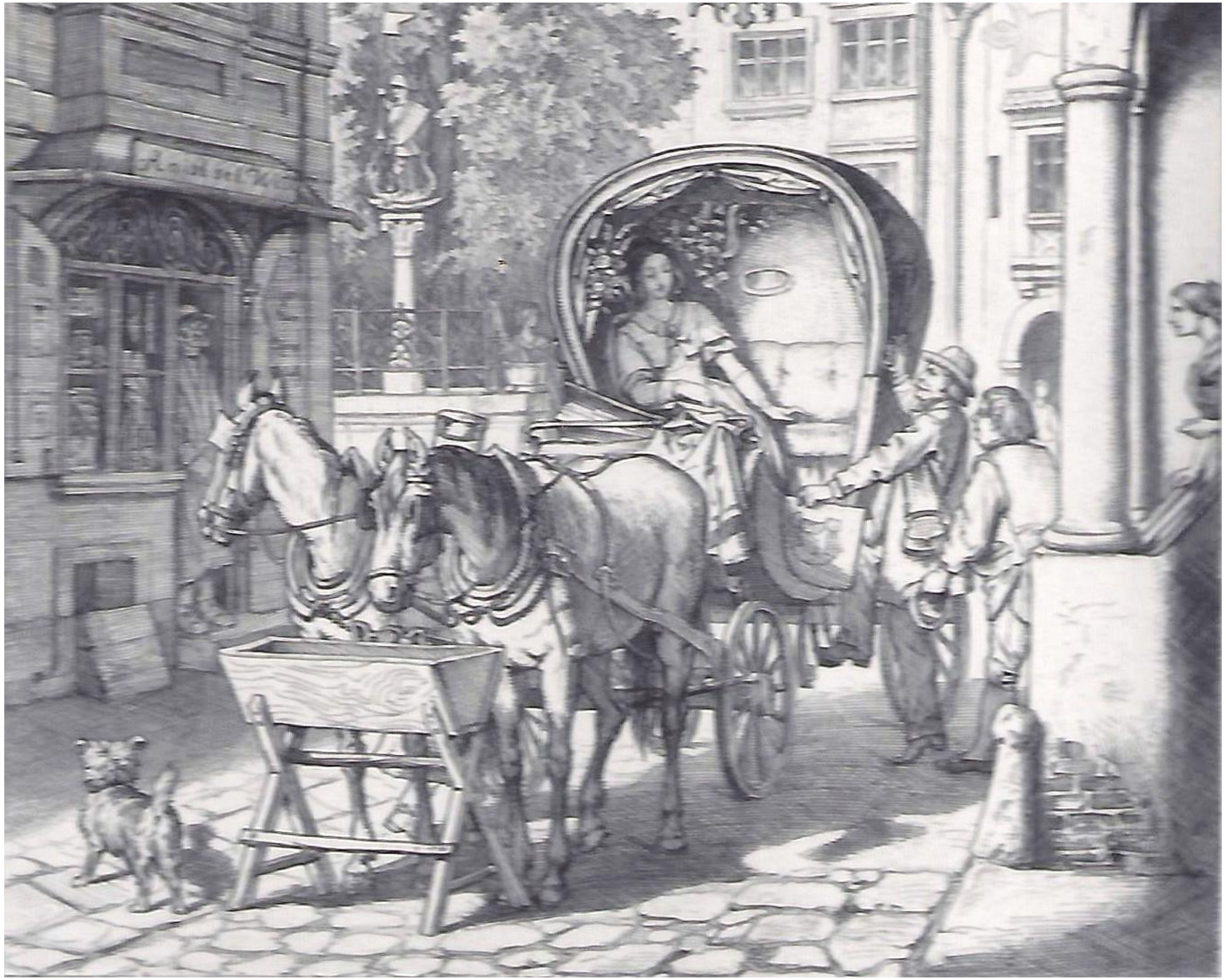
Autonomous Driving

Meeting critical factors in times of change

Oktober 2021

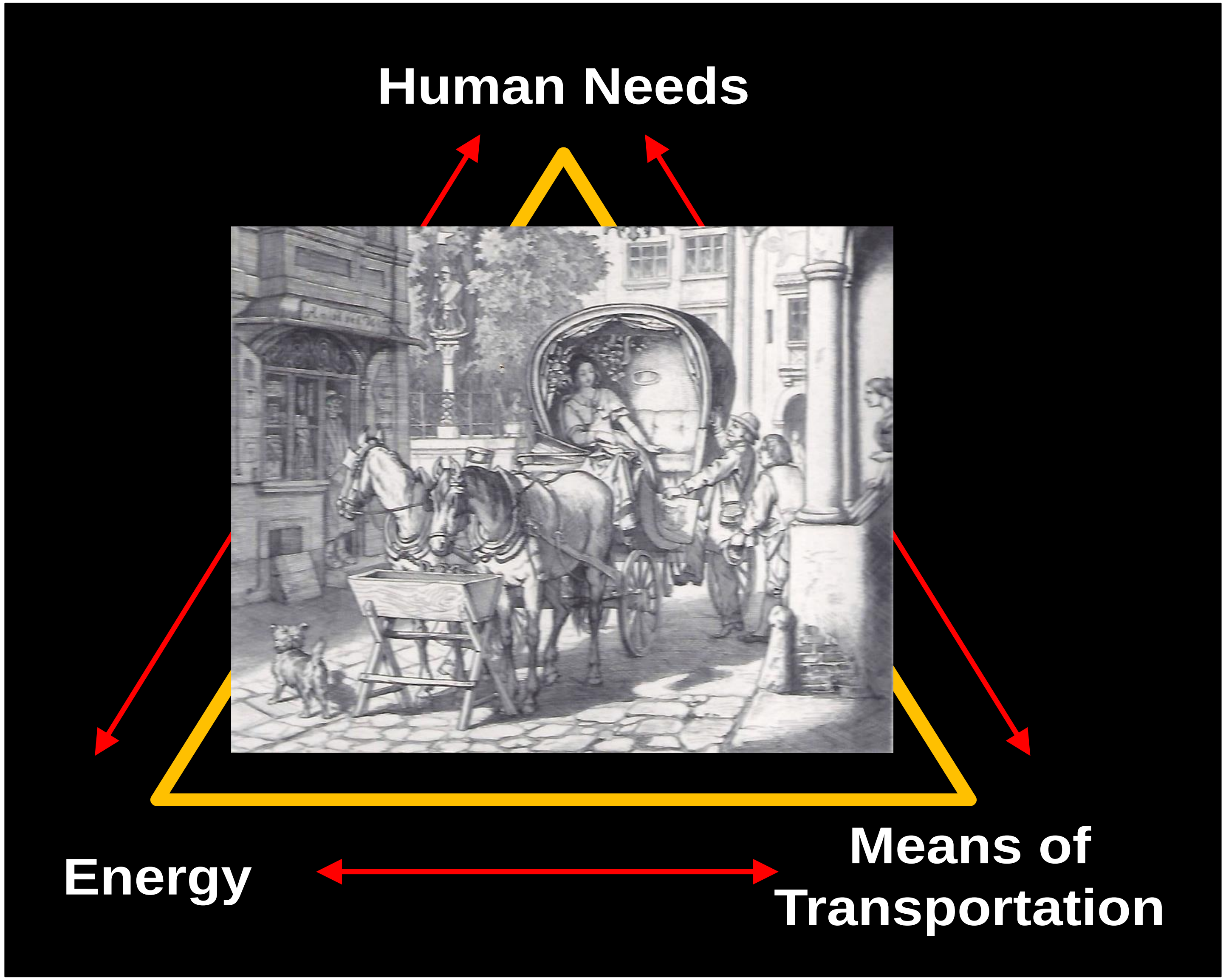
Prof. Tjark Siefkes

Ingrediencies of Mobility



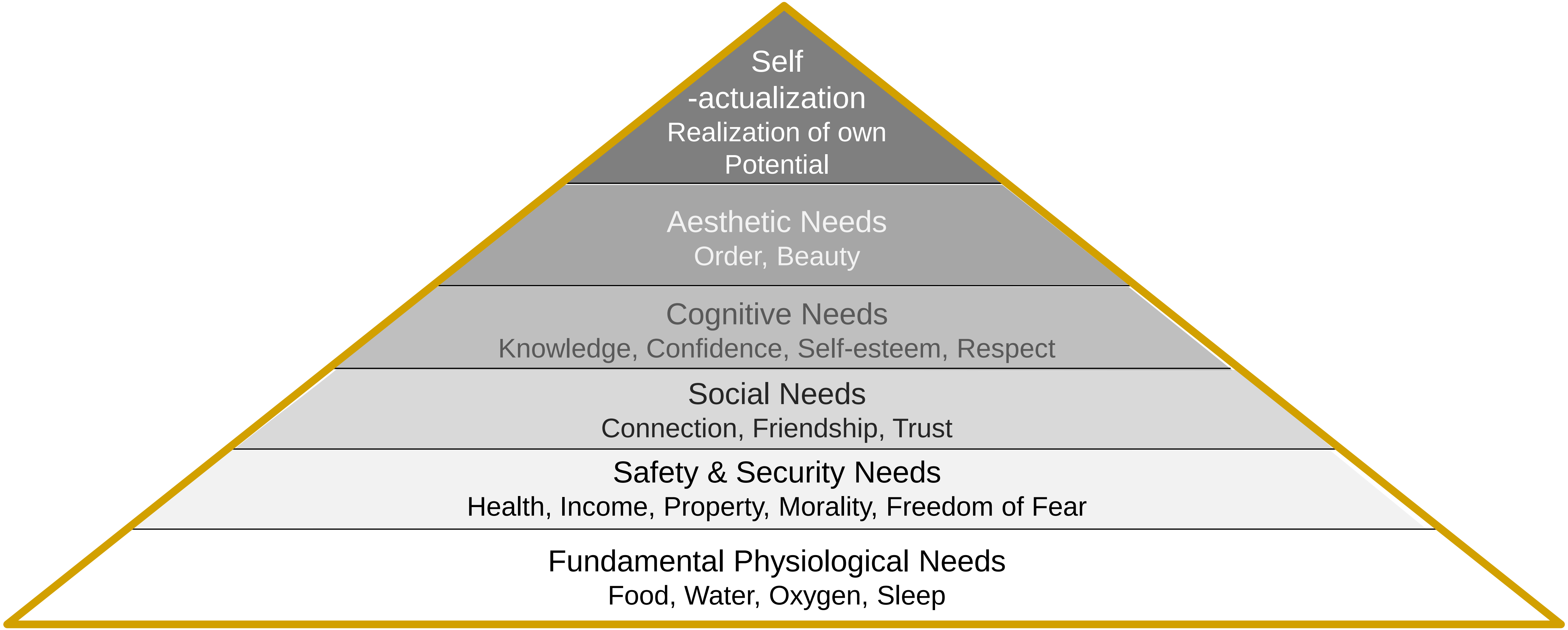
Moritz von Schwind: „The Honeymoon Voyage“.
Original from 1850. Etching from 1879.
Collection Tjark Siefkes

Ingrediencies of Mobility



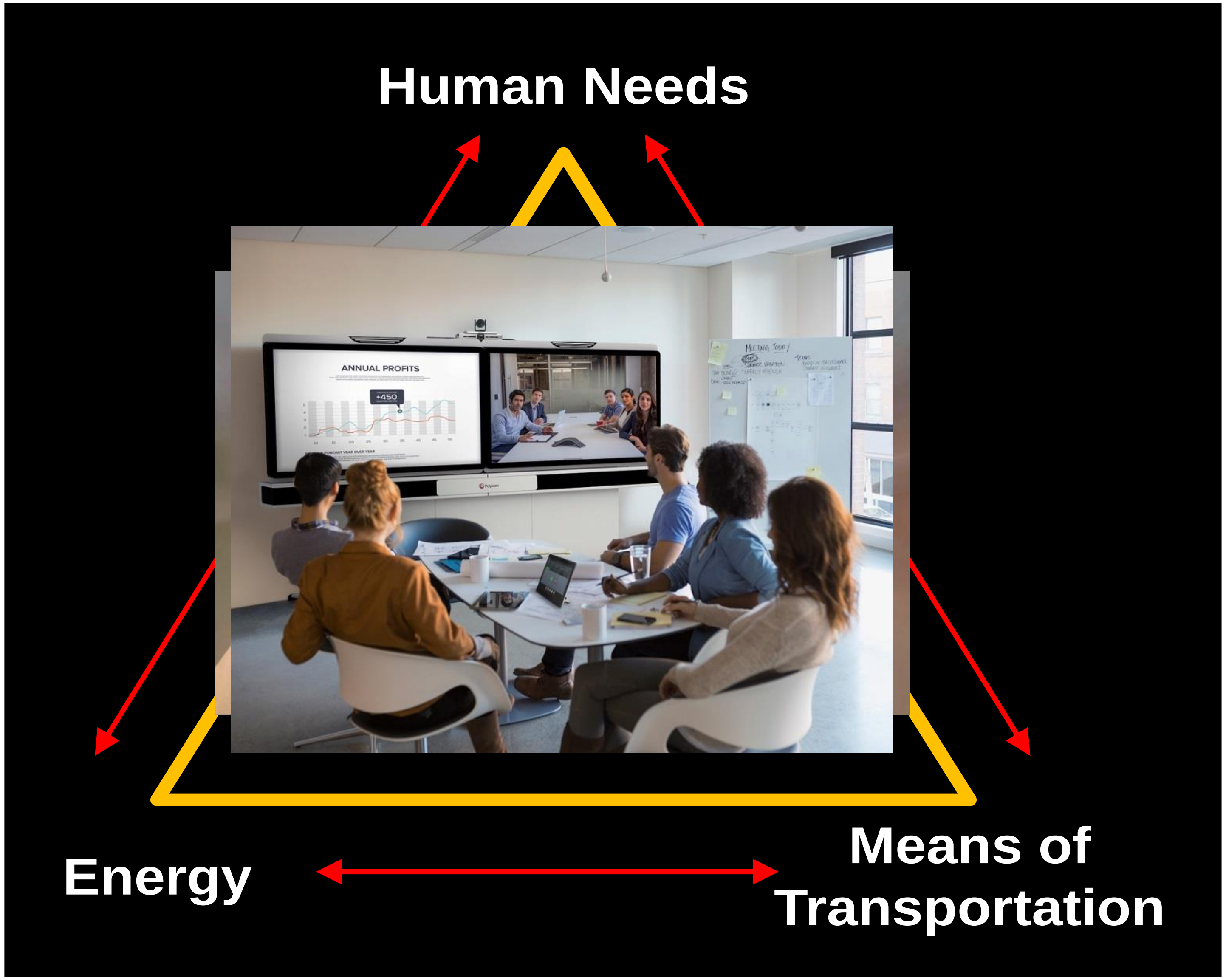
Source: DLR

The Hierarchy of Human Needs



Source: Abraham H. Maslow: The farther reaches of human nature. New York: The Viking Press. 1971.

Ingrediencies of Mobility



Digitization in the Automotive Industry

"The number of transistors in a dense integrated circuit doubles approximately every two years" Gordon Moore, 1965.

Illustrated for a 1971 VW Beetle:

1971	2021
a) Speed (Performance)	
120 kph	**4 Billion kph**
b) Costs	
2900 Euro	**0,14 Euro**

Foto: Classic Driver Market

How does driverless Driving affect the Transport System?

