NTT DATA
Trusted Global Innovator

AUTONOME AUTOS IN DER CLOUD TESTEN – SZENARIENBASIERT UND MIT OPENSOURCE

Gesellschaft für Informatik, Regionalgruppe München
Johannes Kreckel, Dr. Margarete Sackmann

Agenda

Agenda

Kurzvorstellung

Johannes Kreckel

Produkt Manager Simuloop, ADAS/AD Validation

- Kenner der Automobilbranche
- Berufliche Stationen sd&m (Cap Gemini), Proxicom, Nexolab, Softlab/Cirquent, NTT DATA

Dr. Margarete Sackmann

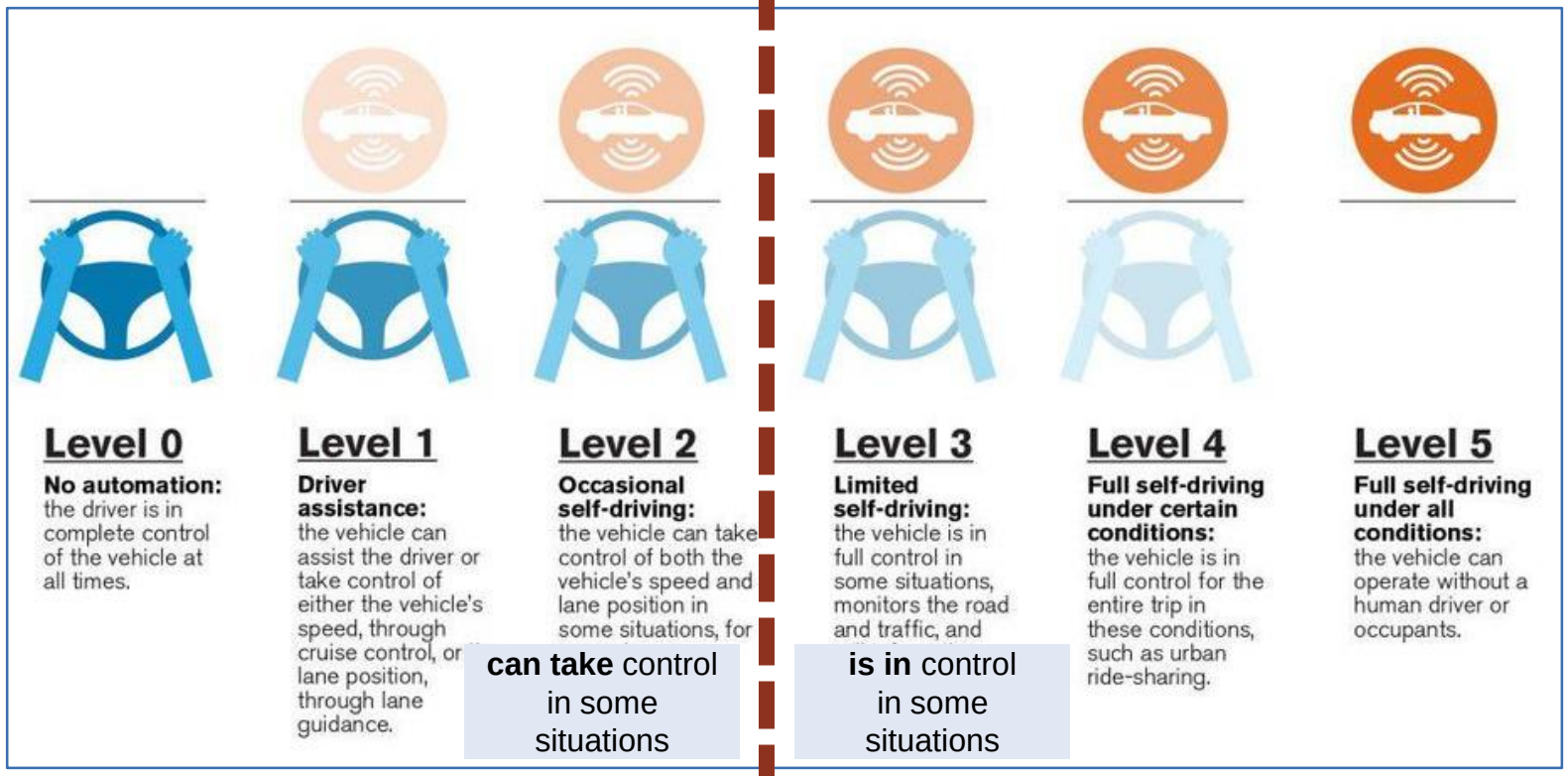
Senior Consultant Cloud Solutions & Simulation

- Forschungsaufenthalt in Kanada, zu hochverfügbaren Systemen in der Telekommunikation forschte
- Expertin NTT DATA, für Cloud-Projekte und Datenmanagement

Agenda

Where are we now? - Levels of autonomous driving.

Tipping point



Products for consumer available

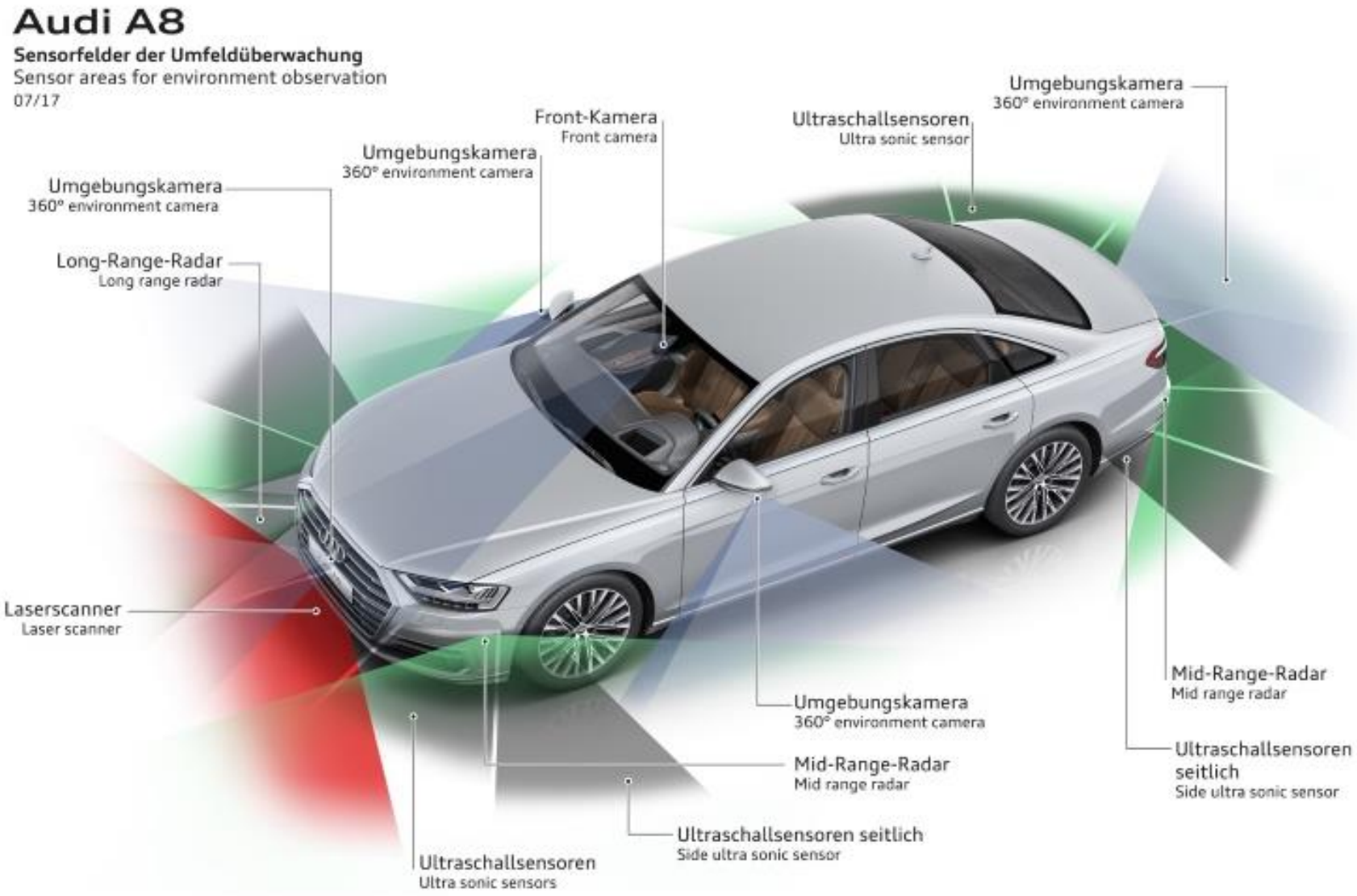
ADAS Advanced Driver Assistence Systems
Fahrerassistenzsysteme

