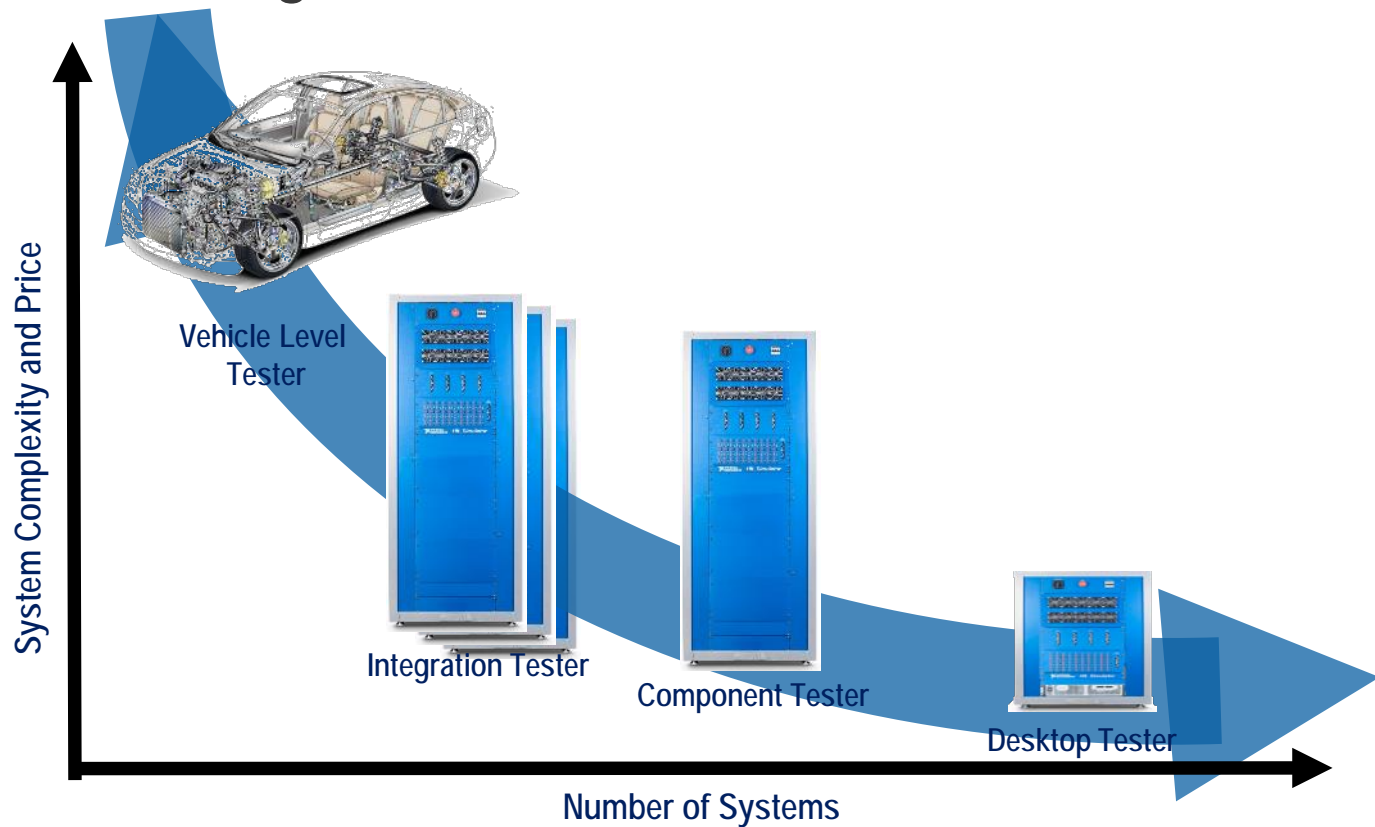


Mobile

- Doppler Effects
- Acceleration, Jerk
- Multi-car scenarios
- Various speed

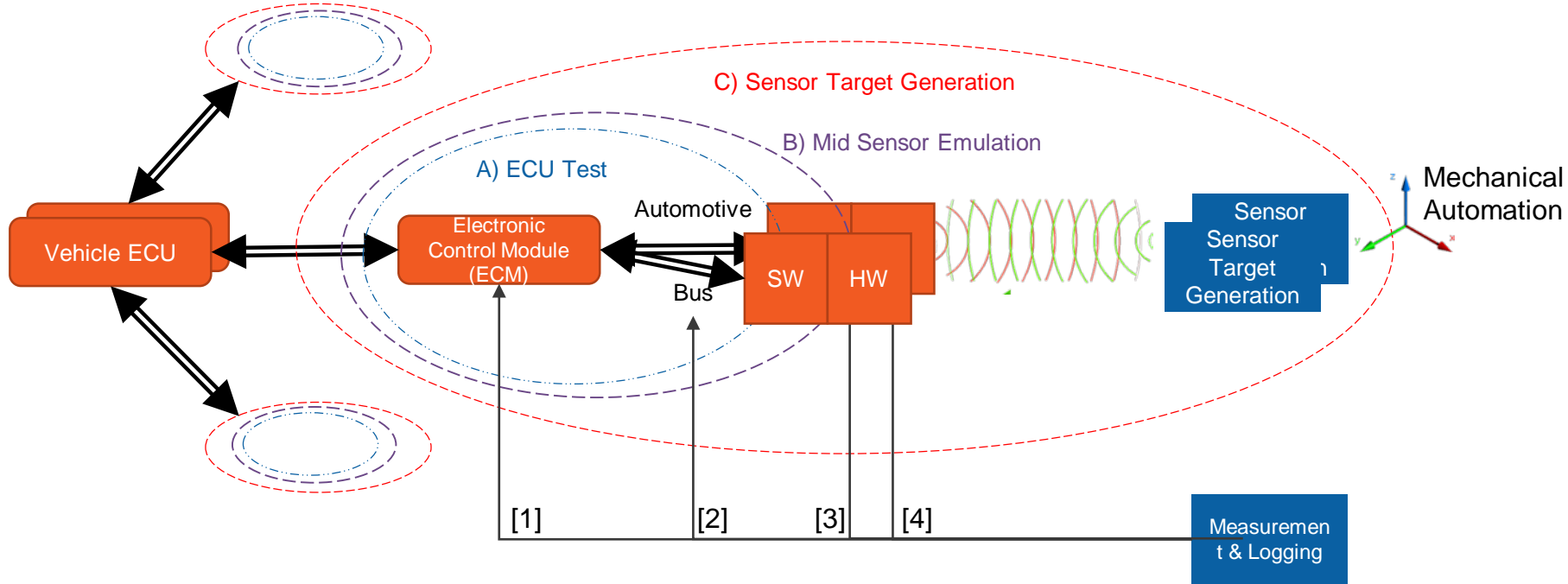


Levels of Testing



Vehicle Level Test Scenario

Question : For each sensor, can you please share which generation is necessary, as well as measurements are necessary?



