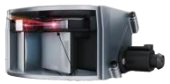
DNA for Automated Driving

Jeremy Dahan
May 8th, 2017

A Driverless Car Developer‘s World in 2017

Radar

Camera

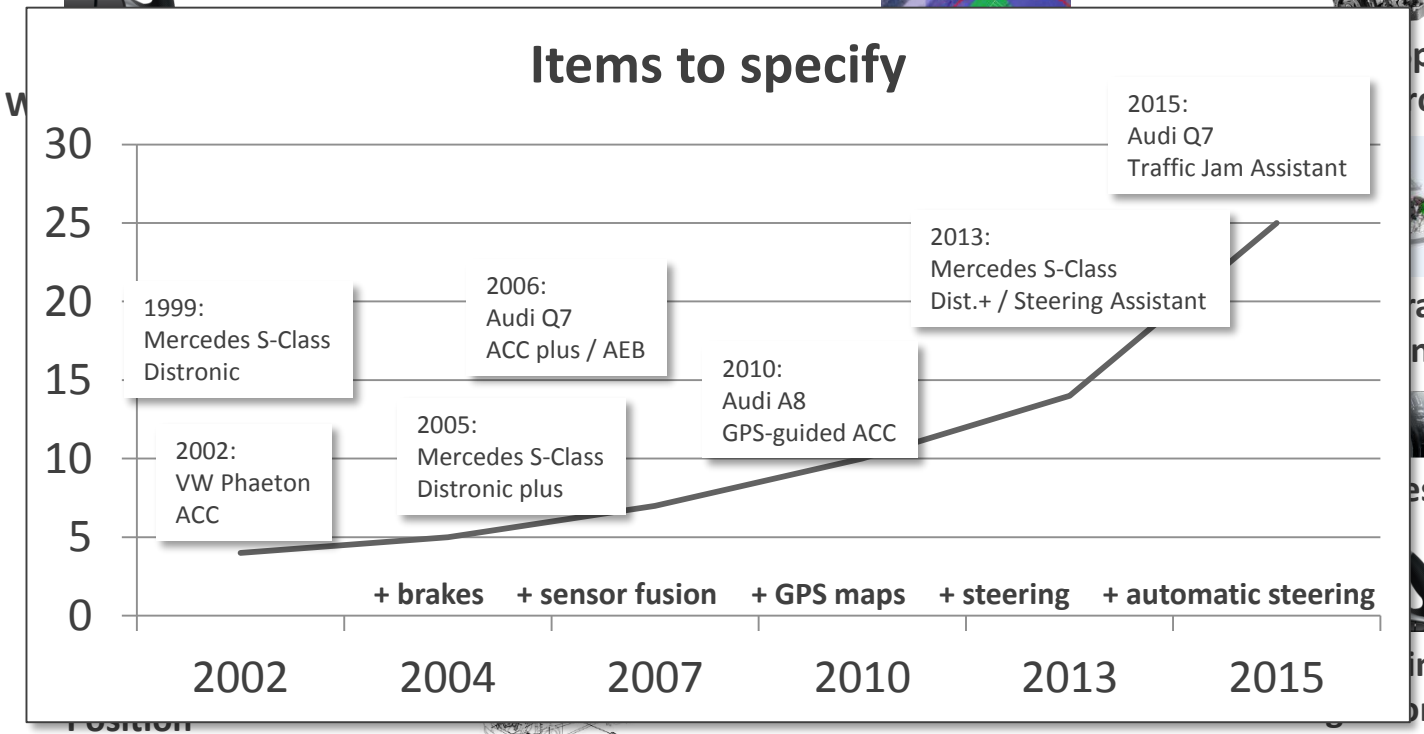


LIDAR

Sonar

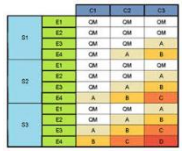
Maps

Vehicle
ego motion

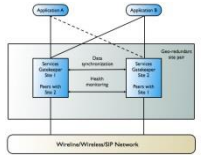


Head Unit

Side Tasks



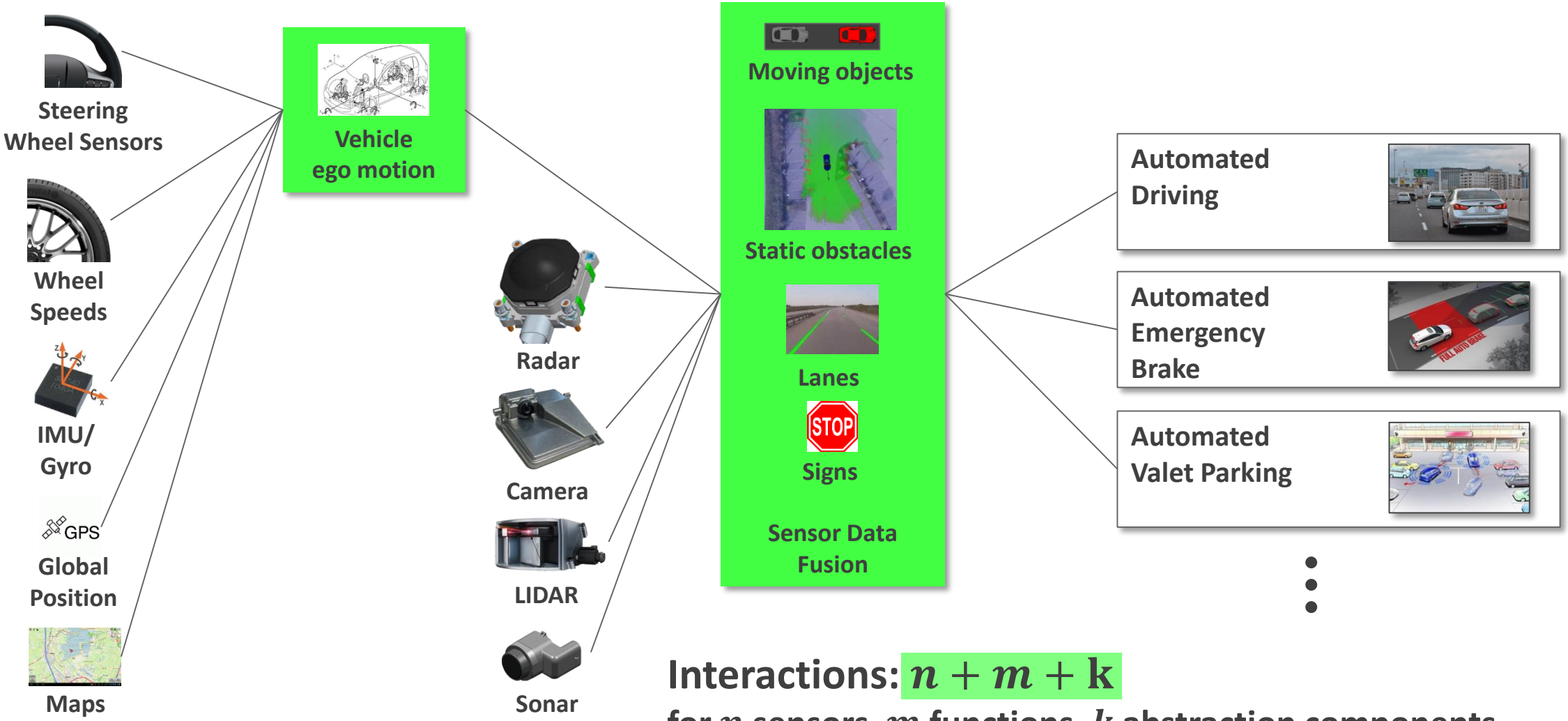
Functional
safety



Redundancies

Items to specify: 24

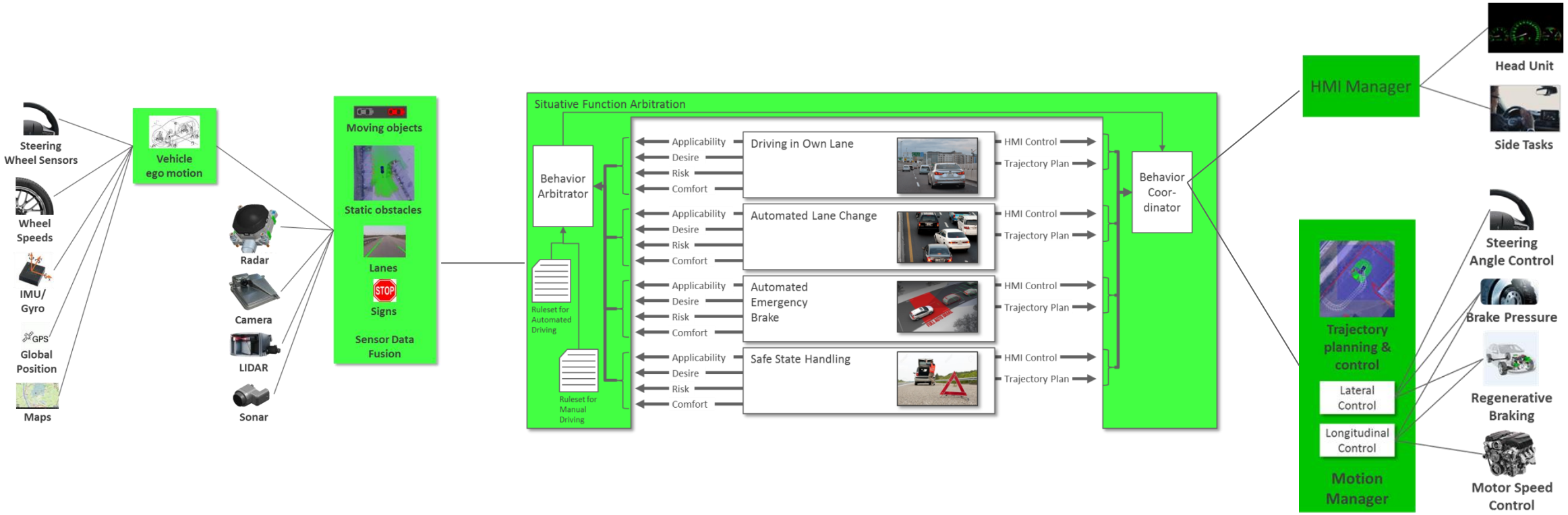
What helps? Sensor Data Fusion



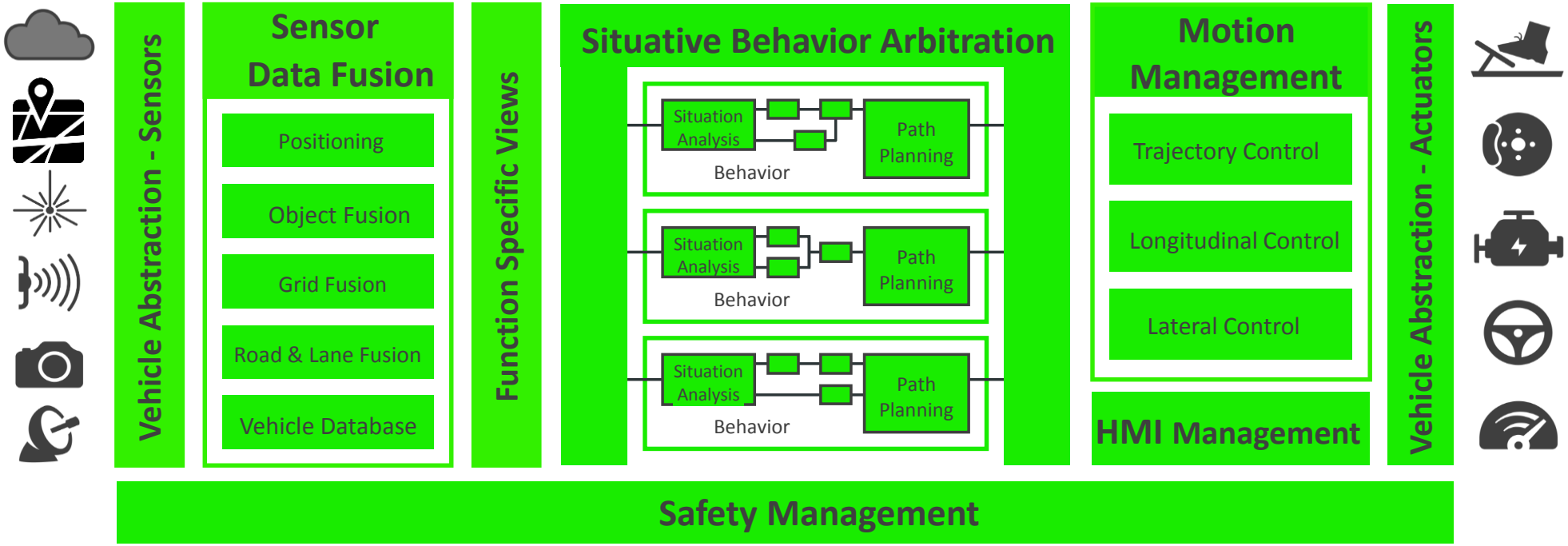
