Test of Automated and Connected Vehicles – essential Research Areas

Simulation as an important Tool for the Development
of Automated and Connected Vehicles

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Wissen für Morgen

Automated and Connected Vehicles (1/2)

– The mobility of the future should be

  – safe
  – secure
  – clean and efficient

– In particular, automated and connected vehicles will significantly help to

  – improve traffic flow
  – reduce the occurrence of critical situations
  – optimize the handling of planned and unplanned incidences
  – relieve the pressure on drivers and the environment
  – generate added value and stimulates innovative business models

– As the market penetration, the degree of automation, and the level of interconnection will rise, the benefits that can be derived from these developments will also increase.
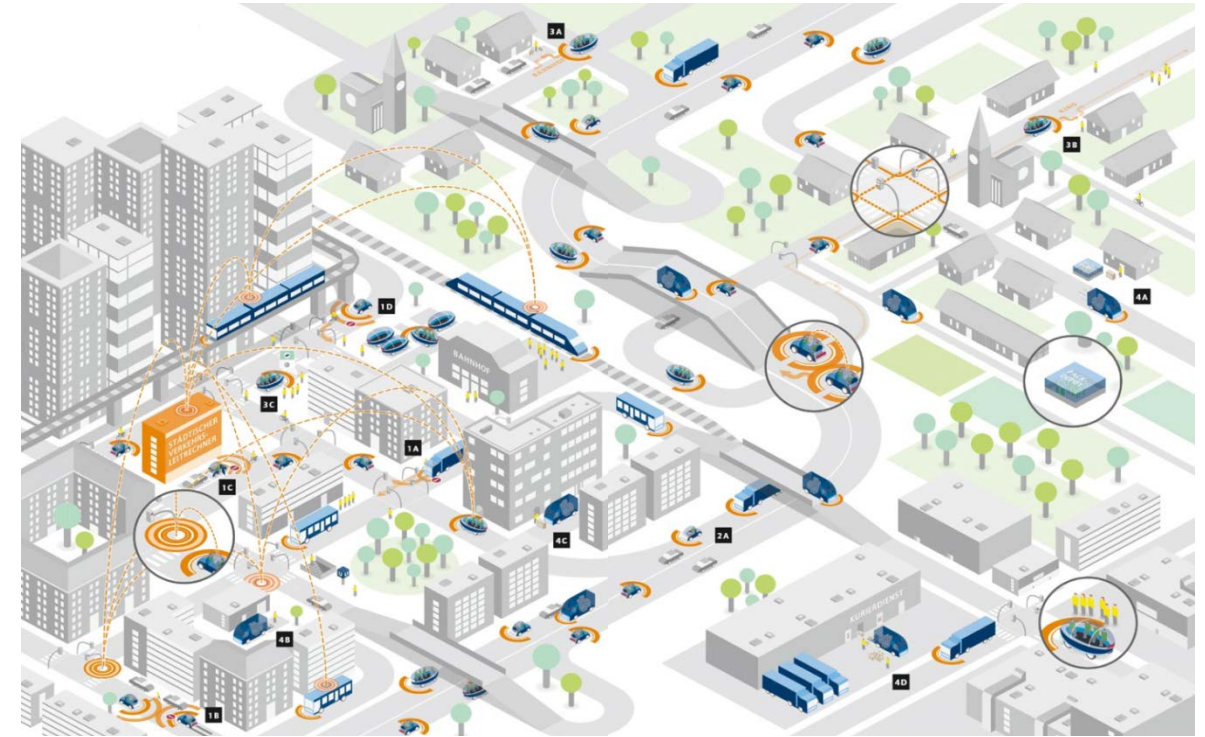
Abbildung: acatech

(cf. Strategy for Automated and Connected Driving of the Federal Ministry of Transport and Digital Infrastructure (BMVI))

Automated and Connected Vehicles (2/2)

– Beside the action areas

  – *Infrastructure*
  – *Interconnectivity*
  – *Cyber Security* and *Data Protection*
  – *Legislation*

the action area *Innovation* is currently of high interest in Germany

– Within the action area *Innovation*

  – methodologies and tools/toolchains for verification and validation
  – infrastructures / test fields for development and test

of automated and connected vehicles are major topics

– Other topics are automated and connected vehicle functions / human-machine interaction / the social dimension of automated and connected traffic-systems, and intelligent traffic-infrastructures etc.
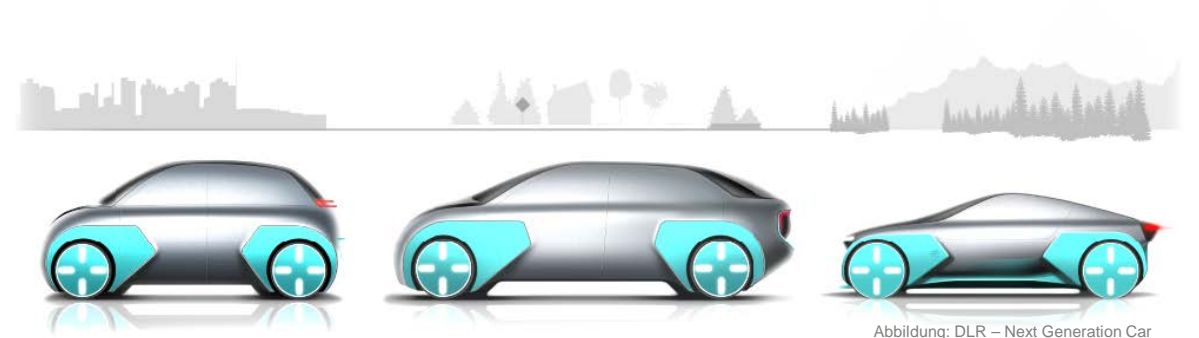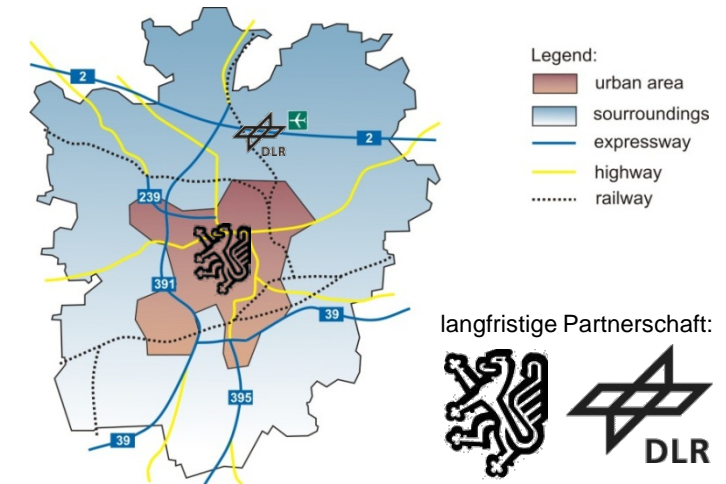
Abbildung: DLR – Next Generation Car

