Senatsverwaltung
für Umwelt, Verkehr
und Klimaschutz

Berlin

SAFARI DIGITALES TESTFELD STADTVERKEHR

Automated and connected driving in Berlin-Reinickendorf

14. November 2019

Funded by:
Bundesministerium
für Verkehr und
digitale Infrastruktur

AGENDA

SAFARI DIGITALES TESTFELD STADTVERKEHR

- What is SAFARI about?
- Partners and key figures
- The Digital Urban Testbed of Berlin
- Information System for Road Data (VISS)
- Work packages and results

LET‘S START THE JOURNEY

SAFARI DIGITALES TESTFELD STADTVERKEHR

What is SAFARI about?

- Digital High Definition Maps (HD Maps) are a prerequisite for
  - Automated and connected driving/ Connected and autonomous vehicles (CAVs)
  - Data processing on many administrational departments (e,g, road maintenance, conctruction site management)
  - Real-time information services for the public and all modes (e.g. routing systems for public transport and road users, pedestrians and cyclists)

Courtesy of SenUVK

LET‘S START THE JOURNEY

SAFARI DIGITALES TESTFELD STADTVERKEHR

What is SAFARI about?

SAFARI aims at

- Developing and testing the sensory for environmental awareness and localization under real world conditions
- Deploying and testing of communicating road infrastructure and V2X-services
- Self-updating HD maps as important contribution to the digitalization of the administrational tasks and the traffic management

Courtesy of SenUVK

LET‘S START THE JOURNEY

SAFARI DIGITALES TESTFELD STADTVERKEHR

Partners and key figures

- **Strong partners located in Berlin**
  - Senate of Berlin (Senatsverwaltungen Umwelt, Verkehr und Klimaschutz und Wirtschaft, Energie und Betriebe) and District of Reinickendorf
  - Researchers DCAITI, FOKUS Fraunhofer and FU Berlin
  - Industry Leaders Hella Aglaia mobile vision GmbH and IAV GmbH
- Funding sums up to **4,3 Mio.** Euro
- 31 months of research
- Deutsche Telekom AG is associated partner

Partner

Funded by:

Bundesministerium für Verkehr und digitale Infrastruktur

SAFARI TESTBED

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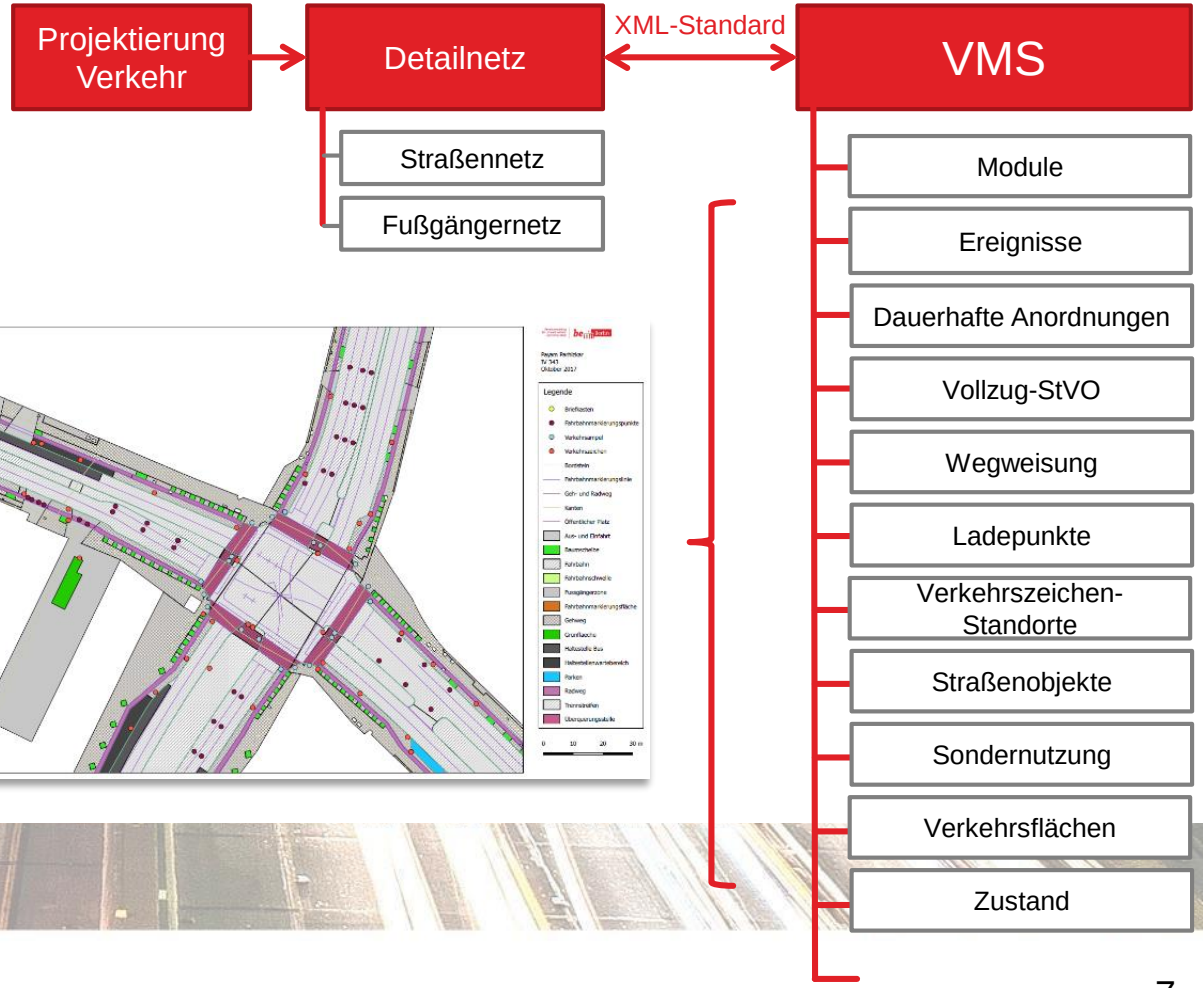
The Digital Urban Testbed Berlin

- Highly differentiated structure of the quarter (part of an highway, tunnels, 6 km main roads, 10 km side roads, separate lanes for bicycles, public transport) and highly differentiated usage of the infrastructure
- 13 traffic signal controllers at intersections and pedestrian crossings
- Technical deployment integrated in the ongoing modernisation of the traffic signal controller infrastructure
- Experienced workforce and mapping experts on Senate of Berlin and district level

HD MAPS

Information system for road data (VISS)

- Digital HD-map as basic data
- Central and unified data of the road infrastructure of Berlin
  - Connected with attributes and geo data
  - Used in all departments of the transport authority
- updated via multi-sensor **mapping data collection**
- Published via *FIS-Broker*
- additional objects had to be defined and added for SAFARI
- Research and administration in a process of bilateral learning



AP 1 PROJECT MANAGEMENT

SAFARI DIGITALES TESTFELD STADTVERKEHR

Work packages and results

- Regular meetings and workshops, weekly telephone conferences
- Excange with other testbeds
- Exchange on research and administrational level (Braunschweig, Hamburg and Ingolstadt)
- Project presentation as flyers, web site, „corporate design signage“ for test vehicle

