

KICK-OFF WORKSHOP

STUDY PROJECT ASAM OPENTEST



Testing in AD Development from Requirements to Results on Different Platforms

Overview of Testing Fields and Tools

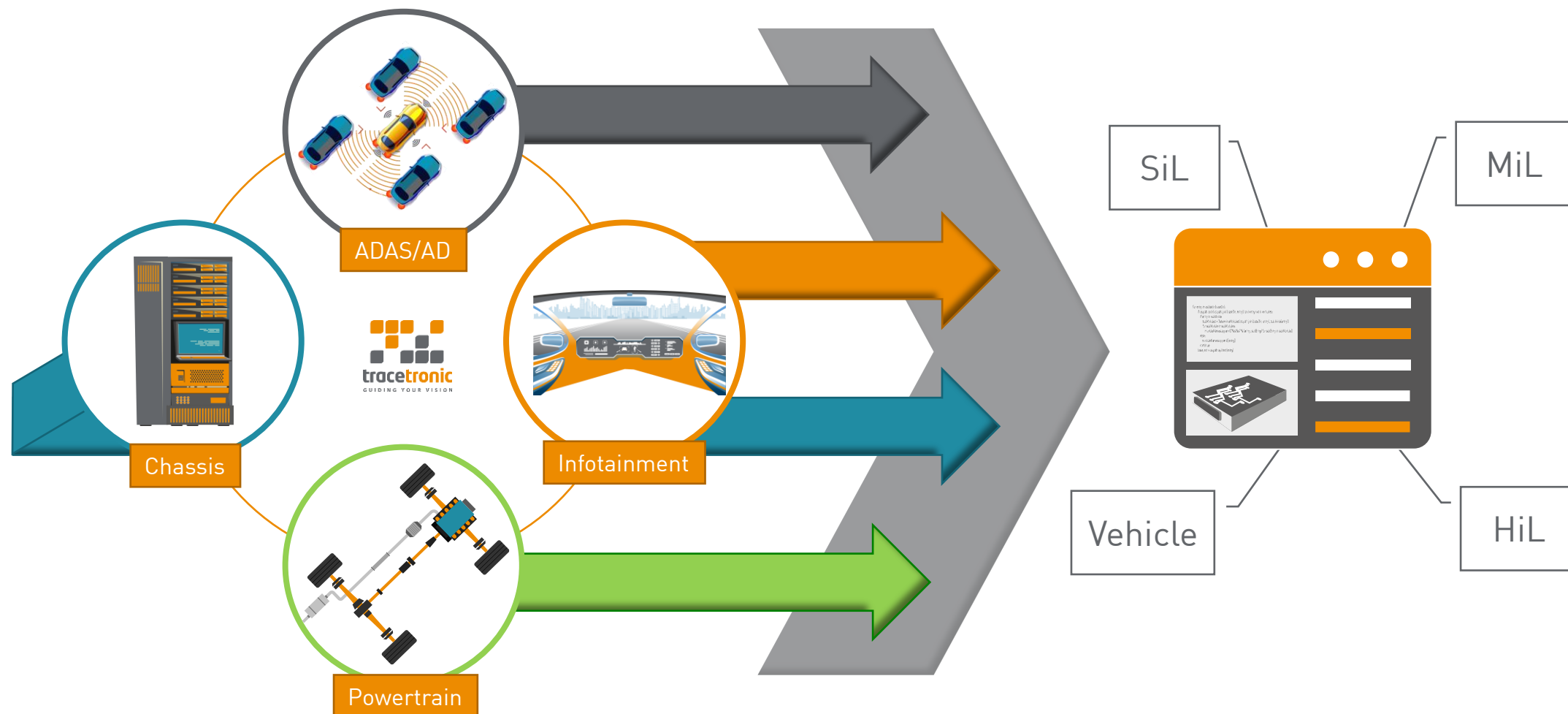
Relationship between Requirements, Test Cases and Platforms

Test Management System



Overview of Testing Fields and Tools

Overview of Testing Fields



Overview of Tools

(Co-)Simulation, vECU

- FMI
- MATLAB/Simulink
- Simulink RT
- FEP
- ADTF
- dSPACE VEOS
- Synopsys SILVER
- Synopsys Virtualizer
- ...

Environment Simulation

- CarMaker
- CarSim
- VTD
- ModelDesk
- MotionDesk
- PreScan
- SCANeR
- CARLA
- ...

Diagnostics

- DTS
- EDIABAS
- DiagRA
- ODIS
- ...

HiL realtime

- ControlDesk
- LABCAR
- VeriStand
- NovaSim
- PUMA
- OPAL-RT
- Morphee
- ...

Misc

- VISA
- ETHERNET
- Multimedia
- Appium
- LabView
- ...

