BUILDING BLOCKS OF CONNECTED & AUTOMATED MOBILITY SERVICES

Use cases for the mobility of tomorrow

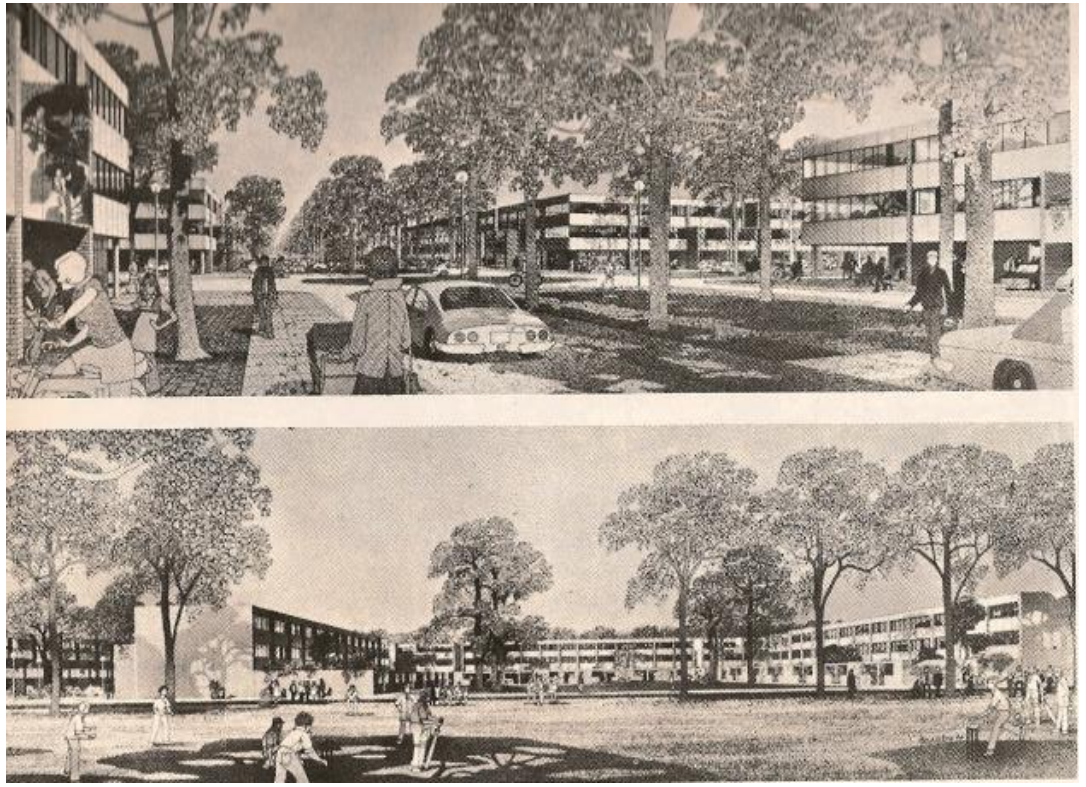
Convention A, 23.9.2022
Michael Ortgiese

DLR

Agenda

- Services and conditions for the market launch
- Building blocks for automated mobility Services
- Validation and Verification: Test beds and simulation

A Picture of the Future



Source: Bosch, Benevolo

Building Blocks for Smart Mobility

New definition of public transport

Public Transport & New Vehicle Concepts	Flexible Services	Sharing

- Public transport is the back bone of a future mobility system. It takes all the transport performance
- Timetables are becoming more flexible
- Sharing will be an important complementary building block for specific activities

Building Blocks for Smart Mobility

Faces of Availability

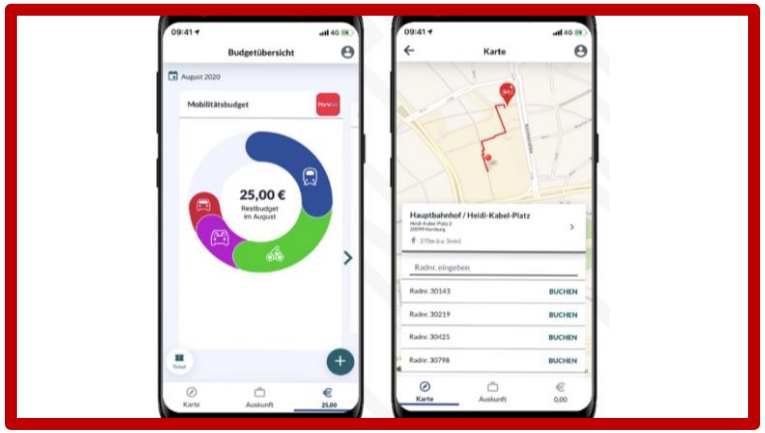
Micro Mobility (not solely shared)	Servcie2People	Digital Services
		

- Micro mobility will contribute its part. Bicycles are key for short distance mobility.
- Service2People – finally an alternative for thinly populated areas?
- Digital Services gain importance, but do they reduce routes?

