AVL List GmbH (Headquarters)

AVL and ECSEL - Introduction on AVL and Automated Driving

Visit of ECSEL Meeting Istanbul

Februar 18th, 2020

Juergen Holzinger

About Us

AVL is the world's largest independent company for development, simulation and testing technology of powertrains (hybrid, combustion engines, transmission, electric drive, batteries and software) for passenger cars, trucks and large engines.

The headquarter of AVL is in Graz, Austria.

EXPERIENCE
>70 years !

5 powertrain elements

RESEARCH 10%
of turnover in-house R&D

INNOVATION 1,500
granted patents

STAFF

11,000 employees

65% engineers and scientists

GLOBAL FOOTPRINT

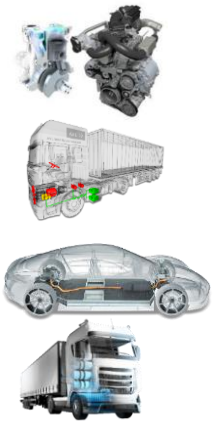
30 engineering locations
- **>220** testbeds
- Global customer support network

Customer Challenges and AVL Business Areas

MASTERING SPEED & COMPLEXITY

AFFORDABLE AND LEGISLATION COMPLIANT VEHICLES

- Combustion Engine Vehicle
- Hybrid Electric Vehicle
- Battery Electric Vehicle
- Fuel Cell Electric Vehicle



MOBILITY TRENDS

- Autonomous Driving (ADAS,AD)

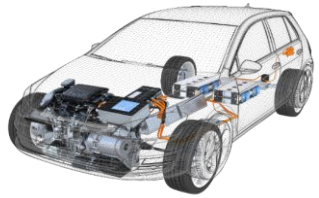
- Shared and Connected Mobility

- Green and Sustainable Technologies

Testing and Instrumentation

Advanced Simulation Technologies

Engineering Technology Provider



A STRATEGIC GLOBAL PARTNER

AVL STRATEGY

CEO MESSAGE

MISSION & VISION

PROPULSION & INTEGRATION IN VEHICLE

AUTOMATED DRIVING & MOBILITY

INTEGRATED & OPEN DEVELOPMENT PLATFORM

PRODUCTION ORIENTATION

GLOBAL EXECUTION & SUPPORT

CUSTOMER ORIENTATION & EFFICIENCY

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HiPERFORM

3CAR

ENABLE-S3

AUTO DRIVE

Robust SENSE

EMC²

NEW CONTROL

CESAR

ARROWHEAD

CRYSTAL

SCOTT

Productive4.0

SafeCer

iDev40

SmI40

MADEin4

ECSEL Project Clusters are significant for AVL's success

2009-2016

Syst. Eng., Interoperability & Dependability

CESAR CRYSTAL

€50/82M budget
55/68 partners
9/10 countries

2013 -2021

Industry 4.0

Participation in 6 ECSEL projects

2015 – 20xx

Automated Driving

ENABLE-S3

€68M budget
70 partners
14 countries

2015 -2021

Electrification

HIPERFORM

€41M budget
31 partners
8 countries

High Efficient and Performant EV

Highly Automated & Connected Safe Vehicles

Development for Efficient Production

Cost-Efficient Methods and Processes for Safety & Security Relevant Embedded Systems

Automated, Connected, Electrical Vehicles

- High Efficiency
- Zero Emission
- Zero Fatalities

AVL project coordinator | Other ECSEL projects with AVL | Other H2020 projects with AVL