NI Based Distributed HIL Solution

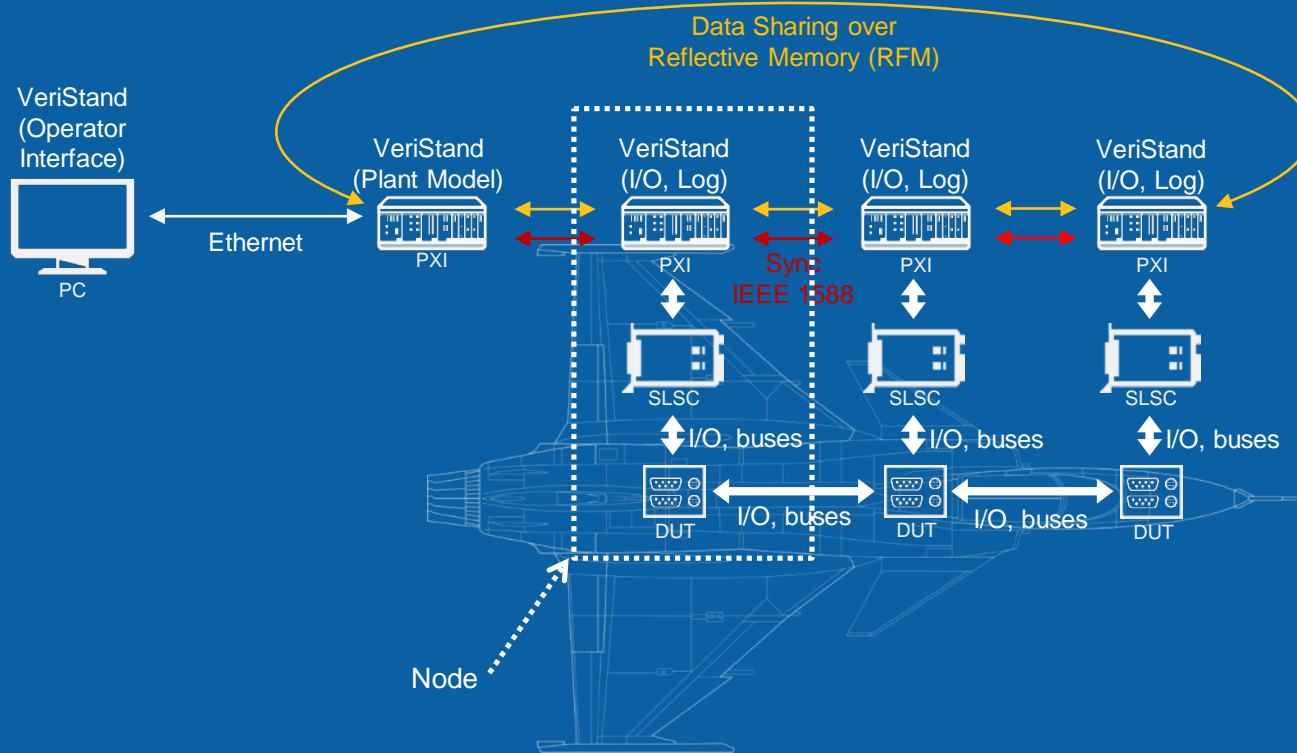




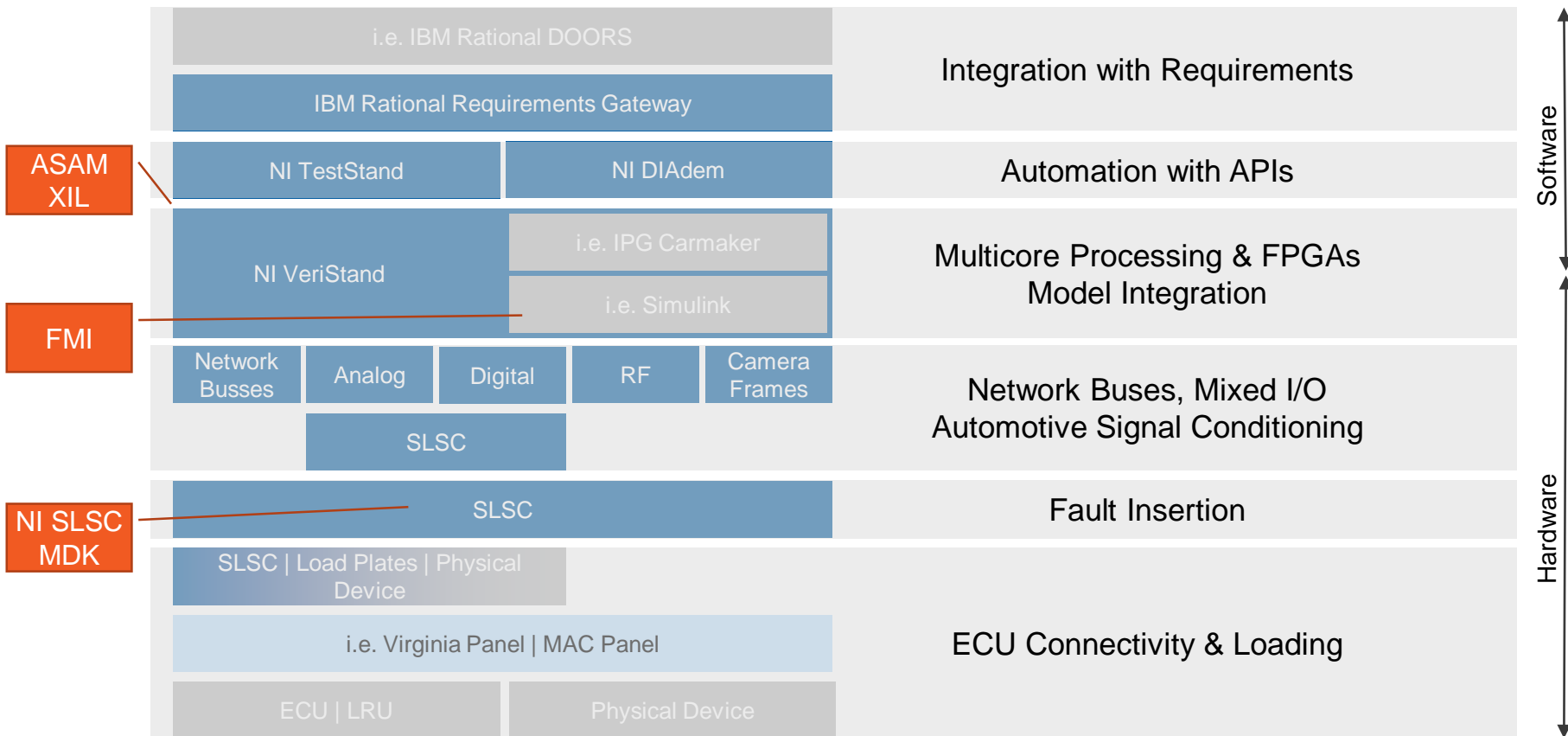
Image source: PSA Peugeot Citroën

“By adopting open and scalable NI hardware and software platforms, we reduced a number of prototype systems by 30% and increased test bench usage by 100%”

—Gregory Gackel, Electronic Integration & Verification Manager, PSA Peugeot Citroën

