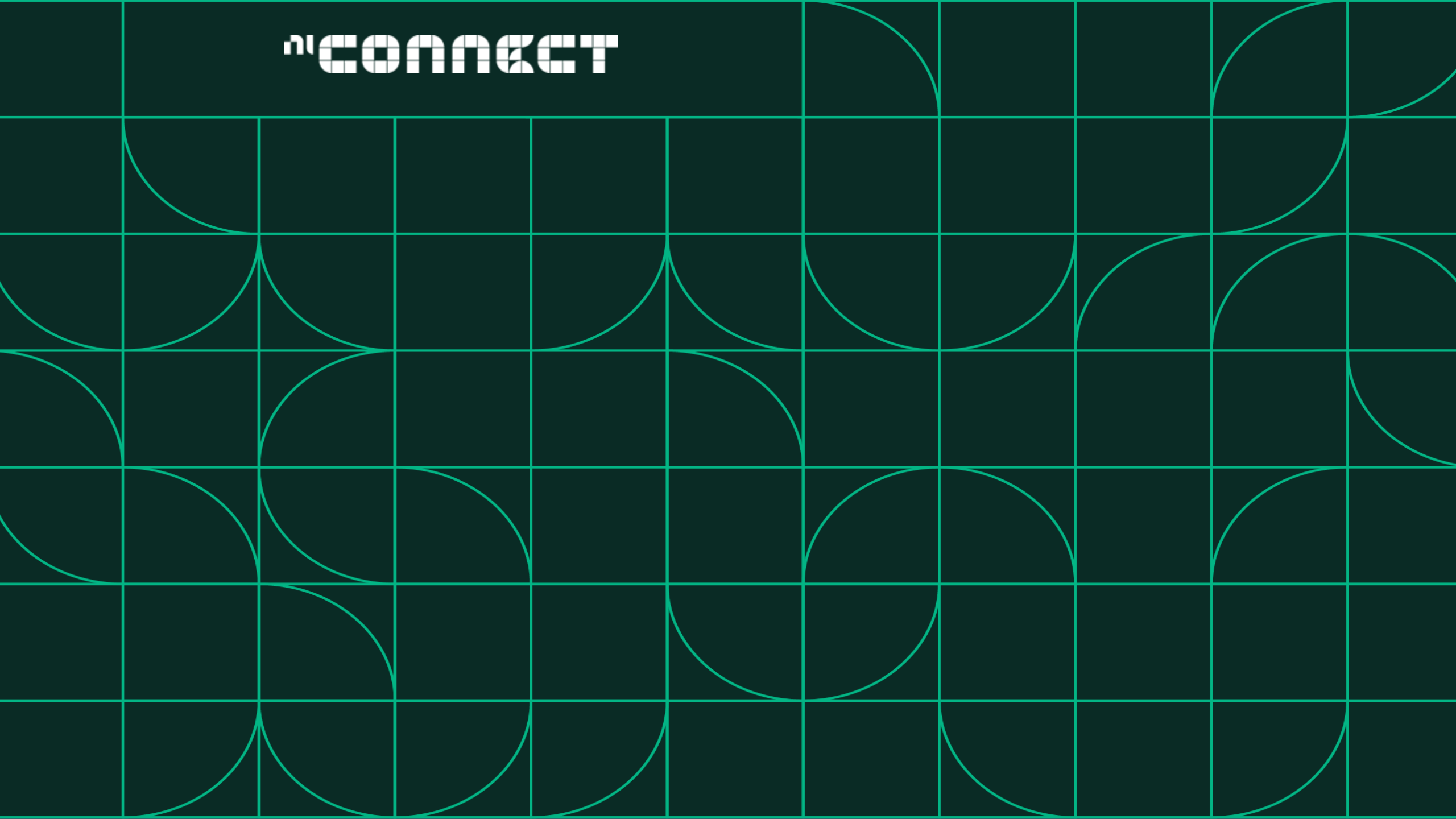


W  **LC**  **ME**  **AUST**  **N**

י"ח **CONNECT**





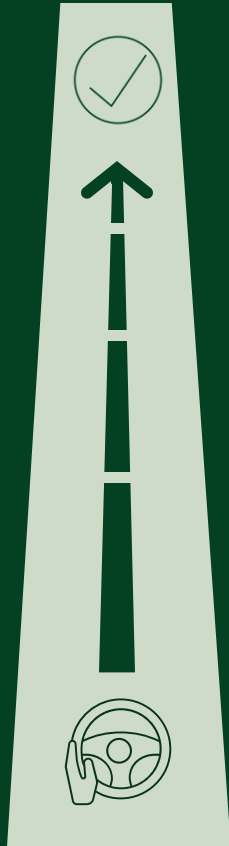
Mastering Data Replay and HIL for ADAS and AD Together

May 25th, 11:15 AM

Christine Sparks,

Senior Business Development Manager
ADAS and Autonomous Vehicles, NI

Quality
OF MILES



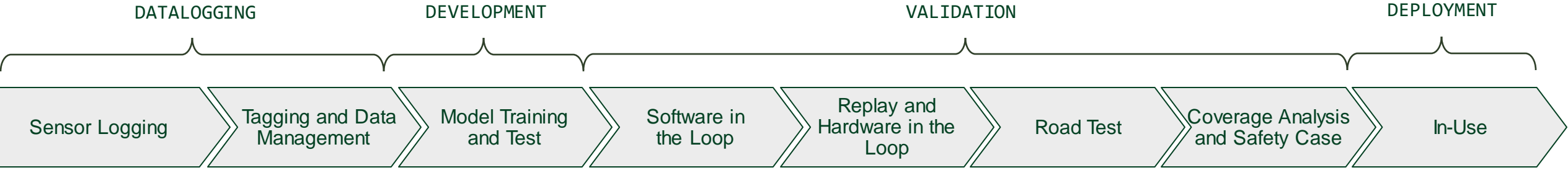
Quantity
OF MILES

INDUSTRY LOOKBACK ON WHY REPLAY AND
HARDWARE-IN-THE-LOOP TEST IS CRITICAL

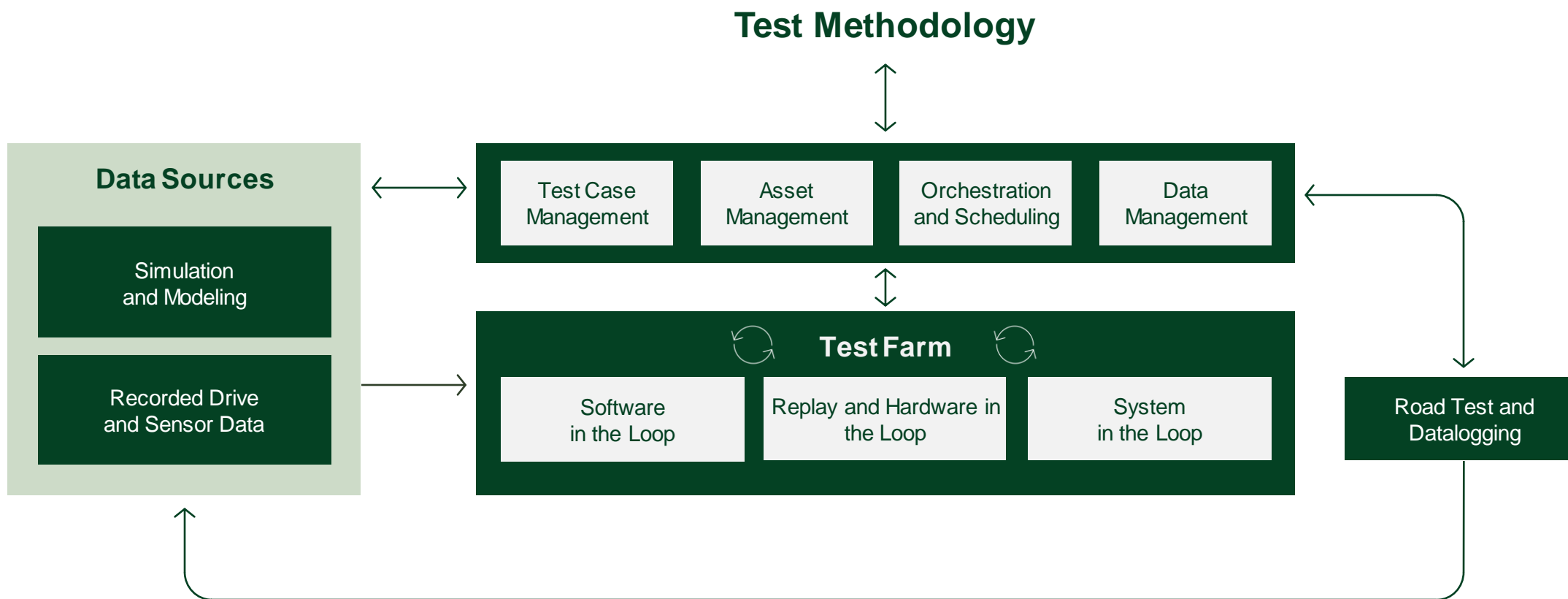
With Autonomous Vehicles, How Much Testing is Needed?