Building Blocks for Smart Mobility

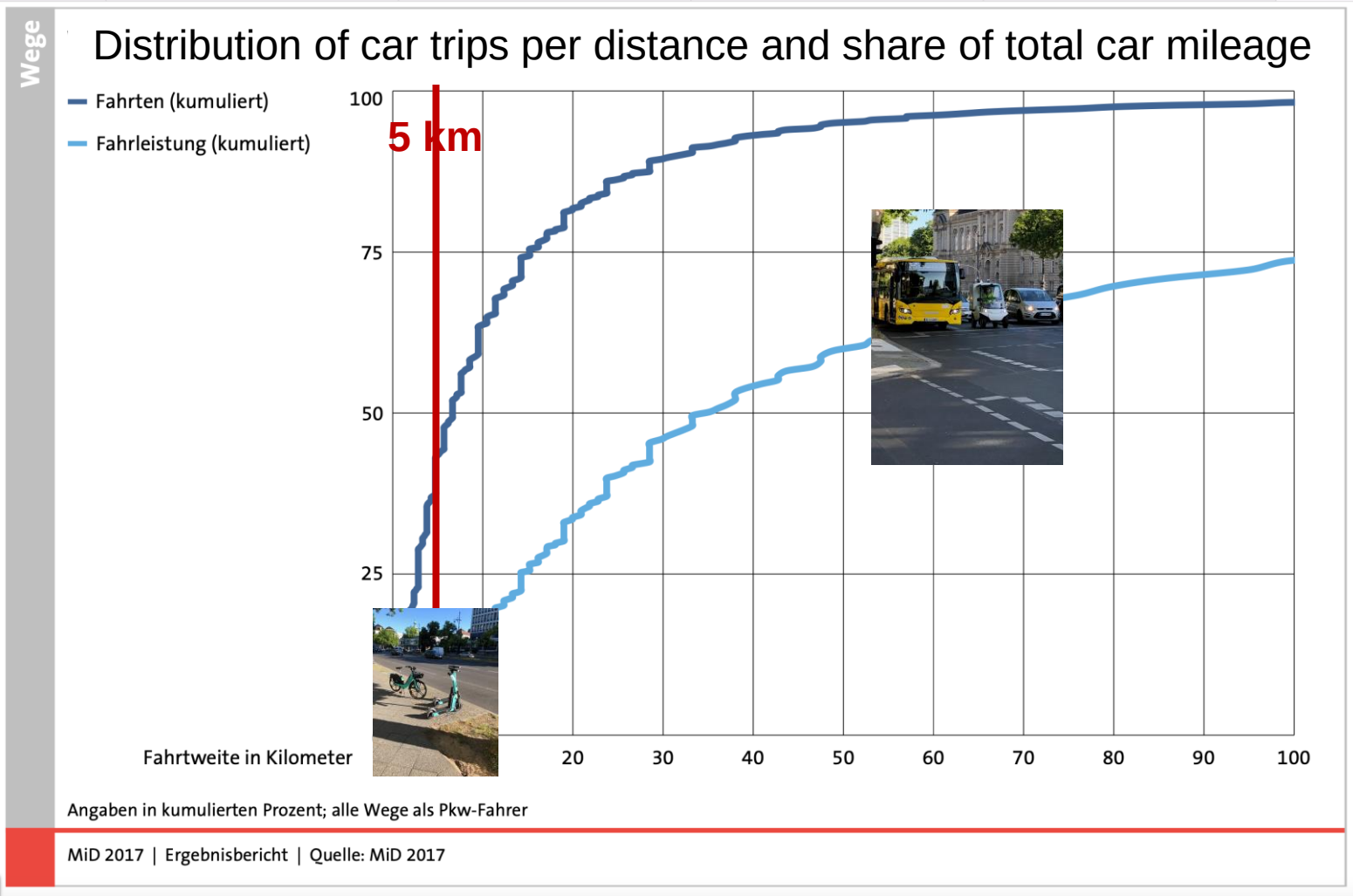
Digitalization & Automatization

Connecting Services (Information, Booking, Billing)	Automatization	Logistic Concepts

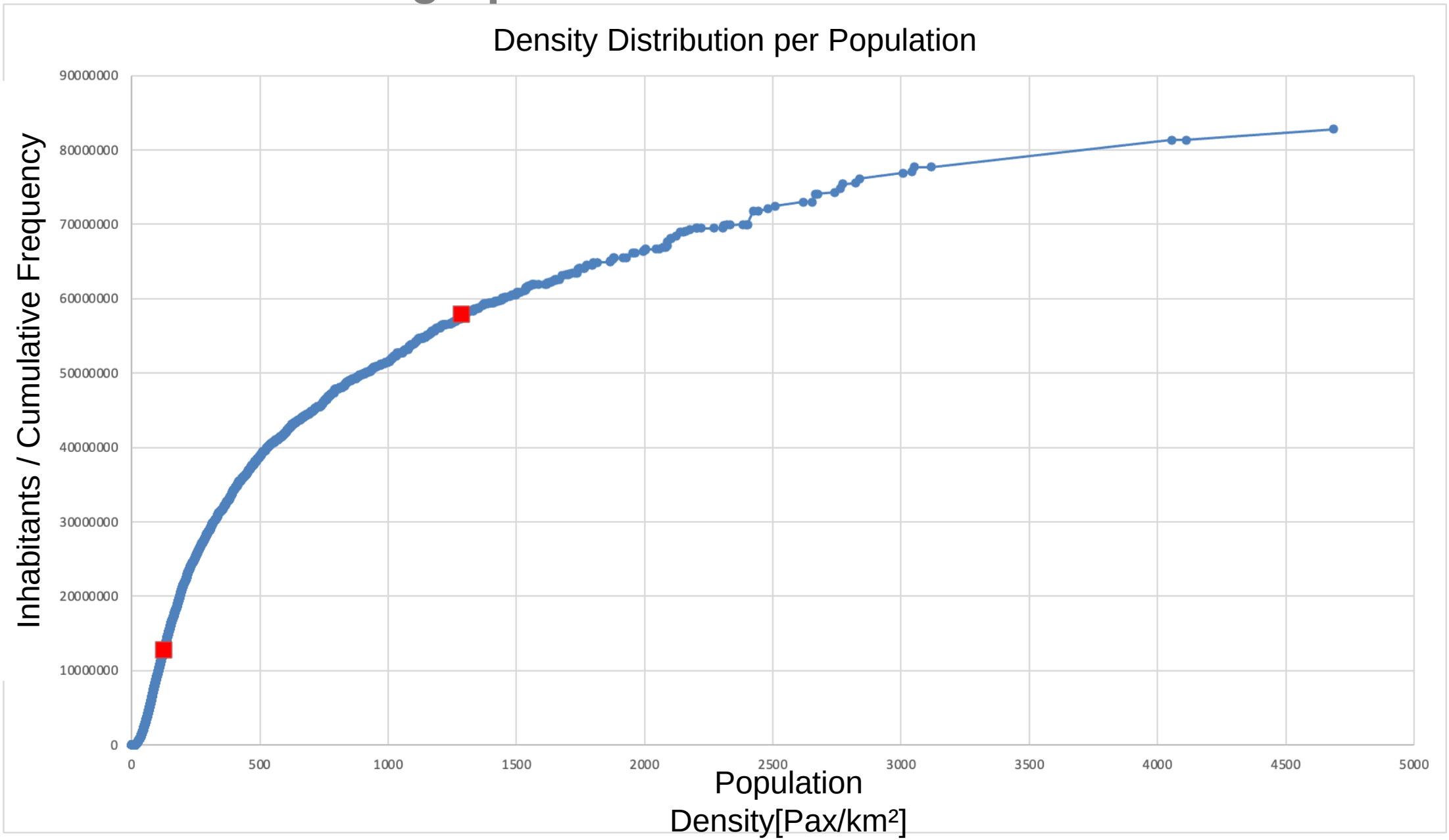


- Service offers will be digitally connected but physical offers still have to be attractive!
- No way around automatization, but there have to be more and more use cases.
- Logistics gain importance – options for combined transport have to be checked.

How big are the shift potentials really?
Trips versus traffic performance



Offers and Geographical Structures



Offers and Geographical Structures

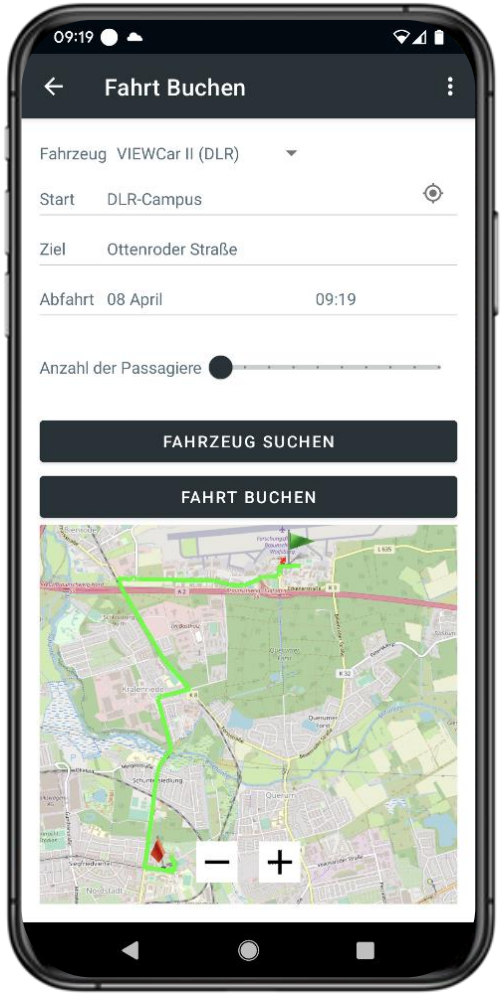
Agenda

- Services and conditions for the market launch
- Building blocks for automated mobility Services
  - Virtual Stops
  - Vehicle-Pedestrian Interaction
  - Vehicle-Cyclist Interaction
  - Prioritization of emergency vehicles
- Validation and Verification: Test beds and simulation