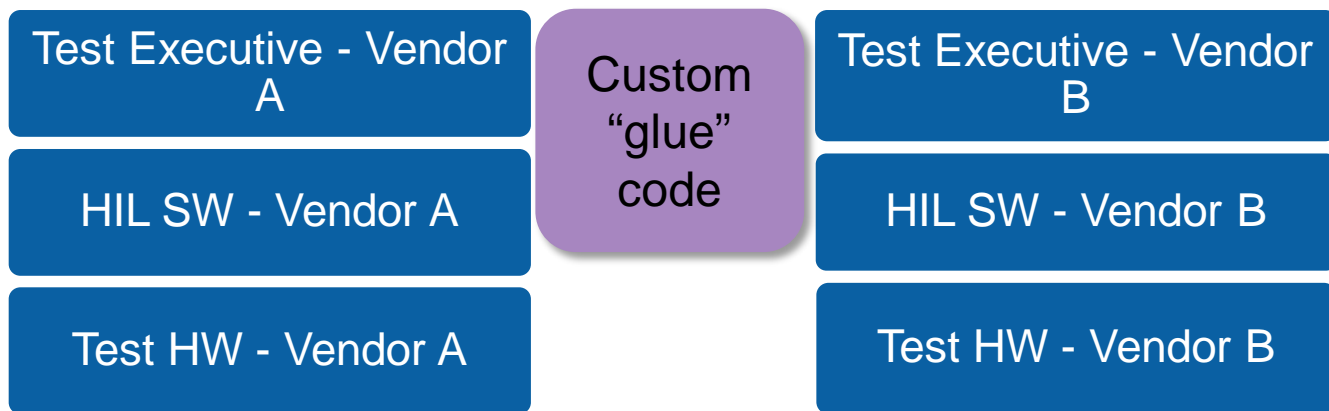
Open Platform & Interoperability

HIL Architecture Built on the NI Platform



Flexible HIL Platforms Avoid Lock-in

- Restrictive HW/SW limits test expansions
- Difficult to migrate test benches between facilities
- Forced to retrain engineers and technicians
- Custom solutions required to ensure interoperability

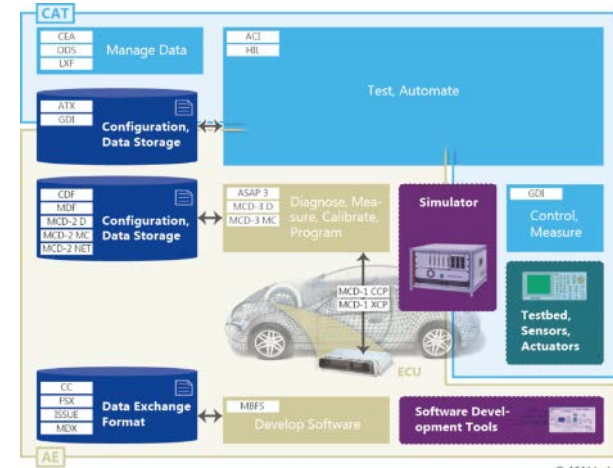


Who is ASAM?