Industry Research Challenges

New technology fields

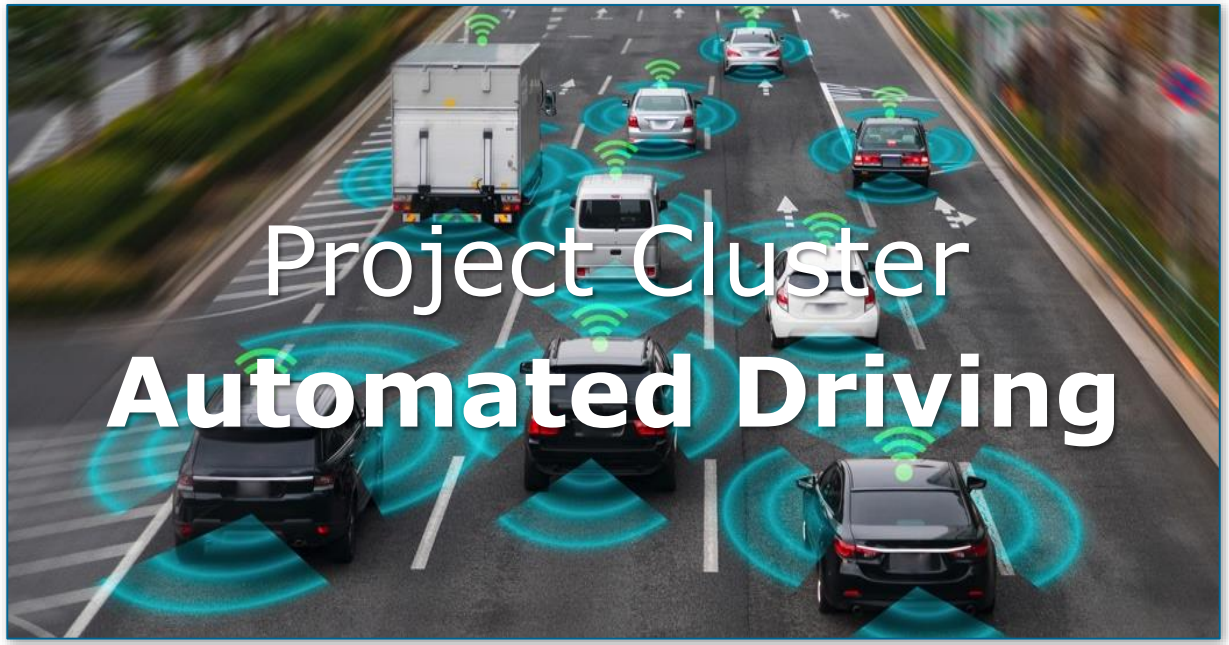
- New architectures & artificial intelligence (GPU, edge, cloud RT)
- Radar / Lidar sensors, cameras & image processing, aging, sensor simulation
- Human monitoring & transition scenarios

New validation methods

- New V&V types & perimeters (scenario & context-based, V2X, OTA, cloud)
- V&V of adaptive embedded systems, AI generated controls, cyber-security

New customer segment

- Link to shared & connected mobility
- Involve new players in collaborative research (faster, more agile projects)