Picture: DLR

Potential Benefit

- **Reducing mileage and number of vehicles** through
  - **Bundling** of trips (Ridesharing)
  - **Modal shift by linking different modes**, more use of bicycles, pedestrian traffic, public transport
- Optimization of traffic flow (**low energy consumption; reduction of traffic jams**)
- Location of sensors and data processing into **infrastructure; shared use**
- **New business models**

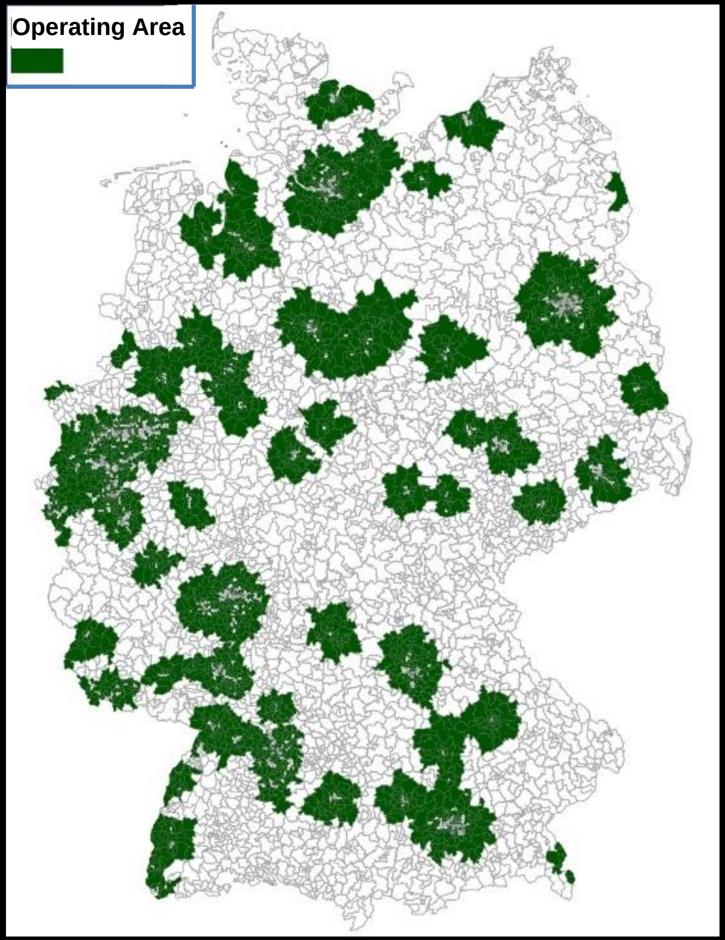
Potential Risk

Picture: Radoslav Droz-dezewski (wikimedia)

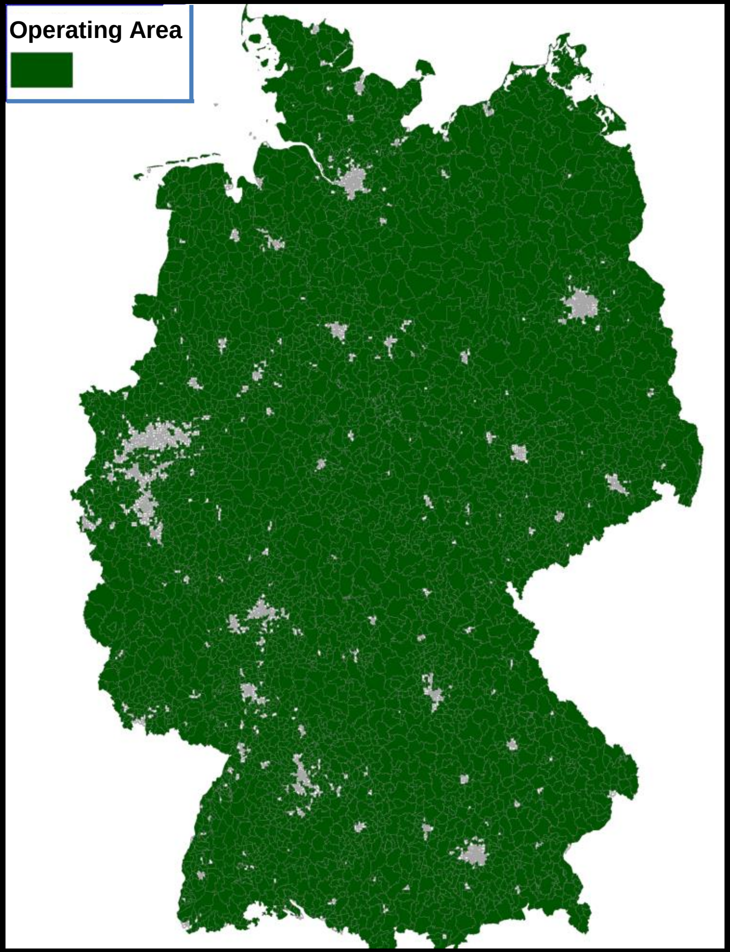
- **Mileage and number of vehicles increase** through
  - **Ease** of driving
  - **Empty trips** (mobility on demand); it could even be that the average occupancy level drops below 1
- In the event of a **malfunction**: Dependence on specialist staff
- **Higher average speed** (motorways)
- **Increased energy consumption** of sensors and IT