(cf. Strategy for Automated and Connected Driving of the Federal Ministry of Transport and Digital Infrastructure (BMVI))

Application-Platform Intelligent Mobility (AIM) (1/14)

(2009 … 2014 …)

Large-scale research infrastructure in the area of Brunswick (Germany): An entire city serves as a platform for application-oriented research and development-activities in the field of intelligent mobility

- AIM consists of

  - databases, models, simulation toolboxes and simulators
  - dedicated test tracks
  - real urban areas within the city of Brunswick
  - selected surrounding areas around the city of Brunswick

- Besides observation it is possible to influence selected large-scale aspects (e.g. traffic flows) and microscopic aspects of traffic/mobility (e.g. via traffic lights and assistance and automation systems).

- The different building blocks of AIM are represented by a set services / service-clusters.

Legend:
- urban area
- sourroundings
- expressway
- highway
- railway

langfristige Partnerschaft:

DLR

Niedersächsisches Ministerium für Wirtschaft, Arbeit und Verkehr

Niedersächsisches Ministerium für Wissenschaft und Kultur

Application-Platform Intelligent Mobility (AIM) (2/14)

Services / Service-clusters provided by AIM

– Overview

Databases / Maps / Models
→ Simulation / Simulators

Laboratories / Test Beds /
Driving Simulators

Infrastructure / Proving Grounds / Living
Labs – for Development and Test

Vehicles

Data-Platforms / Backend-Systems
for Data and Services

– Reference track
– Traffic flow in the BS region
– Traffic flow data in the BS region
– Modular Mock
– Modular and S...   ...for ITS Components

– Test tracks
– Refer...
– ...ace / iLane
– High-precision positioning in the BS urban area
– Virtual traffic management centre

– ...services
– Traffic management / traffi...
– D...
– ...ger (rail) transport data
– Mobility portal

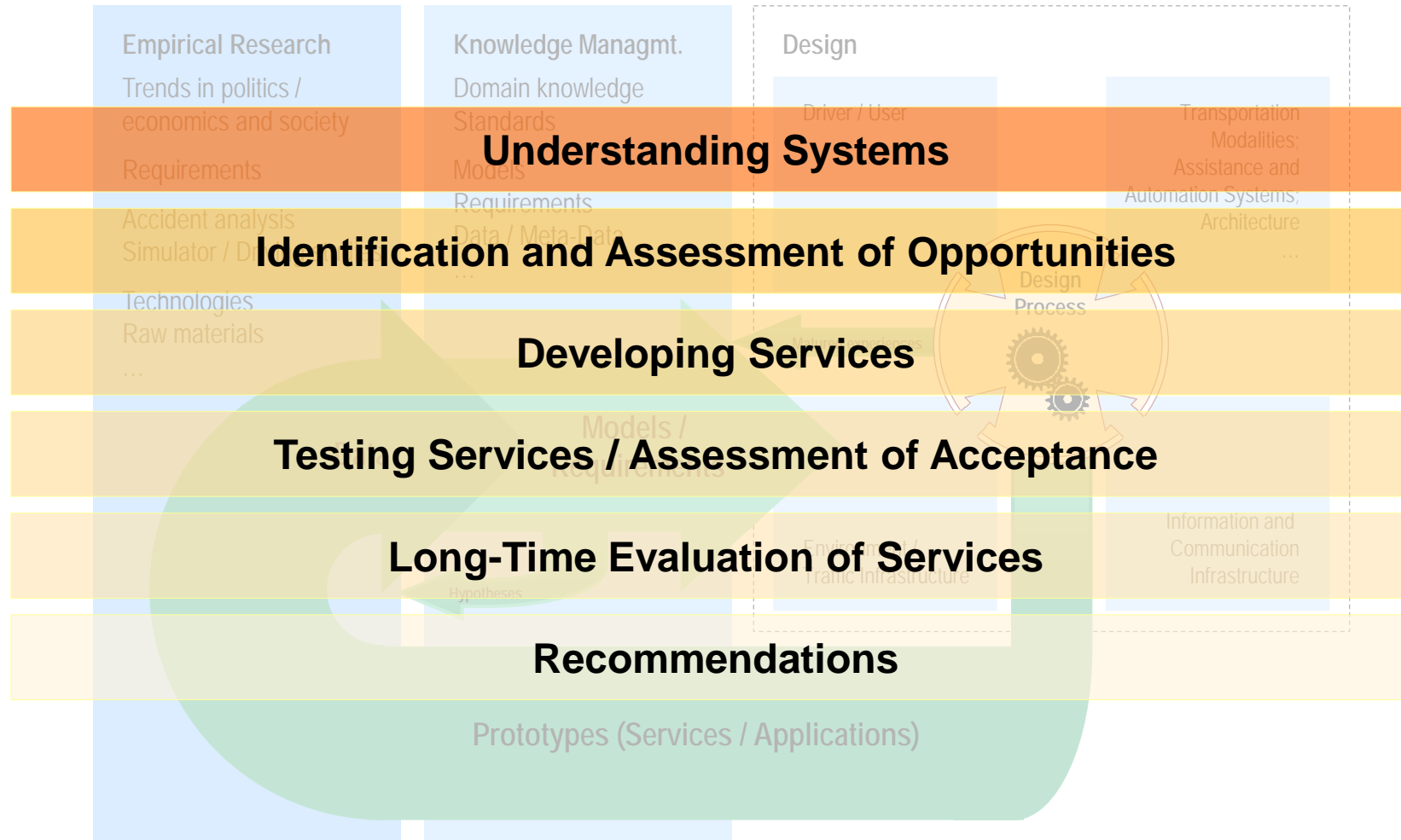langfristige Partnerschaft:

Application-Platform Intelligent Mobility (AIM) (3/14)

Methodological Framework
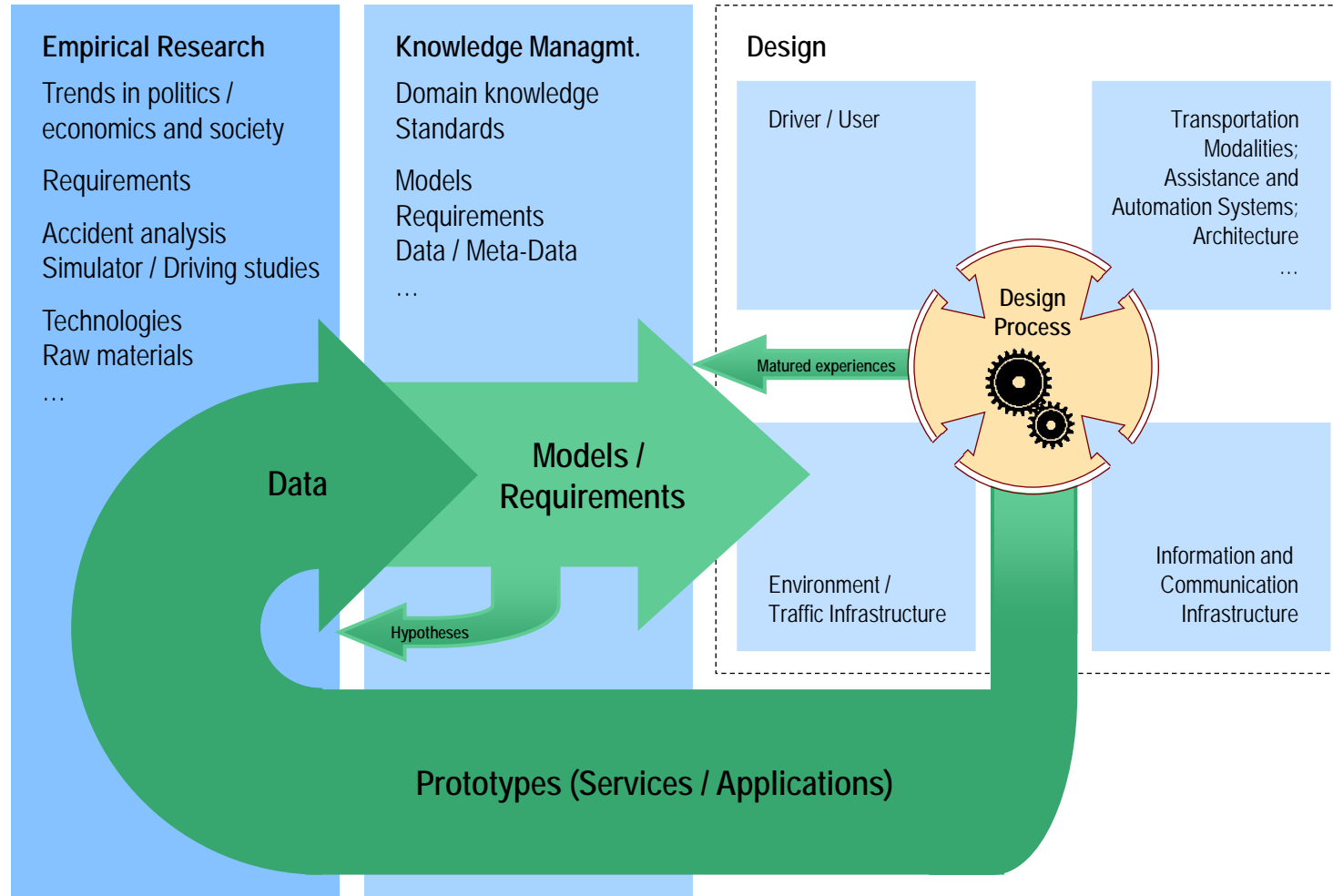
Application-Platform Intelligent Mobility (AIM) (4/14)
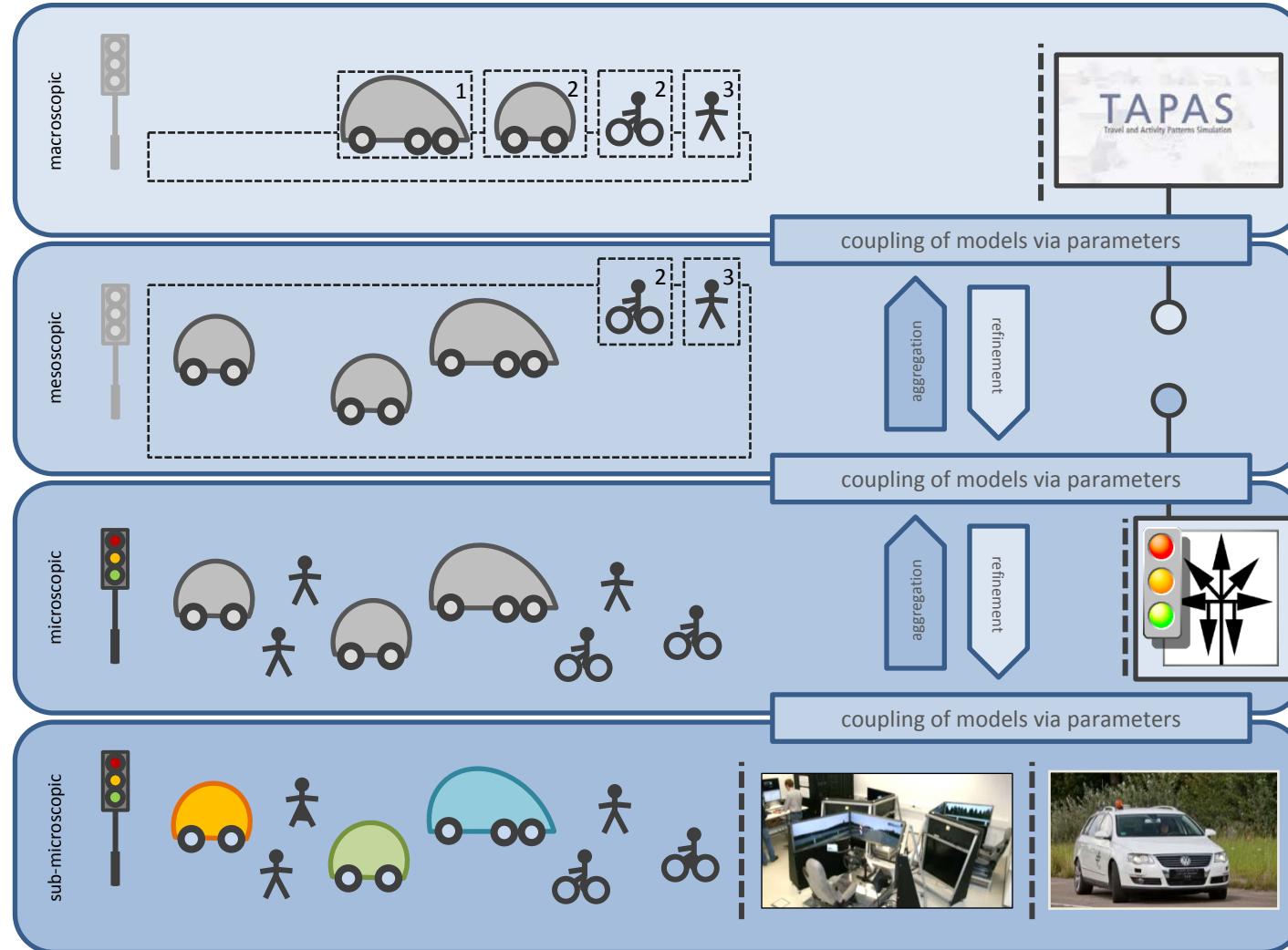**Methodological Framework**