Interactions: $n + m + k$

for n sensors, m functions, k abstraction components

What helps? Architecture Is Key To Managing Complexity

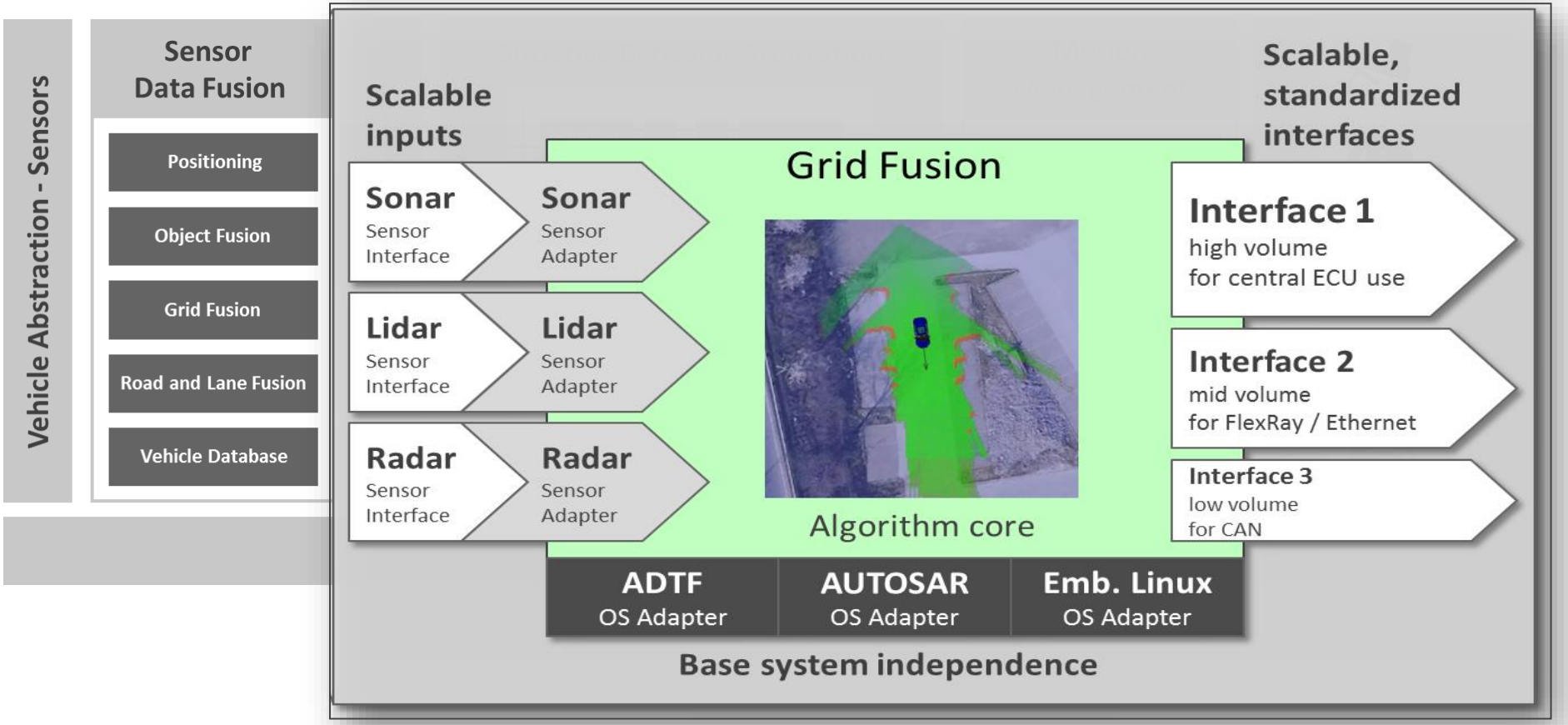


Software Framework for ADAS and Automated Driving



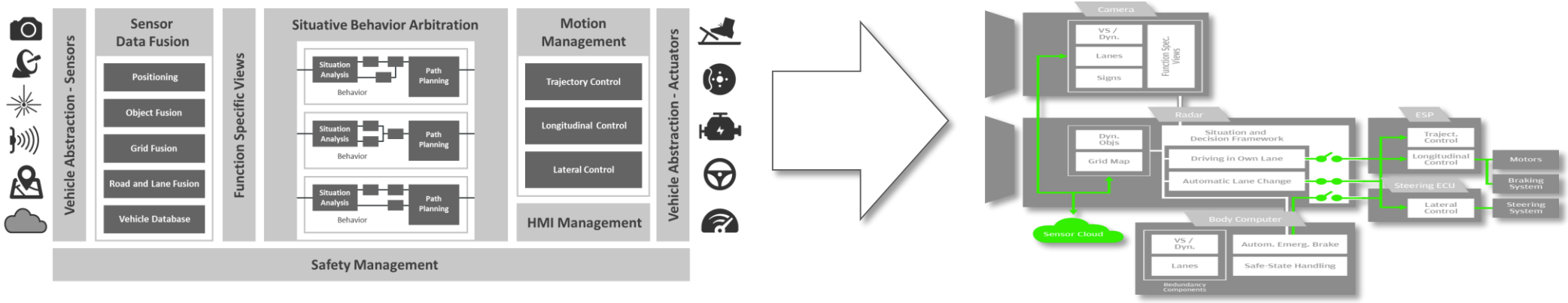
Interfaces for • Interoceptive sensors – wheel ticks, steering angle, accelerometers / gyros • „Smart“ environment sensors – point clouds, object lists • ADASISv2/3 for map, SENSORIS for cloud	Integrated safety concept • System health monitoring and diagnosis • Safe-state triggering • Options for redundant environment model and functions (e.g. minimal risk	Interfaces for • Kinematic vehicle components • Instrument cluster • Infotainment display www.open-robinos.com

Standardized Interfaces

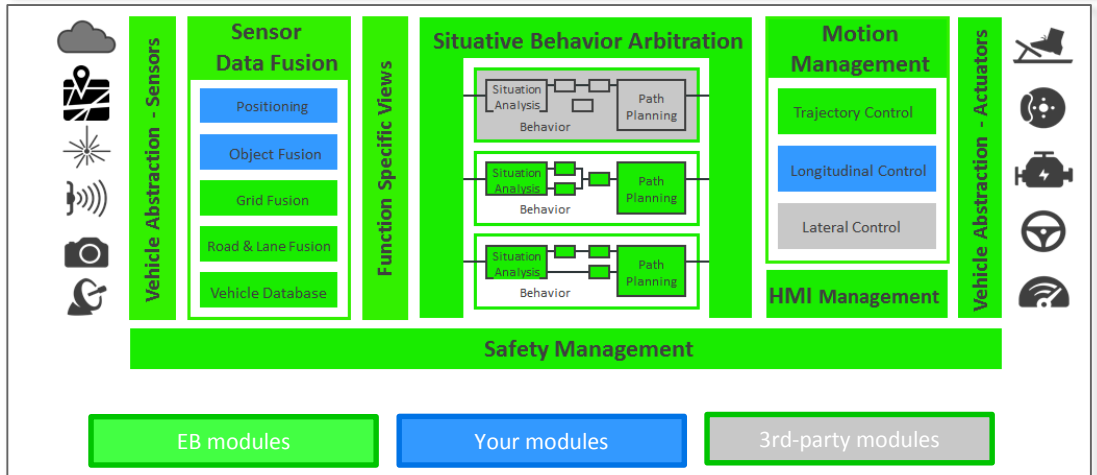


Every software component has
- scalable, documented and standardized interfaces to other components
- exchangeable interfaces to the base system / OS
- a pre-industrialized algorithm core

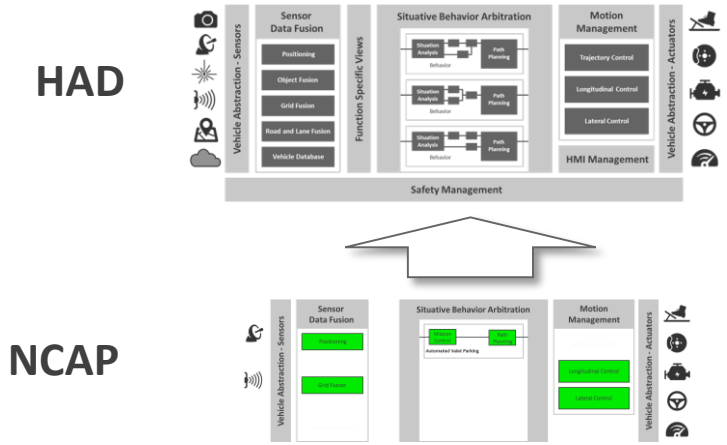
A Modular Software Framework Enables You to…