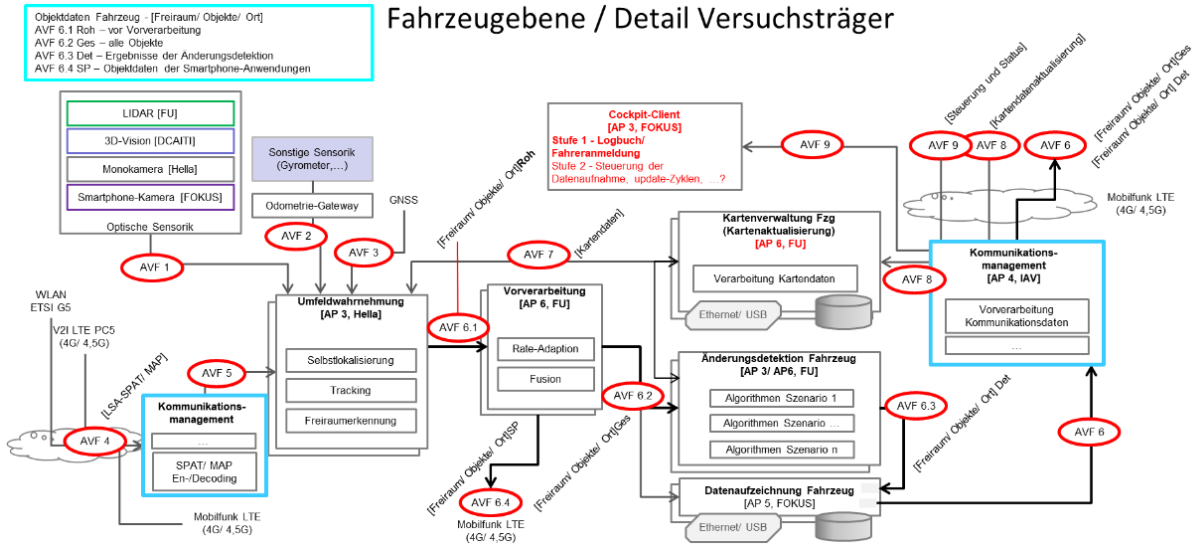
Courtesy of Hella Aglaia

AP 2 SYSTEM DESIGN SPECIFICATION

SAFARI DIGITALES TESTFELD STADTVERKEHR

Work packages and results

- Agreement on main focus of the partners
- Three layered system architecture – vehicle/road users, communication infrastructure and backend
- Set of requirements and interfaces securing interoparability
- Technical coordination of the deployment

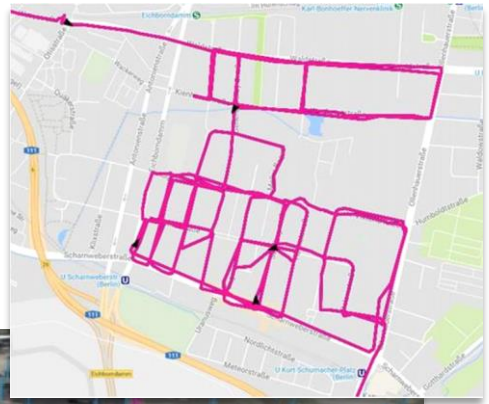


Courtesy of BLIC/ SCOPE

AP 3 ENVIRONMENTAL AWARENESS

Work packages and results

- Algorithms for self localisation, environmental awareness and object detection deployed on all test vehicles
- Technical setup of the test vehicles including a simple mono camera based detection system for a vehicle of the District of Reinickendorf
- Data acquisition in the testbed and performance tests of the sensory in different light and weather conditions with
  - Special LIDAR-Sensors
  - 3D-Vision
  - Mono camera (prototype near product level)
  - Smartphones for low-cost perception