Virtual Stops

Smartphone APP

Booking

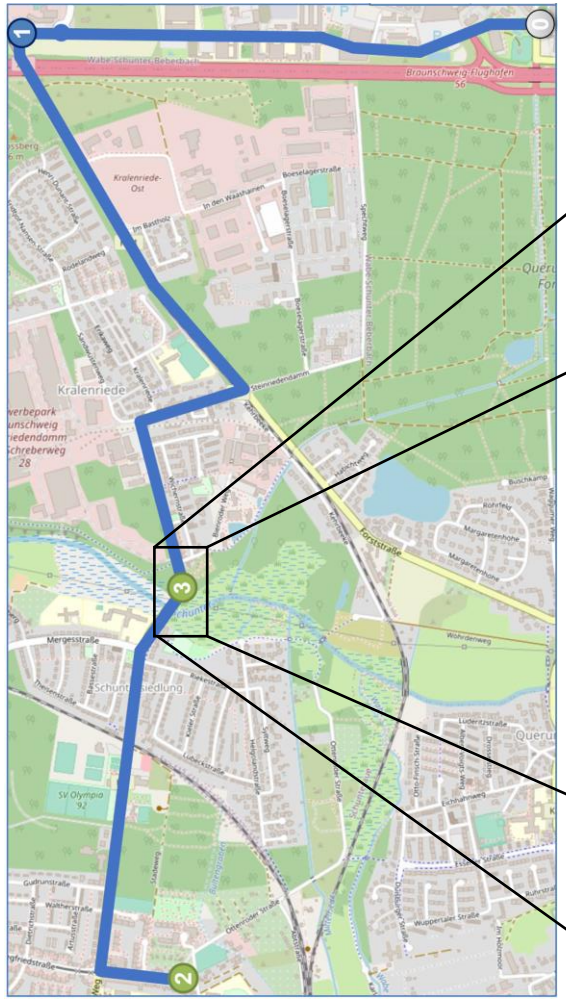


Navigation

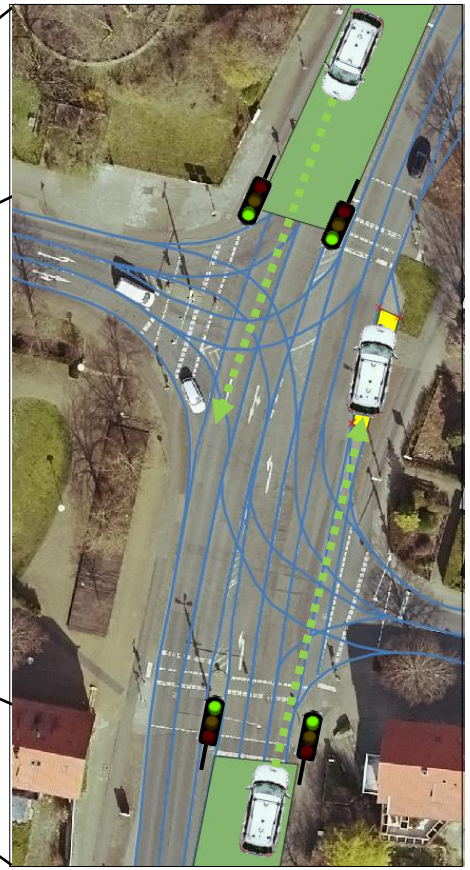
Virtual Stop

Prioritization of Public Transport with ITS-G5 V2X

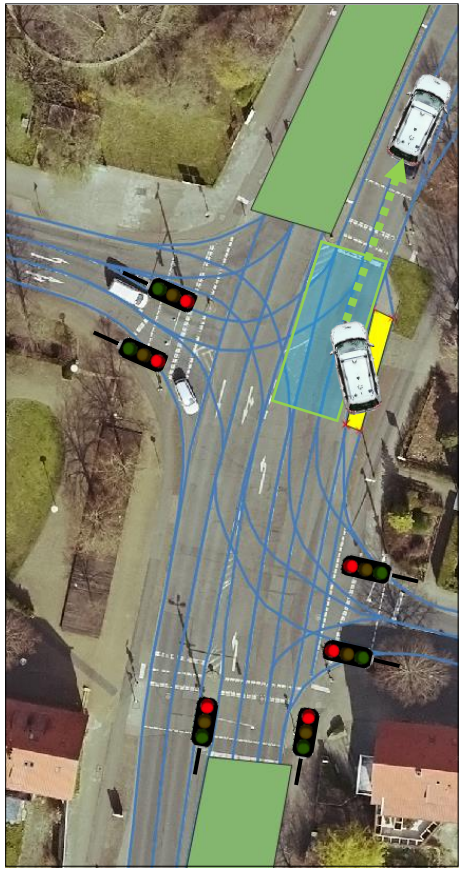
Tostmannplatz, Braunschweig



Use Case 1: Shuttle-Prioritization



Use Case 2: Safe Exit from Parking Spot



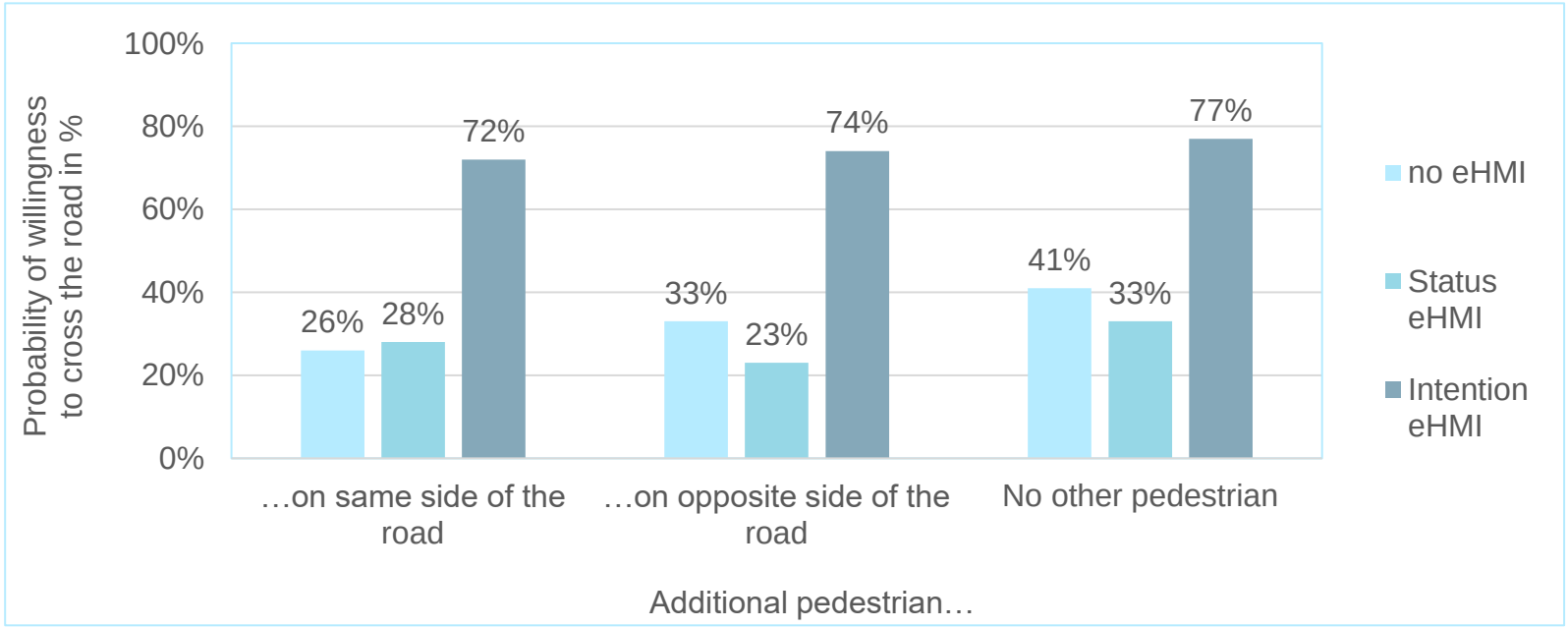
- Shuttle sends V2X-SREM (**S**ignal **R**equest **E**xtended **M**essage) message of prioritization request
- Traffic Control (AGLOSA) prioritizes shuttle at intersection
- Realization and demonstration at Tostmannplatz in Braunschweig

Human-Centred Evaluation – eHMI for Urban Automated Driving

- Aim
  - Explore **user interaction** in AVF in **complex traffic situations**
    - Reduction of user uncertainties through iHMI (LED light band)
    - Creating trust in automation behavior
  - Explore **AVF communication with other VT**
    - Pedestrians willingness to cross
    - Increase in perceived safety
- Research goal
  - Description of **natural communication and interaction** in **real traffic** and in **virtual laboratory environments**