Source: DLR

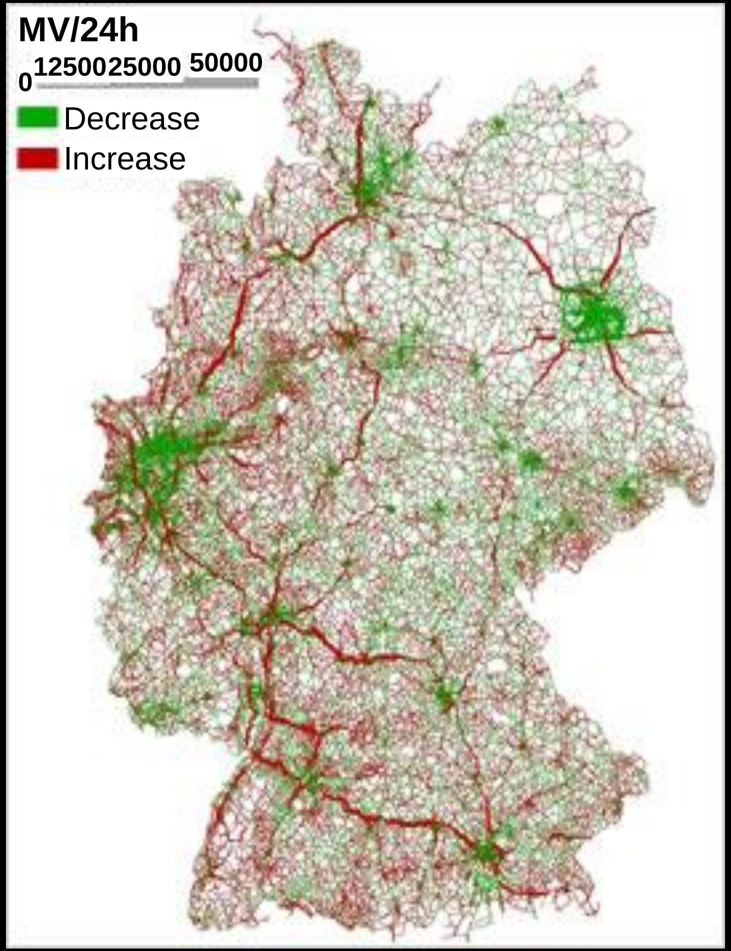
Mobility Areas in Germany



Suburban



Suburban + Rural

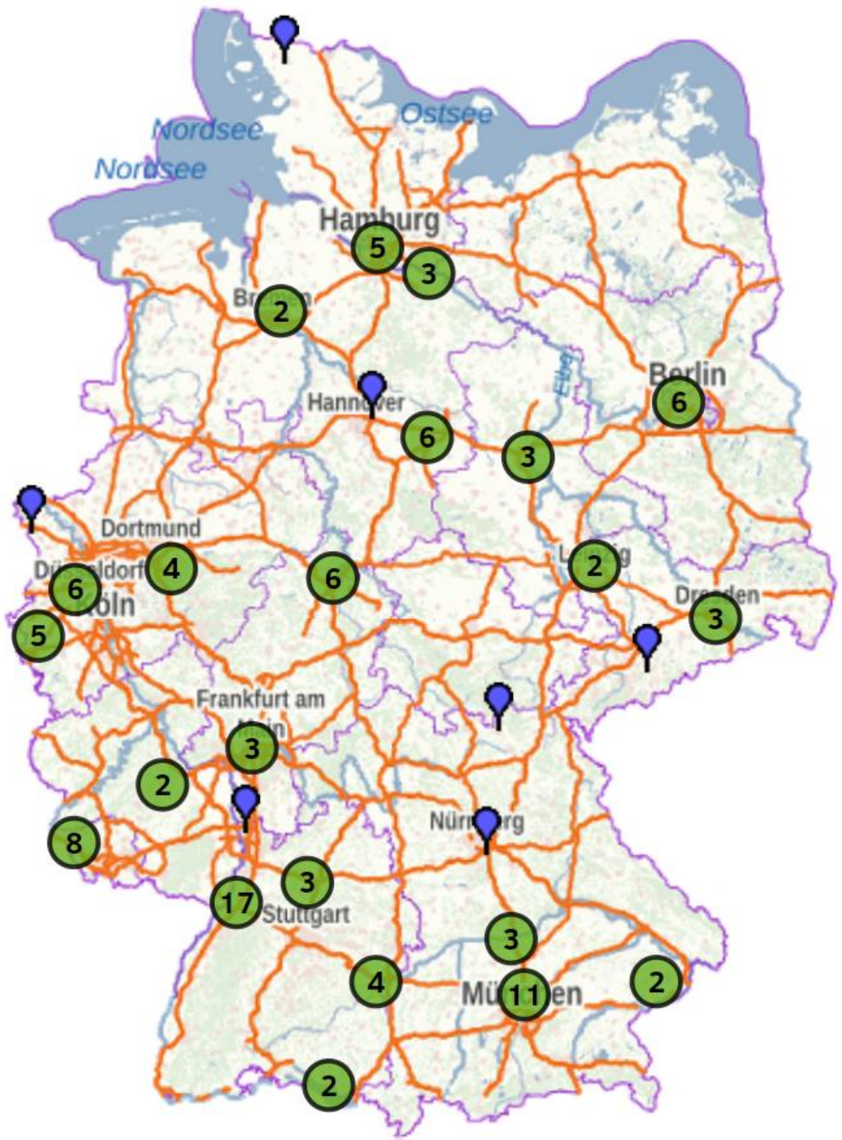


Example Motor Vehicle Traffic: Decrease | Increase 2010 to 2040

Source: DLR

Connected and Automated Driving in Real Traffic in Germany

26 Digital Mobility Test Fields
142 Digital Mobility Projects



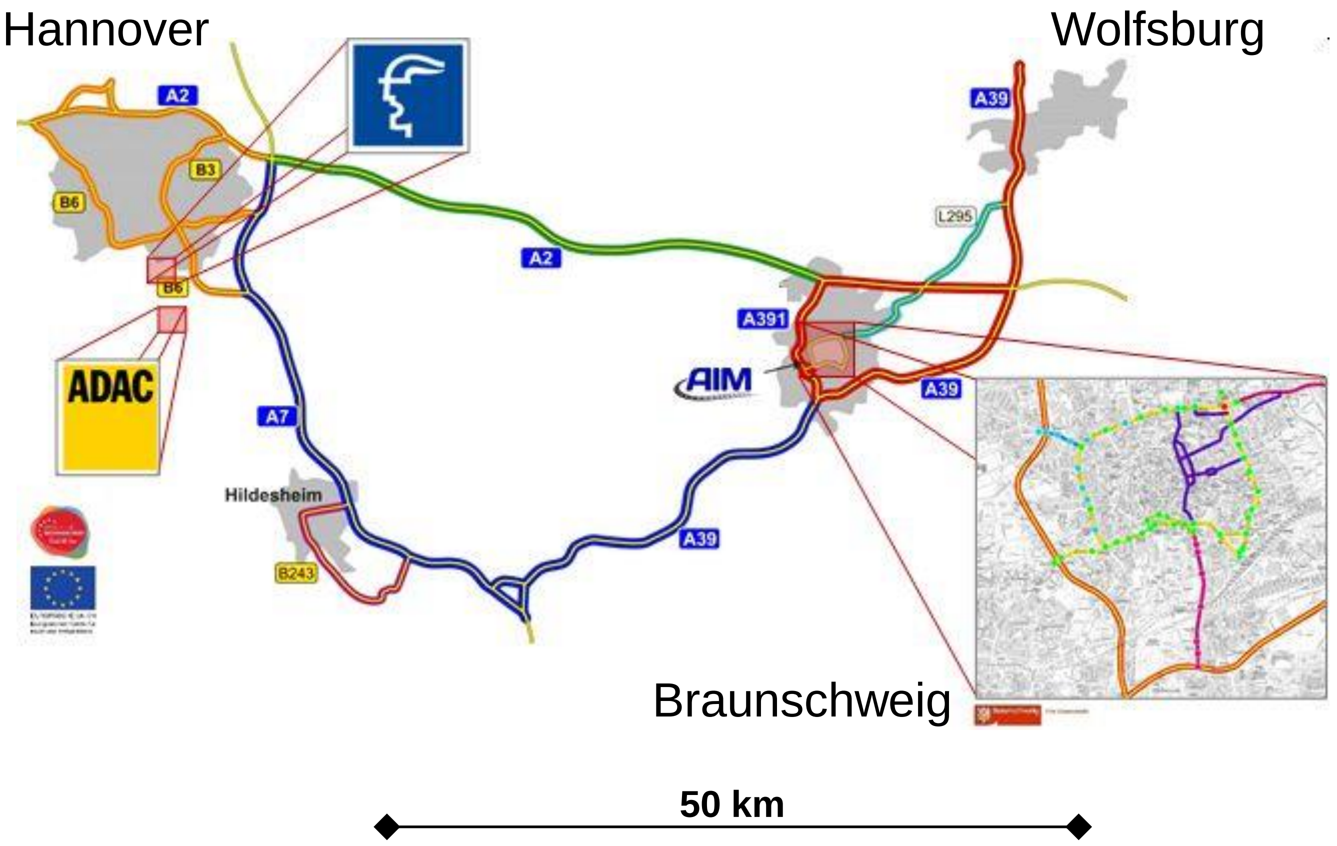
Source: Bundesanstalt für Straßenwesen (BAST): https://www.testfeldmonitor.de/Testfeldmonitoring/DE/Home/home_node.html (retrieved 07 Oct 2021)

AIM 2009 2014 2024

TESTFELD NIEDERSACHSEN 2014 2019 ... 2029
Für automatisierte und vernetzte Mobilität

Application Platform Intelligent Mobility & Test Field Lower Saxony

- **Various types of roads** (280km)
- **Road capturing units –** anonymized acquisition of traffic objects and their trajectories → Ground Truth
- **Communication technology –** Car2X via WiFi 802.11p and cellular radio
- **Maps –** highly accurate and up-to-date for simulations and real vehicles
- **Scenarios and models –** parameterizations and sub-models for setting up ecologically valid simulations
- **Interfaces to signal and detection technology and to information systems –** connection to traffic control technology or traffic management
- **Background systems –** data management and provision of online services
- **Cadastre for the condition of the test field –** documentation of the test field quality