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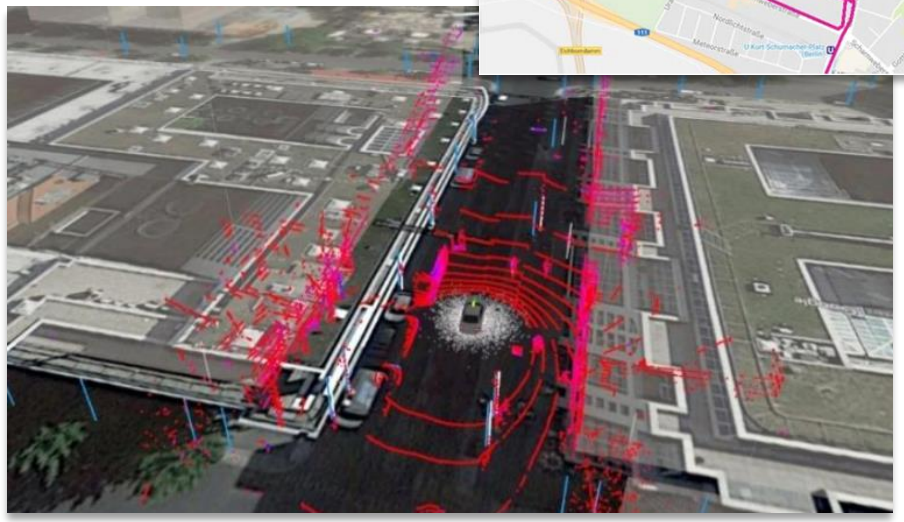
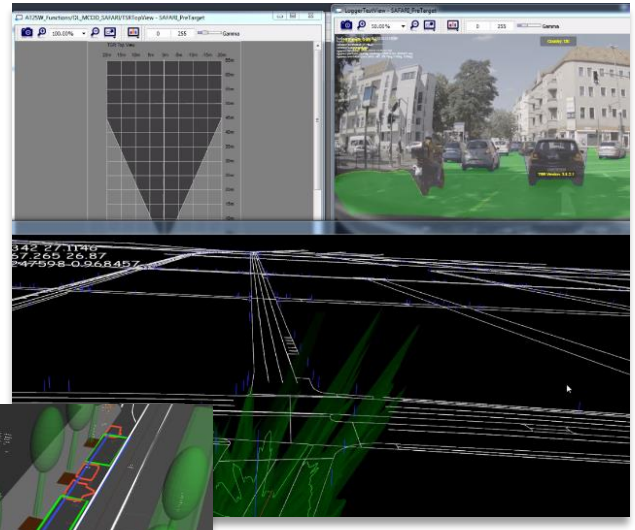


Coutesy of DCAITI

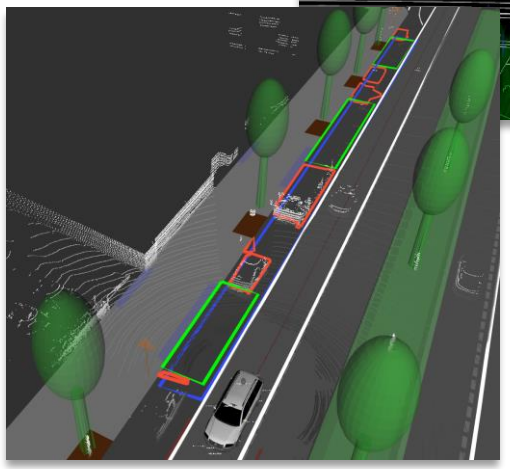
AP 3 ENVIRONMENTAL AWARENESS

Work packages and results

- comparison of land marks on the map and detected / recognized land marks in the testbed show a high accuracy of the detection algorithms or the map data
- Self localisation of the vehicles using the land marks tested successfully with three different methods (Lidar, 3D-Vision, mono camera)
- the detection algorithms are also detecting objects of road infrastructure (signs, poles, traffic lights), street funiture and free parking space
  - The map data contain information about the parts of the street on which parking is allowed
  - Either the free space is detected directly or the parked vehicles



Courtesy of Hella Aglaia

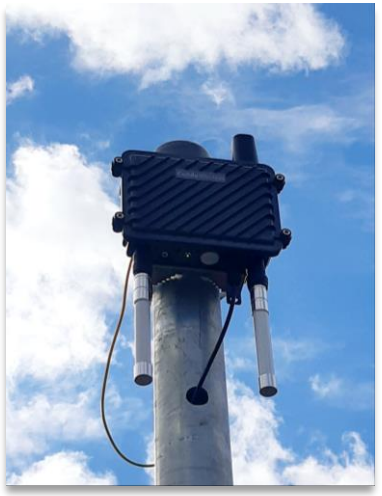


Courtesy of FU Berlin

AP 4 COMMUNICATION MANAGEMENT

Work packages and results

- Analyzing different V2X communication standards (pWLAN-V2X, mobile comm. LTE/ 4,5 G and cellular V2X) for road side units (RSU)
- Identifying and analyzing infrastrutcture elements (lamp posts, poles for signage, street furniture containing clocks, …) which could be used to install small cells
- Identifying administrative tasks regulating the deployment of RSU and small cells to guarantee electric-mechanical safety and IT-security (contracts and safety/security)
- 8 RSU and 2 Small Cells installed
- Testing and monitoring of data transmission and data



Courtesy of SenUVK

Green Light Optimal Speed Advisory (GLOSA) services are based on the SPAT/MAP information which RSU provide via V2X-communication.