  - **Identification of relevant scenarios** and suitable parameters

Human-Centred Evaluation – eHMI for Urban Automated Driving

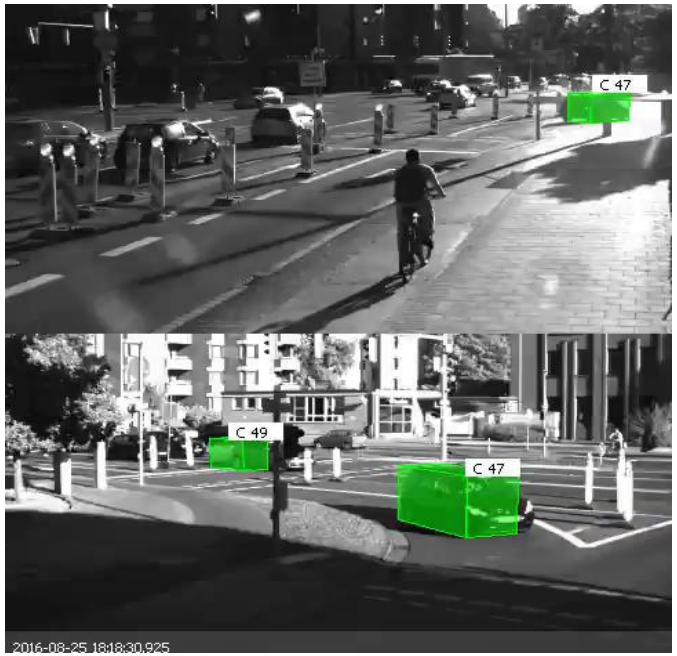
- Results
  - Pedestrians are more willing to cross
  - Increase in perceived safety - even when several road users are present at the same time in complex traffic situations

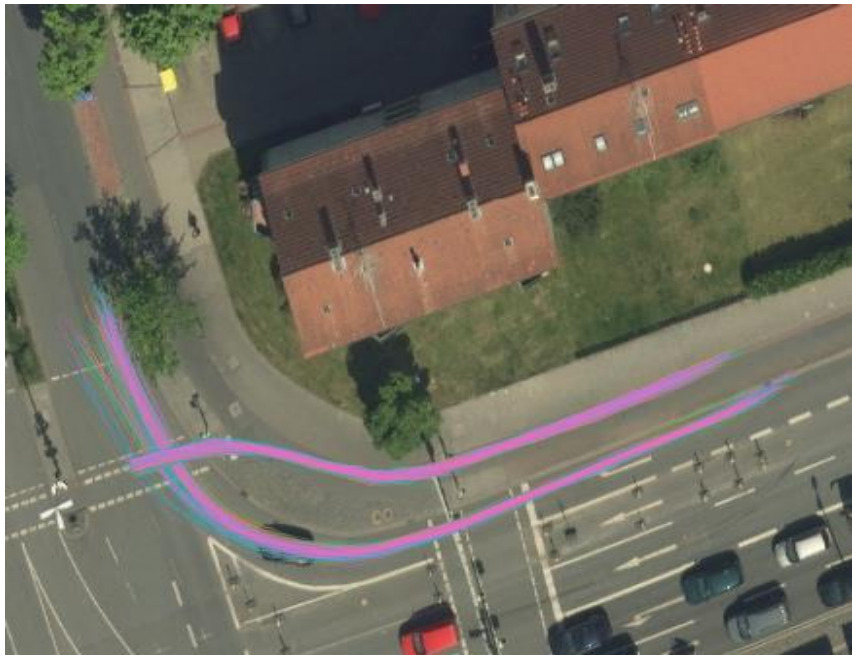


Wilbrink, M., Nuttelmann, M. & Oehl, M. (2021, September). Scaling up Automated Vehicles' eHMI Communication Designs to Interactions with Multiple Pedestrians – Putting eHMIs to the Test. 13th International Conference on Automotive User Interfaces and Interactive Vehicular Applications. Association for Computing Machinery, New York, NY, USA, 119–122. DOI:https://doi.org/10.1145/3473682.3480277

Human-Centred Evaluation – Vehicle-Cyclist Interaction at urban intersections

- Research goal
  - Description of **natural communication and interaction** in *real traffic* and in *virtual environments*
  - Identification of **relevant scenarios** and **suitable parameters**