Disconnected Solutions Throughout Development



Workflow for ADAS and Autonomous Test



Increasing Simulation During the Validation Test Process

Decreasing road tests by shifting or expanding left is critical to meet the test coverage need it for autonomous vehicles.

Test organizations are struggling to move in this direction and still rely heavily on expensive and time-consuming real-world test techniques.



SIMULATION TEST

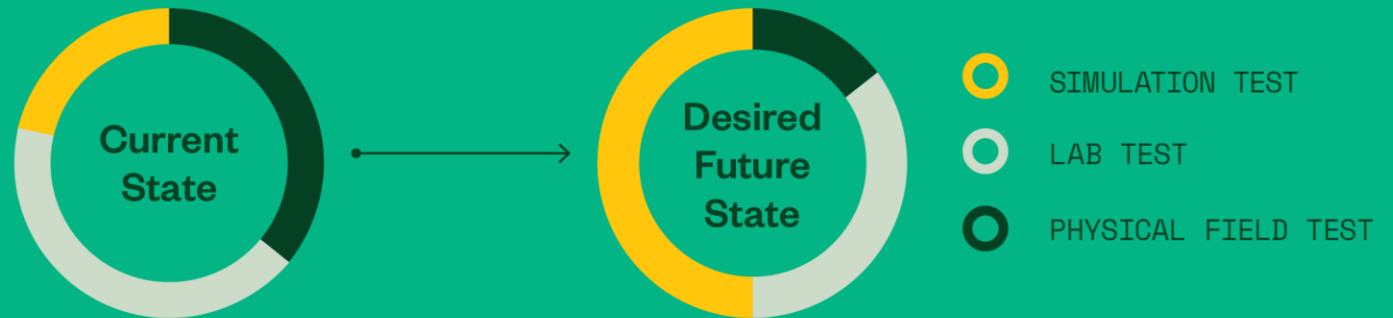


LAB TEST



PHYSICAL FIELD TEST

People surveyed reported a disparity between their current and desired future breakdown of their V&V processes



What's Stopping You?



Fidelity Requirements

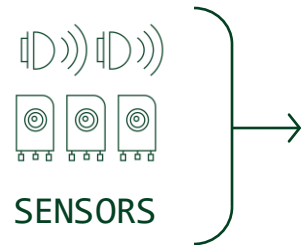


Toolchain Complexity



Lack of Trust

ADAS AD Solutions



Record



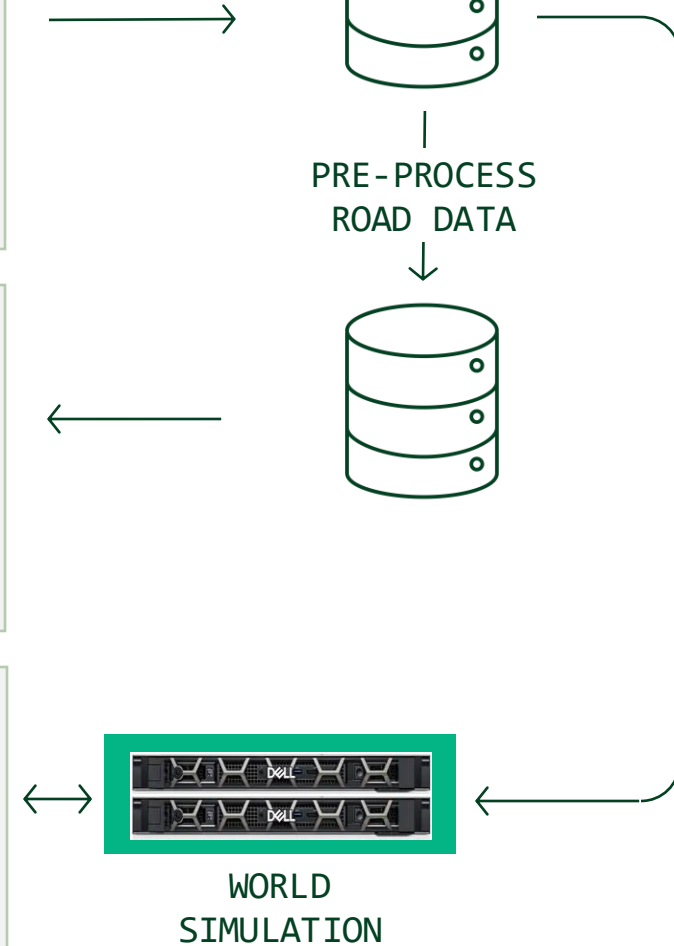
Replay



HIL

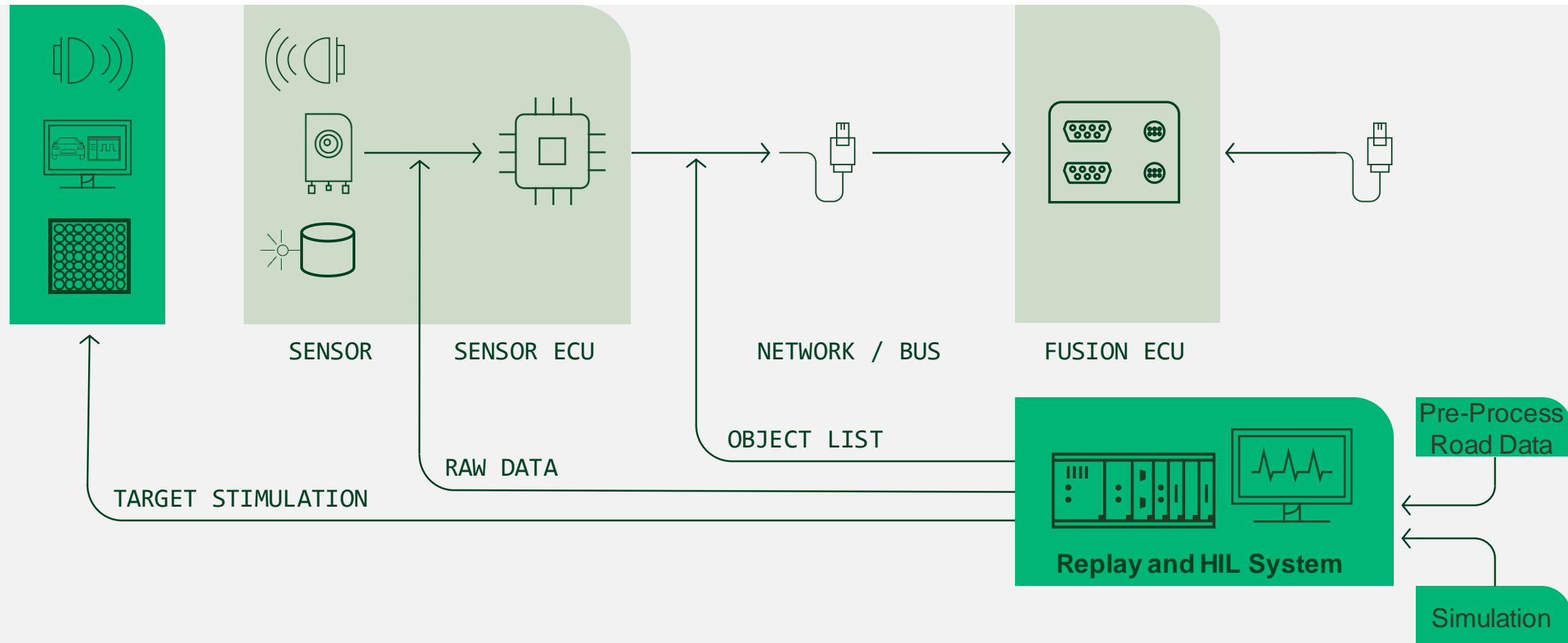


PRE-PROCESS
ROAD DATA



Challenges of ADAS Replay and HIL Testing

DATA INJECTION | DATA QUALITY | DATA VOLUME & THROUGHPUT | TIMING AND DATA SYNCHRONIZATION | SIMULATION MANAGEMENT
SIMULATION FIDELITY | SCENARIO TEST COVERAGE | REPEATABILITY | FAULT COVERAGE | TEST MANAGEMENT | AND MORE...