- Association for Standardization of Automation and Measuring Systems
- Coordinates the development of technical standards
- Incorporated in Germany
- Focused on the automotive industry
- National Instruments is a member



Association for Standardisation of
Automation and Measuring Systems



Source: ASAM , asam.net
(© by ASAM e.V.)

Unlock Heterogeneous Test Systems

ASAM XIL API

VeriStand

Vendor B
SW

Vendor C
SW

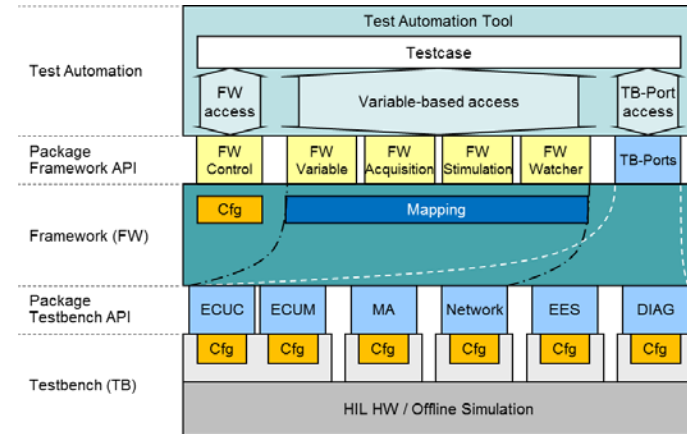
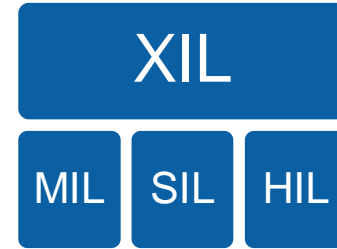
NI
Hardware

Vendor B
HW

Vendor C
HW

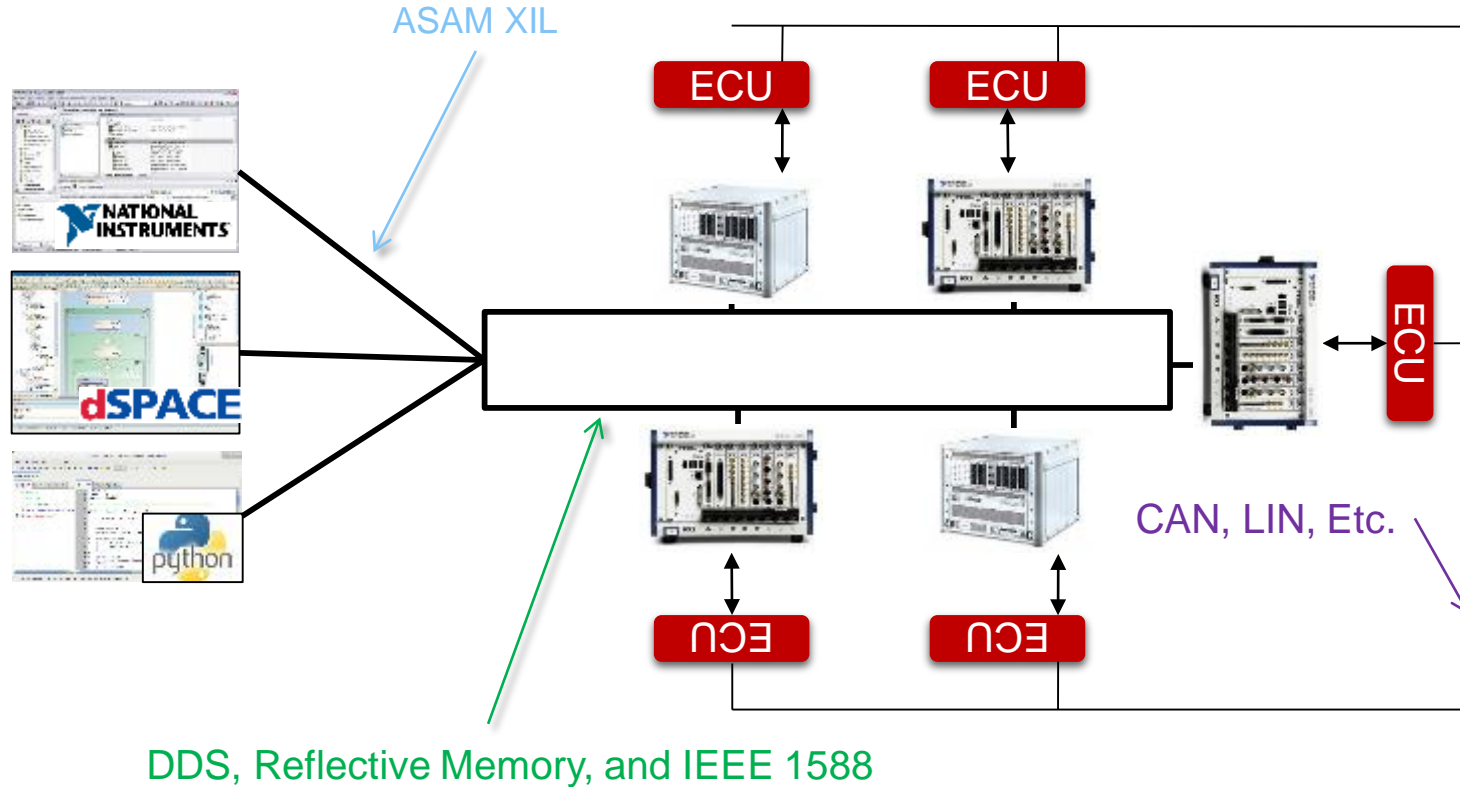
What is the ASAM XIL API?