Application-Platform Intelligent Mobility (AIM) (5/14)

Databases / Maps / Models → Simulation / Simulators (excerpt)

Application-Platform Intelligent Mobility (AIM) (6/14)

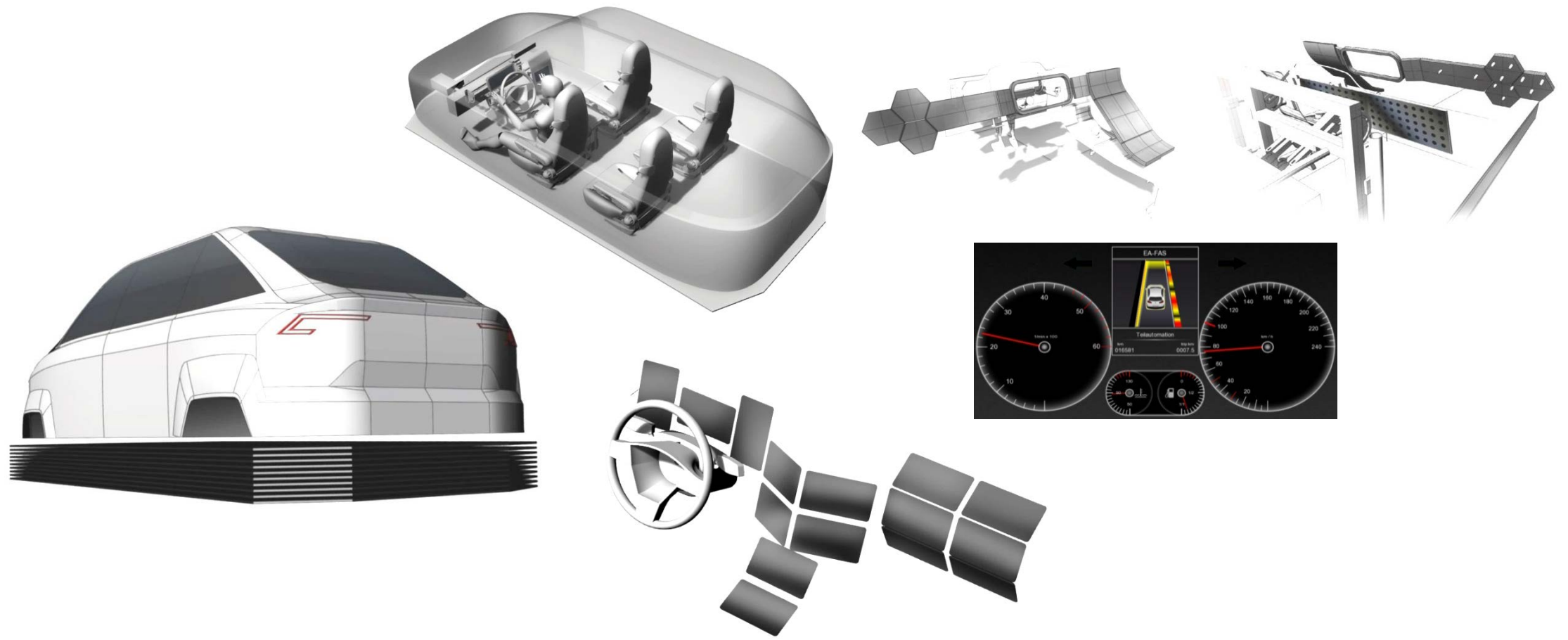**Databases / Maps / Models → Simulation / Simulators (excerpt)**