Map onto concrete ECU architecture

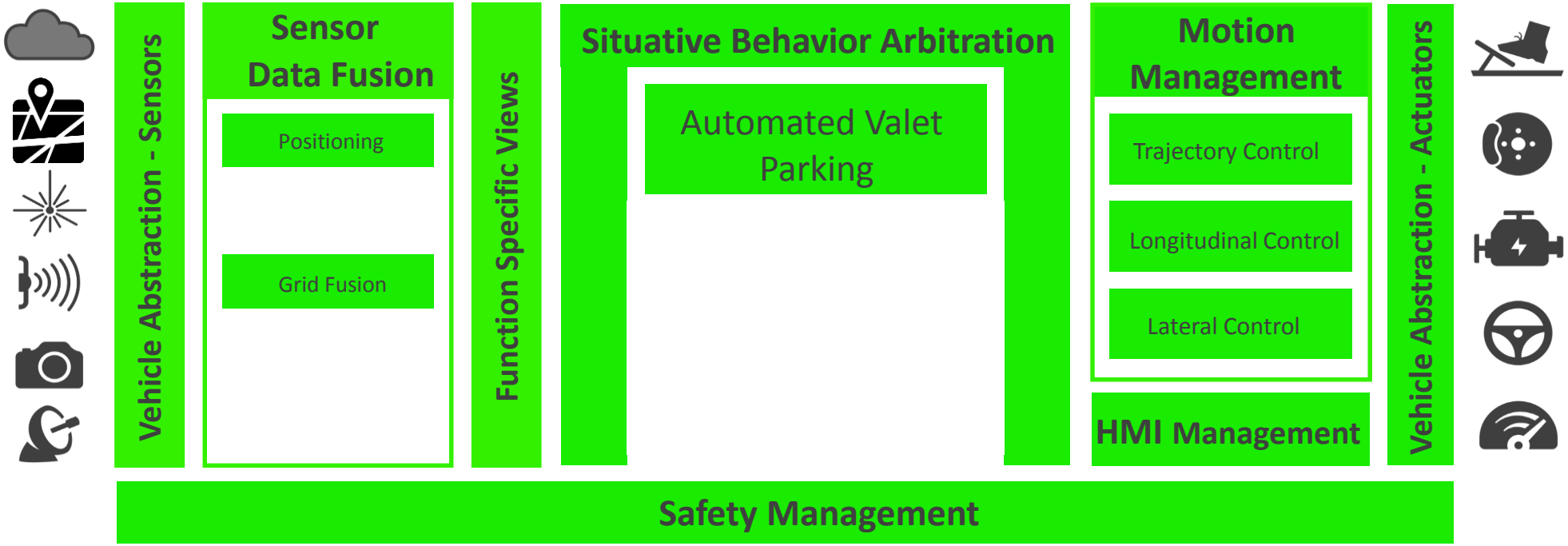


Ensure differentiation, shorten time to market

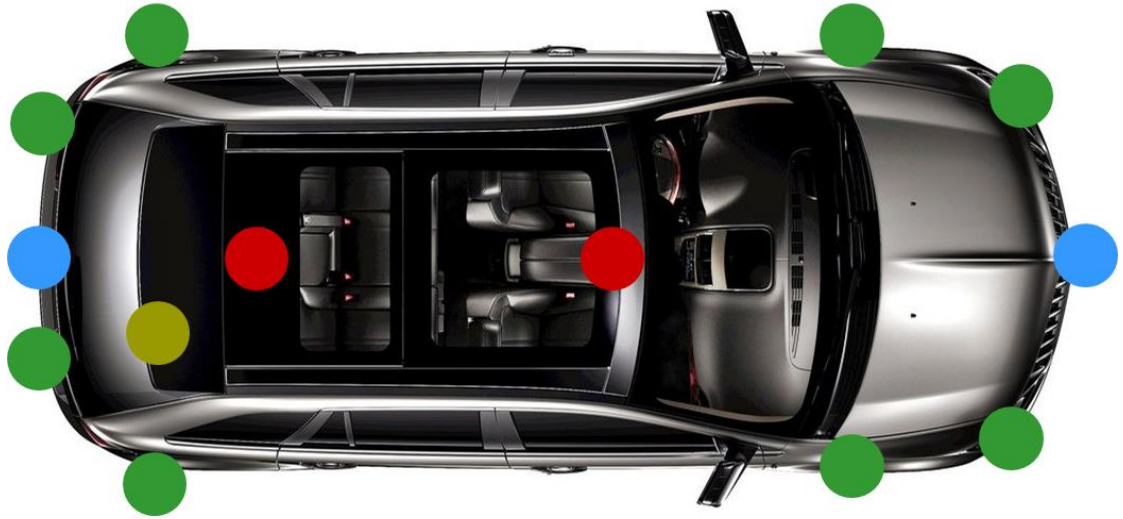


Upgrade across models / Upgrade over time

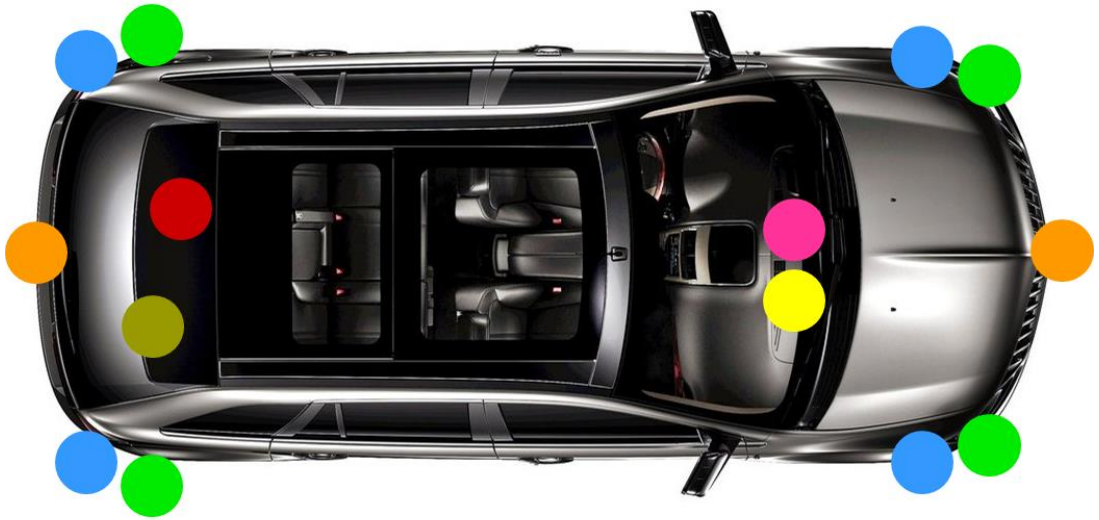
Application example: Automated Valet Parking



Application example: Automated Valet Parking from one to another one

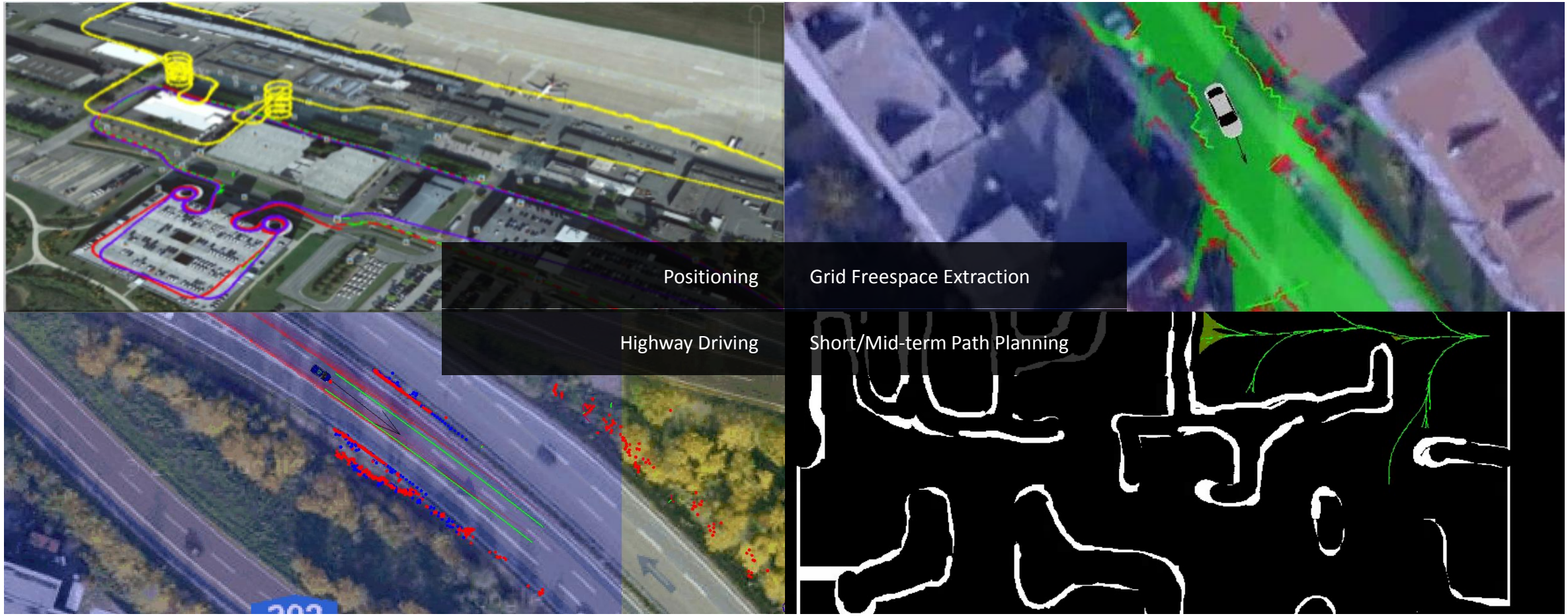


120 LIDAR
Sonar
carPC
GPS + IMU

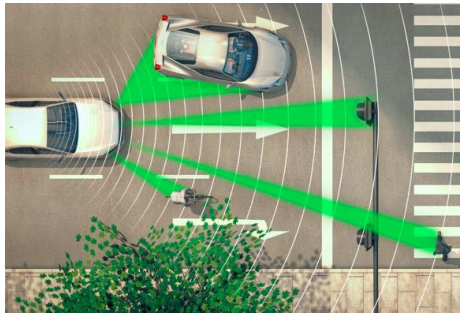


360 LIDAR
Short Range Radar
Long Range Radar
Smart camera
Camera
GPS + IMU
carPC

Software framework in action



What about maps?