Development, R&D, Regulatory Discussions

Start of vehicle in full control

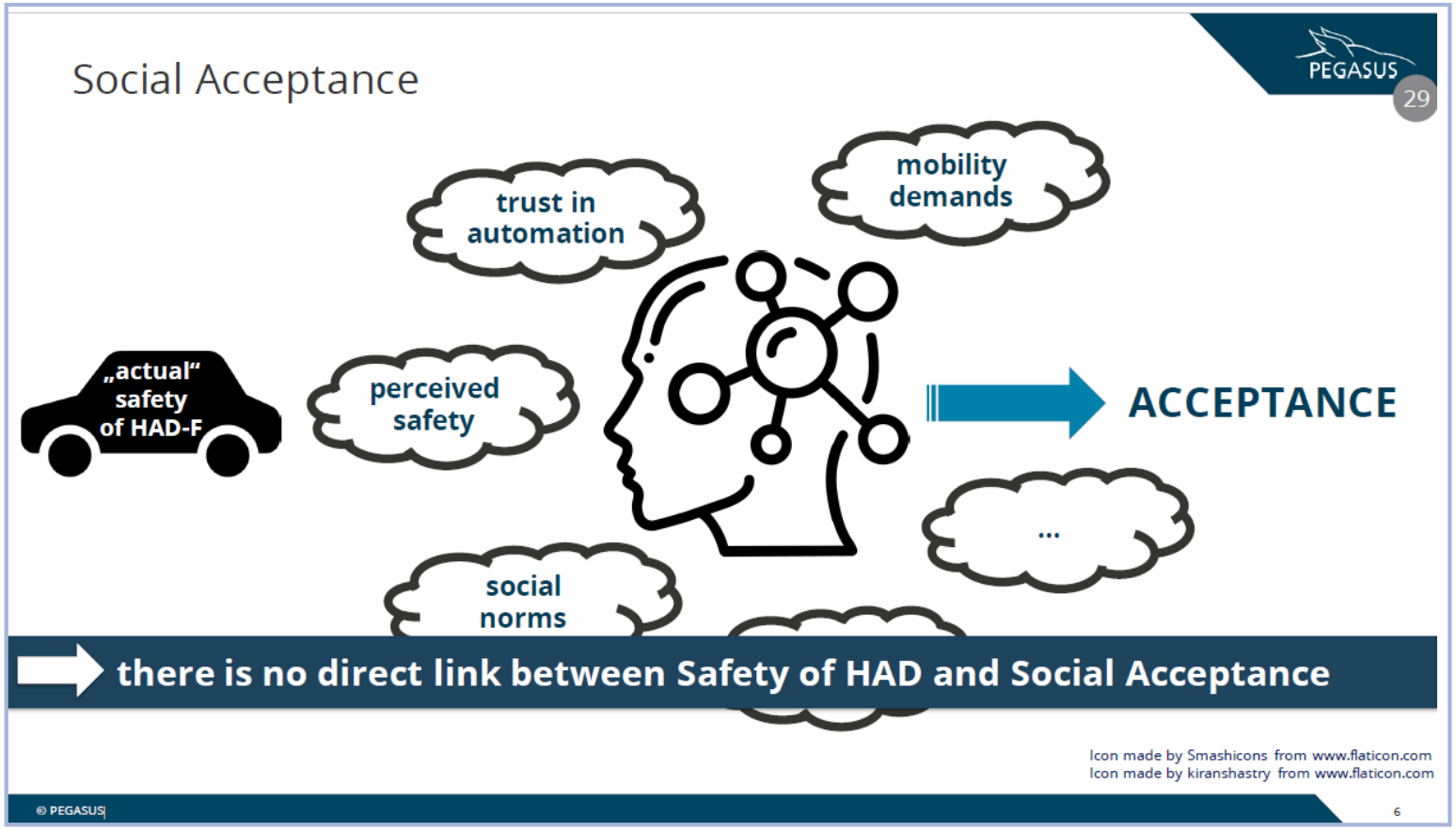
Source: NHTSA, SAE

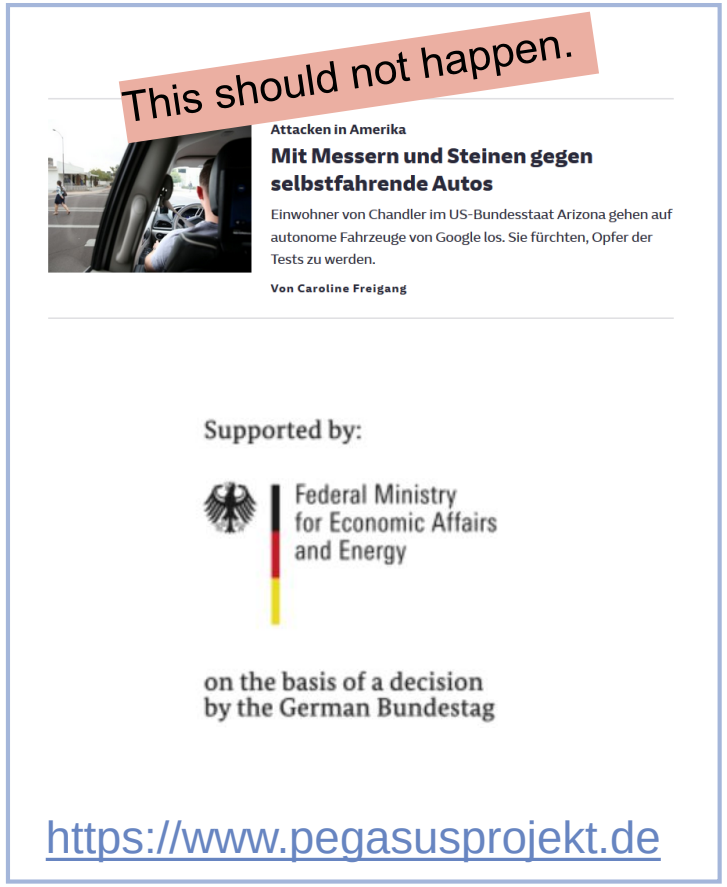
Autonomeous cars using a complex hardware.



https://www.autonomousvehicletech.com/articles/155-intel-solutions-to-be-used-in-2018-audi-a8-for-level-3-driving

PEGASUS project spent significant efforts for R&D on securing automated driving effectively.





https://www.pegasusprojekt.de

The kilometer-based approach for safeguarding does not work anymore.

Example: Highway Pilot

Required test kilometers (KM): $6{,}6 \sim 13{,}2 * 10^9$ km

- Source: Calculated by taking current accident statistics
- Challenge: Changing HW/SW requires doing testing again (regression testing)
- Paradoxes: The less accidents happens the more test kilometers are required

Learning AI systems

„We know about accidents but not about near miss accidents and critical situations" Prof. Winner