Debugger

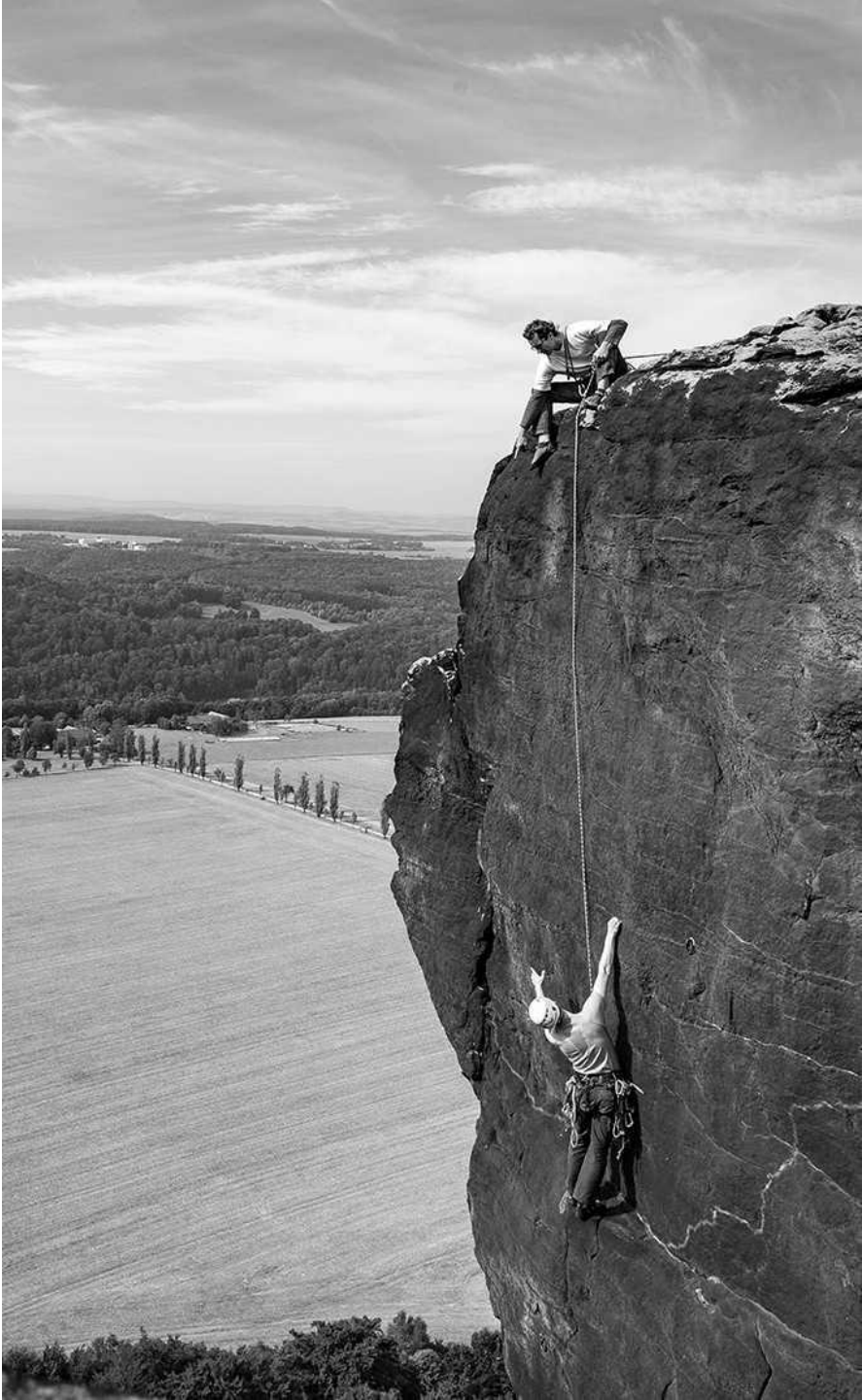
- TRACE32
- UDE
- GDB Debugger
- ...

Bus and Logger

- CANoe/CANalyzer
- BUS-HW: Vector, PEAK, IXXAT, ETAS, ...
- bluePiraT
- VIGEM Data Logger
- ...