ENABLE-S3
International Project Consortium

68 Partners

70 M€ budget

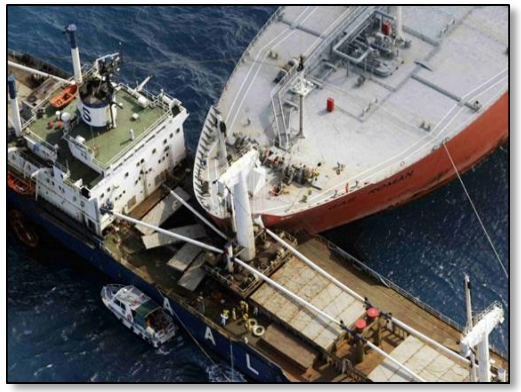
16 Countries

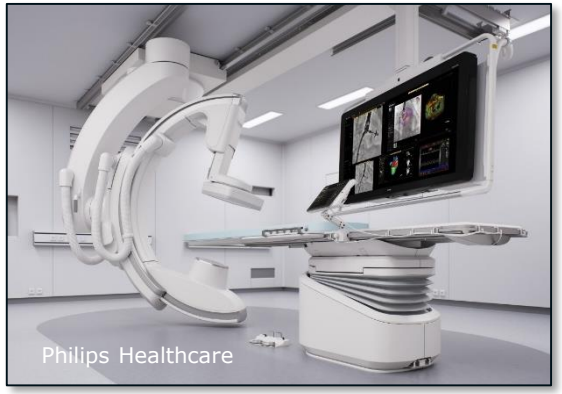
6 Domains

12 Use Cases

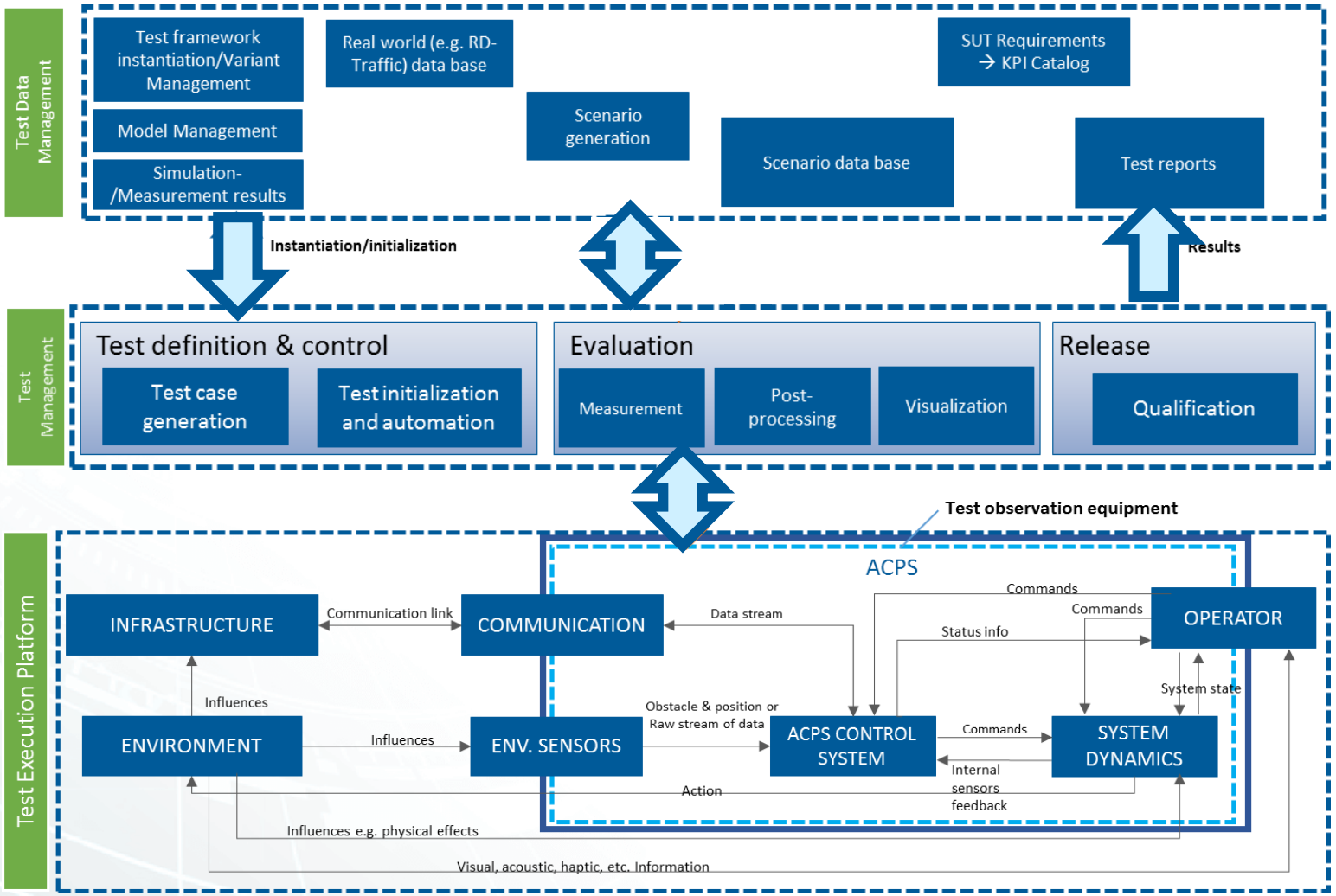
Industry & academia

How to avoid this?
…. and achieve that?