Range of ego sensors are limited

- Reduce speed in advance before sign is reached
- Warn driver in time before autonomous driving road ends so that he can take back control

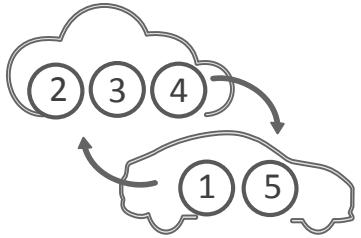
Recognition algorithms are limited

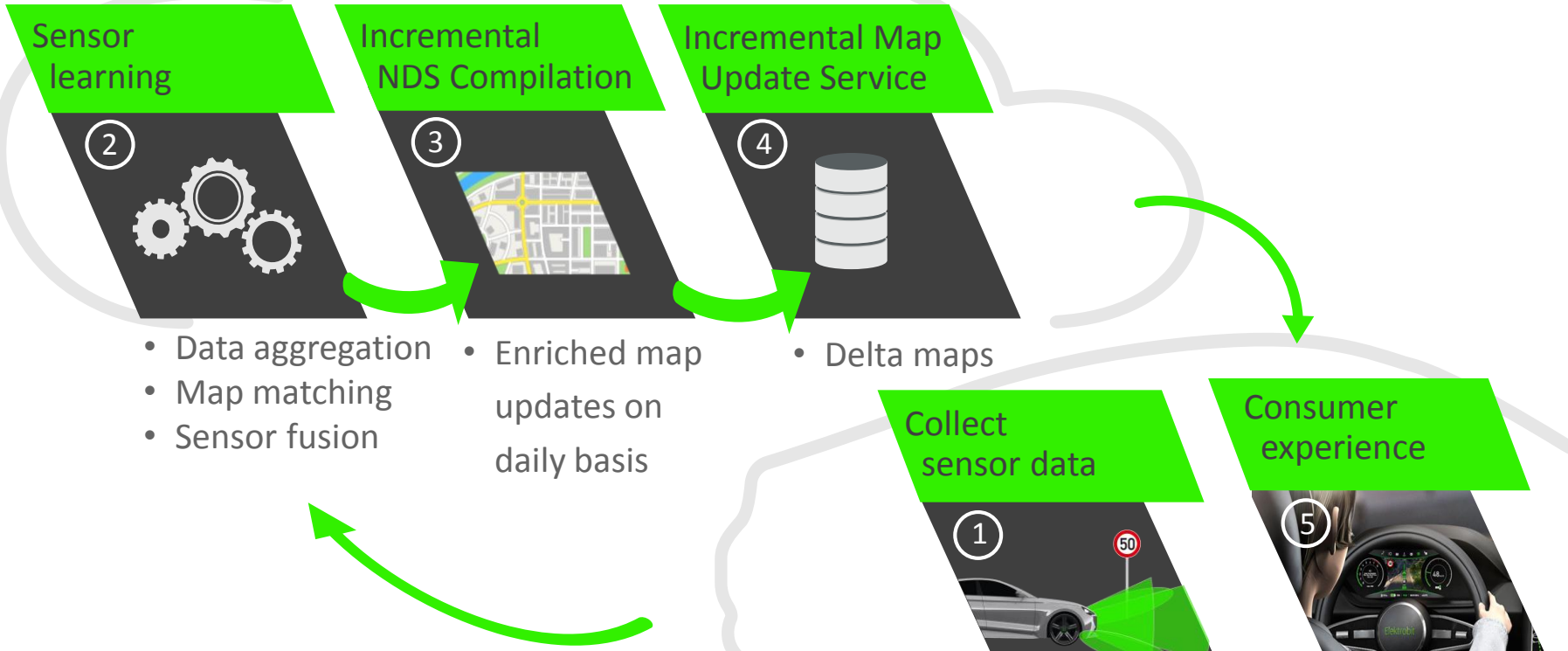
- E.g. truck hides speed sign
- E.g. weather conditions for recognition of a traffic sign
- Accuracy of a recognized sign can be improved by multiple observations

Not all information needed can be derived from sensor observations

- Which country / states specific traffic rules apply to the vehicle in its current position? E.g. left hand driving vs. right hand driving (safety critical!)

Sensor-based Learning for Predictive Driving





- Data aggregation
- Map matching
- Sensor fusion

- Enriched map updates on daily basis

- Delta maps

- Secure connection and transfer

- Always up to date electronic horizon for ADAS functions

How sensor data is collected and sent

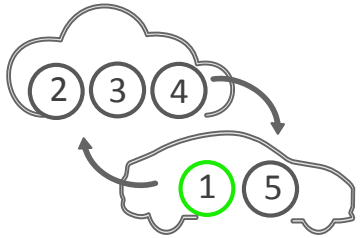
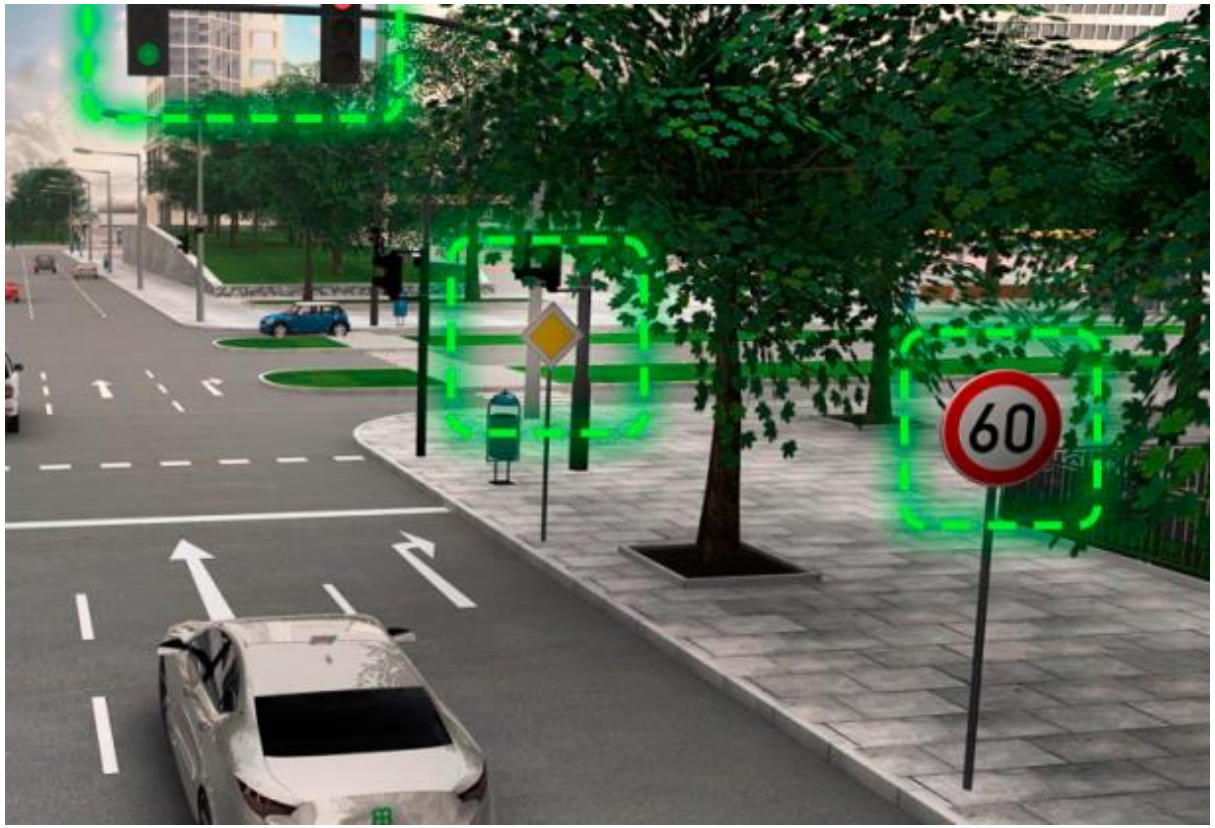
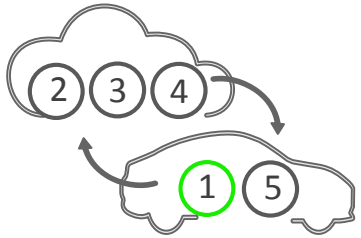