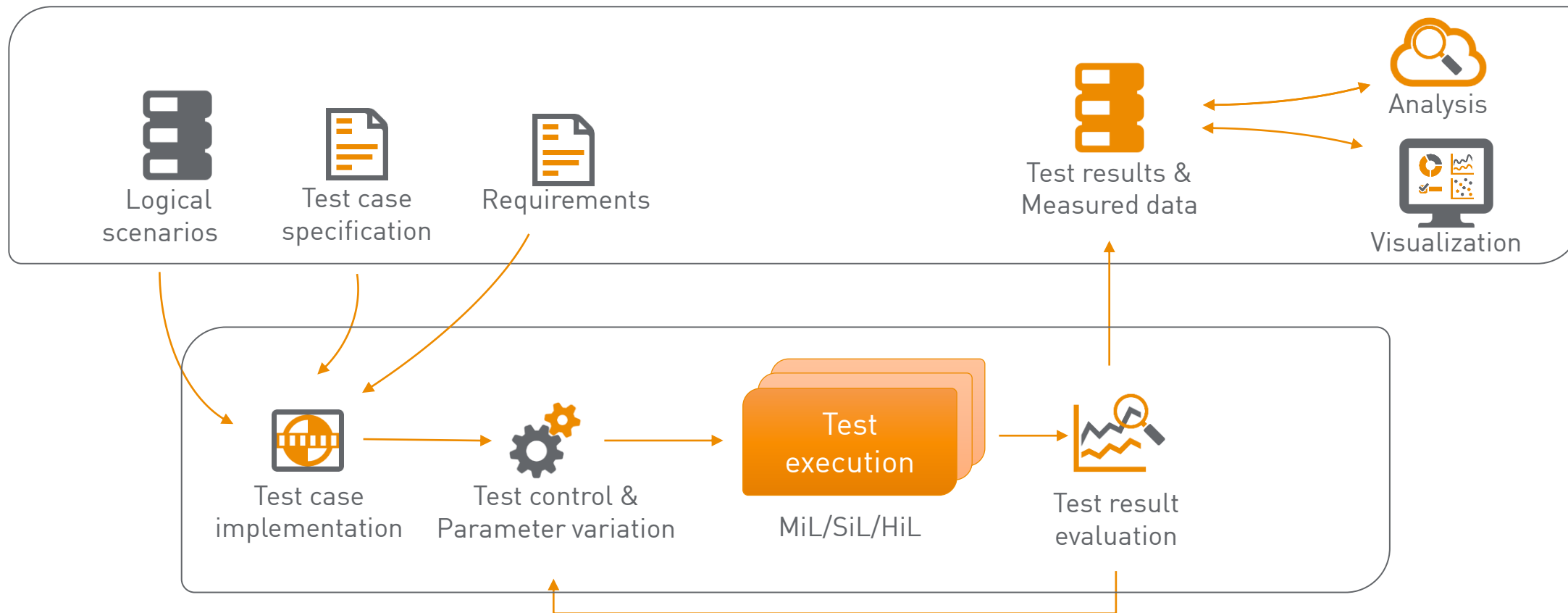
Meas/Calib

- INCA
- ATI Vision
- CANape
- ...



Relationship between Requirements, Test Cases and Platforms

Requirements and Test Cases - Overview



Requirements and Test Cases - Definition

A brief insight into the theory - Definition of terms according to ISTQB

A Requirement is

- condition or capability to solve a problem
- must be fulfilled by a software/hardware
- satisfy a contract, standard or specification

A Test Case contains

- set of input values
- execution preconditions
- expected results
- execution postconditions

A Test Case is developed to verify a

- particular objective
- particular program path
- specific requirement

Requirements and Test Cases - MiL



Requirement:

The Emergency Brake Assist function is active as soon as the vehicle is ready to drive

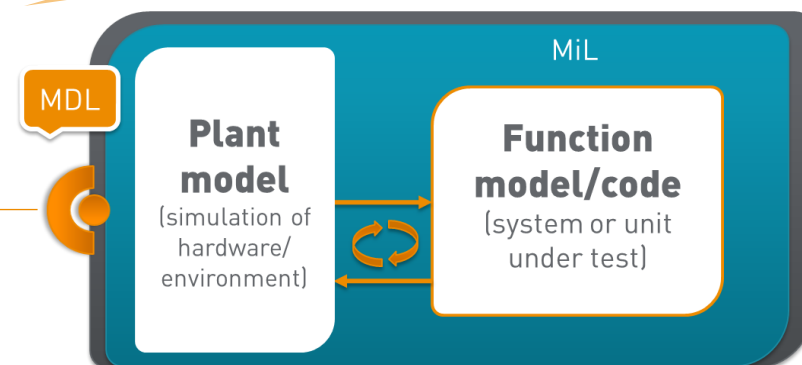
MiL Test Case:

Precondition: Initialize Model
Connect Model to Function code

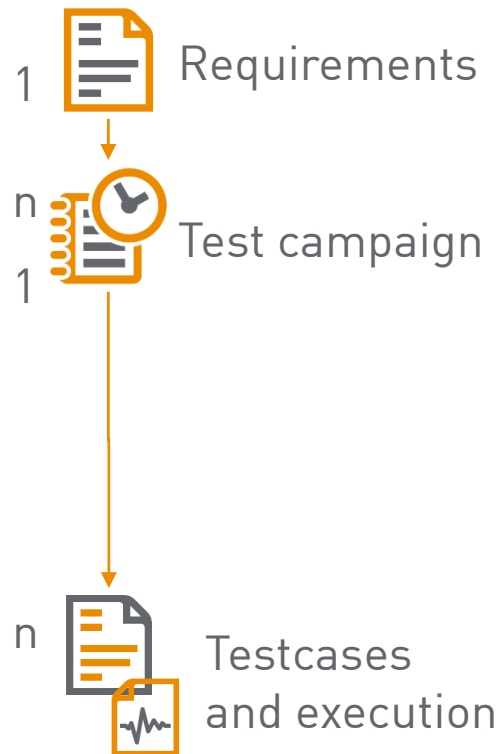
Action: Start Engine
Set: v = 0, Check AEB = activated
Set: v = 10, Check AEB = activated
Stop Engine
Check AEB = deactivated

Postcondition: Check if the system is in a correct state

- Trivial test cases without scenarios
- Same test case even though different MiL tools
- Different test focus: component, subsystem ...