- Communication standard between:
 - Test automation tools
 - MIL, SIL, HIL test systems
- Standard method to access testing hardware
- Goal: increase test reuse, decouple test HW and SW
- C# source library
- Current version: 2.0.1



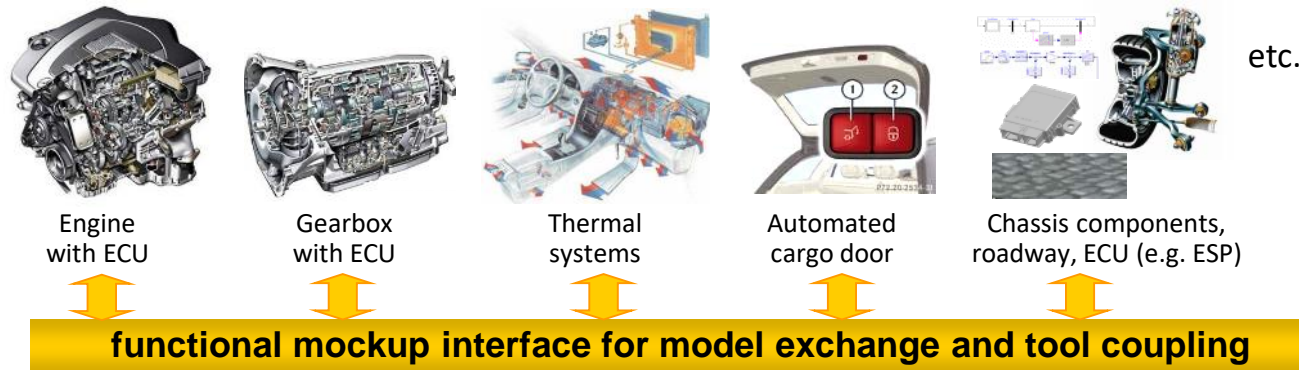
Source: ASAM, asam.net
(© by ASAM e. V.)

Integration HIL Test System Using XIL API



FMI – Overview

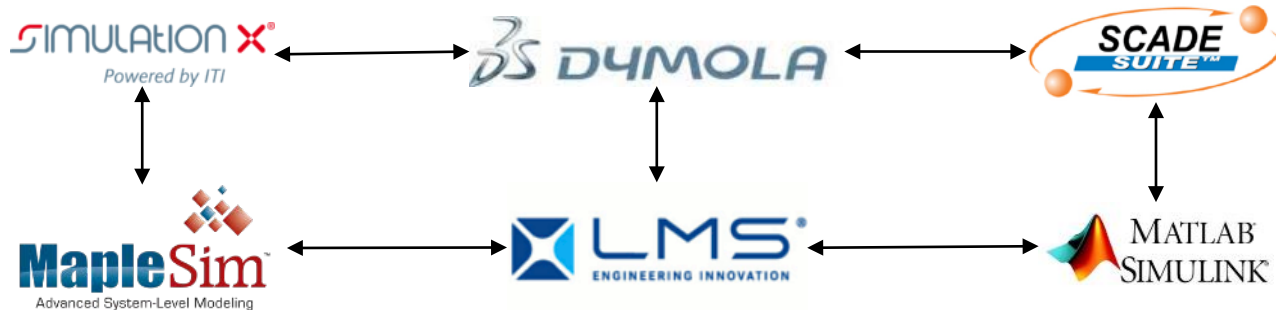
- FMI development initiated, organized and headed by **Daimler AG**
- Improved Software/Model/Hardware-in-the-Loop Simulation, of models from **different vendors**.
- **Open Standard**