Source: DLR

Application Platform Intelligent Mobility & Test Field Lower Saxony

Source: DLR

Finding Solutions for an extreme high Amount of Challenges

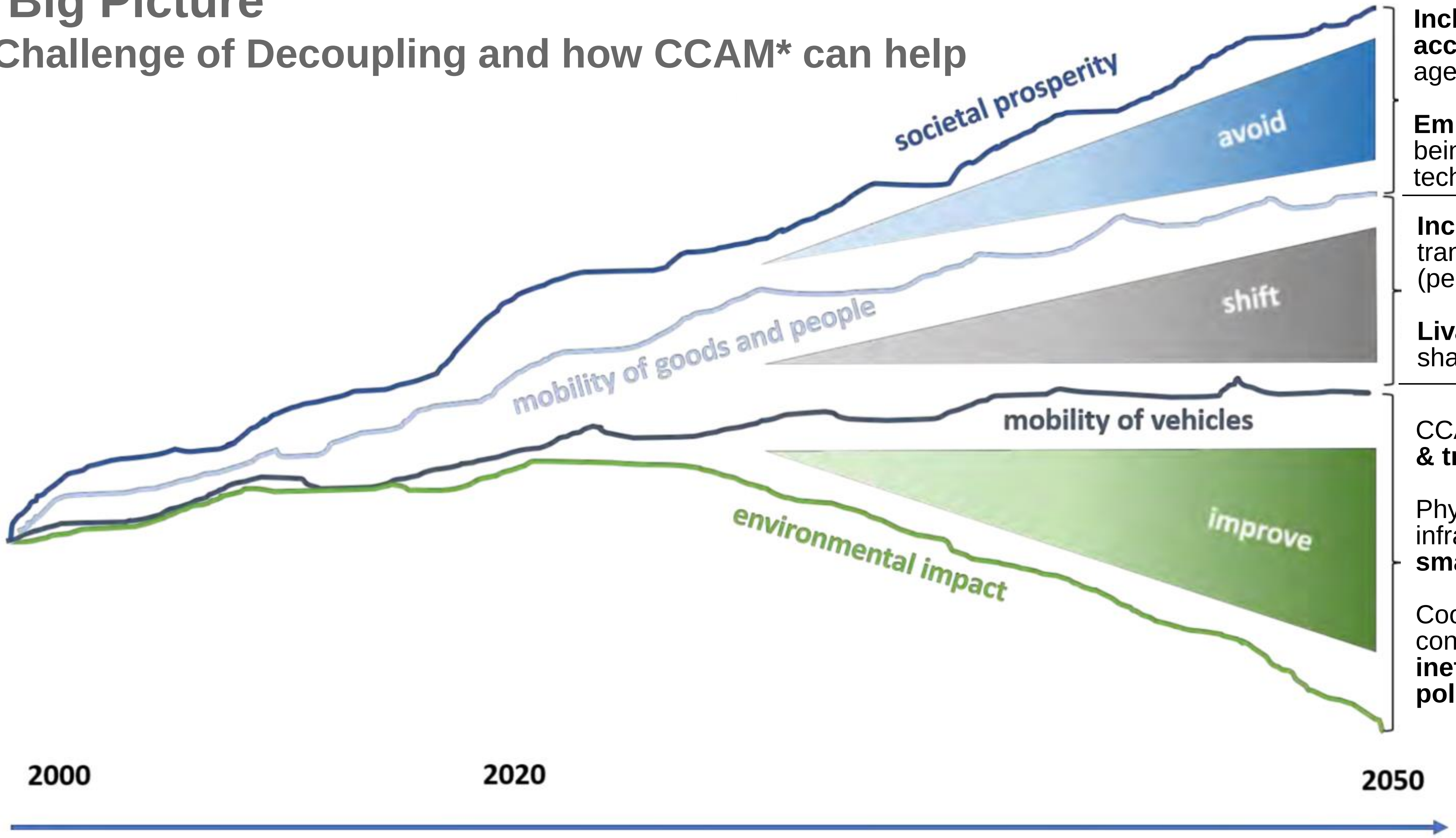
Challenges are e.g.
- ✓ Dealing with uncertainties
  - in the detection area
  - outside the detection area
- ✓ Dealing with unknown situations outside the defined operational design domain (ODD)

Solution approaches e.g.
- ✓ **Technical supervision**
- ✓ Remote operation
- ✓ Car to Infrastructure Connectivity
- ✓ Comprehensive fleet learning

Example: **Technical Supervision** - Minimum Risk Maneuver, MRM

Source: DLR

The Big Picture
The Challenge of Decoupling and how CCAM* can help



Inclusion and accessibility in an ageing society

Employment in Europe being world leader in CCAM technology

Increased efficiency of transport flows (people and goods)

Livable cities based on sharing mobility

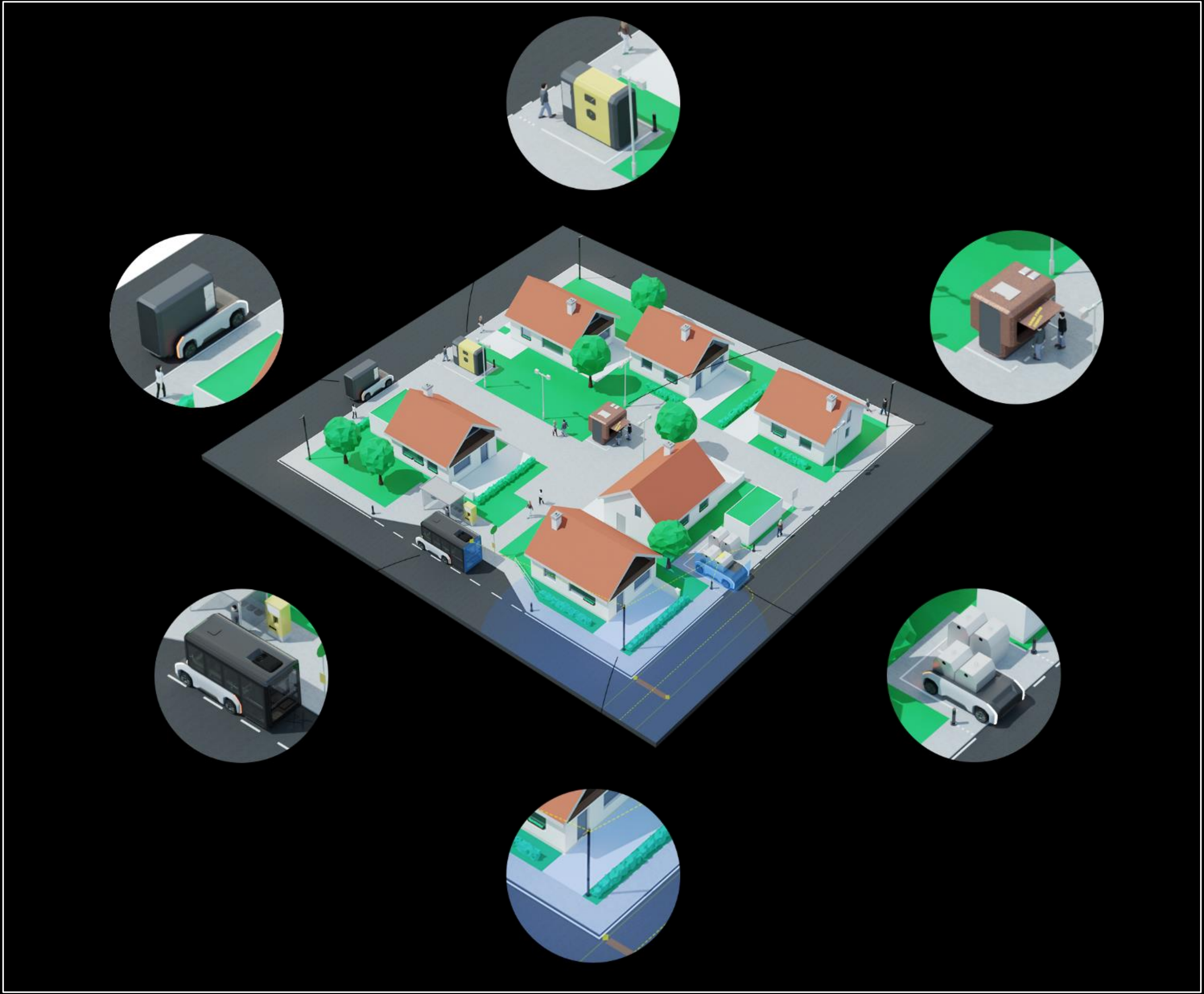
CCAM **optimizing fleet & traffic management**