Requirements and Test Cases - SiL



Requirement:

The failure of a sensor is detected by the ADAS/AD function.
There is no collision and the TTC is not critical

Variation of scenario
parameters

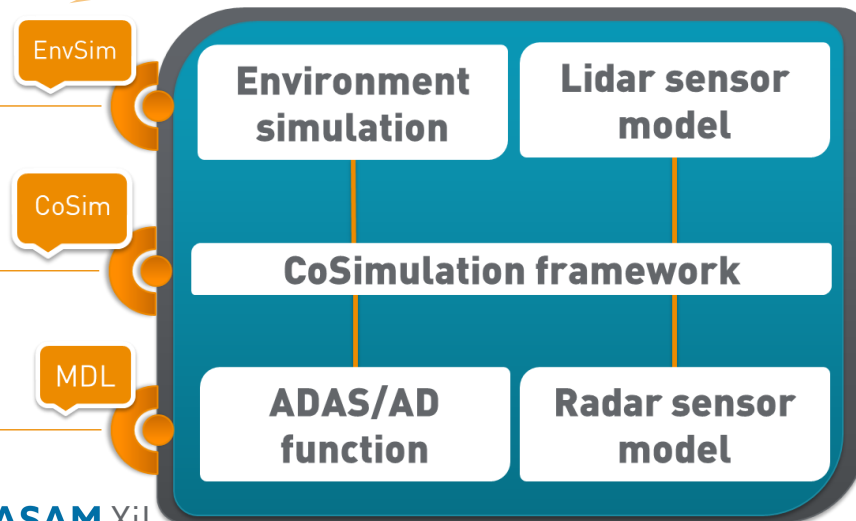
SiL Test Case:

Precondition: Initialize System
Configure System

Action: Load, parameterize scenario, start
Set: ad_paramter = 20
Set sensor fault
Check sensor fault → True
Reset sensor fault
Check sensor fault → False
Check Collision
Calculate and Check TimeToCollision

Postcondition:

- Variation of scenario but also of other test quantities
- Several tool connections
- A test case not only describes the positive case
- Different test focus: component, subsystem, system

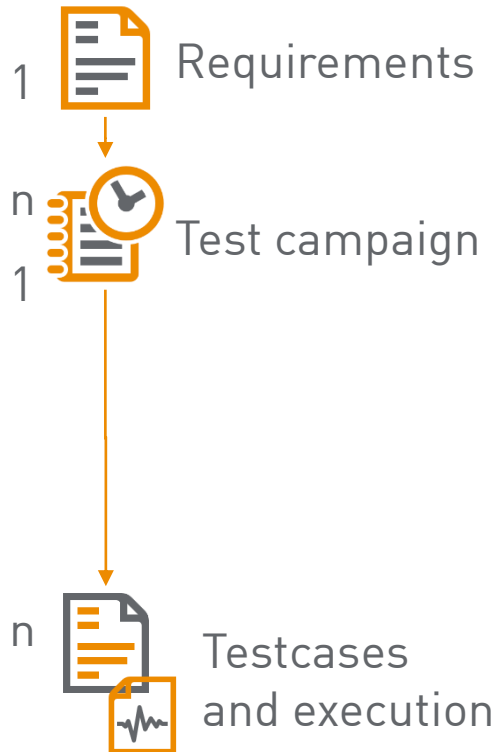


 ASAM OpenScenario

 ASAM OpenDrive

 ASAM XiL

Requirements and Test Cases - HiL



Requirement:

The highway pilot system does not hand over control to the driver in regular scenarios

Variation of various scenarios

HiL Test Case:

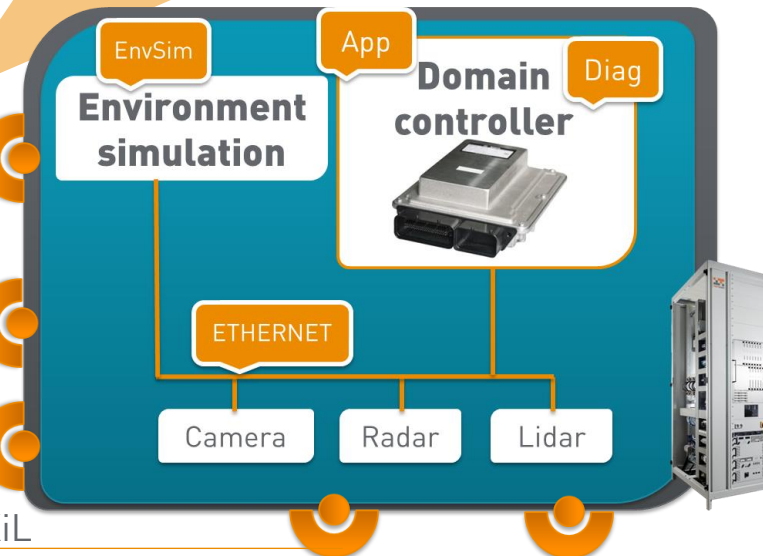
Precondition: Start engine

Action:

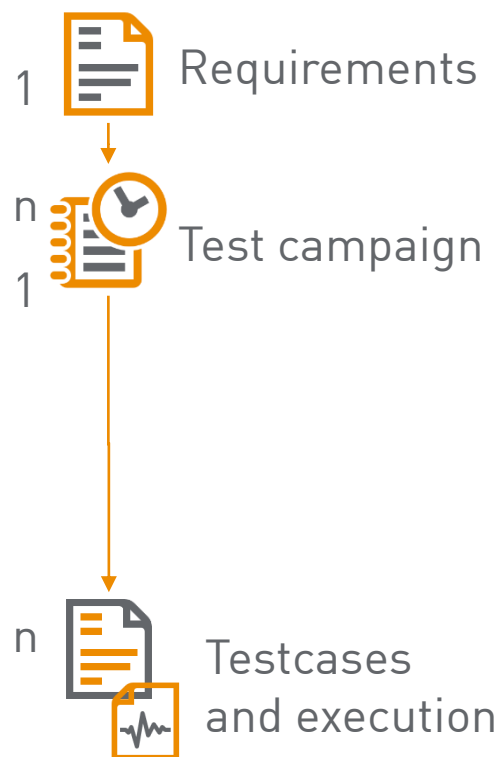
Load, parameterize scenario start
Check error memory ist empty
Check AD function is in state RUN
Check ETHERNET signals
Check, that there are no memory errors during the simulation
Check, that the function was always in Running mode during the simulation

Postcondition: Stop engine

- Testing of time critical reactions of the system
- A test case that applies to a wide variety of scenarios
- Metrics are not always necessary



Requirements and Test Cases - Vehicle



Requirement:

The highway pilot system does not hand over control to the driver in regular scenarios

Vehicle Test Case:

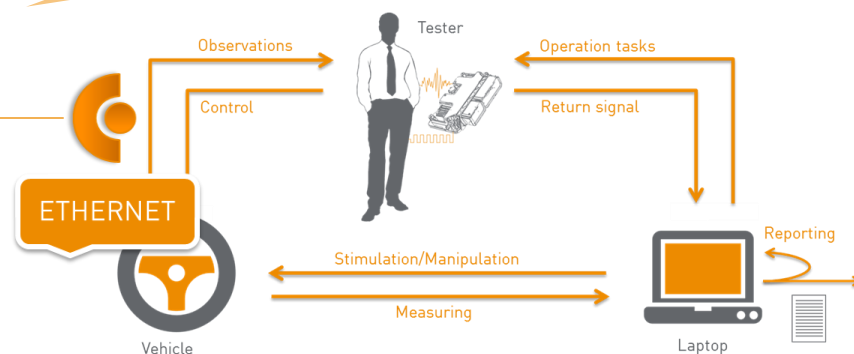
Precondition: Preparation to perform the abstract scenario

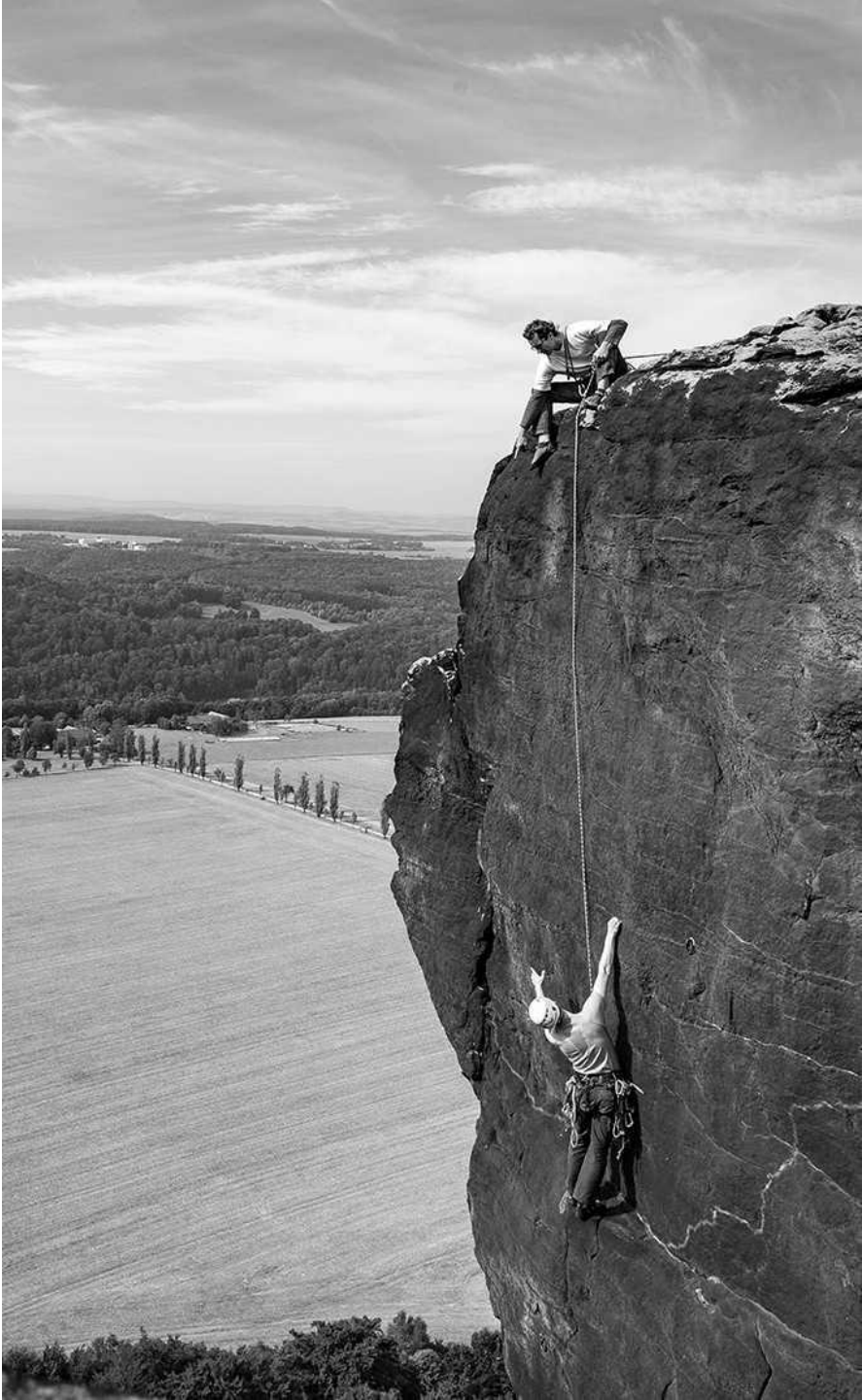
Action:

- Drive onto a highway
- LaneChanger: Accelerate to 80 km/h
- Switch on the highway pilot
- Check, that there are no memory errors during the simulation
- Check, that the function was always in Running mode during the simulation

Postcondition: Stop engine

- In vehicle testing, bus connections can support the tester
- Guided test cases in vehicle testing
- Scenarios on real routes not necessary, only on test tracks
- Test focus: complete system



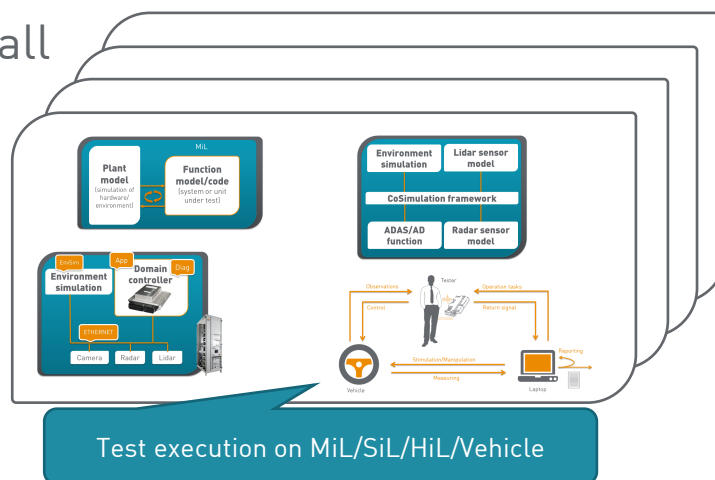


Test Management System

Test Management System – Manage Results

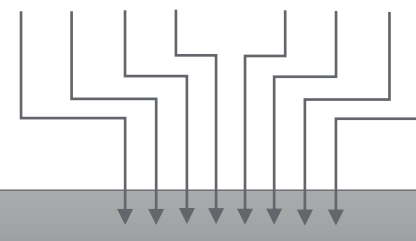
Scope of testing across all

- Requirements
- Test campaign
- Scenarios
- Test cases
- Sw version of DUT
- Platforms



Test results:

- Reports
- Logs
- Recordings
- Movies
- Metadata



ASAM ATX (Automotive Test Exchange)

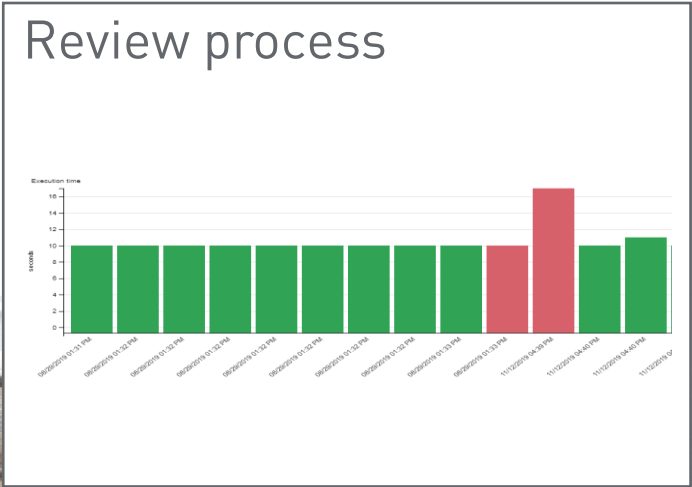
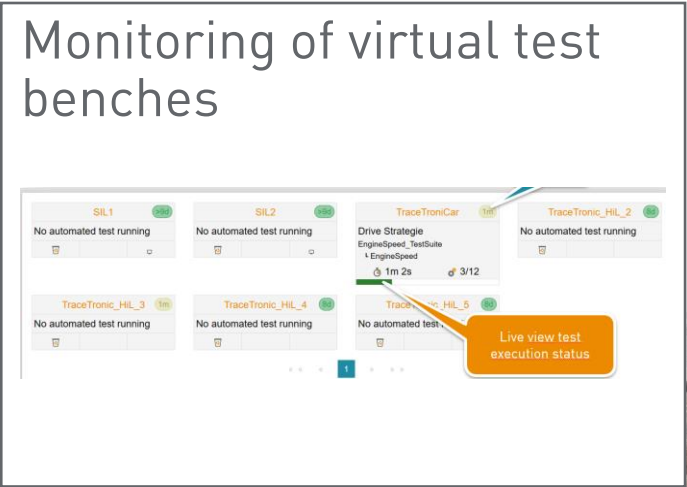
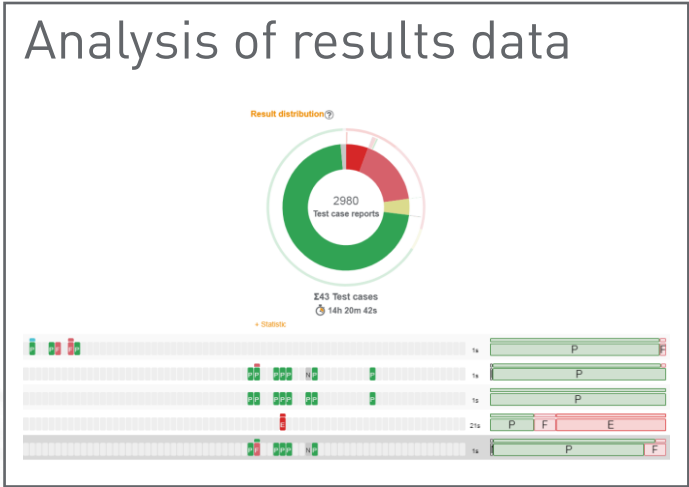