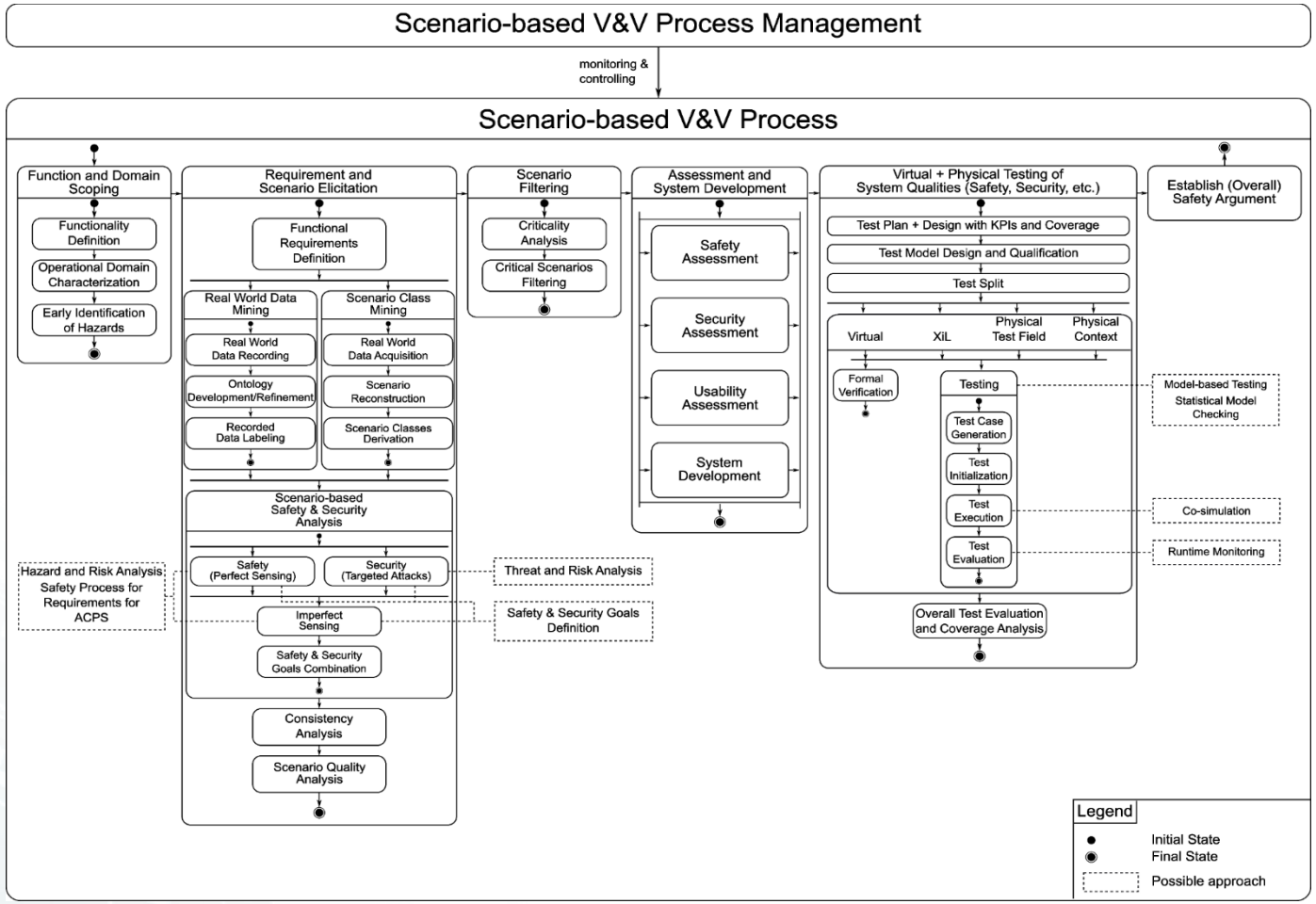




Generic Test Architecture



Methodology of ENABLE-S3



Methodology results of ENABLE-S3

AVL

Scenario-based V&V methodology

Methodology takes a holistic approach from the initial understanding of the operational context until the final safety and security argument.

Scenario-based V&V methodology is generic

Methodology subsumes best-practices collected in 6 different application domains.

Scenario-based V&V provides basis for the technical developments in the project

It also is the "glue" between other key outcomes


ENABLE-S3 AIT

Home About V8

The V&V-Patterns

Pattern Name	Purpose
Test Plan Specification	using a generic template based on ISO/
Scenario-based V&V Process	Whole process from operational scenar scenario design to verification
Requirement and Scenario Elicitation	Combined elicitation of requirements a
Abstract Scenario Mining	Mining of abstract scenarios covering t
Abstract Scenario DB Design	Creation of a set of abstract scenarios a
Scenario Representativeness Checking	Quantification how well a set of abstrac
Scenario-based Safety & Security Analysis	Refinement of functional requirements abstract scenario
Derive Safety Requirements for Autonomous Driving	Scenario- and fault-tree-based pattern
Formalized Verification and Analyis	Verify that the design of a system or pr is indeed dependable
KPI-Model based Validation	Apply Design-of-Experience based beha needed to validate a SuT
KPI-Catalogue Definition	Identification of (application specific) K
Closed-Loop Testing	Validate the SUT (System under Test) in
MiL (Model in the Loop)	Testing a model of the SUT in a simulat
SiL (Software in the Loop)	Testing the SUT software in a simulated closed-loop setting
HiL (Hardware in the Loop)	Testing the target SUT (hard- and softw assessing its correct operation in a clos
Co-Simulation Based V&V	Construction and execution of a co-sim
Semi-virtual Testing	Estimation of the risk that a given SuT v
Statistical Model-Checking based Validation	Application of statistical model checkin
Recorded Data Labeling	Generation of Ground Truth Data relat