Small Cells guarantee high coverage and transmission rates in a 5G network

AP 4 COMMUNICATION MANAGEMENT

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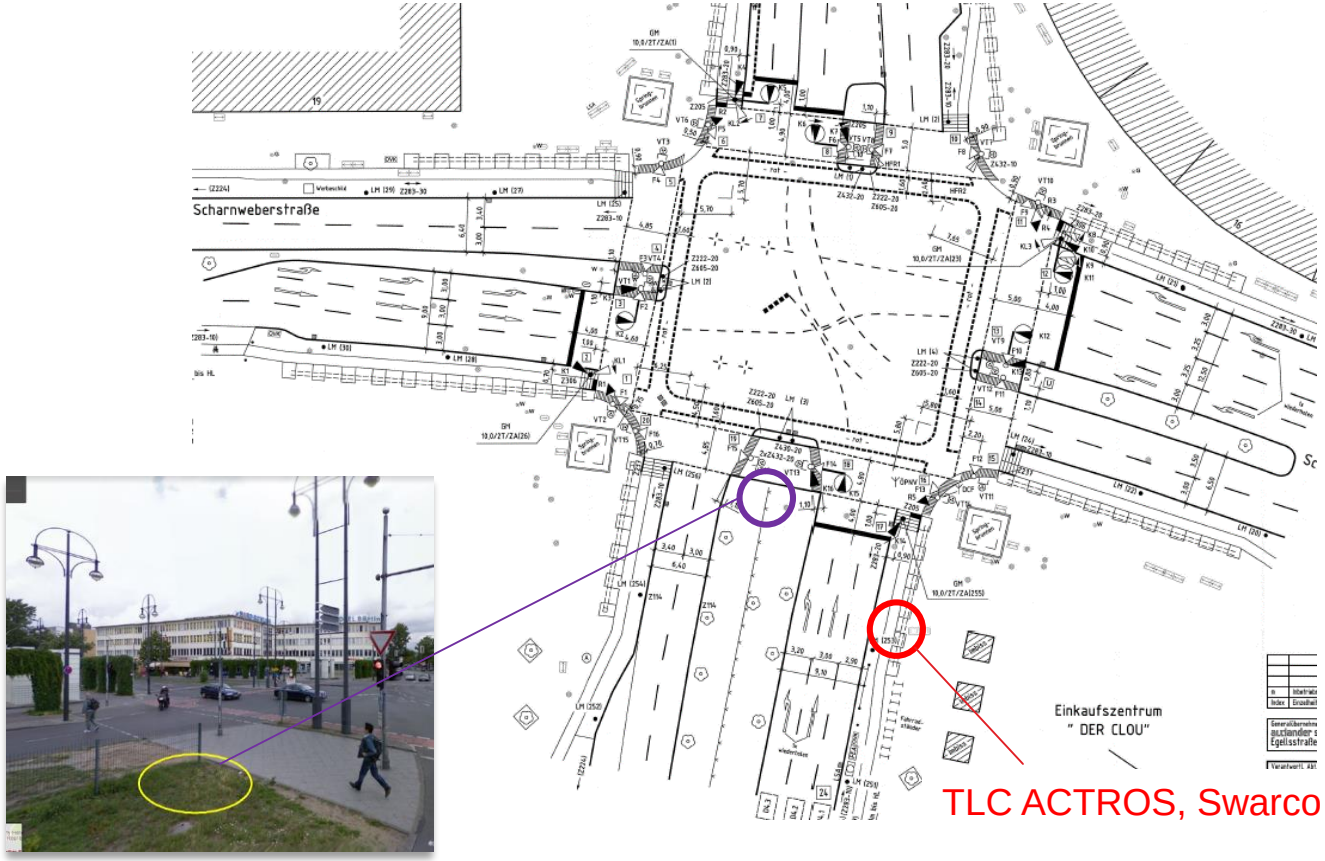
Installation of V2X-equipment at LSA 14052 Kurt-Schumacher-Platz