Project team /
Testmanagers

Store and analyze test
results centrally





Test Management System - Features



Coverage functionalities

| Test Case | Passes | Failures | Errors | Status |
|-----------------|-----------|----------|--------|--------------|
| Brake Warning | 33% (3/9) | | | |
| HIL-Tests | 0% (0/3) | | | |
| MIL-Tests | 33% (1/3) | | | |
| SIL-Tests | 67% (2/3) | | | |
| BrakeWarning_01 | 1 | 65 | 3 | FAILED |
| BrakeWarning_02 | 0 | 0 | 0 | No test runs |
| BrakeWarning_03 | 1 | 9 | 2 | PASSED |

Reporting

1 Test Summary Report

1.1 Test Summary Report Identifier

Identifier: REPORT_IDENTIFIER

1.2 General Information

Report author: MichaelG (MichaelG)

Project: Demo

Creation date: 29.11.2019 10:34

Overall verdict: **FAILED**

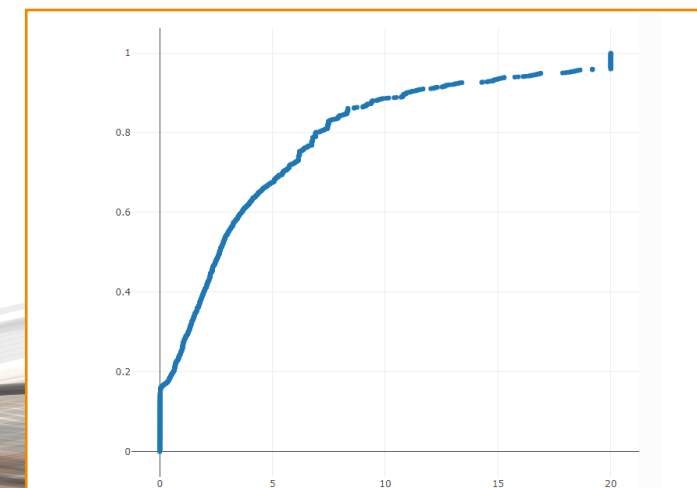
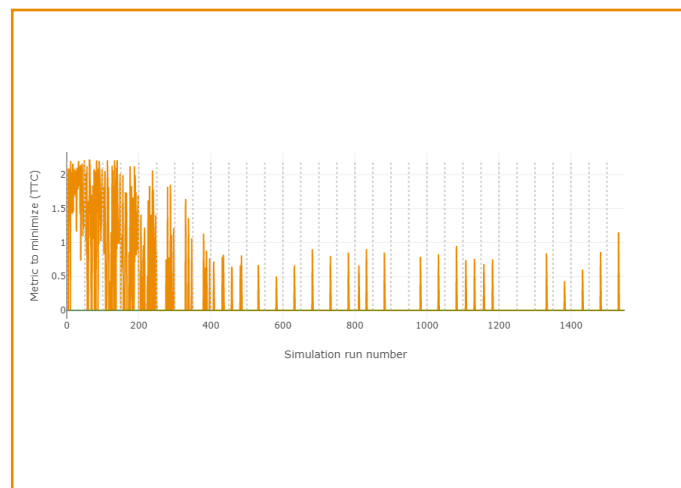
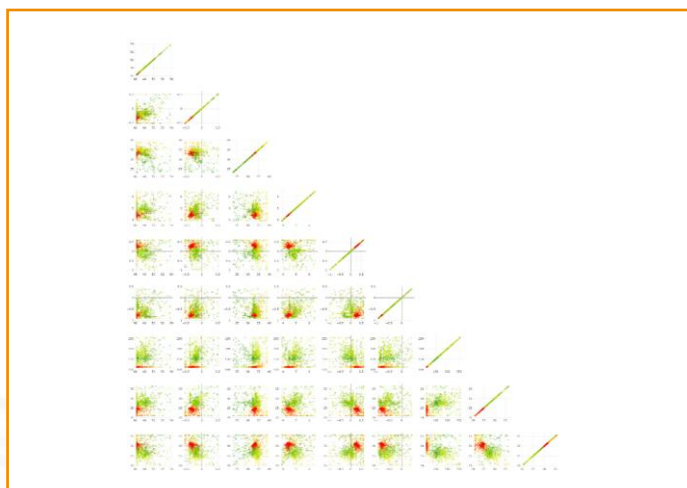
This report was generated with TEST-GUIDE based upon a [report filter](#).