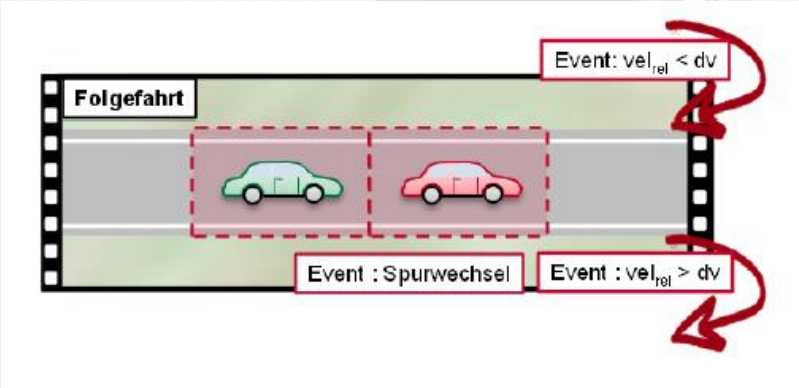
Earth– Sun:
$150 * 10^6$ km

There is the urgent need for new methods and tools for testing and securing autonomous vehicles.

- Winner, Handbuch Fahrerassistenzsysteme, Springer 2015
- https://www.golem.de/news/zulassung-autonomer-autos-die-laengste-fahrpruefung-des-universums-1611-124139-2.htm
- https://www.heise.de/newsticker/meldung/Selbstfahrende-Autos-Aufwand-fuer-Testfahrten-ist-gigantisch-3273866.html

Approaches for Safeguarding

Scenario Based



Virtual Simulation

NTT DATA

Layered composition of scenarios.

Concrete Scenario Definition
Ready for Cloud Execution

Layer 6
Digital Enrichment (e.g. V2X)

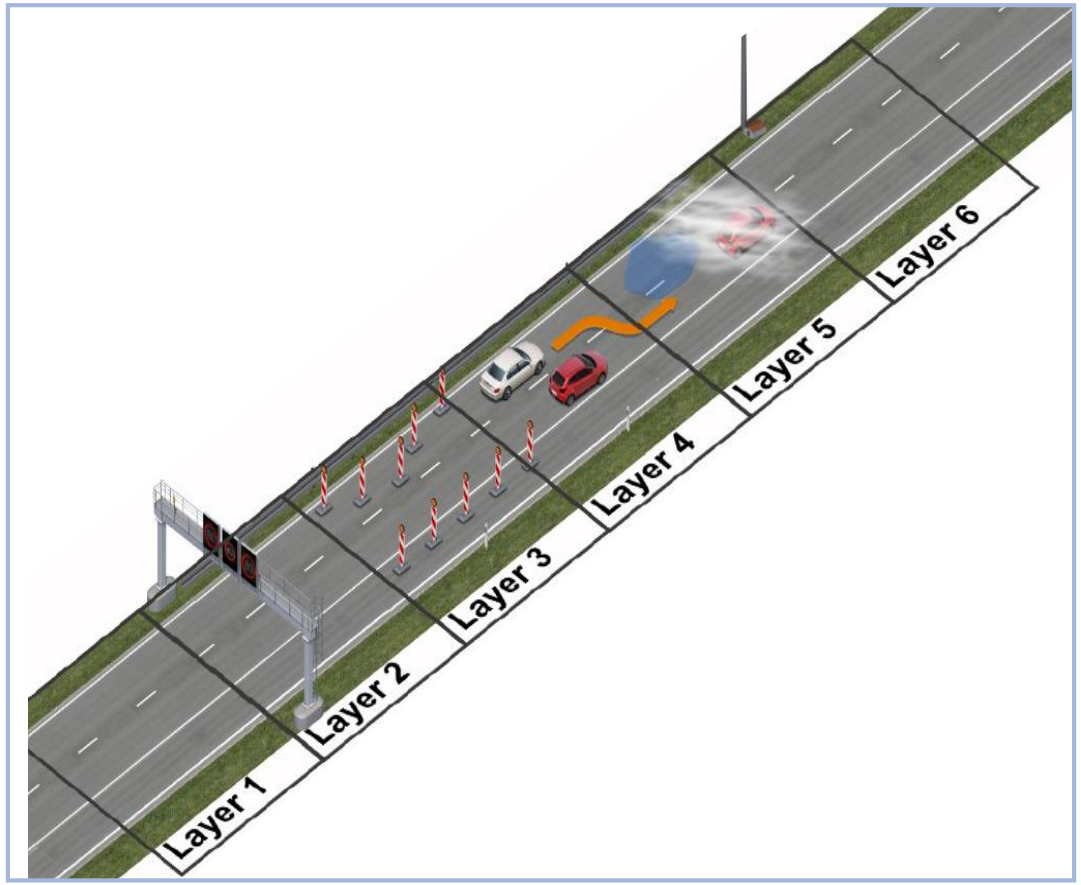
Layer 5
Environment (Weather and other conditions)

Layer 4
Objects (Static, Dynamic, Maneuver)

Layer 3
Temporary Manipulation

Layer 2
Traffic Infrastructure

Layer 1
Road-Level



Scenarios will also be organized by different levels of abstraction.