NI'S SOLUTION FOR ADAS REPLAY AND HIL

Replay and HIL System AD

MAXIMUM INTEROPERABILITY

Move back and forth between
replay and HIL test

ENSURE DATA FEED

Throughput, timing & sync
of real or simulated data

SYSTEM INTEGRATION & EVOLUTION

Certified partner – Konrad Technologies



UNIFIED TEST SYSTEM

Single toolchain for ADAS validation

OPEN SOFTWARE-CENTRIC

Interface with 3rd party simulation tools,
IT infrastructure and cloud services providers

MAXIMIZE TEST COVERAGE

Run more test in the lab

FUTURE PROOF SYSTEMS

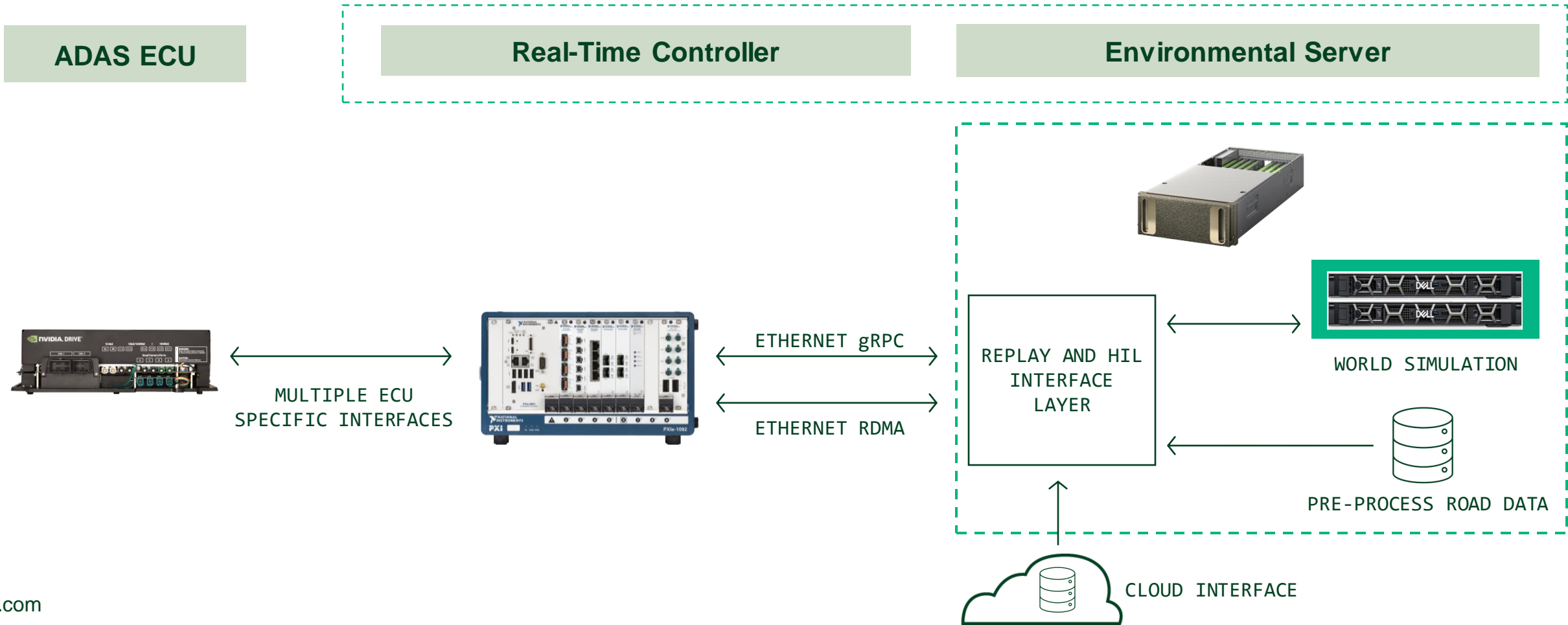
Customization and flexibility

ADAS Replay and HIL Test System



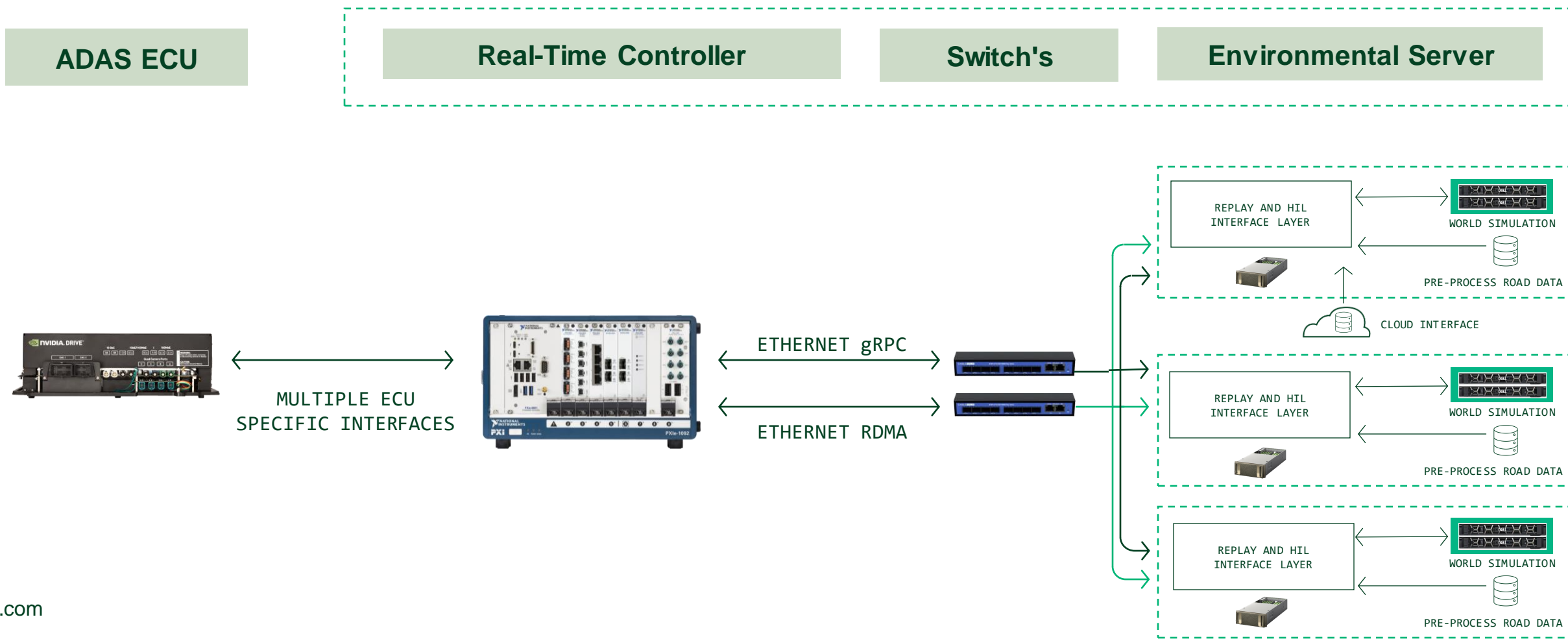
ADAS Replay and HIL Test System

Environmental Server



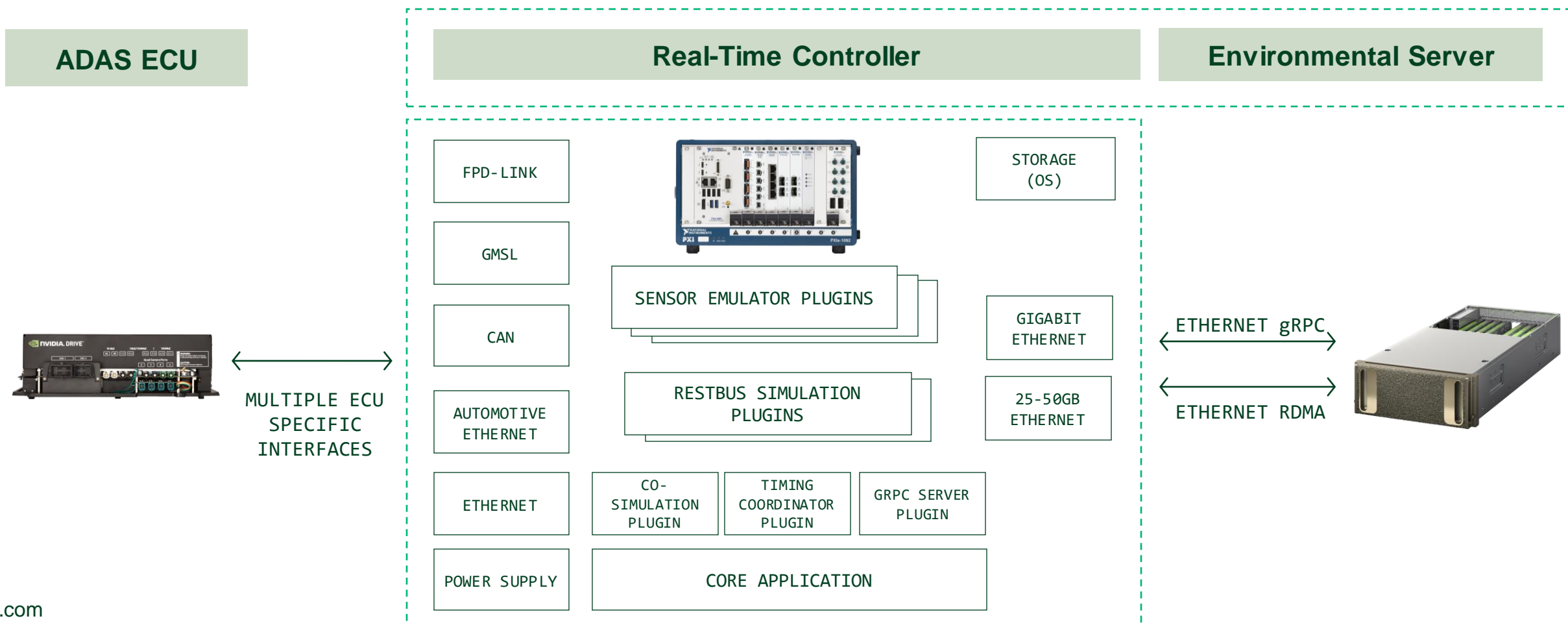
ADAS Replay and HIL Test System

Environmental Simulation Distributed

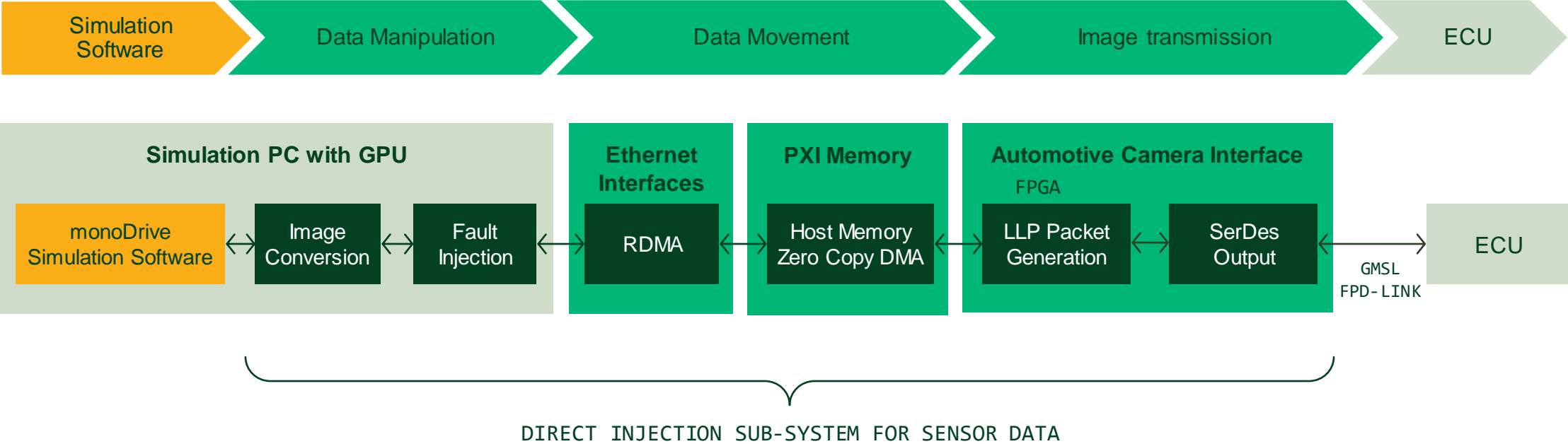


ADAS Replay and HIL Test System

Real-Time Controller



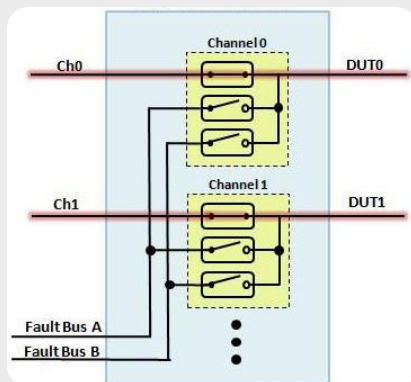
Direct Injection Sub-System for Sensor Data