Physical & digital infrastructure **enabling smart traffic**

Cooperation & connectivity **reduce inefficiency and pollution**

Source: Conference of European Directors of Roads (CEDR), Working Group Connectivity, Automation and Data (CAD)

*CCAM: Cooperative, Connected and Automated Mobility



Autonomous mobility in urban and suburban areas. Source: DLR

Introducing Industry 4.0 into Mobility
Towards 24/7 Operation – Taking Mobility to a Higher Level

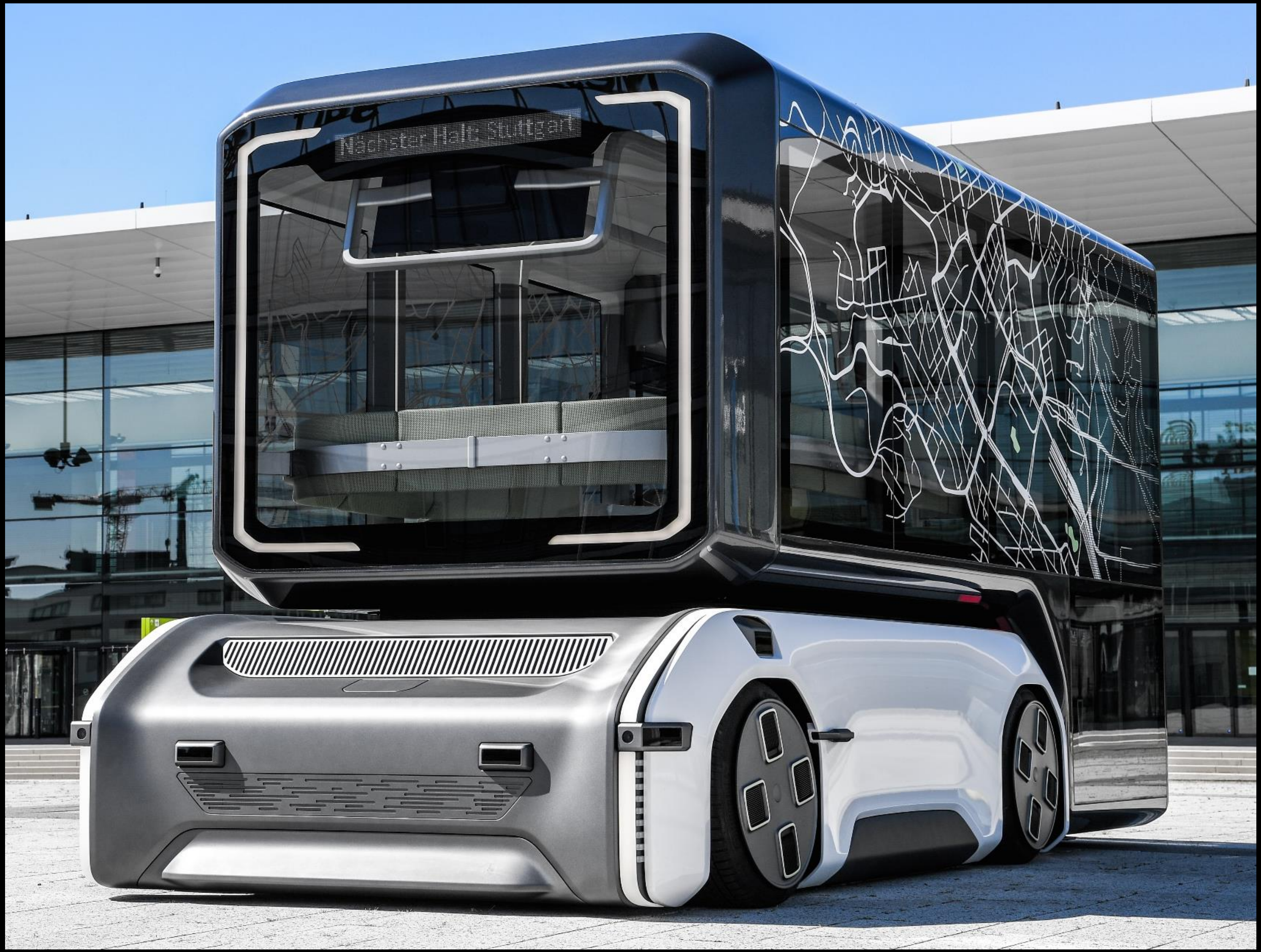
Four Design Principles
- Interconnection
- Information transparency
- Technical assistance
- Decentralized

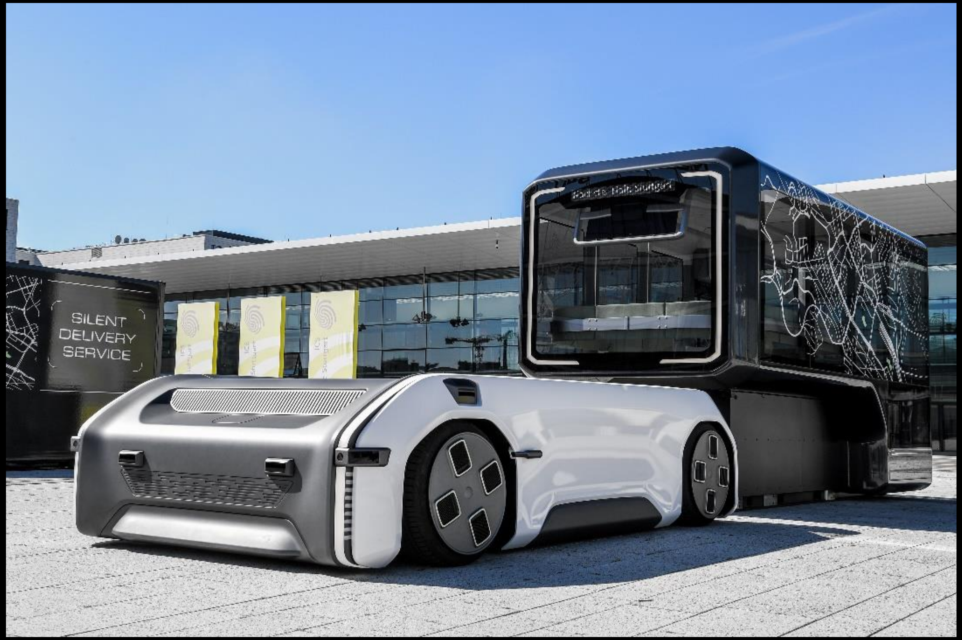
Four Major Technology Components
- Cyber-physical systems
- Internet of things (IoT)
- On-demand availability of computer system resources
- Cognitive computing

➔ **Managed Automated Driving**

Source: DLR

DLR





U-Shift, size: 3.5t.
Source: DLR

U-Shift

Economical Urban Mobility Concept

24/7

Modularization “on the road”

High flexibility and adaptability

Partner: DLR Deutsches Zentrum für Luft- und Raumfahrt, FKFS, KIT, ulm university universität uulm