Image processing

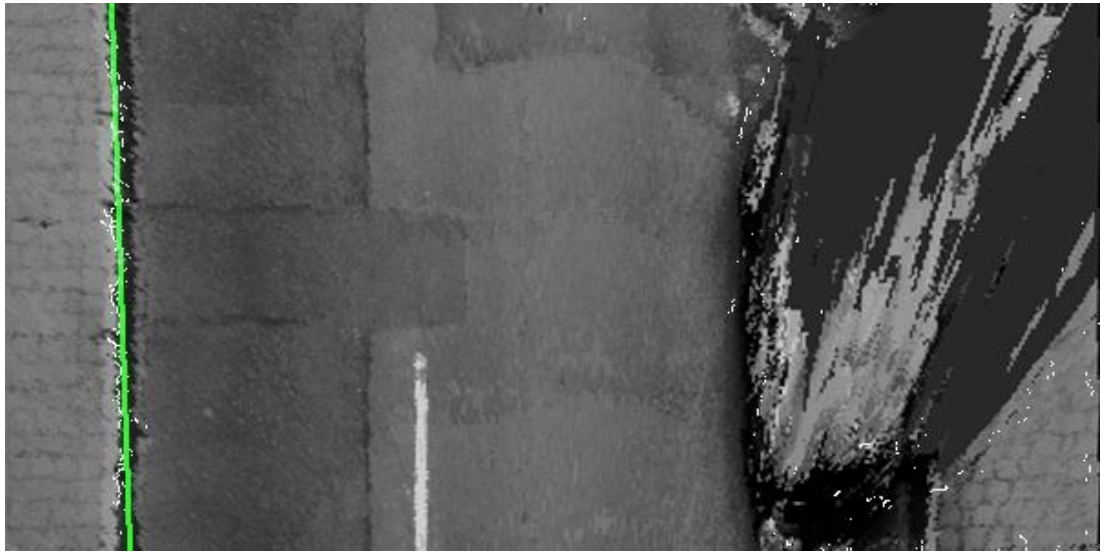
- Objects form camera recognition modules
- Create 2.5D maps of the road
- Algorithms for feature extraction:
  - image processing
  - machine learning
- Objects that can be extracted:
  - lane markings
  - lane Geometry
  - road boundaries
  - lane arrows
  - traffic signs