Making Systems Fault Tolerant through Fault Injection

No Fault

Physical Level



Fault Injection

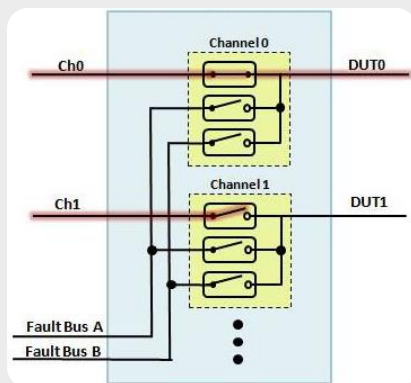


Image Level



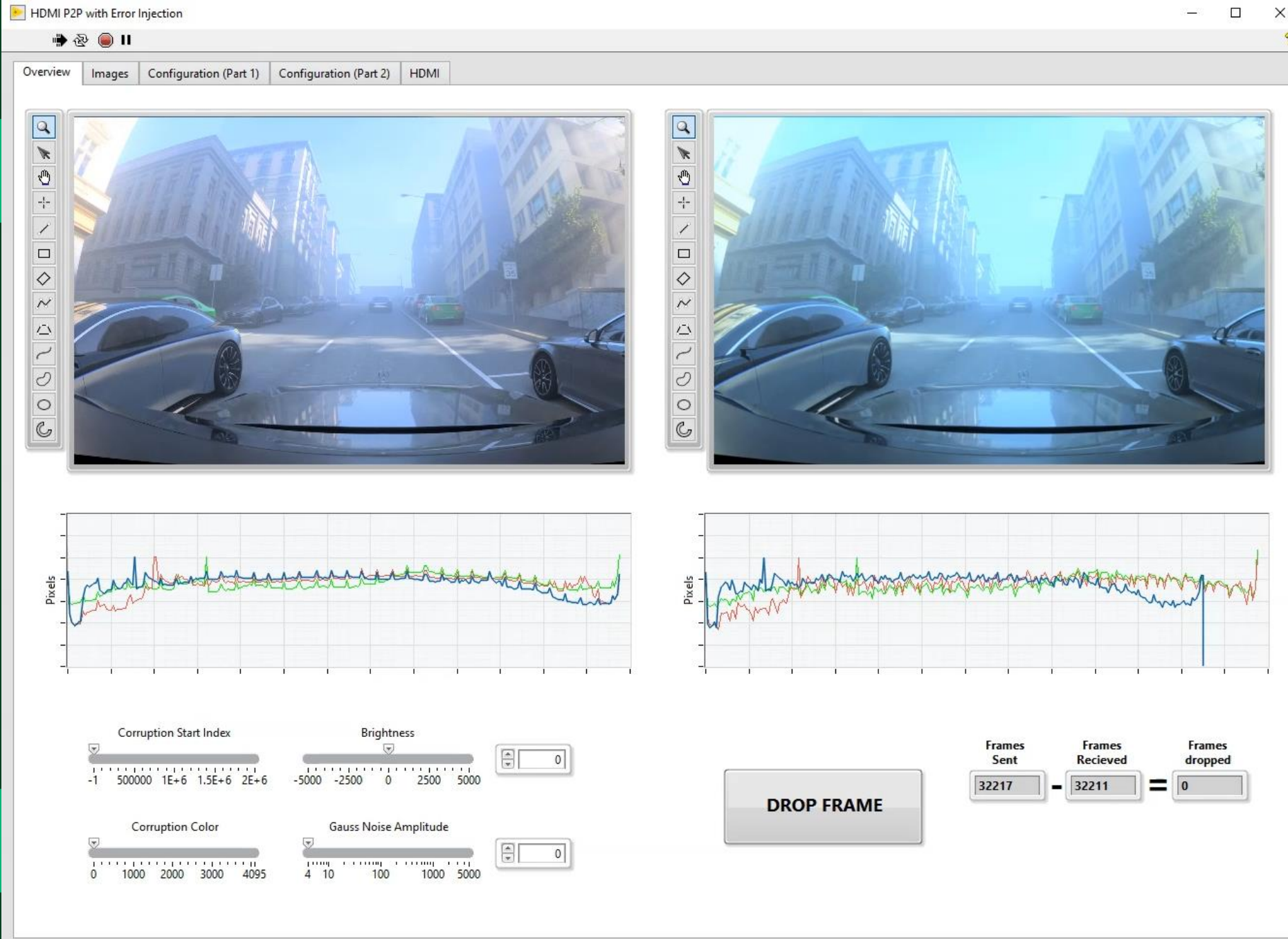
Pixel Level



OPEN-CIRCUIT HARDWARE SIMULATION

IMAGE BLUR¹

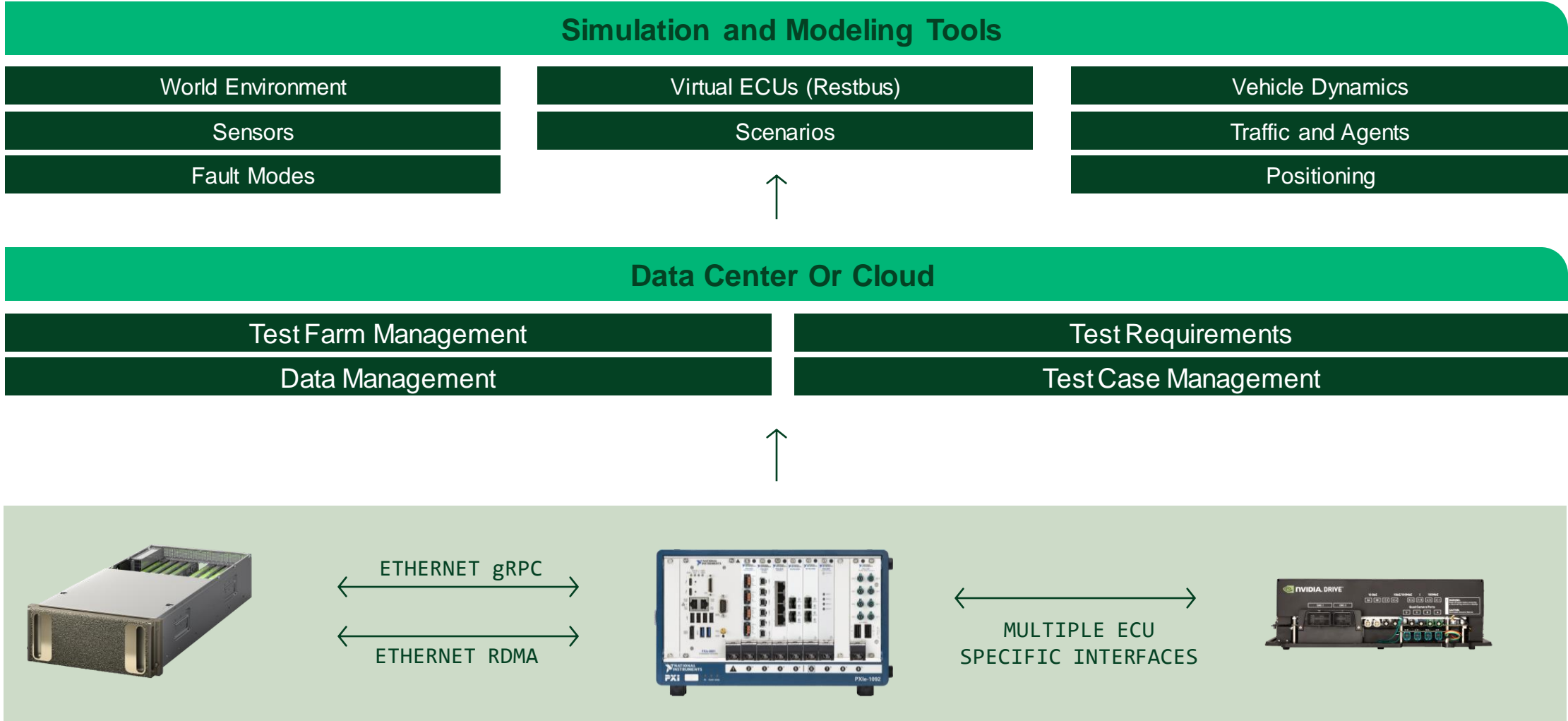
PIXEL CORRUPTION AND GAUSSIAN NOISE¹



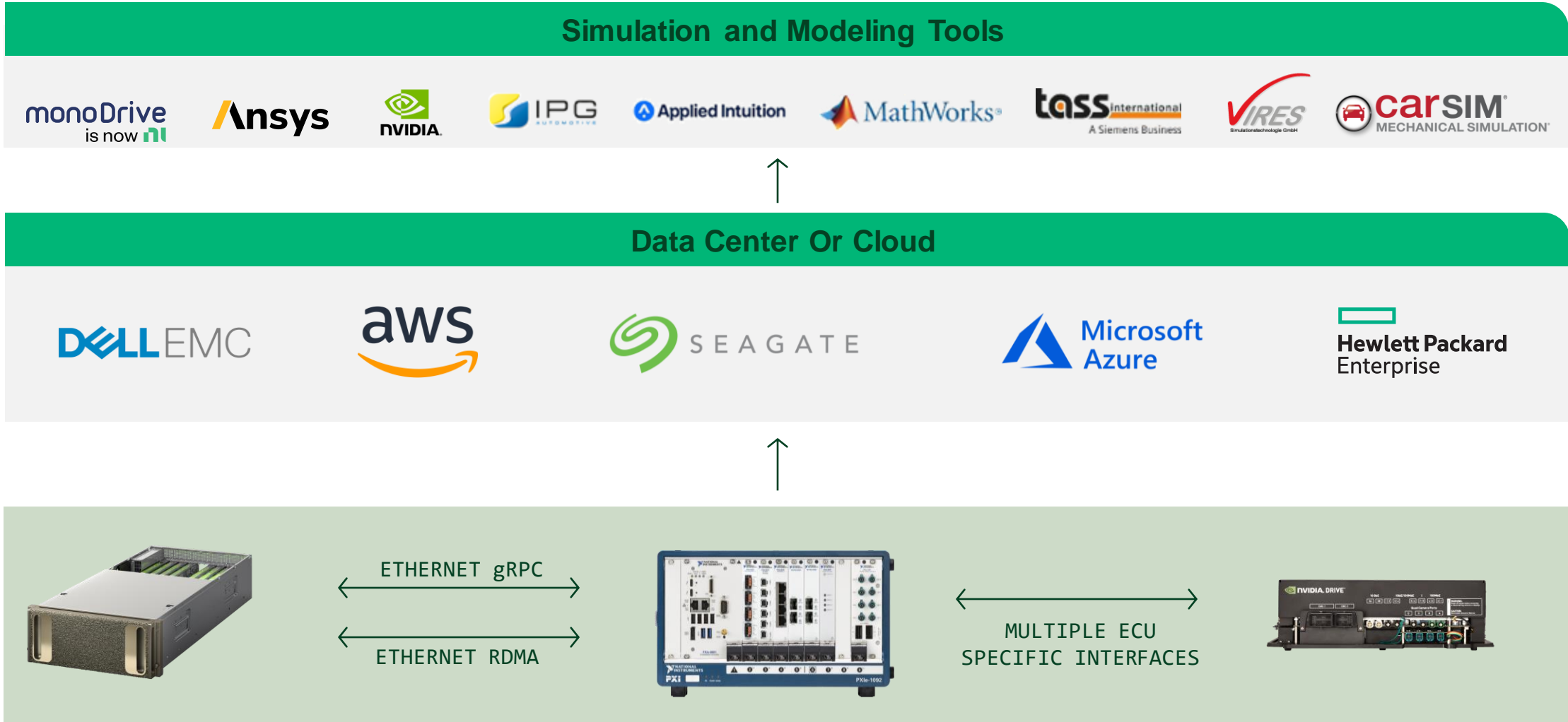
By aggregating and injecting real-world road test data to several ADAS ECUs in parallel, with our ADAS Replay and HIL System, NIO expects to shorten time-to-market for the mass production of their next-generation L4 vehicle platform.



ADAS Replay and HIL Scalability and Infrastructure



ADAS Replay and HIL Scalability and Infrastructure



Valeo's ADAS HIL Farms

VIRTUAL VALIDATION

large scale simulation capability
with **8 HIL & SIL FARMS**
on sites and in the cloud
running **250+ test benches**

40
PETABYTES



PHYSICAL VALIDATION

worldwide network of
9 TEST TRACKS
with on-site facilities
running **250+ vehicles**





konrad
...technologies...