Managed Automated Driving
Increase of Complexity and Benefits

Location of Data Processing
many variants: vehicle, infrastructure, cloud

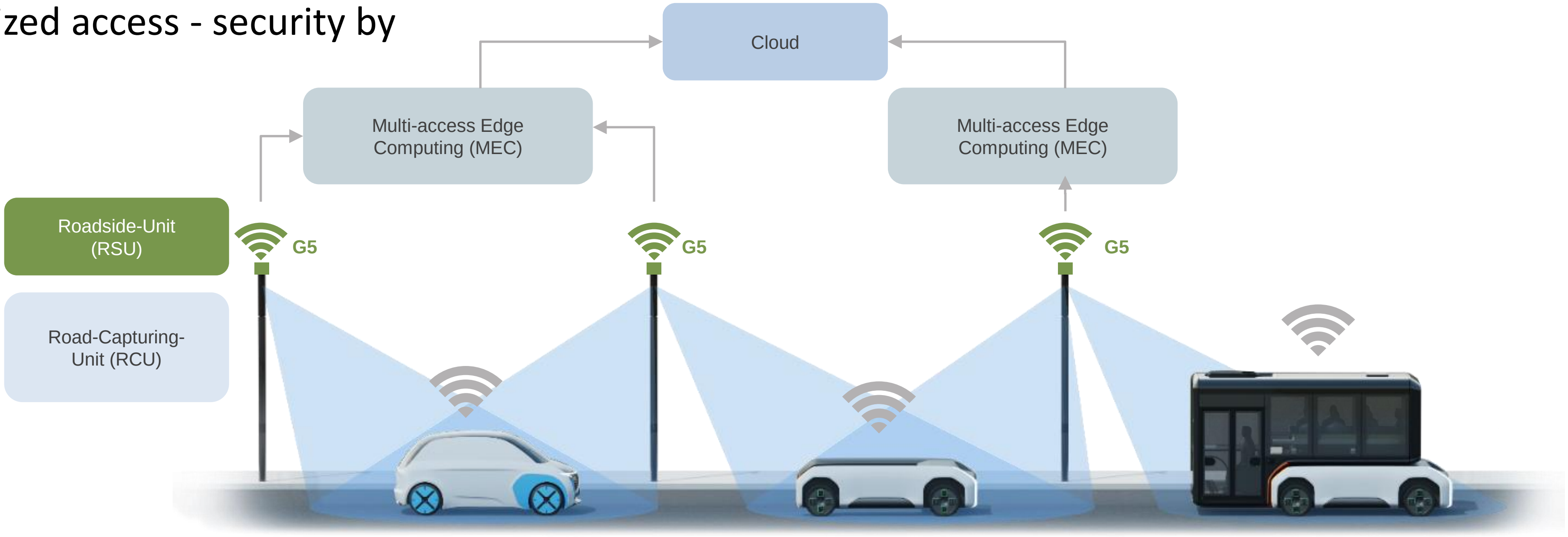
Data Security
- Technology for anonymization - privacy by design, e.g. faces / license plates
- Protection against unauthorized access - security by design
- Regulation of access rights
- Legal regulation like GDPR

Acceptance / Certification

Ownership & Operation

Business Models

. . .



Possible architecture concept for managed automated driving with control center, data processing in the cloud.

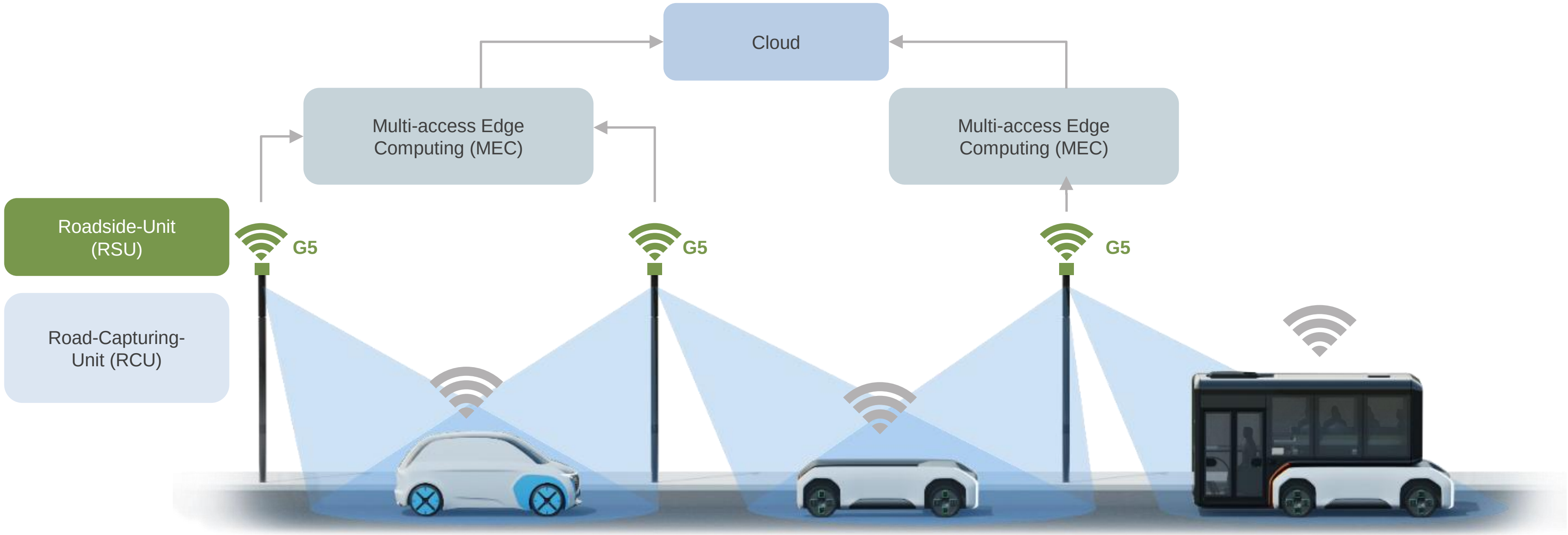
Picture: DLR

Managed Automated Driving
Increase of Complexity and Benefits

Higher safety and efficiency in mixed traffic

Local zoning

Stepwise introduction !



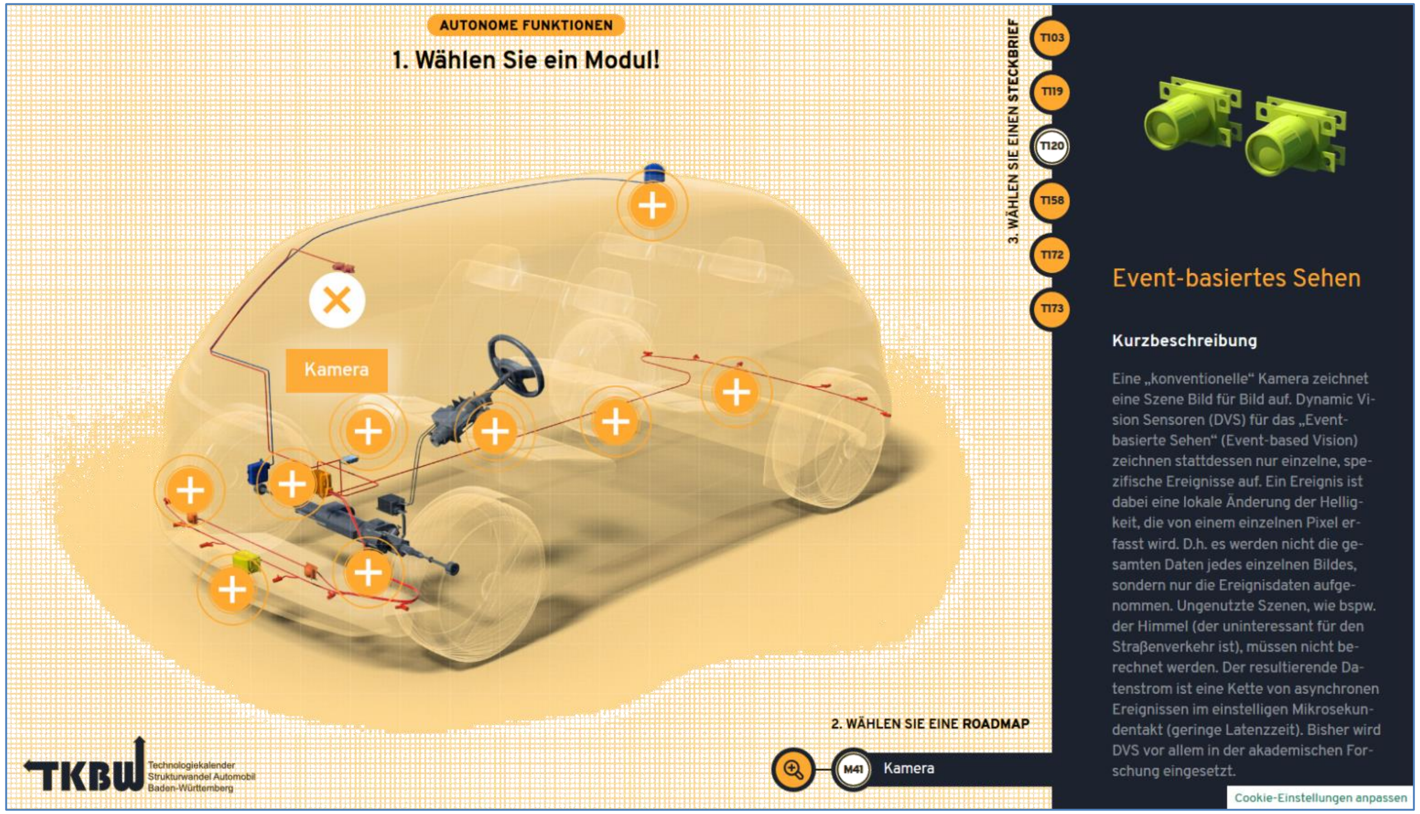
Possible architecture concept for managed automated driving with control center, data processing in the cloud.