AP 5 SELF-UPDATING HD MAP

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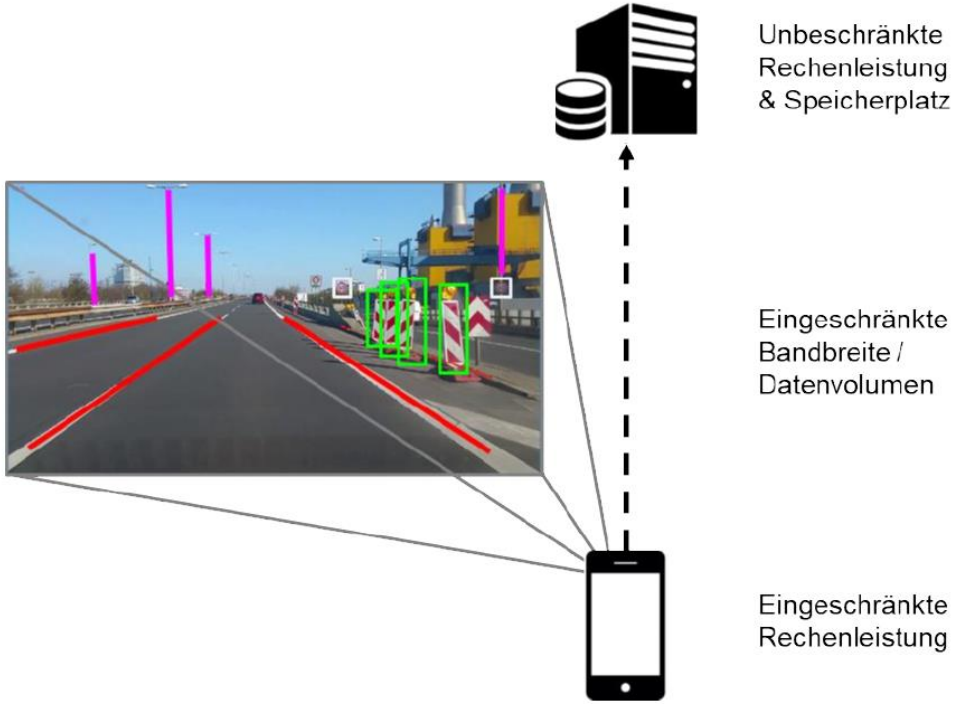
Work packages and results

- Definition and implementation of backend-environment
- Deploying online and offline data acquisition
- Deploying of change detection algorithms and refinement of the algorithms (deep learning)
- Specification of the self-updating process and necessary workflows
- Analyzing the digitalization of administrational processes regarding digital maps, road maintenance and traffic information