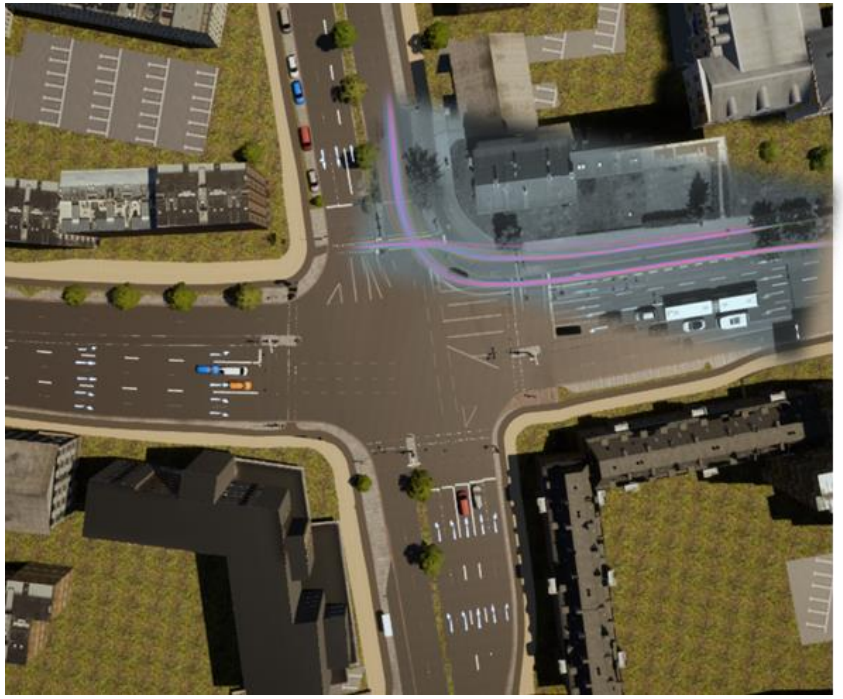


(2.2) @CITY Human-Centred Evaluation – Vehicle-Cyclist Interaction at urban intersections

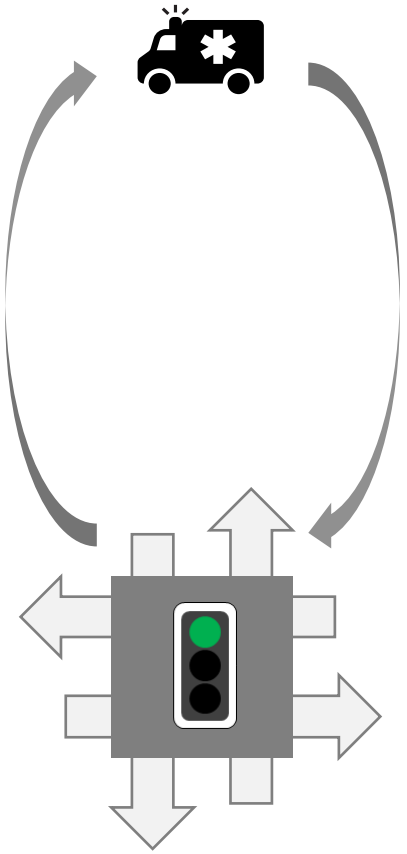
- Research goal
  - Description of **natural communication and interaction** in *real traffic* and in *virtual environments*
  - Identification of **relevant scenarios** and **suitable parameters**







Research Concept Prioritization of Emergency Vehicles
Holistic coverage

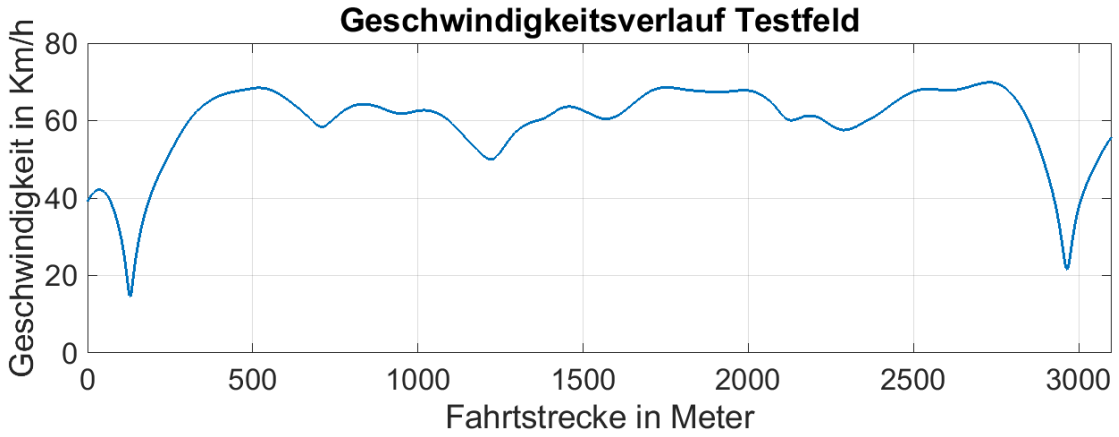


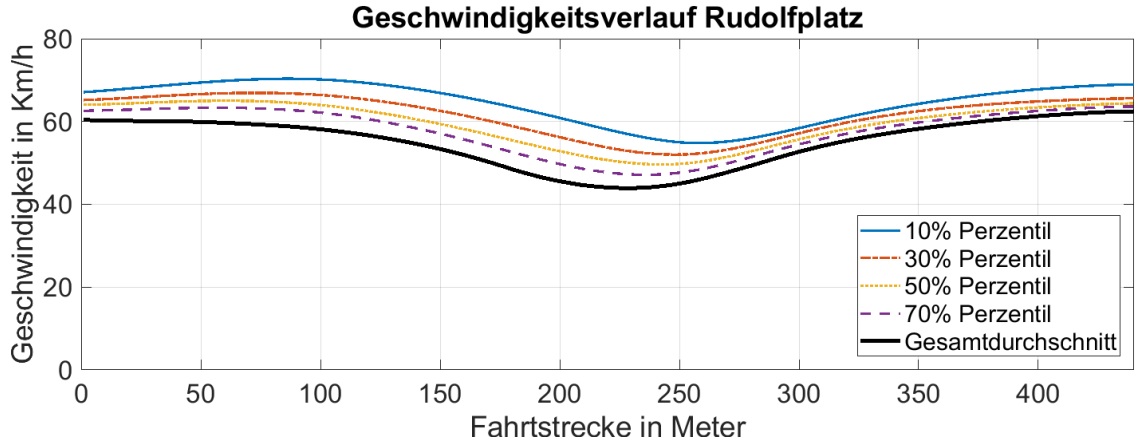
Vehicle

Communication

Traffic Management

BOS-Velocities at Test Bed





- Nodes as problem areas
- Assumption: Prioritization leads to higher mean journey time → reach higher percentile