Functional Scenario → **Logical Scenario** → **Concrete Scenario**

Defined Scenarios

- Lane Change

Parameter Space Definition

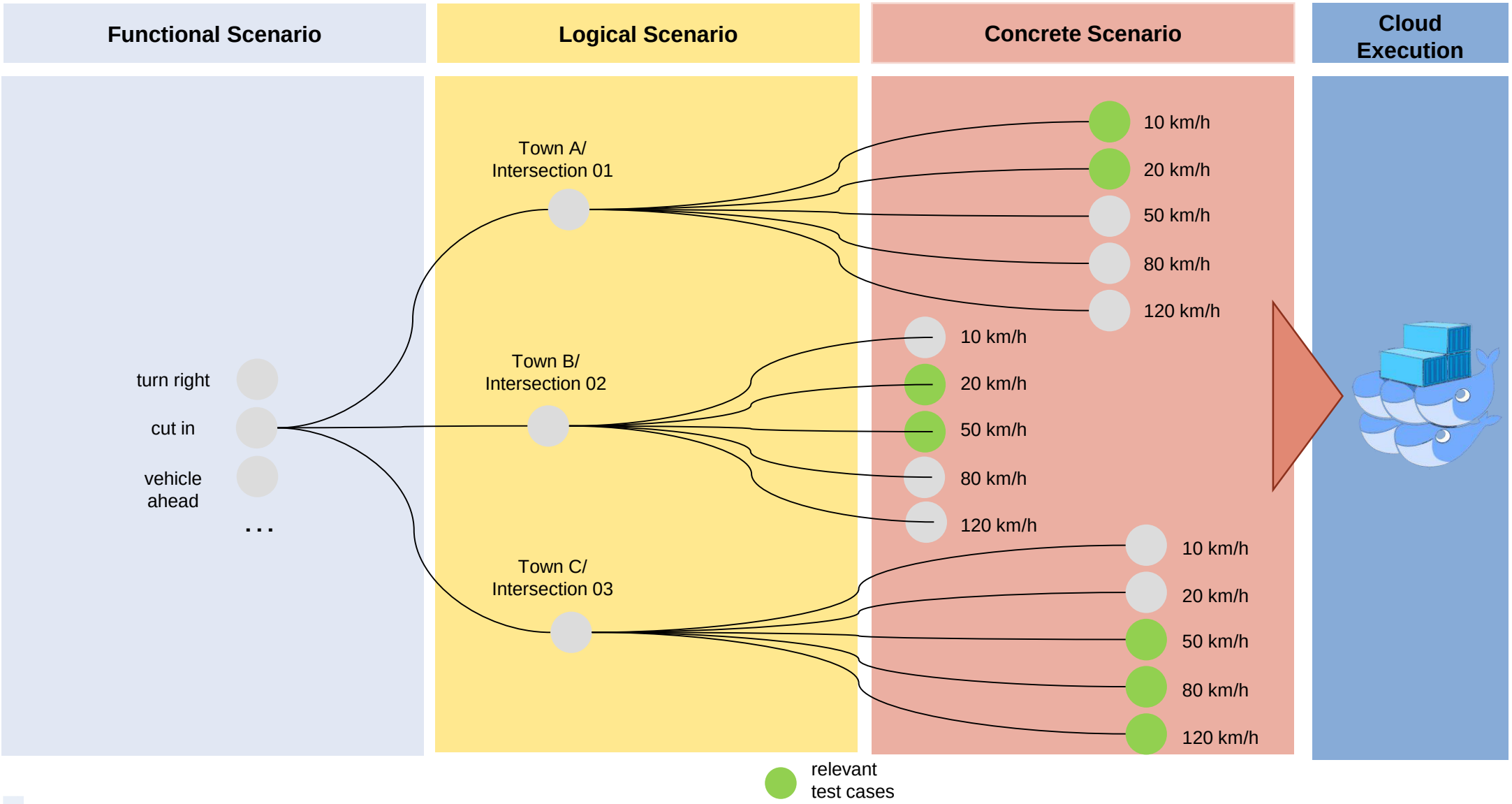
Parameter	Space Definition
Lane Width	2,5m – 3,75m
Speed Limit	80 km/h – 130 km/h
Velocity Actor:	60 km/h – 140 km/h
Initial Distance Ego-Actor	30 m – 150m

Parameter concrete value

Parameter	#1	#2	#3	…
Lane Width	2,5	2,5	2,5	…
Speed Limit	80	100	100	…
Velocity Actor:	60	60	120	…
Initial Distance Ego-Actor	30	50	90	…

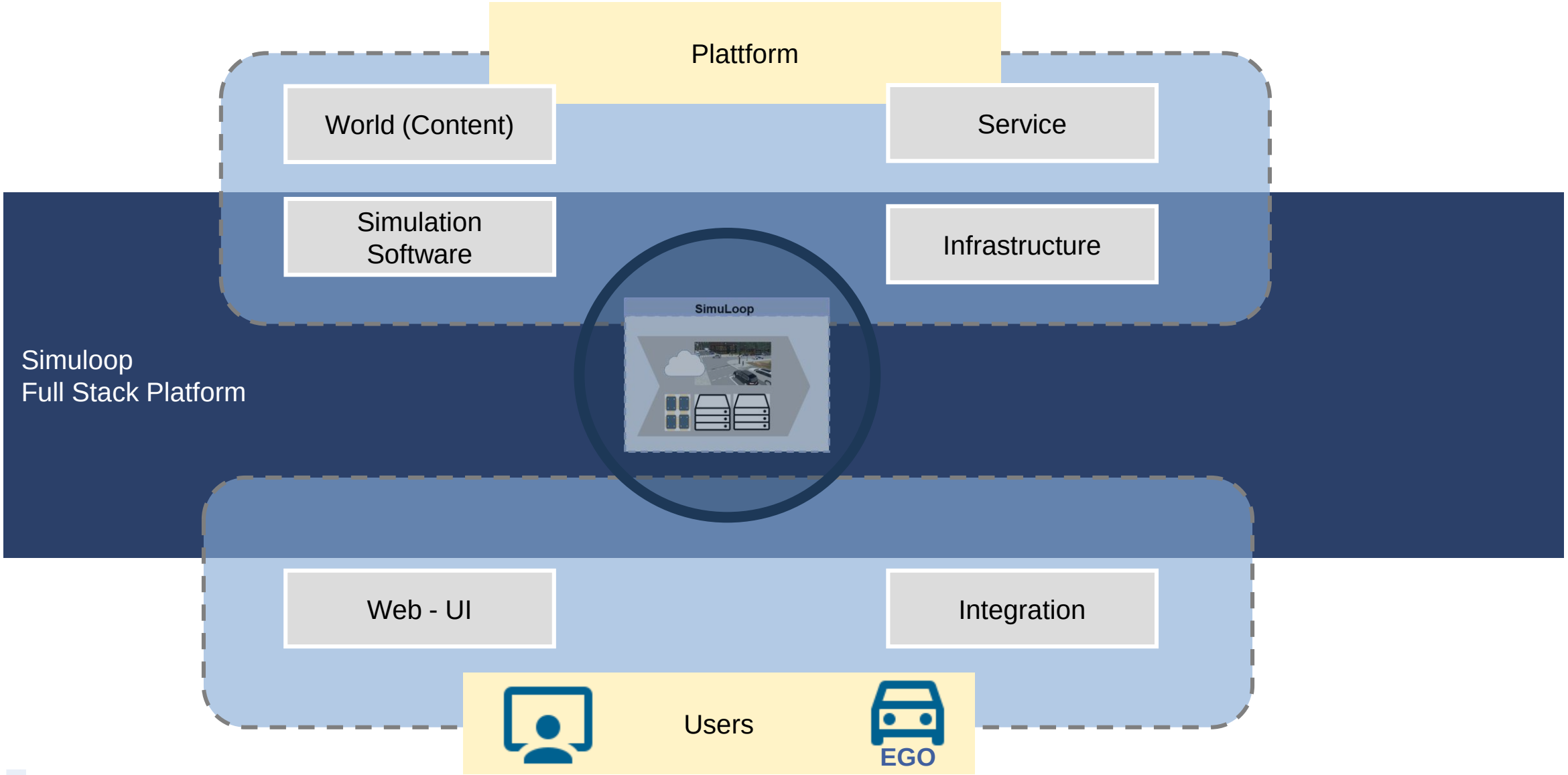
See OpenScenario, Open Drive, Pegasus for Details
→ https://www.pegasusprojekt.de/de/
→ https://www.asam.net/standards/detail/openscenario/