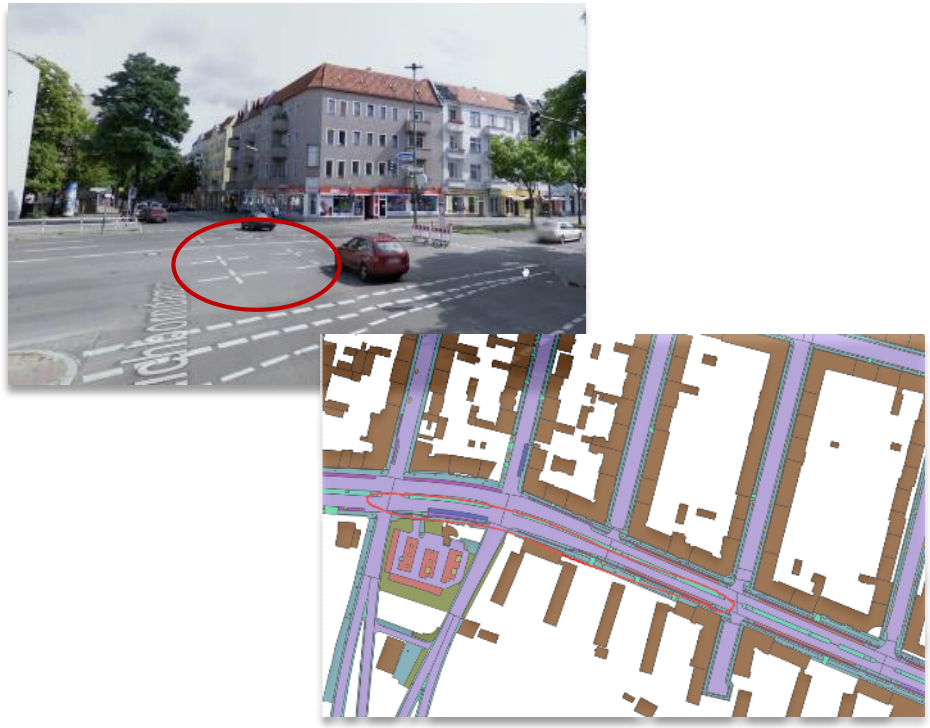
Courtesy of FOKUS

AP 5 SELF-UPDATING HD MAP

SAFARI DIGITALES TESTFELD STADTVERKEHR

Work packages and results

- Lessons learned helped to update the object catalogue
- SAFARI change detection identified several deviations between map and reality
- Currently additional detected possible deviations are analyzed
  - incorrect map data
  - not yet updated data
  - incorrect realisation



AP 6 SYSTEM INTEGRATION

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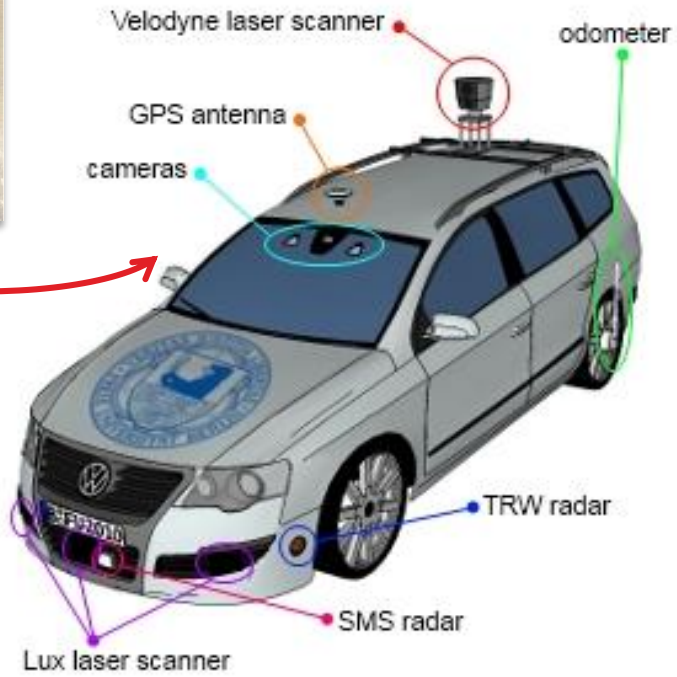
Work packages and results

- Integration of sensors, cameras and communication (Codha Wireless MK 5)
- Implementiation of self and object localisation and object detection
- Implementation of change detection
- Implementation of interface to backend
- Test of sensors and sensor fusion
- Test of V2X-communication
- Automated driving at the testbed