AN **ECOSYSTEM** CAN SOLVE
THE ADAS/AD END-TO-END VALIDATION CHALLENGE

From Replay and HIL System AD to Your Tailormade Solution

NI Certified Partner Konrad Technologies Provides

Runtime and GUI Customization

System Installation

System Debug and Troubleshooting

Configuration Based on Test Requirements

I/O required to interface with all of the connections on the ECU

Real-time System Performance

Interfaces to environmental simulation and fleet data repositories

Time and synchronization of real and simulated sensor data

Standard on Every System

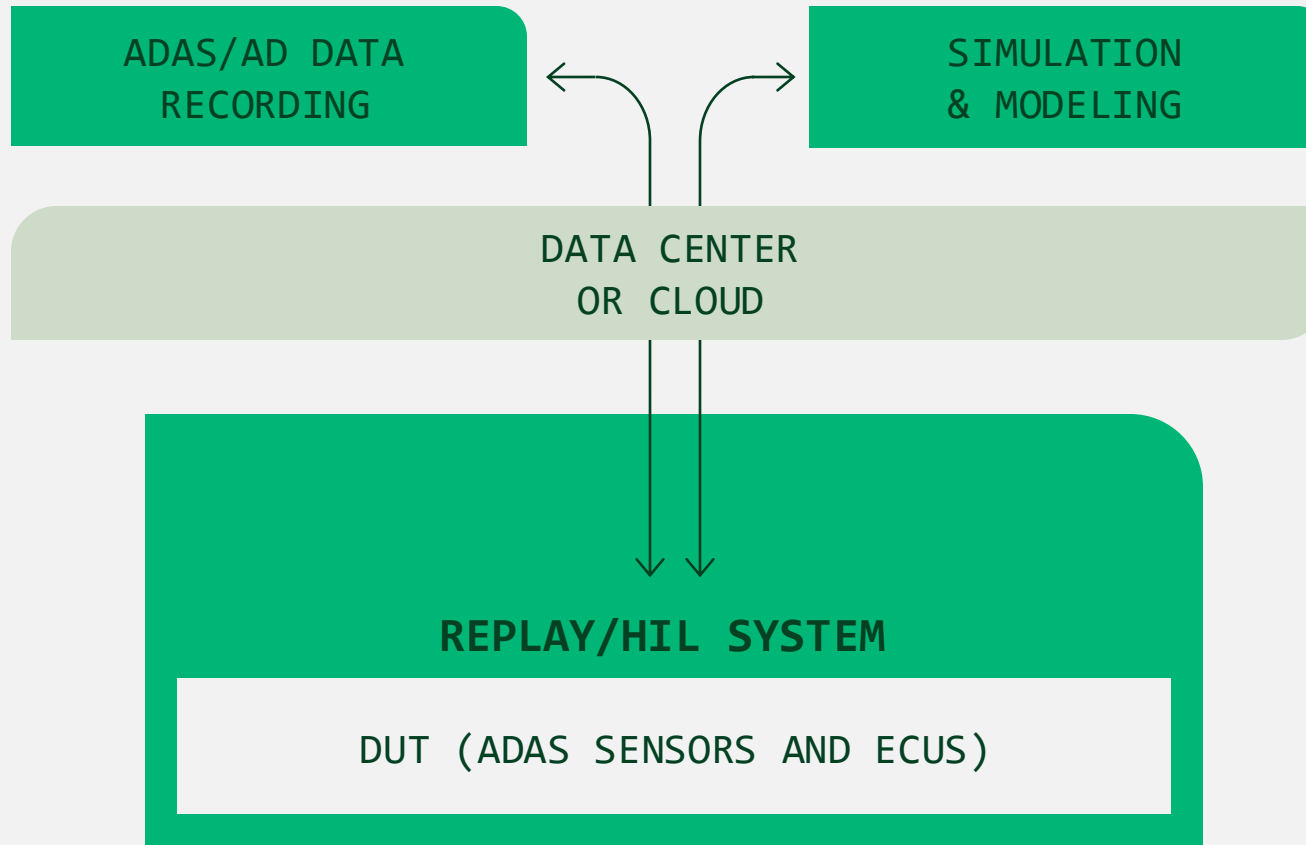
PXI System Controller and Chassis

Standard Software to switch between Data Replay
and HIL within the same system

APIs and Examples for Customization

OUT-THE-BOX
ADAS REPLAY AND
HIL EXPERIENCE
BY NI

One Single Platform for Record, Replay & Closed-Loop HIL





DATA RECORD
SYSTEM AD



SIMULATION
& MODELING

DATA CENTER
OR CLOUD



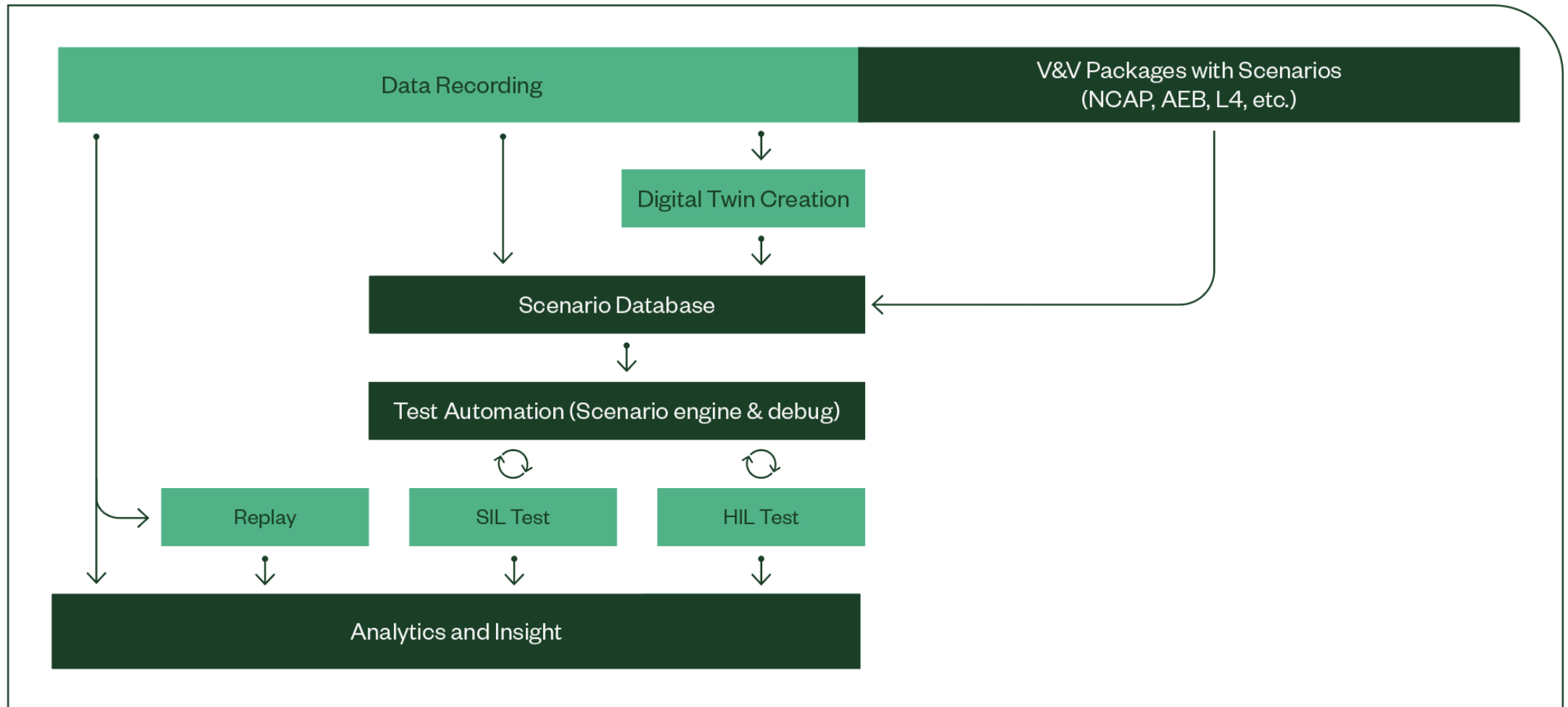
REPLAY/HIL SYSTEM



BENEFITS

One Single Platform for Record, Replay & Closed-Loop HIL

ADAS/AD Workflow - Test Coverage Analysis





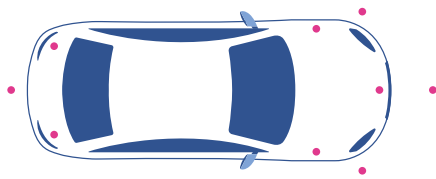
Enabling Scalable and Safe Deployment of Autonomous Vehicles & ADAS while Dealing with an Infinite Test Space

Introduction to Foretellix

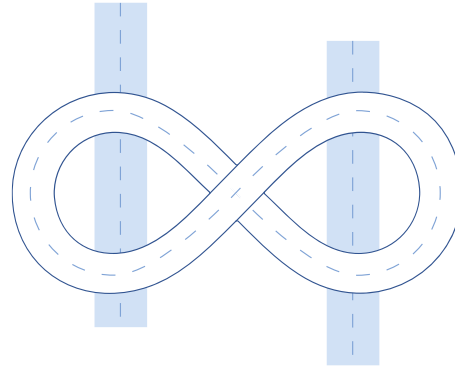
Bindesh Patel,

Product Manager, Foretellix

Autonomous Driving Systems Verification and Validation Challenges



Ensuring your system is safe and performant.