Key Result: Scenario Detection

Systematic overview

of available (scenario) data sets

Shared language & approach

for scenarios in safety validation

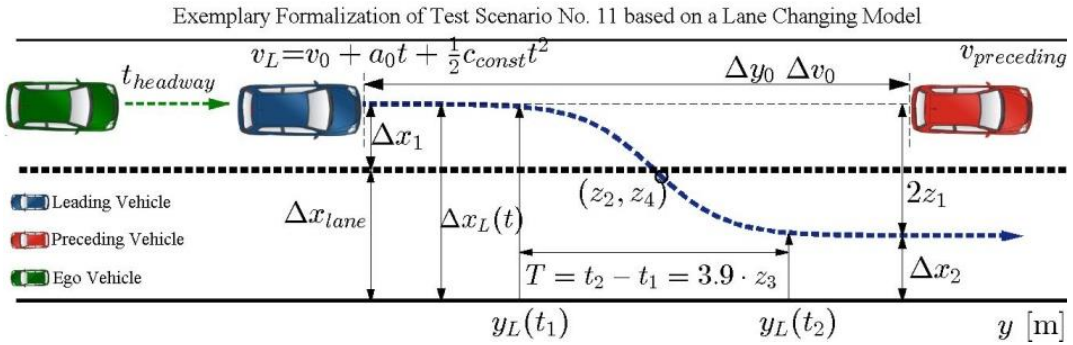
Scenario detection algorithms

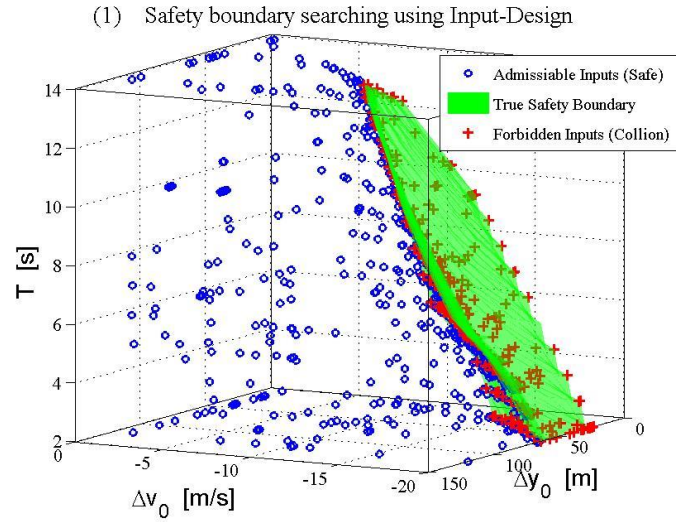
for activity or manoeuvre detection

Algorithms

for critical case identification, test case generation and OpenDRIVE®/ OpenSCENARIO® generation