Courtesy of FU Berlin

AP 7 DEMONSTRATION AND EVALUATION

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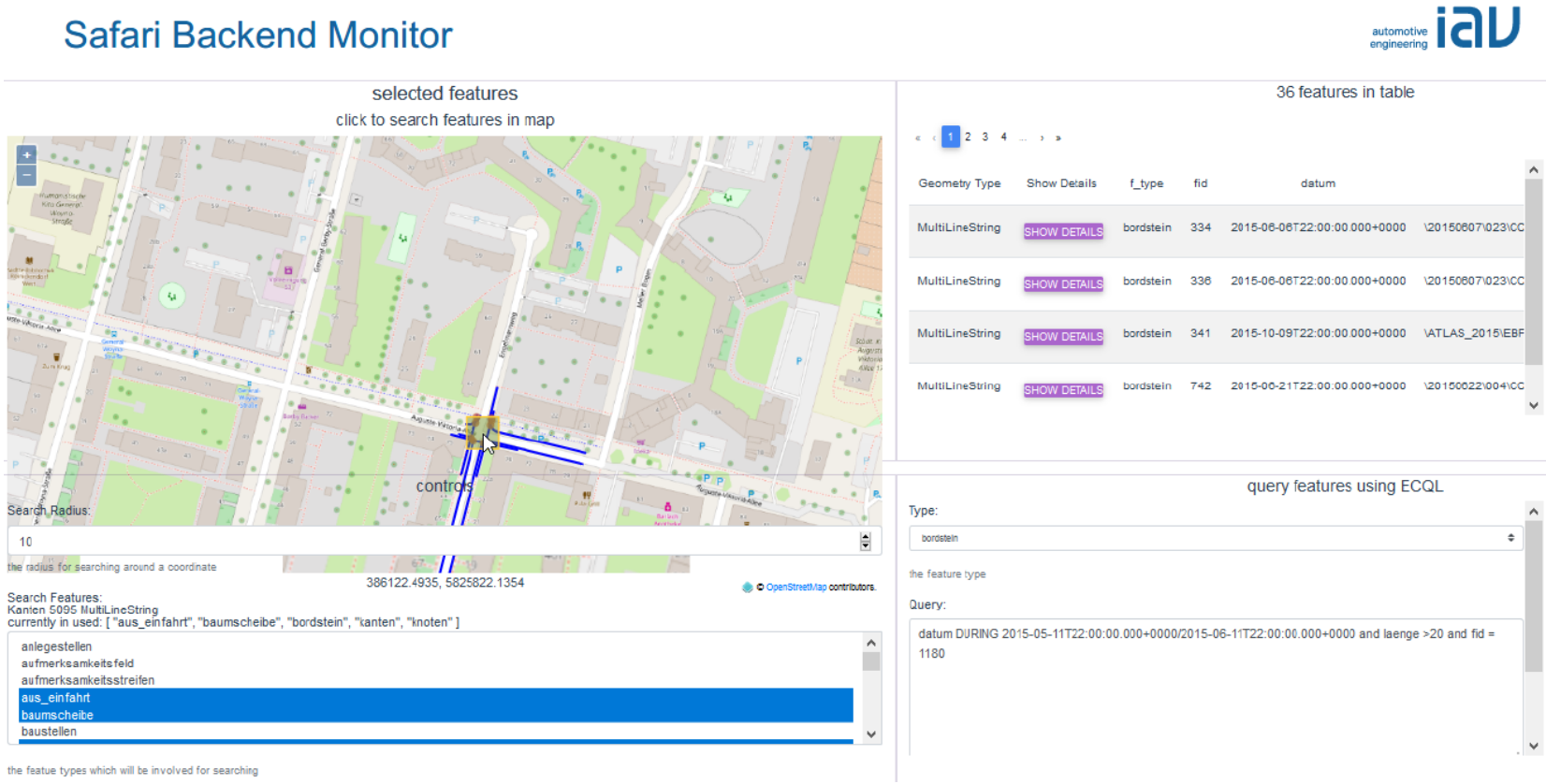
Work packages and results

- Two interim demonstrations held
- Final Demonstration planned on the 10th of December
- Results have also been demonstrated at other events
- Evaluation under way



Showing acquired data, map data and detected changes

Courtesy of IAV

THANK YOU FOR YOUR ATTENTION

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