Picture: DLR

Automated Driving Technologies

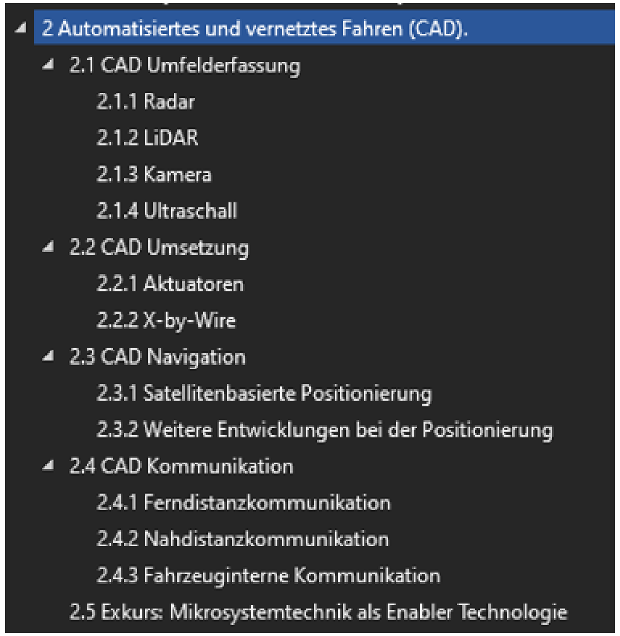
Technical Roadmap & Guidance for Industry

Click & Learn “Upcoming Technologies”



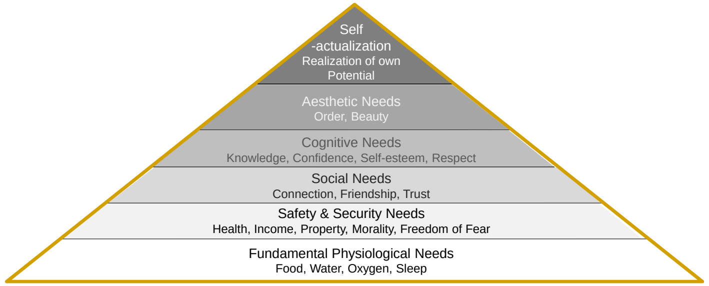
https://www.transformationswissen-bw.de/technologiekalender-app#/

Pilot Point “Transformation Knowledge”



Source: DLR

The Hierarchy of Human Needs
Dialogue with Civil Society



Technology or a transport innovation alone does not lead to a transformation of the transport system. User acceptance makes the difference.

Mission

- Active dialogue on the vehicle concept with potential future users
- Recording of ideas for use cases of the U-Shift as well as related questions and suggestions
- Enable room for questions and feedback

Source: DLR

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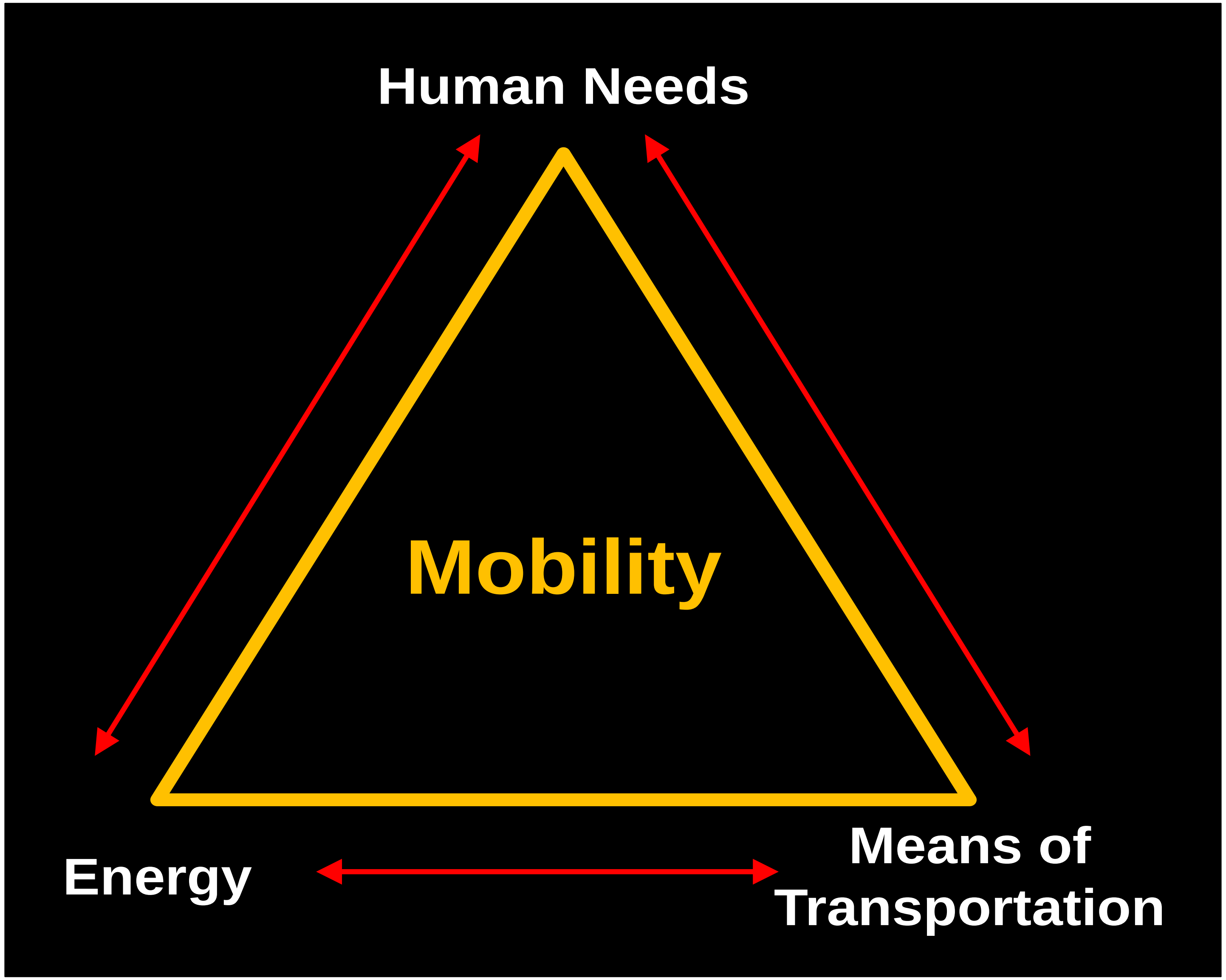

Source: DLR

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