Efficient parameter space population is key for efficient test and validation.



NTT DATA

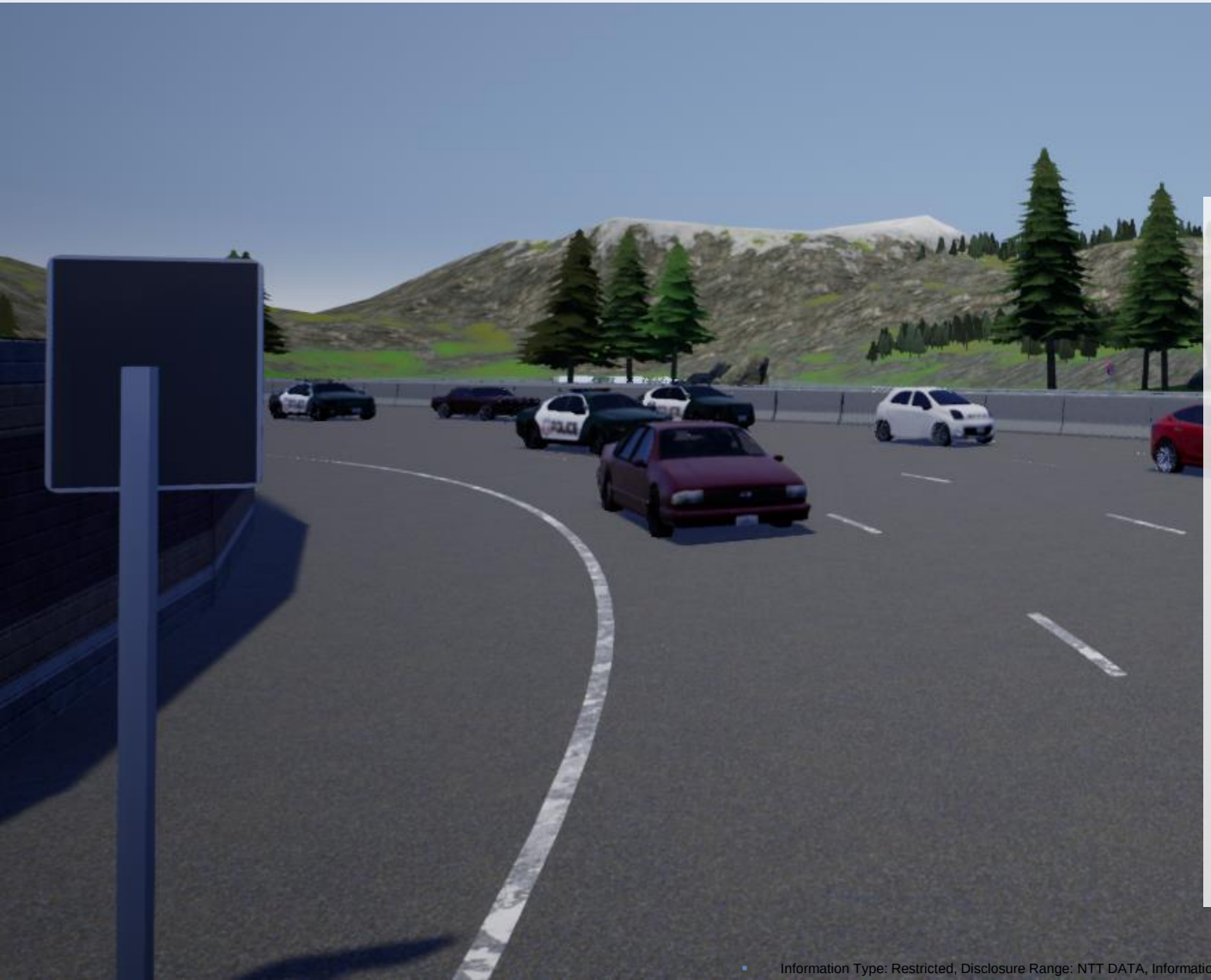
Blueprint for an integrated platform that can be used by engineers to test and validation functions.



NTT DATA

Agenda

CARLA Simulator



- open source: code, protocols and digital assets (buildings, vehicles, etc.)
- sponsored by Intel, Toyota, KPIT and GM
- focus on urban driving -> most complex scenarios for autonomous vehicles
- constantly new features, maps, etc., also through community involvement (e.g. CARLA challenge)
- Based on Unreal Engine
- Sensor suite: cameras, LIDAR, GPS, semantic segmentation, …
- under active development (Intel, University of Barcelona)

CARLA Architecture

Python scripts

controlling

map, weather, vehicles, traffic lights, cameras and other sensors, props

Python API

CARLA Simulator

Unreal Engine 4

optional: Docker container

Simuloop Backend

Ego vehicle

(including cameras and sensors)

Scenario Runner

(map, weather, traffic, props, adversary agents)

Python API

CARLA Simulator

Unreal Engine 4

1-n Docker containers

Hardware and Software Specs

Software

- Ubuntu 16.04
- Unreal Engine 4.21
- Python 3.6
- CUDA 10.0 (Azure)/10.1 (Laptop)
- Python libs: pygame, numpy, networkx, py_trees, psutil, shapely, scipy