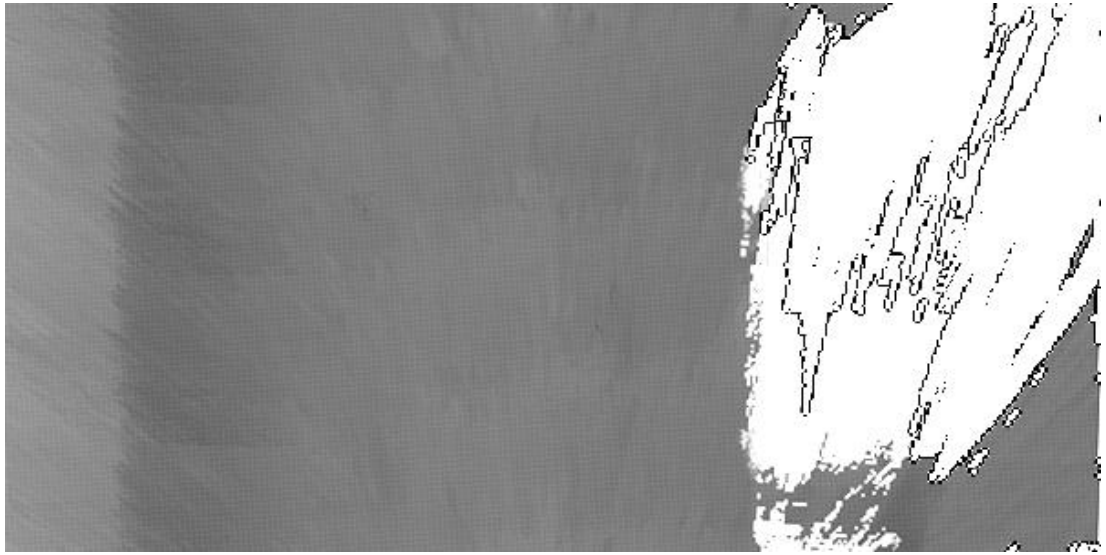
How sensor data is collected and sent



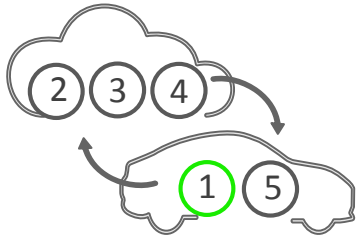
Top View

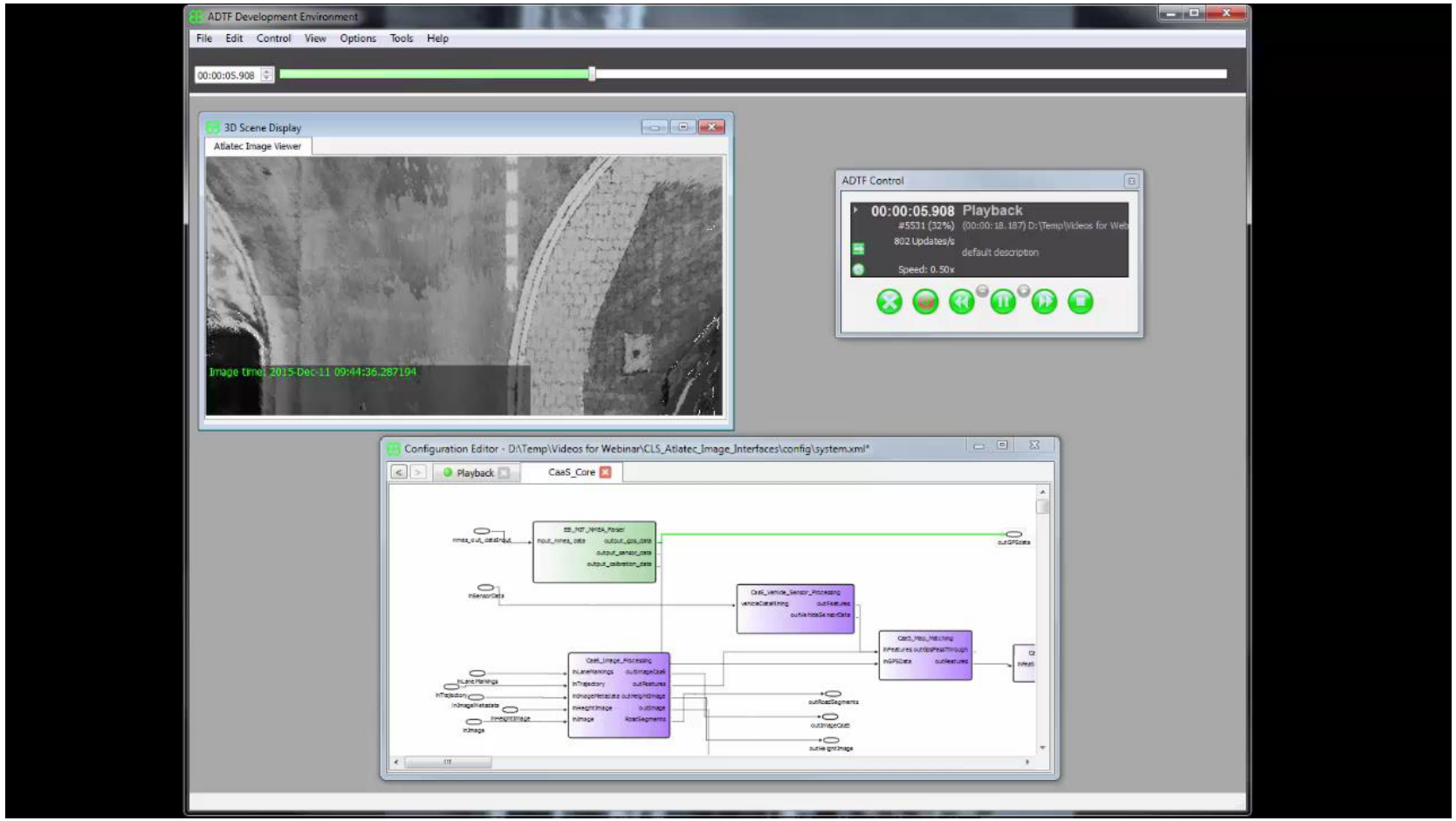


Height Map

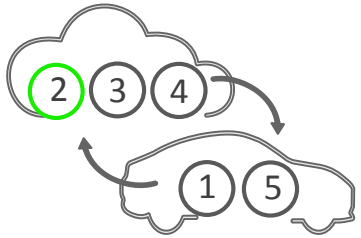


Example: Zebra crossing recognition on 2.5D maps





How to learn from sensor data and enrich maps

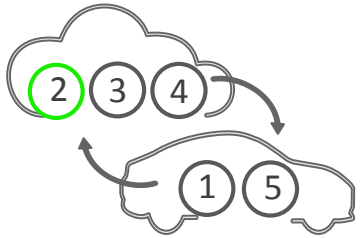


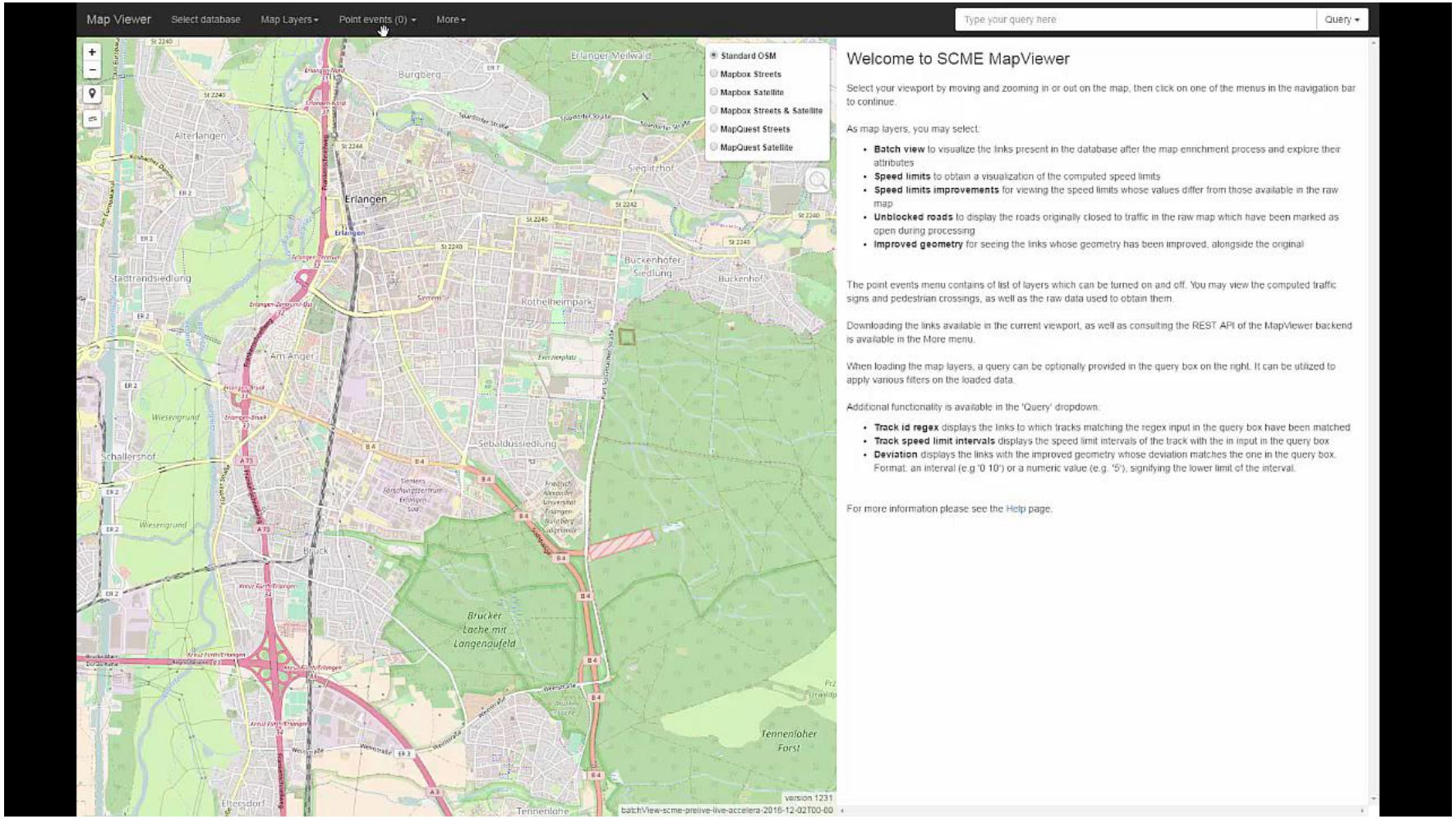
Data processing

- Data cleanup
  - Incoming data is validated regarding location and timestamp
  - Wrong movement profiles (e.g. ferries or trains) are discarded
- Data aggregation
  - Collected data is aggregated into clusters to ensure reliability
  - Clusters are matched on a recent map
  - User data is anonymized to ensure privacy