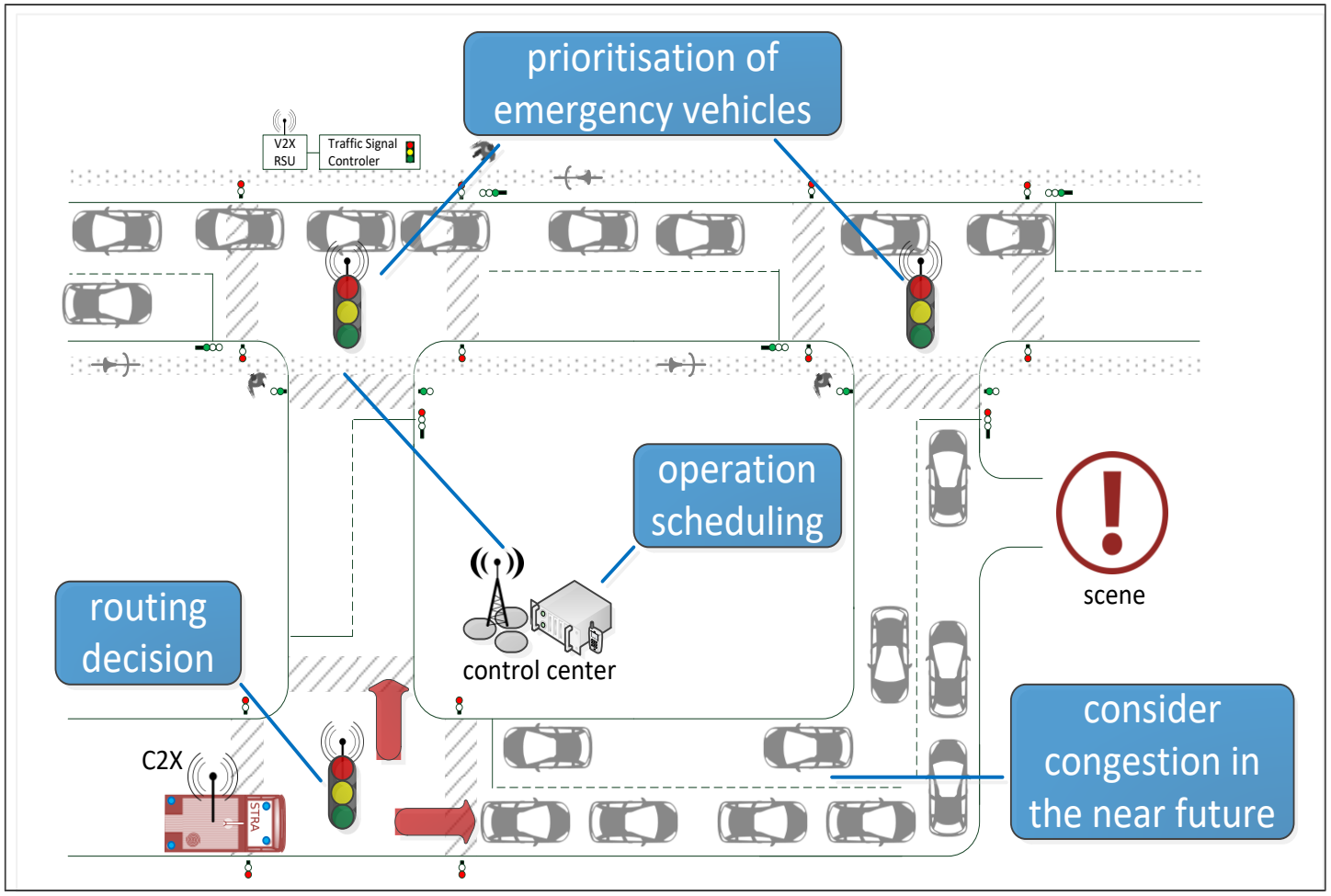
Perzentil	Mittlere Durchfahrtszeit (s)	Zeitgewinn (s)	Prozentualer Gewinn (%)
10%	26,76	5,67	17
30%	28,08	4,35	13
50%	29,12	3,13	9
70%	30,13	2,3	7
100%	32,43	-	-

Durchfahrtzeiten Rudolfplatz

Data and Graphs: Feuerwehr Braunschweig

SIRENE
Project Idea

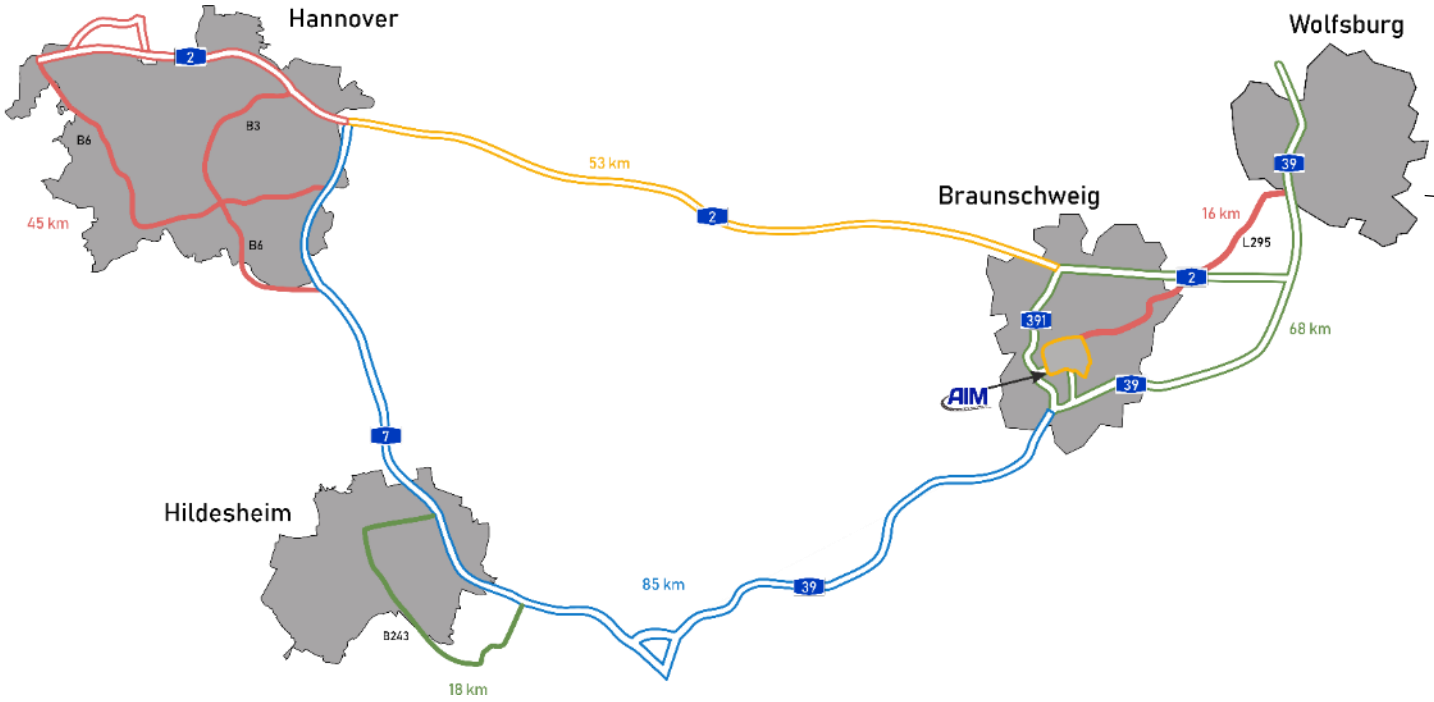
- Linking the rescue control system with traffic situation monitoring, routing and traffic light prioritization
- Dispatching of emergency vehicles taking the route into account
- Optimisation of traffic flow at the traffic light
- Use of different traffic light control strategies