Hardware

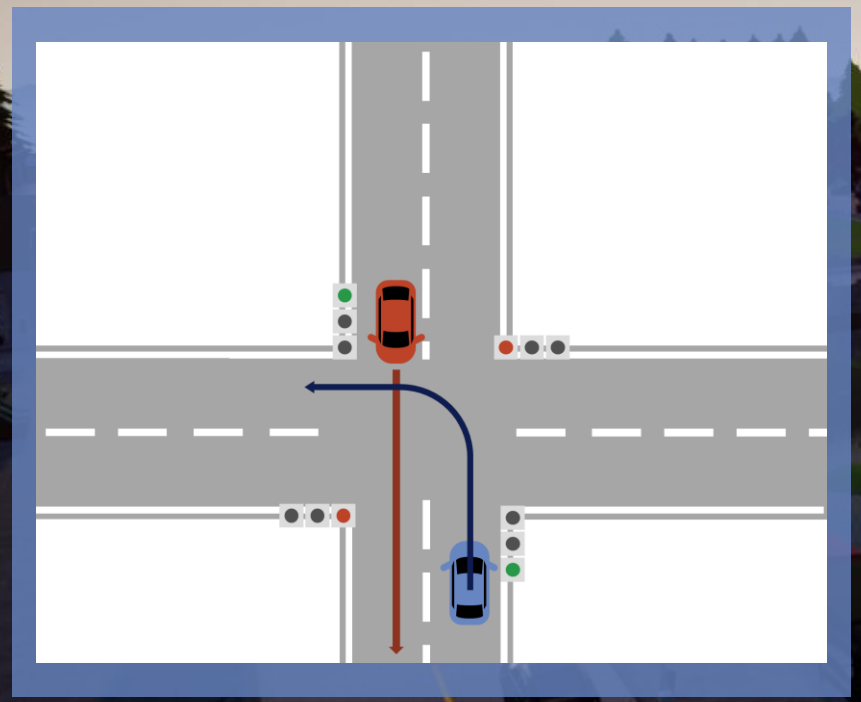
Laptop:

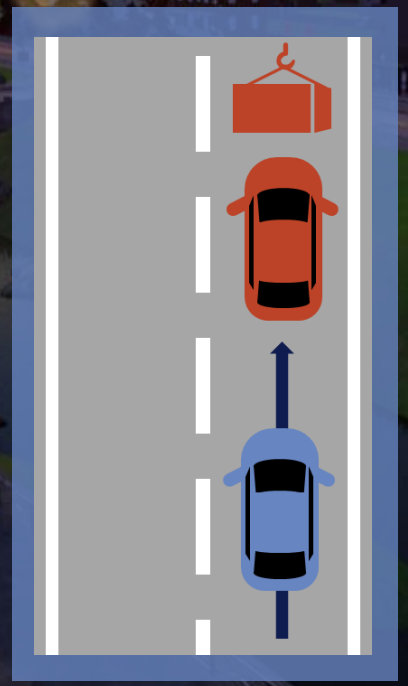
- GPU: Nvidia GeForce GTX 1070
- CPU: 8 Intel Core i7-7700HQ
- Memory: 16 GB

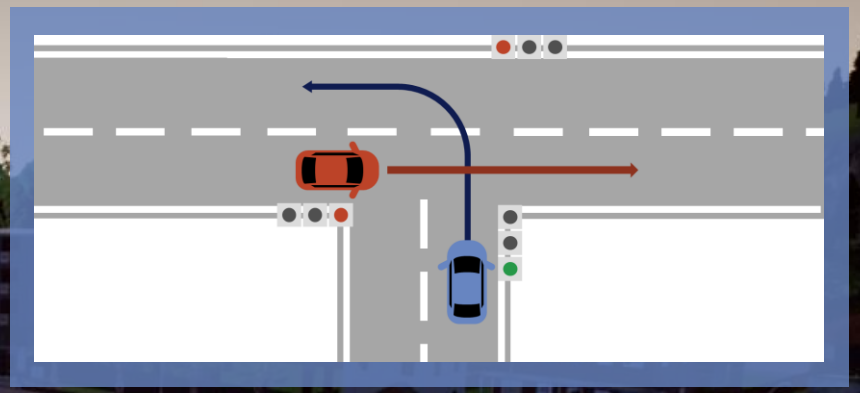
Azure (NV12):

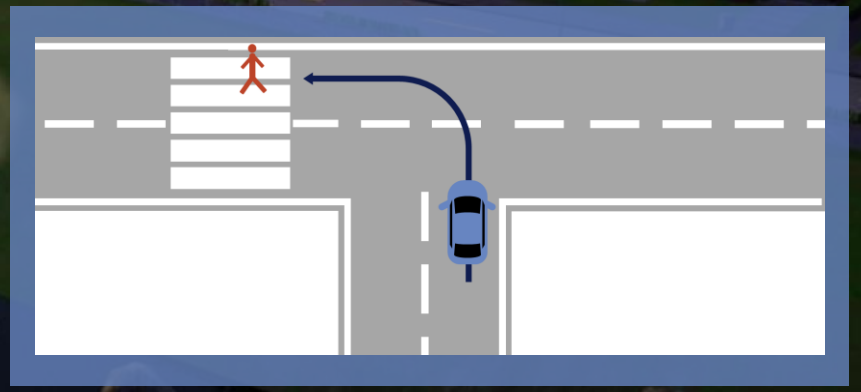
- GPU: 2 Nvidia Tesla M60 (1 physical card)
- CPU: 12 Intel Xeon E5-2690v3
- Memory: 112 GB