Planning tests

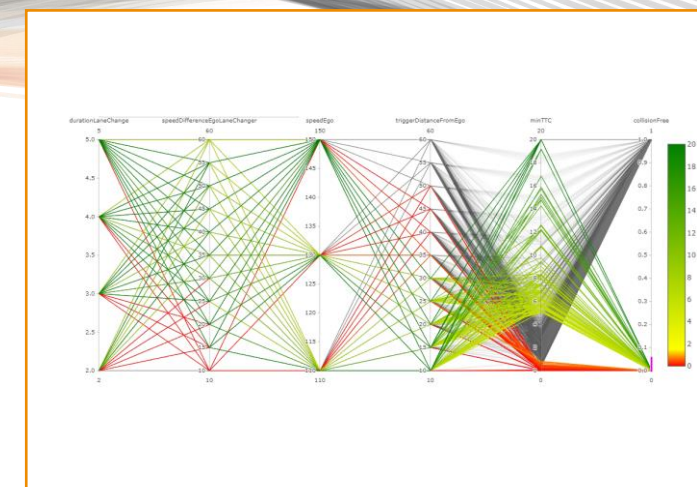
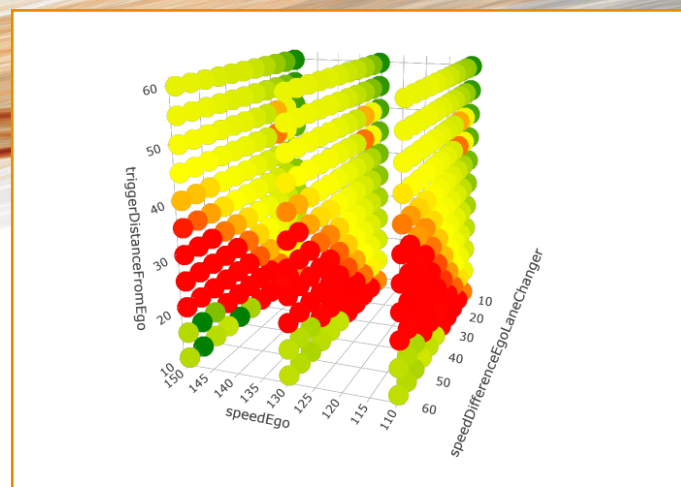
| Label | Date |
|-------------------|-------------------------|
| Main-Release | Nov 30, 2019 5:00:00 PM |
| Basic-Tests | Nov 30, 2019 5:00:00 PM |
| Advanced-Tests | Nov 30, 2019 5:00:00 PM |
| MyFirstSubRelease | Apr 30, 2019 6:00:00 PM |

| Verdict distribution | | | | Progress | Test executions | Test cases |
|----------------------|---|---|---|----------|-----------------|------------|
| N | P | F | E | | 9 | 0 |
| N | P | F | E | | 0 | 0 |
| | | | | | 0 | 0 |

Test Management System - Visualization for result



| Index | Pearson coefficient | Pearson coefficient (abs) |
|--|---------------------|---------------------------|
| speedDifferenceEgoLaneChanger - triggerDistanceFromEgo | -0.554 | 0.554 |
| speedDifferenceEgoLaneChanger**2 - triggerDistanceFromEgo**2 | -0.544 | 0.544 |
| speedDifferenceEgoLaneChanger - triggerDistanceFromEgo**2 | -0.489 | 0.489 |
| triggerDistanceFromEgo + 1/speedDifferenceEgoLaneChanger | 0.488 | 0.488 |
| triggerDistanceFromEgo + 1/triggerDistanceFromEgo | 0.488 | 0.488 |
| triggerDistanceFromEgo + 1/durationLaneChange | 0.488 | 0.488 |
| triggerDistanceFromEgo - 1/speedEgo | 0.488 | 0.488 |
| triggerDistanceFromEgo | 0.488 | 0.488 |
| triggerDistanceFromEgo + 1/speedEgo | 0.488 | 0.488 |
| triggerDistanceFromEgo - 1/durationLaneChange | 0.488 | 0.488 |
| triggerDistanceFromEgo - 1/triggerDistanceFromEgo | 0.488 | 0.488 |
| triggerDistanceFromEgo - 1/speedDifferenceEgoLaneChanger | 0.488 | 0.488 |
| durationLaneChange + triggerDistanceFromEgo | 0.487 | 0.487 |
| durationLaneChange - triggerDistanceFromEgo | -0.487 | 0.487 |





ASAM Standards – TraceTronic participation

TraceTronic is an active member of the following ASAM standards

- ASAM XIL - Generic Simulator Interface
- ASAM ATX - Automotive Text Exchange Format
- ASAM OpenX - Simulation