Application-Platform Intelligent Mobility (AIM) (7/14)

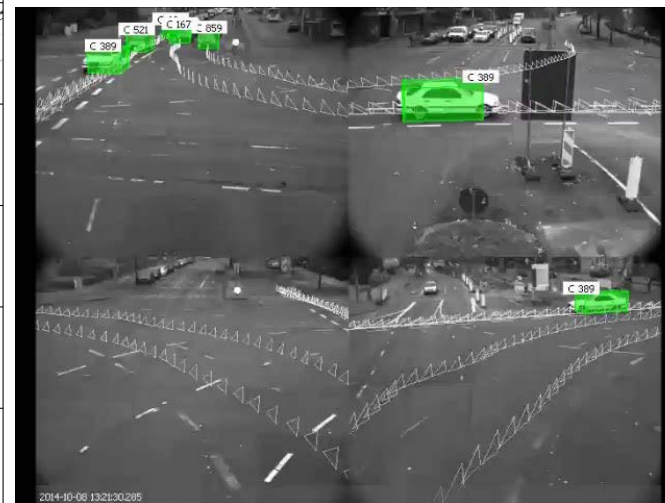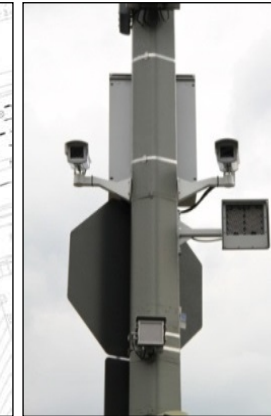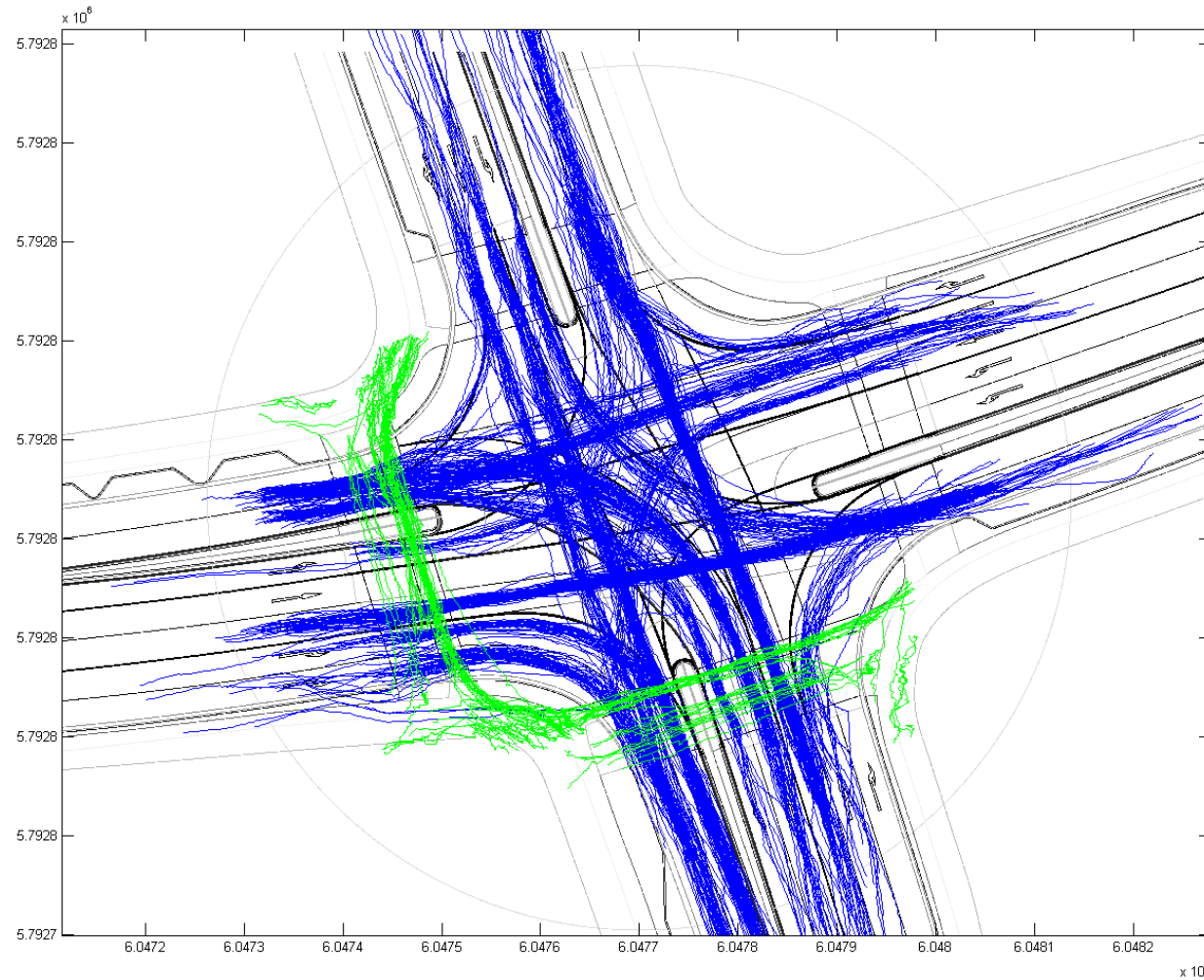**Laboratories / Test Beds / Driving Simulators (excerpt)**