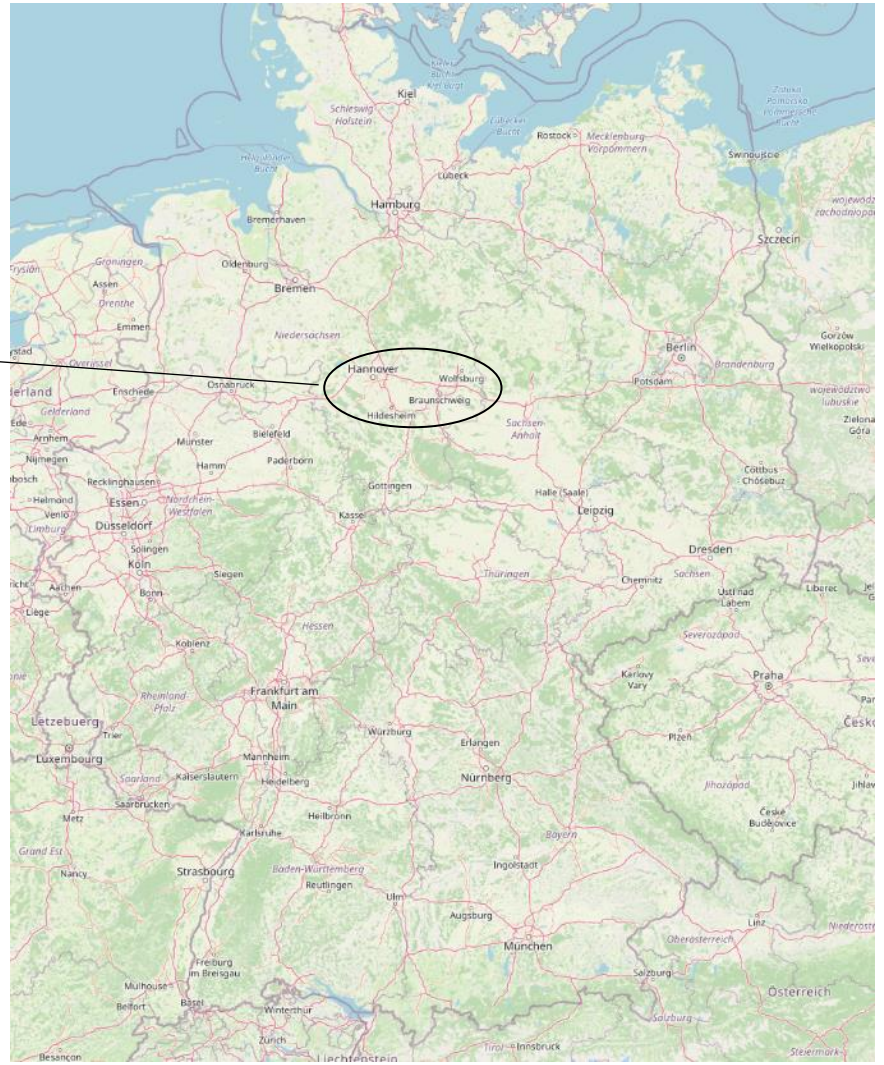


Agenda

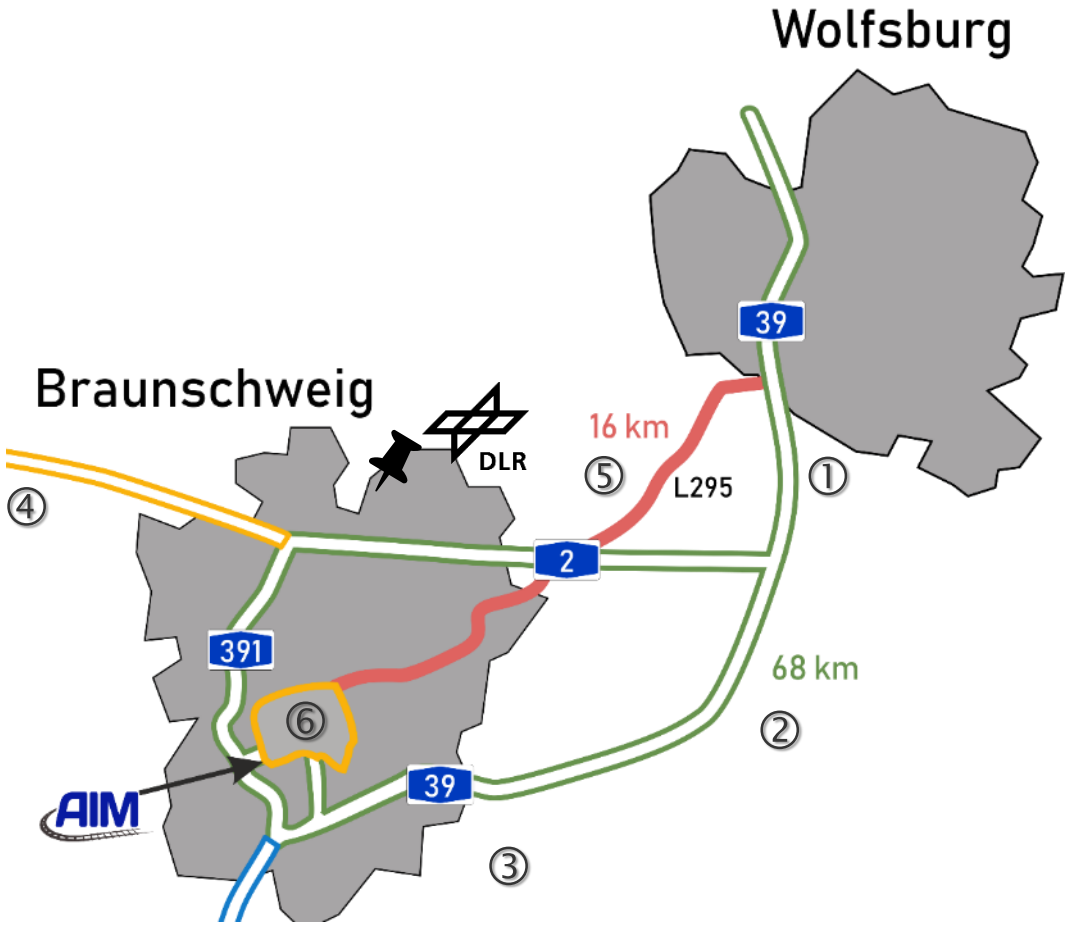
- Services and conditions for the market launch
- Building blocks for automated mobility Services
- Validation and Verification: Test beds and simulation