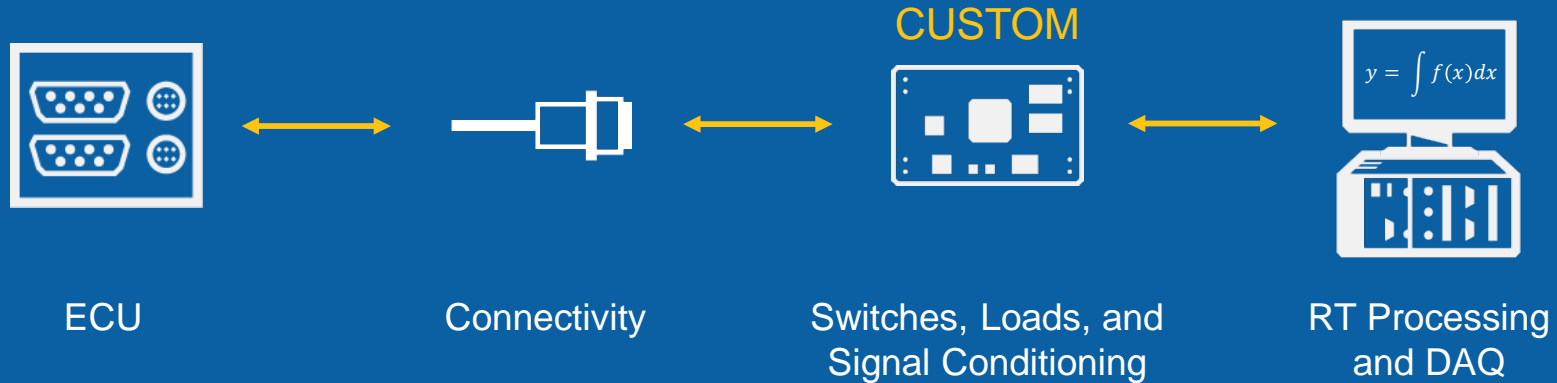
courtesy Daimler

Functional Mock-Up Interface

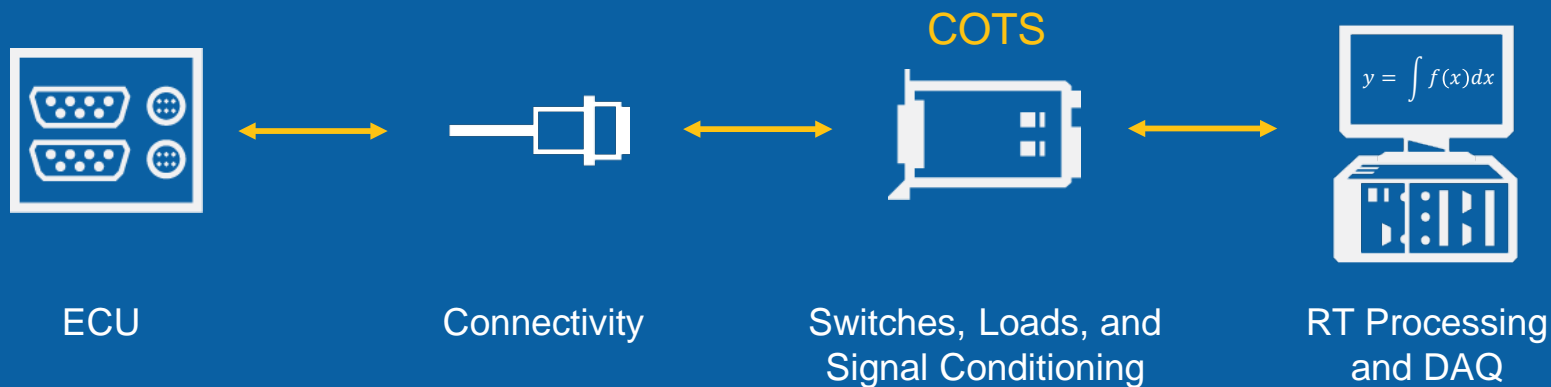
- Functional Mock-up Interface (FMI) is a tool independent standard to support both model exchange and co-simulation of dynamic models using a combination of xml-files and compiled C-code