Application-Platform Intelligent Mobility (AIM) (8/14)

Laboratories / Test Beds / Driving Simulators (excerpt)

Application-Platform Intelligent Mobility (AIM) (9/14)

Infrastructure / Proving Grounds / Living Labs – for Development and Test (excerpt)

Application-Platform Intelligent Mobility (AIM) (10/14)

Infrastructure / Proving Grounds / Living Labs – for Development and Test (excerpt)
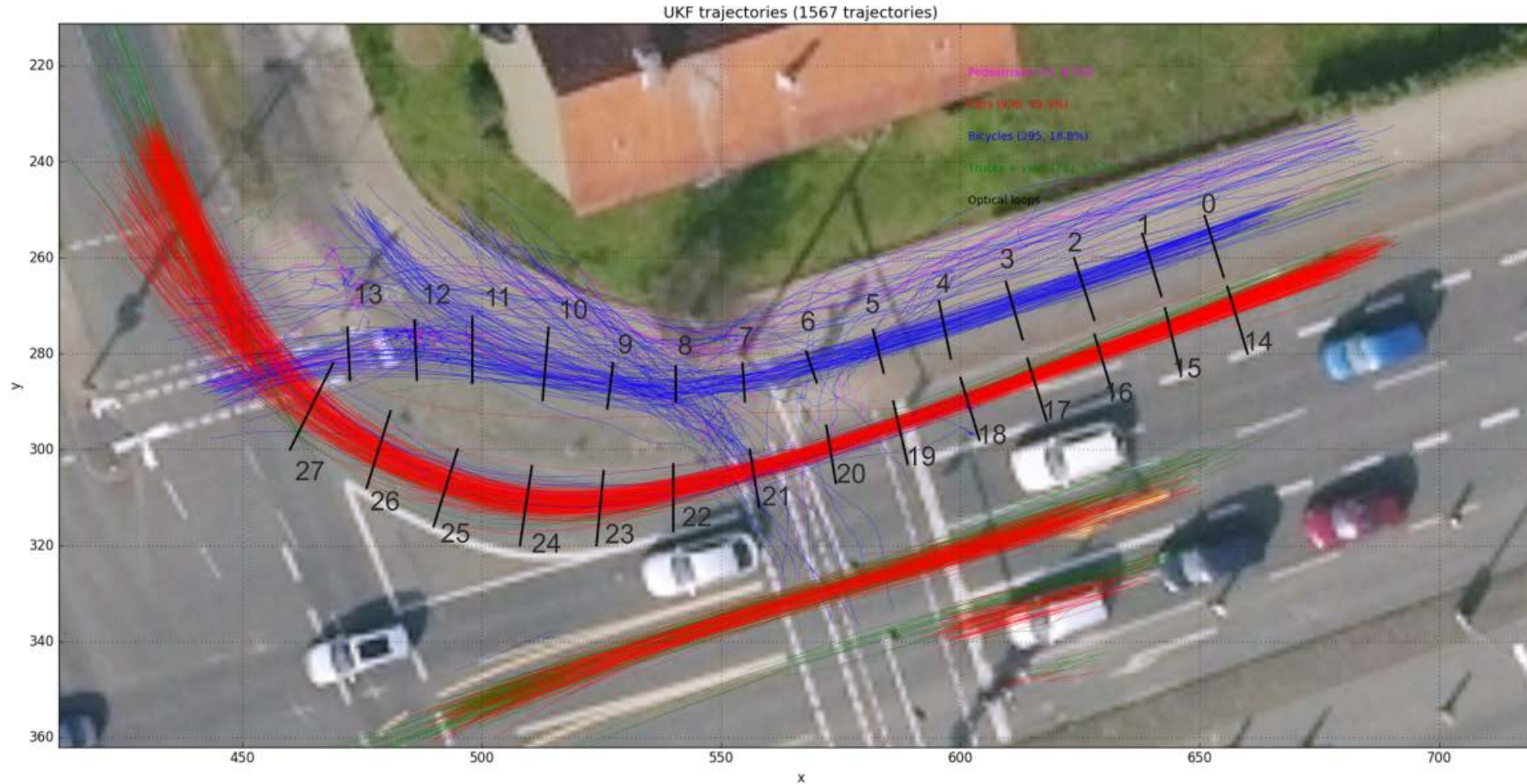
Application-Platform Intelligent Mobility (AIM) (11/14)

Infrastructure / Proving Grounds / Living Labs – for Development and Test (excerpt)