Taming the infinite scenario space with finite resources and time



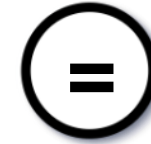
Having an objective metric to determine when you have done enough V&V

The Infinity Challenge

Most Complicated System



Most Complex Environment



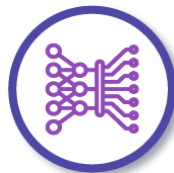
Millions of Scenarios



150M Lines of Code



>100's Chips



Several Machine Learning Systems



Foretify™ Verification & Validation Platform

SCENARIO SPECIFICATION

- Abstract scenario language
- Out-of-the box V&V content

TEST AUTOMATION

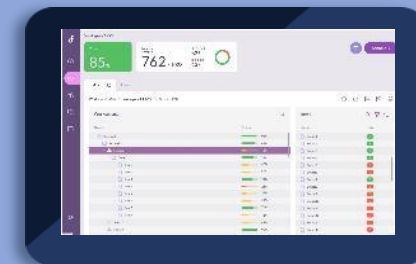
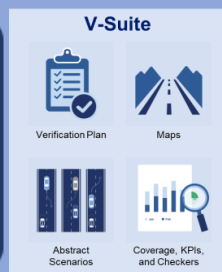
- Hyper-scale automation for running at scale
- Powerful constrained-random test generator

BIG DATA ANALYTICS

- Objective measure of V&V 'done'
- KPI analytics and project dashboards



OpenSCENARIO 2.0



Reduce Time to
Deployment

Using OSC2.0 with a proven, measurable
Coverage Driven V&V solution



Increase Productivity

Highly automated V&V process to
reduce manual engineering effort



Increase Quality

Using tools and methodology for exposing
bugs, unknowns and edge cases



Reduce Cost

Faster time to market with safe system
and lower risk of failure

Foretellix V-Suites – Out-of-the-box V&V Content

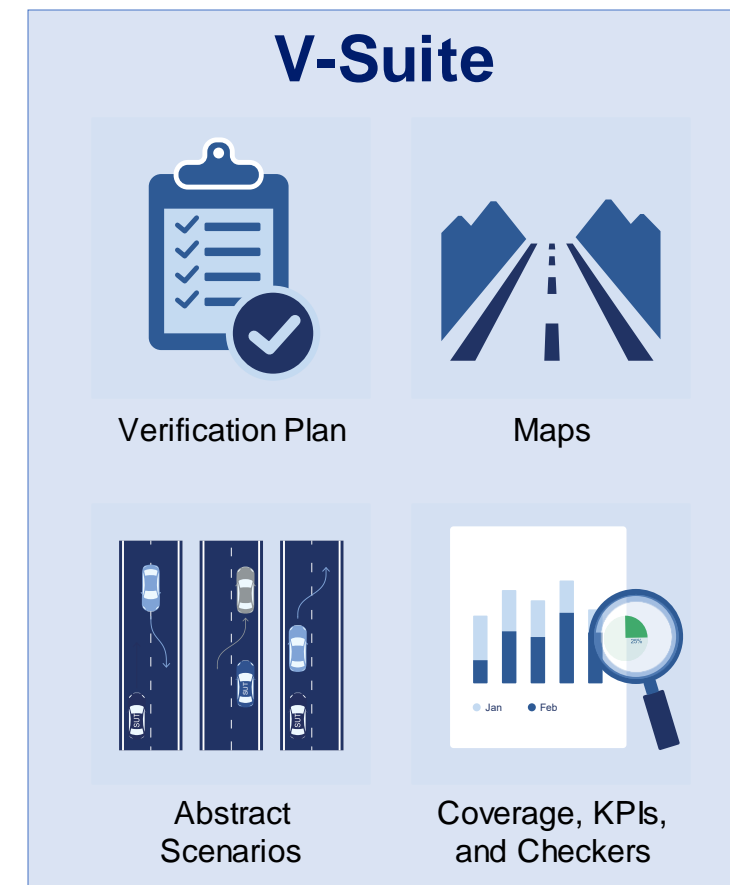
V-suites are pre-built OpenSCENARIO 2.0 verification & validation environments targeted at common ADAS/AV functions and ODDs

Enables a rapid start on adopting coverage driven verification for scaling V&V

Includes many abstract scenarios for generating hundreds of thousands to millions of concrete scenarios

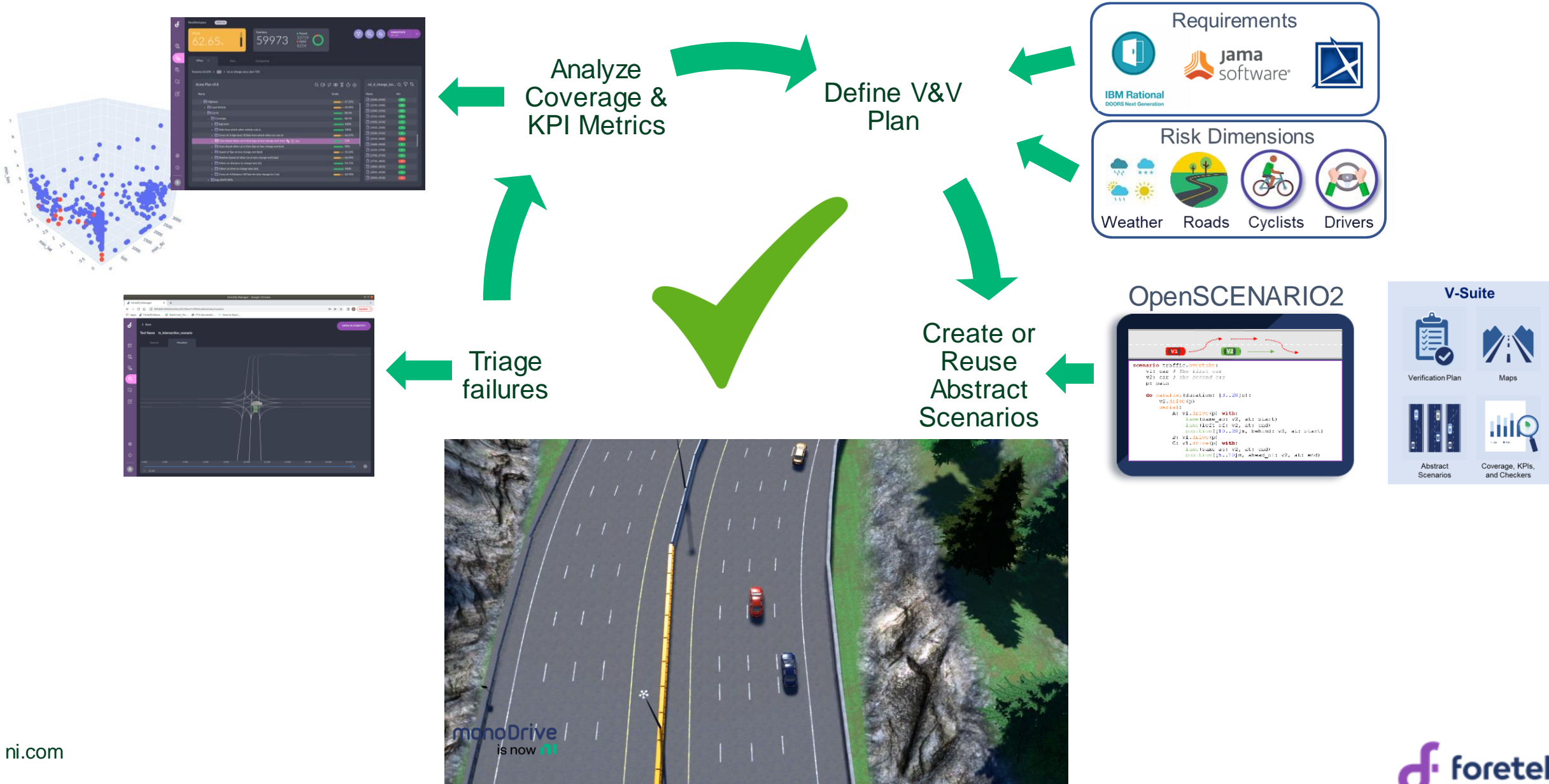
Easily extendable by users for project specific verification & validation requirements