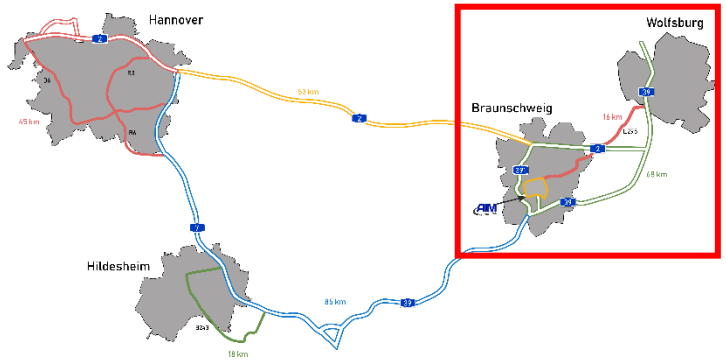
Test Bed Lower Saxony
Location





Test Bed Lower Saxony
Overview





②, ⑥ **Camera-based traffic detection**
Vehicles, other objects, environment

②-④, ⑥ **Communication technology**
V2X via 4G/5G and WLAN (802.11p)

①-⑥ **Maps**
high precision and up-to-date digital maps

①-⑥ **Scenarios and models**
Scenario description, simulation models and simulation software

①-⑤ **Register for test bed status**
Test bed condition (e.g. weather, lane markings, signs, roads)

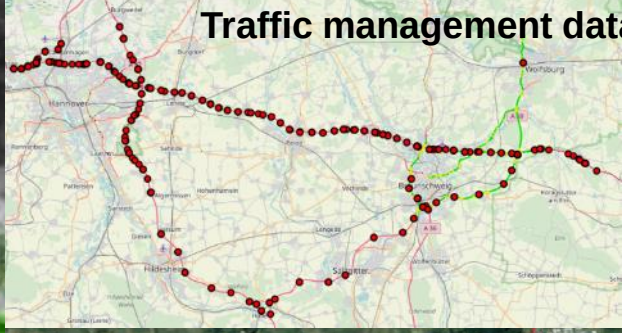
①-④ **Interfaces**
Signal- und acquisition technology
Digital road signs and existing data acquisition sensors
Traffic management information systems
Special events (e.g. road construction work) and traffic flow information

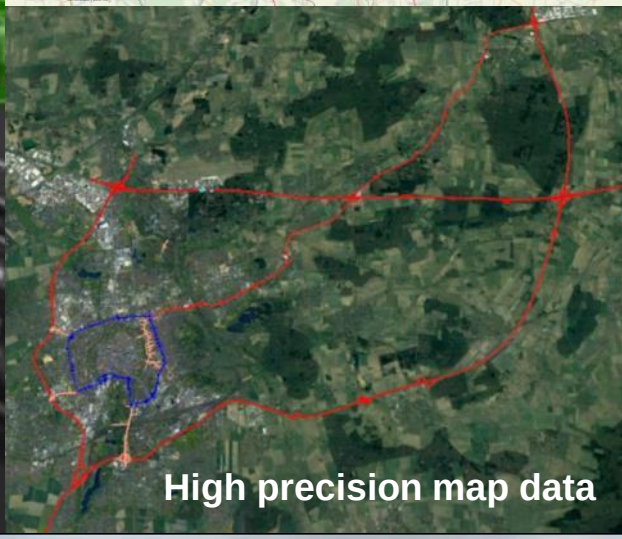
Background systems
Data management and data services

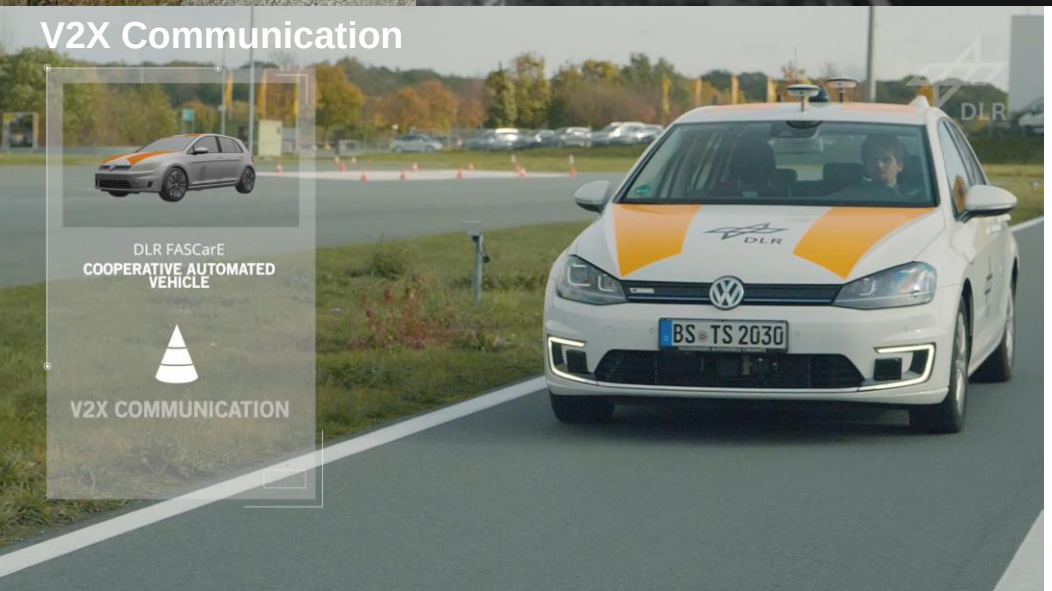
Mobile acquisition
Mobile V2X communication and traffic detection devices

https://verkehrsforschung.dlr.de/en/projects/test-bed-lower-saxony-automated-and-connected-mobility

Camera-based traffic detection


Traffic management data


High precision map data


V2X Communication
DLR FASCarE
COOPERATIVE AUTOMATED VEHICLE
V2X COMMUNICATION
DLR
BS TS 2030


Mobile data acquisition
TESTFELD NIEDERSACHSEN


Simulation - Virtual Test Bed

Test Bed Use Cases

Services \ Use Cases	Ground Truth based System Evaluation	Traffic Flow Analysis	(5) V2X "Day X" Applications	(4) Infrastructure-based V2X	Local Dynamic Map	(1) Test Scenario Identification	(2) Human-centred Evaluation	Track Condition Monitoring	(3) Sensor Validation
Camera-based Traffic Detection	✓	✓		✓		✓	(✓)		✓
Communication Technology		(✓)	✓	✓					
Maps	✓			(✓)	✓	✓	✓	(✓)	✓
Scenarios and Models							✓		
Traffic Management Information		✓	✓			✓			
Test Bed Cadastre		(✓)	✓		✓	(✓)		✓	
Background System	✓	✓	✓	✓	✓	✓	✓	✓	✓
Digital Twin		✓	(✓)	✓			✓	✓	✓

BUILDING BLOCKS OF CONNECTED & AUTOMATED MOBILITY SERVICES

Use cases for the mobility of tomorrow

Convention A, 23.9.2022
Michael Ortgiese

DLR