Application-Platform Intelligent Mobility (AIM) (12/14)
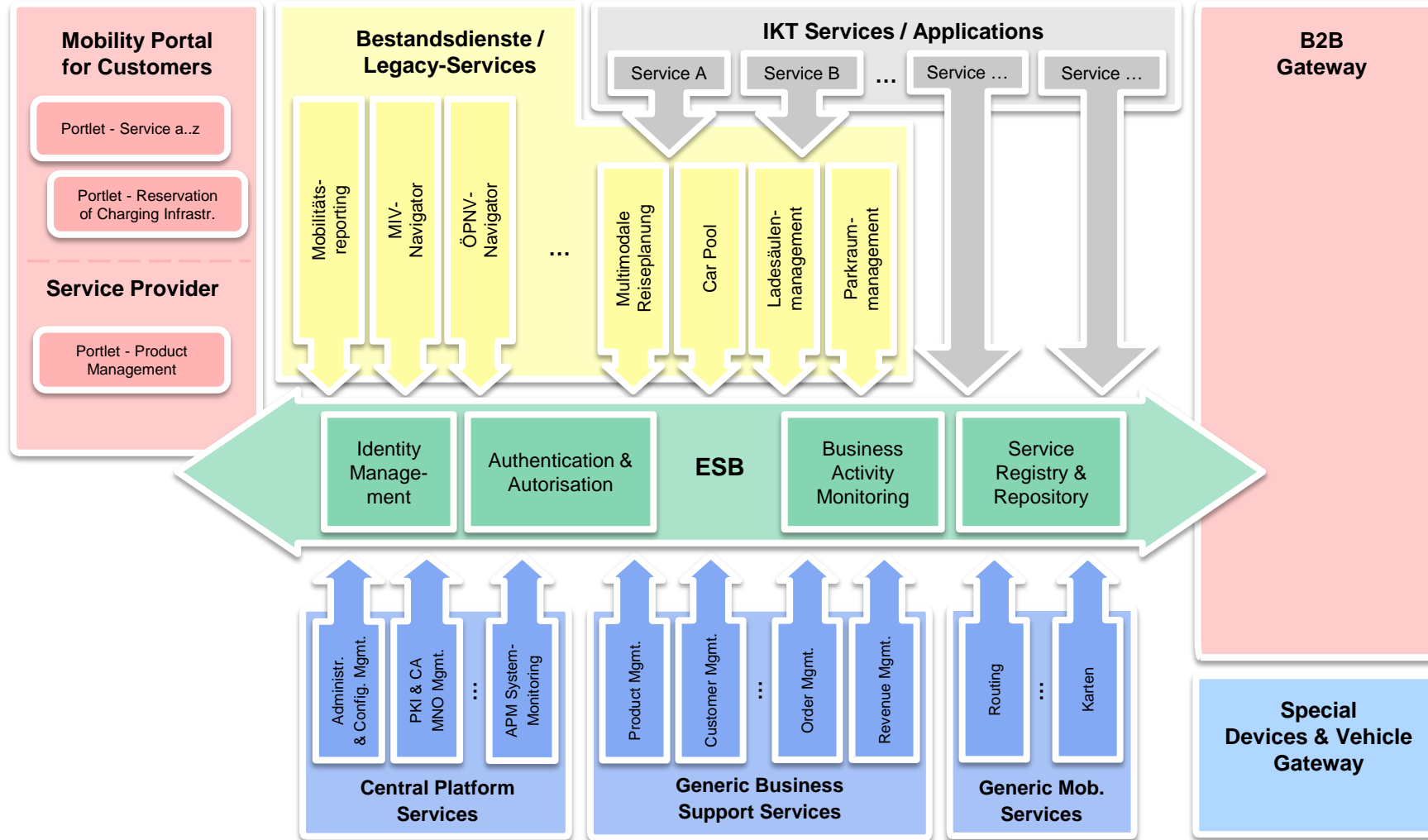
Vehicles (excerpt)

Application-Platform Intelligent Mobility (AIM) (13/14)

Vehicles (excerpt)

Application-Platform Intelligent Mobility (AIM) (14/14)

Data-Platforms / Backend-Systems for Data and Services (excerpt)

Test Field Lower Saxony (1/2)

Approximately 280 km of different types of roads will extend AIM – with a focus on highways. Technical components of the Test Field Lower Saxony are based on established AIM-Components. The integrated use of AIM and Test Field Lower Saxony will be possible.
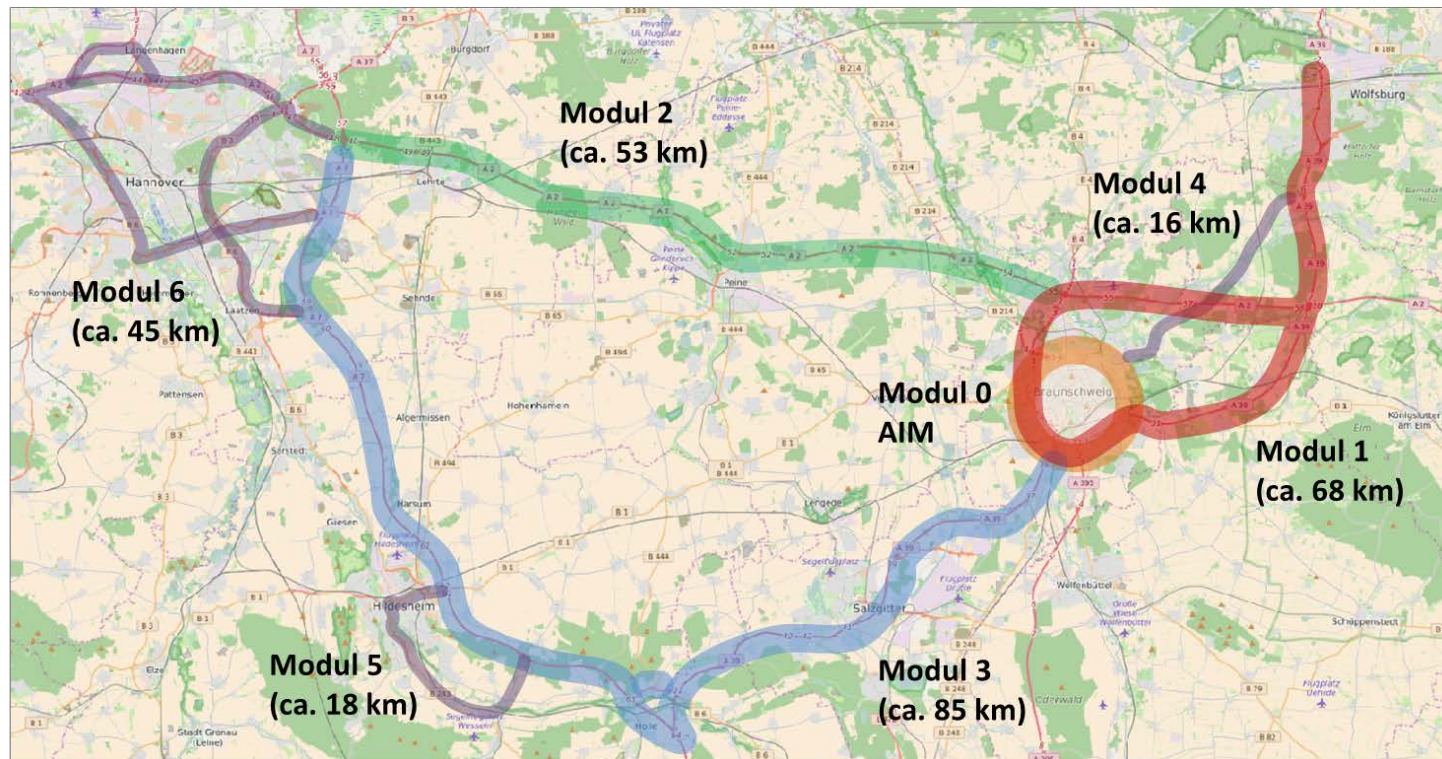