Scenarios

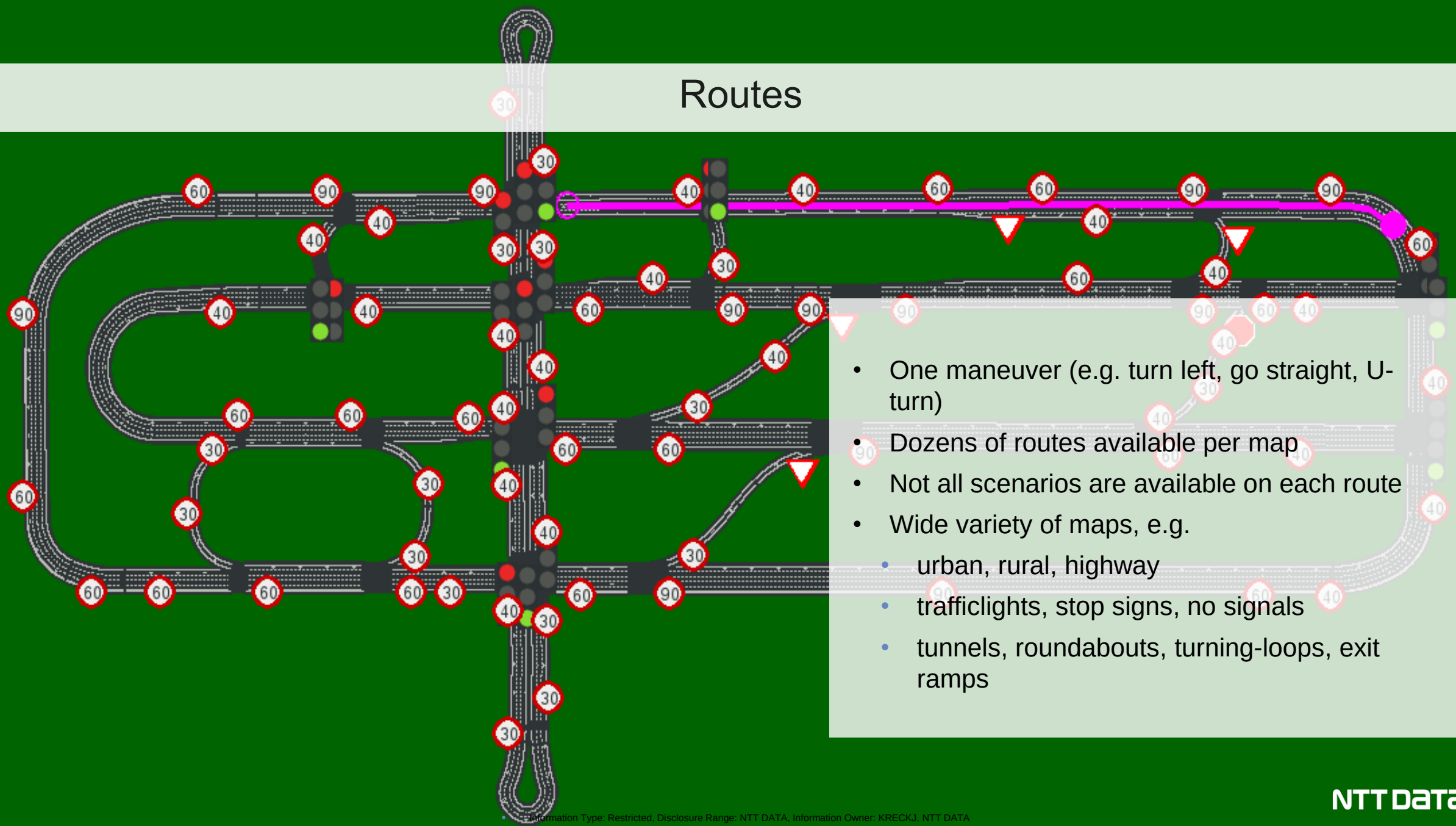








Routes

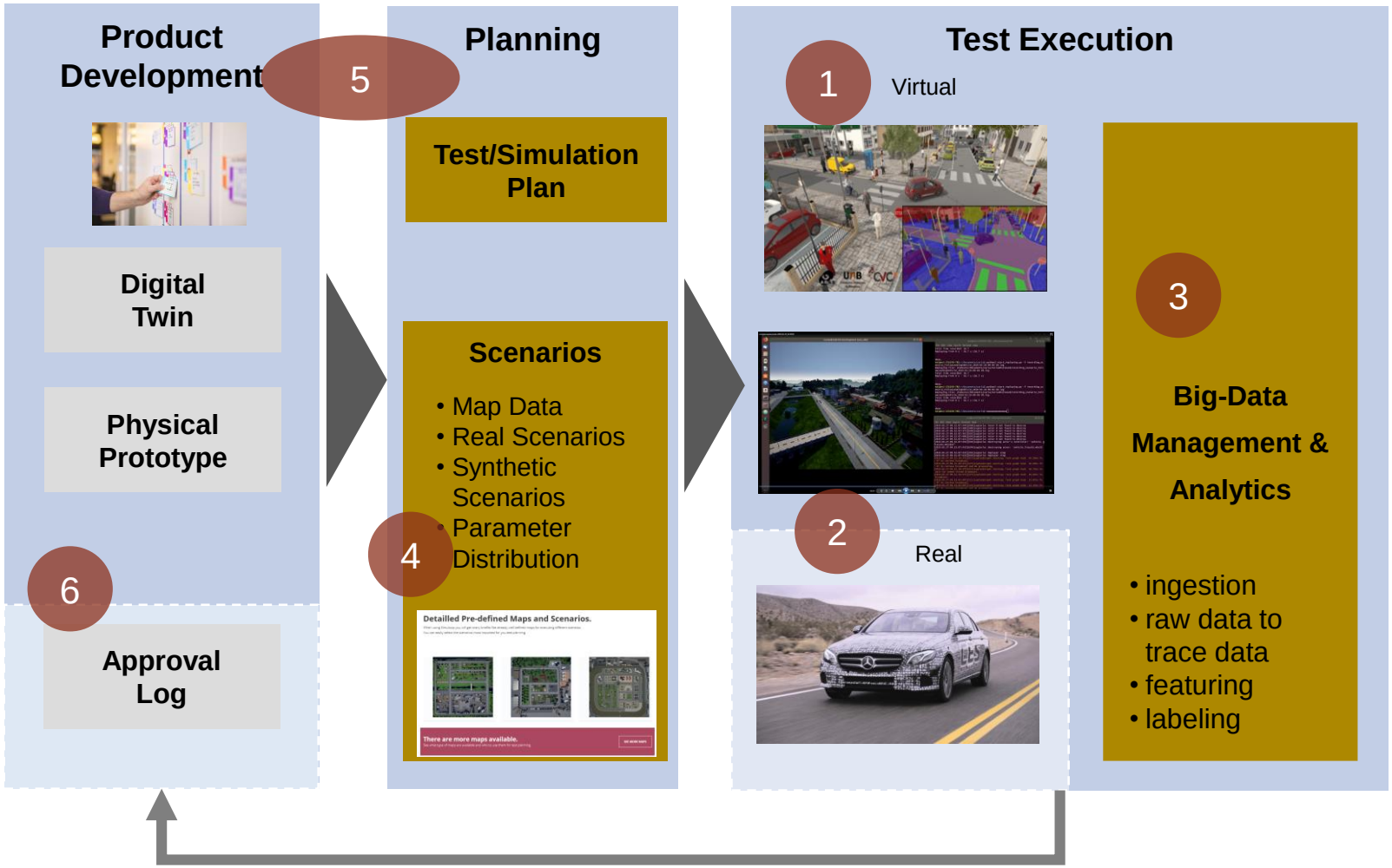


- One maneuver (e.g. turn left, go straight, U-turn)
- Dozens of routes available per map
- Not all scenarios are available on each route
- Wide variety of maps, e.g.
  - urban, rural, highway
  - trafficlights, stop signs, no signals
  - tunnels, roundabouts, turning-loops, exit ramps

DEMO

Agenda

Key areas to address in virtual validation.