Today's Hardware in the Loop System



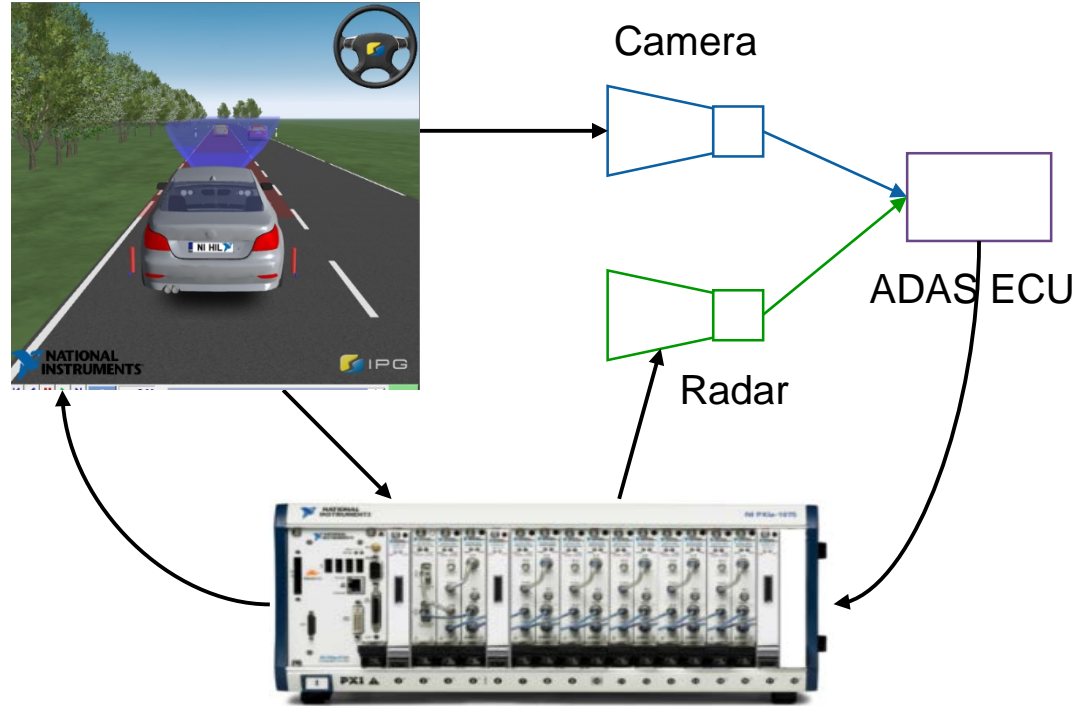
Future Hardware in the Loop System



ADAS Testing Scenarios – System HIL Test

A closed loop system:

- Scene data passed to tester
- Image data taken from scene
- HIL system generates radar object data
- Synchronized camera and radar data sent to ECU
- ECU send command data to vehicle model
- Vehicle response captured in the scene generator



NI HIL Systems



NI HIL Systems

Turnkey HIL Simulator



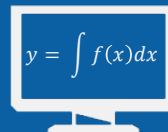
DIY HIL System



Built on Commercial Off the Shelf Components



PXI and RIO



VeriStand



SLSC



Specialty Partners

NI Advantages



Getting Started

Quick and easy to get started decreases the impact of the lack of manpower and shortened testing schedules



I/O Breadth

A broad range of I/O ensures you can meet the test requirements of advancing technology



Customizability

A customizable, open platform lets you adapt to changing requirements and lowers the risk of purchasing a system



Integration

Integration with legacy and 3rd party systems helps you adapt to changing requirements and lowers the investment risk

A Single Approach for V&V and Production Test

NI Automated Test (ATE) Software

- Test Automation
- Hardware Abstraction Layer
- Data Management

NI Real-Time Test (HIL) Software

- Real-time OS
- Mathematical Modeling
- Scenario Simulation