Module 7: Proving ground (with urban appearance) on non-public area.

- **Camera-based Detection** – anonymized detection of traffic objects and their trajectories → ground truth

- **Communication** – Car2X via WiFi 802.11p and Mobile

- **Maps** – highly accurate and up to date maps for vehicles and various simulation-purposes

- **Scenarios and Models** – parametrizations and (sub-) models for the construction of (ecologically) valid simulations

- **Interfaces to Traffic Infrastructure and traffic-related Databases** – e.g. connection to the traffic management

- **Backend-System** – data management and delivery of online services

- **Cadastre** – in particular, documentation of the test field status / quality

Test Field Lower Saxony (2/2)

Core Partner
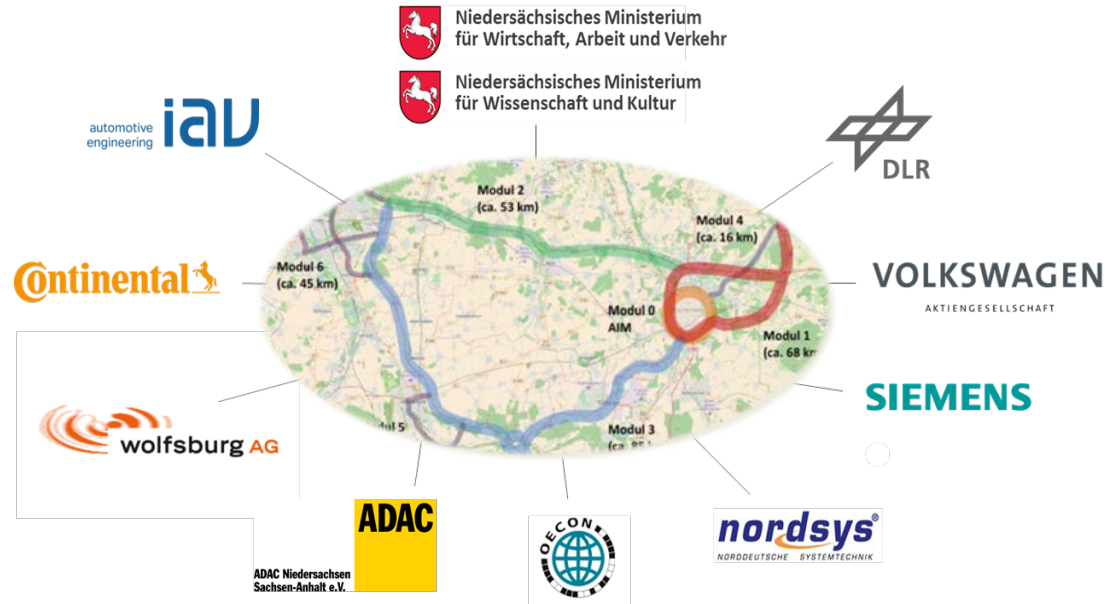
Extended Network of Partners (excerpt)

... und weitere Partner

Karte: © OpenStreetMap-Mitwirkende

PEGASUS (www.pegasus-projekt.info)

(2016 – 2019 / funded by the Federal Ministry for Economic Affairs and Energy (BMWi) / 17 partners from research and industry)

– PEAGSUS addresses methods, criteria, quality metrics and levels as well as generally accepted and reliable procedures to test and assess automated driving functions – focusing on level 3 functions and highways

– Main goals of the project are

  – definition of standardized and reliable procedures for the test of automated vehicle functions based on a variety of tools

    – data management, processing and analysis
    – simulation / simulators
    – test stands and proving grounds
    – test fields / real environments

  – integration of test / assessment in development processes at early stages

  – development of a continuous and flexible tool chain to safeguard automated driving

– PEAGSUS will deliver results which can be directly picked up by automotive industry!

Next Steps …

– Because of the focus on level 3 functions and functions with relevance for highways PEGASUS
  will also be an important starting point for a family of succession projects

– Selected topics with direct relevance for the field of simulation are (This is a very personal selection!)

  – accurate and flexible virtual environments – e.g. highly flexible virtual proving grounds
  – integration of models / coupling of simulations – e.g. standardization

  – data-driven (sub-)model-synthesis
  – data-driven approaches for the identification of test-scenarios / -cases

  – performance-evaluation of different test methods within over-all toolchains to test and assess
    automated and connected vehicles – e.g. regarding validity and application boundaries

  – efficient over-all toolchains based on a wide range of simulation-based tools and other
    test approaches – e.g. test stands and proving grounds

  – …

Thank you for your Attention!

Contact …

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