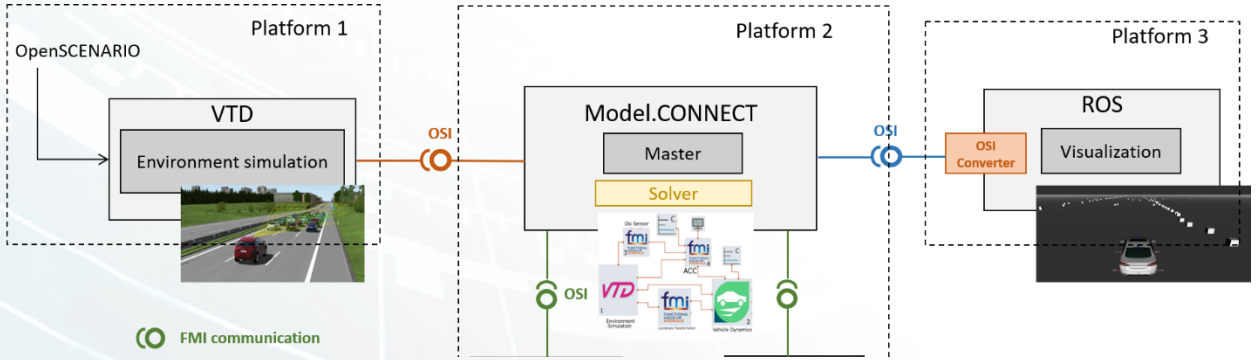
Tool integration

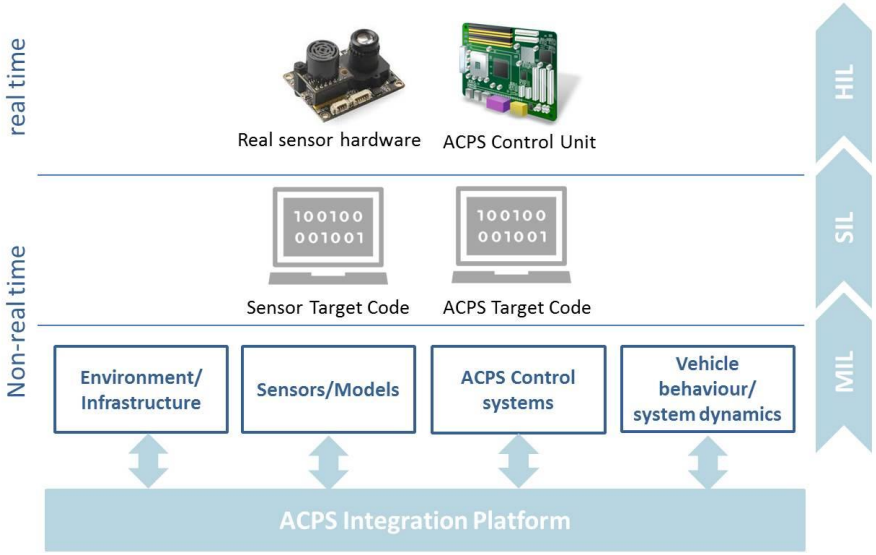


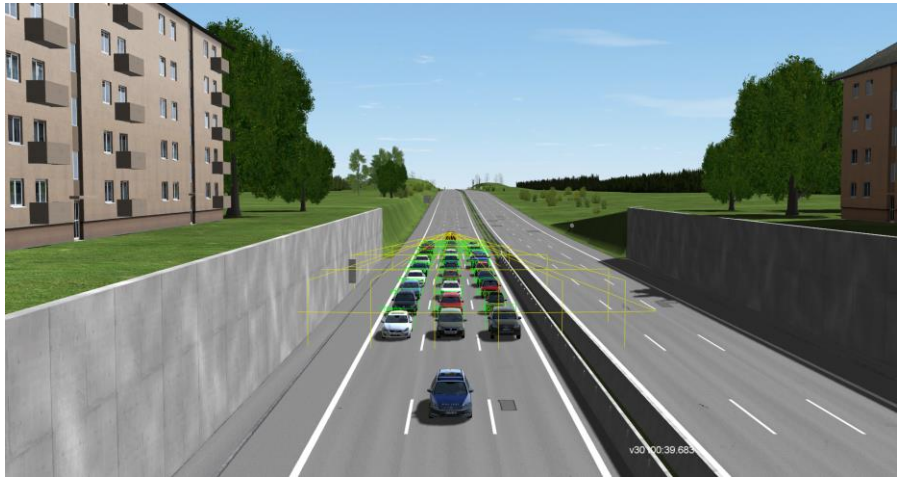


Key Results: Simulation Platform

- Integrated function simulation and environment simulation.
- Made **real-time co-simulation** happen.
- Verification via **distributed co-simulation**.
- Aligned methods between different domains.
- Helped establishing **standards for simulation-based testing** of highly automated systems.







Key Results: Sensors & Stimuli

Developed **generic interface definitions** for the different **sensor models**.

Developed **perception sensor simulation** for different types of sensor systems, e.g., radar and lidar.

Developed approaches for perception **sensor stimulation**, e.g., mixed reality lidar, radar stimulator, for different types of sensors.

Developed solutions for **communication channel simulation**, e.g., wireless communication simulation, V2X channel emulator.


Thank You
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