1 Simulation Cloud

2 NDS, PGD Data

3 Analytics

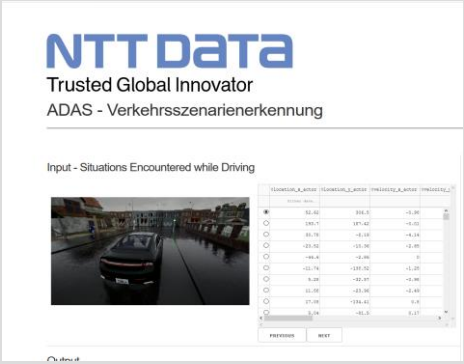
4 Scenario Catalog

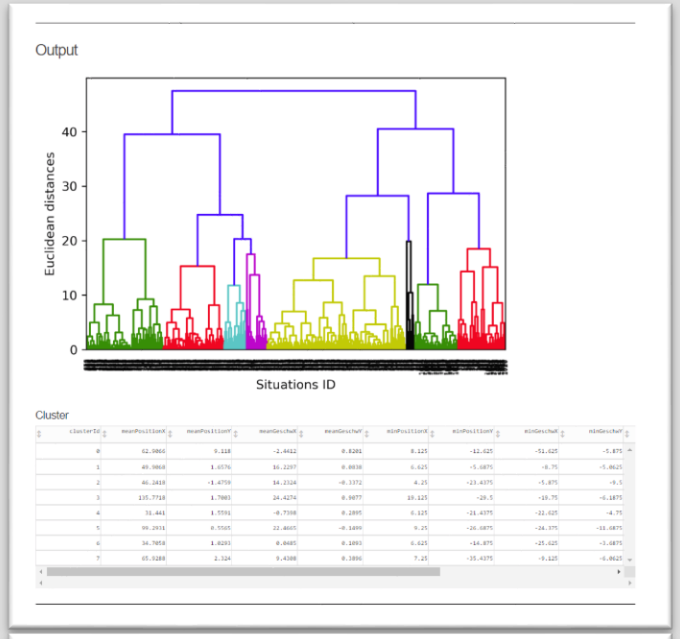
5 Consulting, System Integration

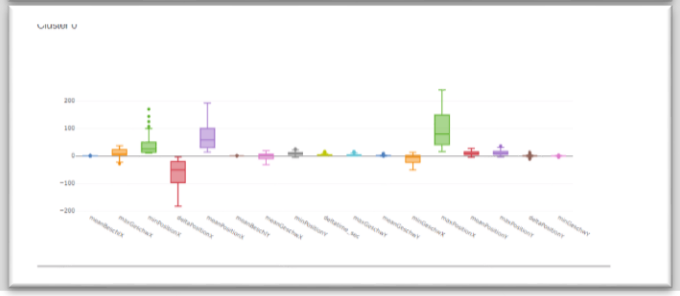
6 Shared Approval Trustbase (Blockchain) *

NTT DATA

With a POC for automated, unsupervised scenario identification NTT DATA is assessing the potential of AI Technologies.



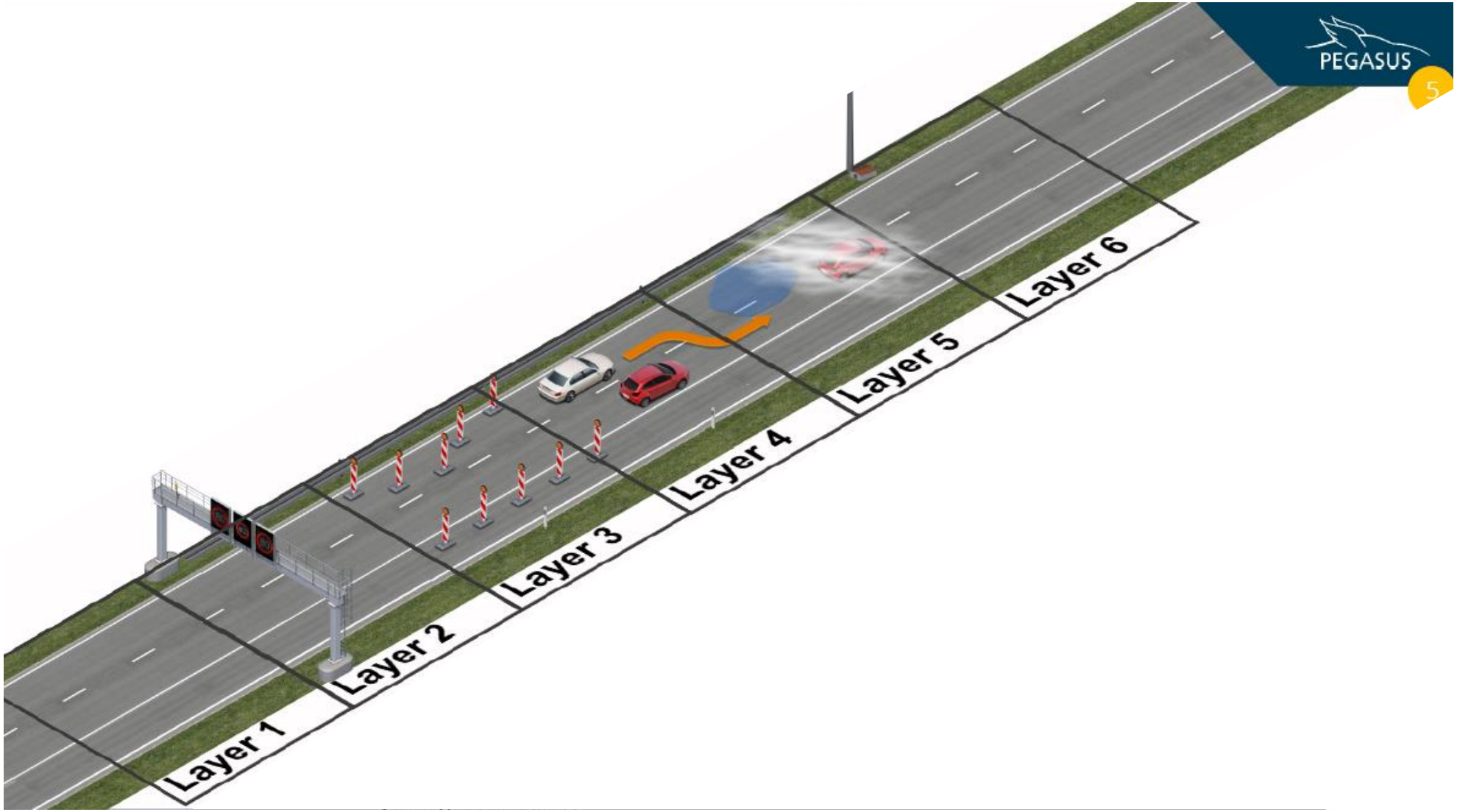




- Qualitative Assessment
- Scenario Coverage Analysis
- Scenario Cloning

https://www.heise.de/ct/artikel/c-t-Schlagseiten-2018-Autonomes-Fahren-Datenschutz-Roboter-Retro-4229633.html

ENDE


PEGASUS
5
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
Layer 6