Continuously improved from usage by leading ADAS/AV customers, Foretellix Domain expertise, and regulatory demands





Foretellix Coverage Driven Verification Flow



NI-Foretellix Best-in-Class SiL-based Scale V&V Solution



Foretify native OPENScenario 2.0 V&V platform increases productivity with hyperscale test automation using ODD and map agnostic abstract scenarios

Powerful constrained-random solver improves quality by finding unknowns and edge cases with coverage metrics for objective measure of 'done'

V-Suites reduce time and effort with out-of-the-box OpenSCENARIO 2.0 V&V environments for ADAS and AV systems

High fidelity sensor models with real-time performance to maximize realism without sacrificing speed

Test optimized workflow to start testing faster and seamlessly move from SiL to HiL

Enables best-in-class, scalable solutions with third party toolchain integration



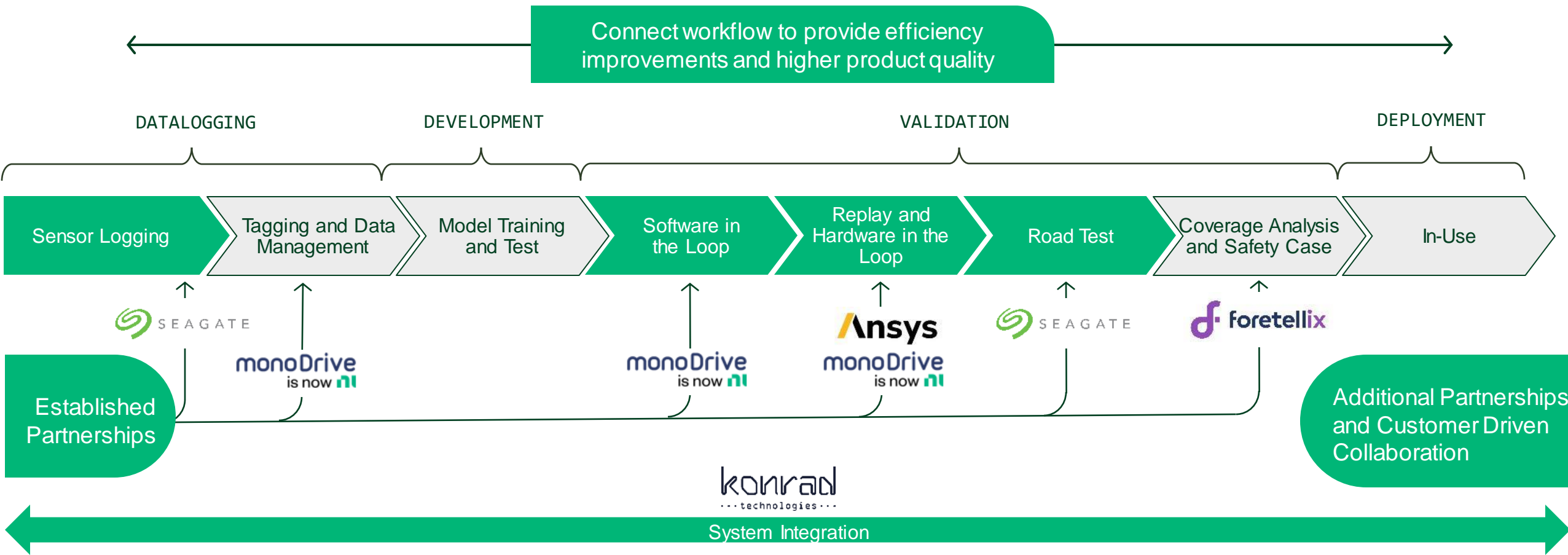
monoDrive
is now 

Serving the ADAS/AD Software Workflow

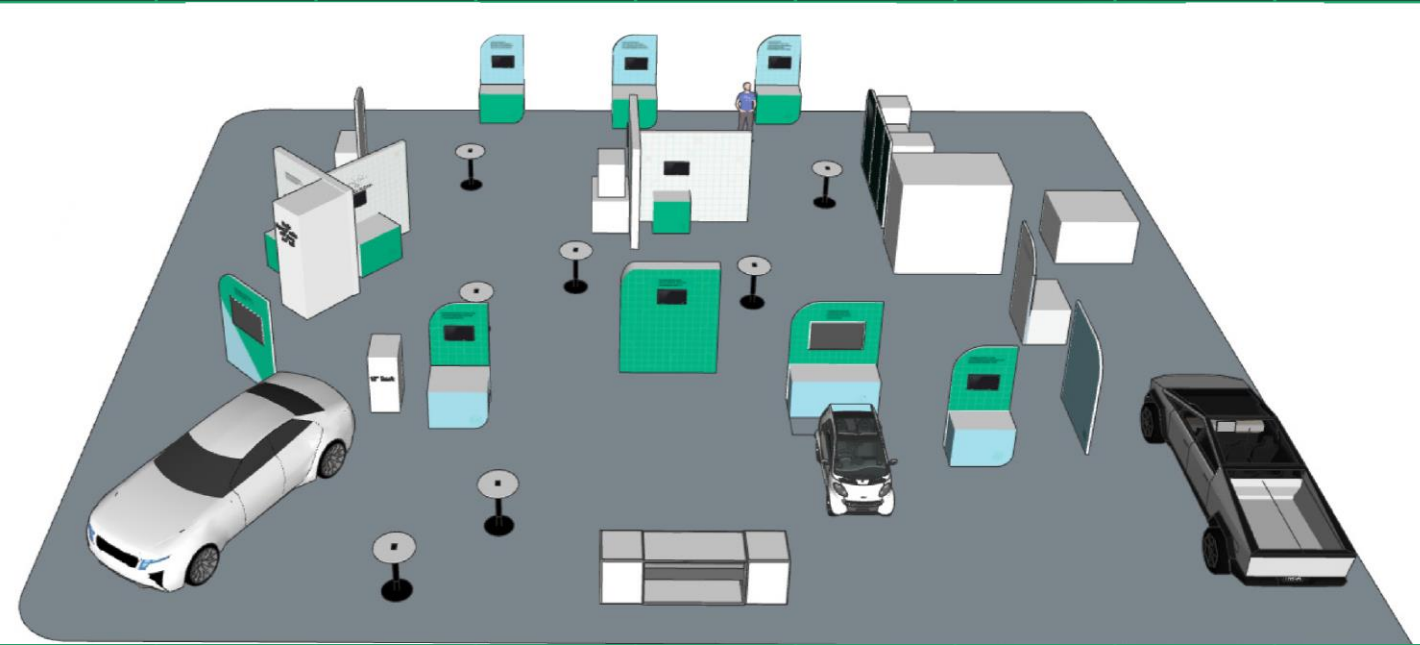
A cohesive toolchain that combines the best-in-class components needed to test ADAS/AD software.

Shows both the “art of the possible” and serves a starting point that already works for customers along with projected market-leading solutions.

Modular and can be changed out to match a customers existing tools/workflows (with work)



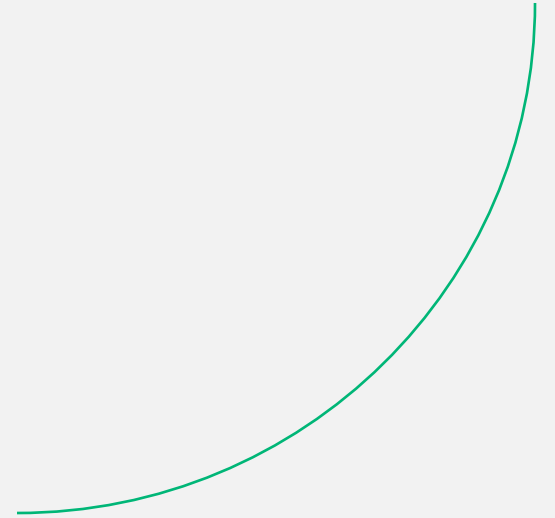
EXPERIENCE LOUNGE



**ADAS REPLAY AND HIL DEMO
SCENARIO-BASED TEST DEMO**



Questions



י"ח **CONNECT**