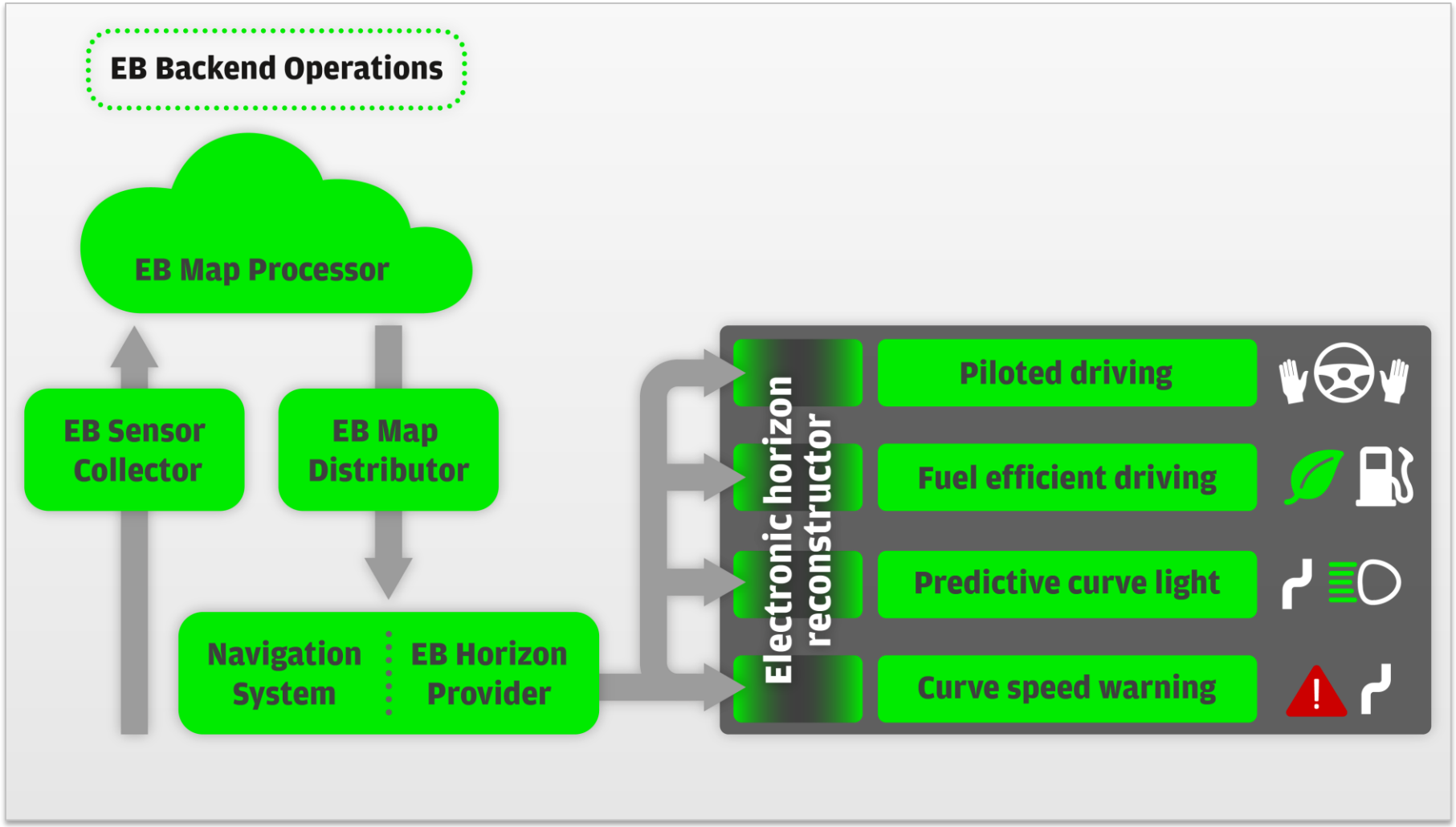
Elektrobit

Example: Zebra crossing in the Cloud





Maps boost ADAS and Automated Driving



DNA for Automated Driving and NVIDIA

EB robinos

EB Assist ADTF

EB tresos

Rapid prototyping

C, C++, Model based

PC

Rapid embedding

C, C++

Evaluation hardware

Automotive grade software

ECU

Elektrobit

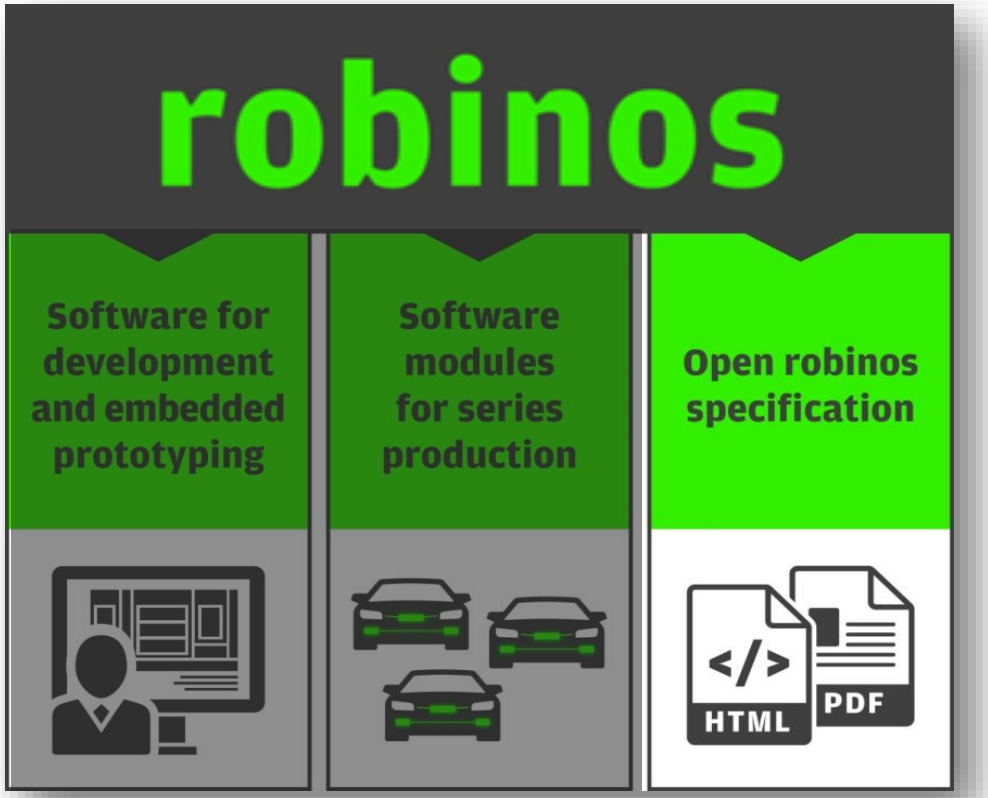
Join the community!

Join the "open robinos specification" group to discuss and develop future joint versions
join@open-robinos.com

EB robinos

- implements the **open robinos** specification
- provides software modules
  - **for prototyping** in EB Assist ADTF
  - **for rapid embedding** on AUTOSAR / DRIVE PX
  - **for production** on vehicle ECU
- developed, tested, verified according to functional safety standards

www.try-eb-robinos.com



Download the open robinos specification

www.open-robinos.com

Open robinos

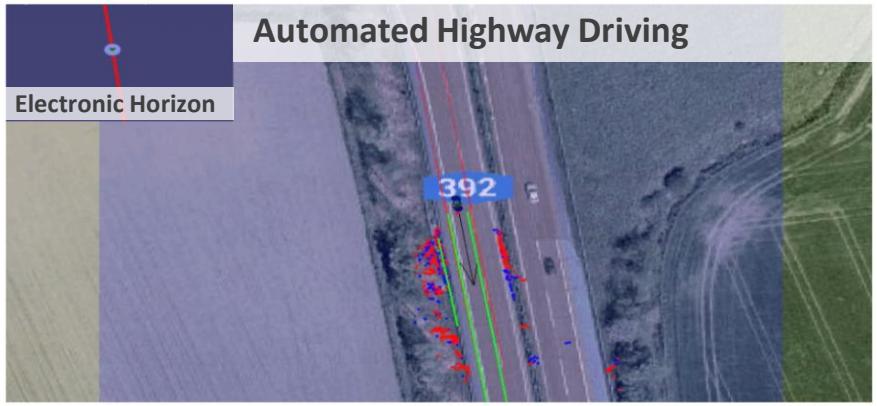
- specifies a **reference platform** for automated driving up to Level 5 (SAE)
  - **architecture**
  - **interfaces**
  - **data flow**
  - **control mechanisms**
  - **software modules**
  - **functional safety aspects**
- **freely available** and licensed as Creative Commons
- **Available for download**

Conclusion

The problem is not difficulty but complexity.

Software frameworks and functional architectures help solve it.

EB robinos is a software framework for automated driving, applicable across car lines and models – it is DNA for automated driving



Thank you!

Elektrobit

www.eb-robinos.com
www.try-eb-robinos.com
Jeremy.Dahan@elektrobit.com