Software Framework for Highly Automated Driving – EB robinos
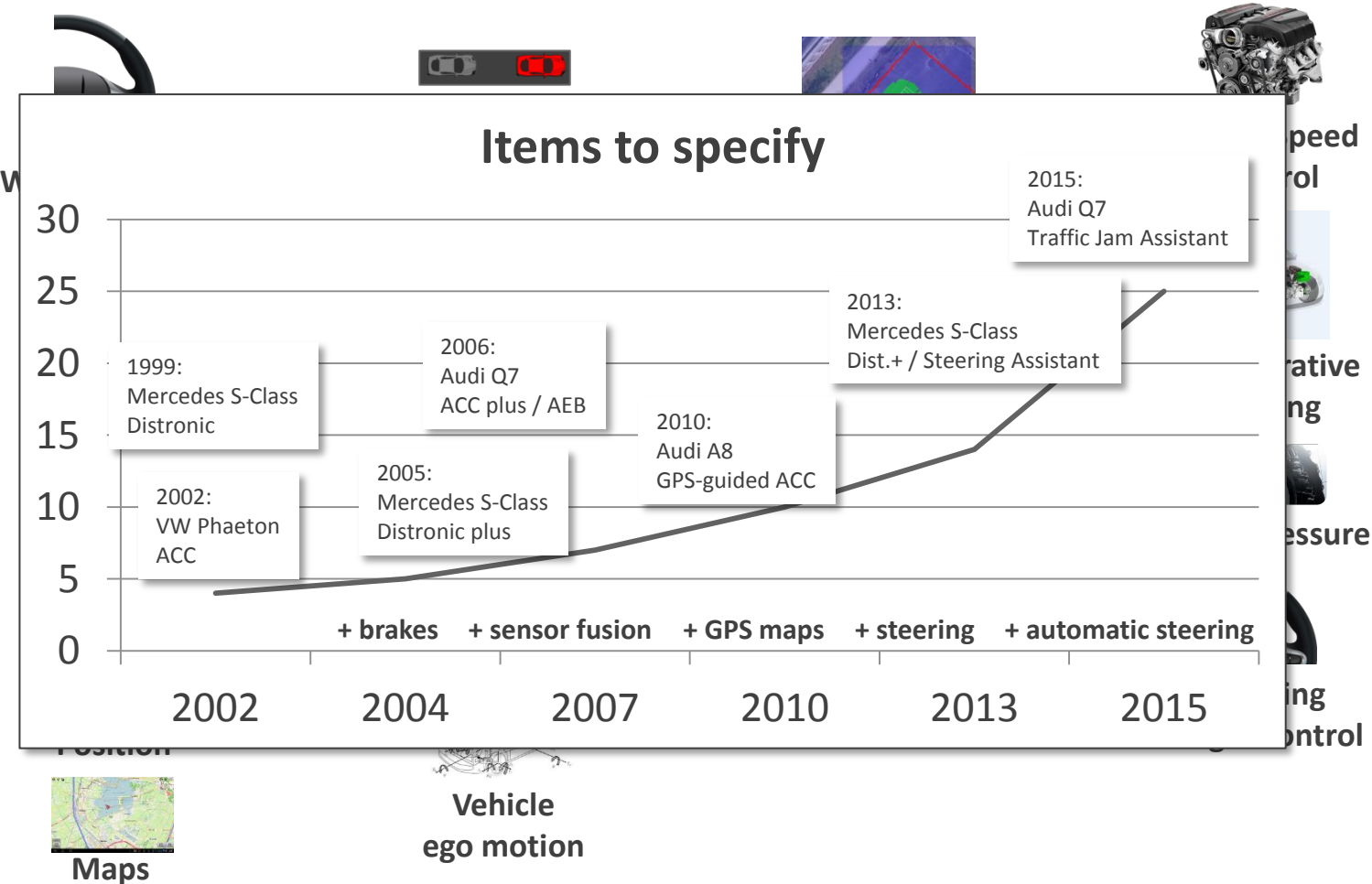
Jared Combs
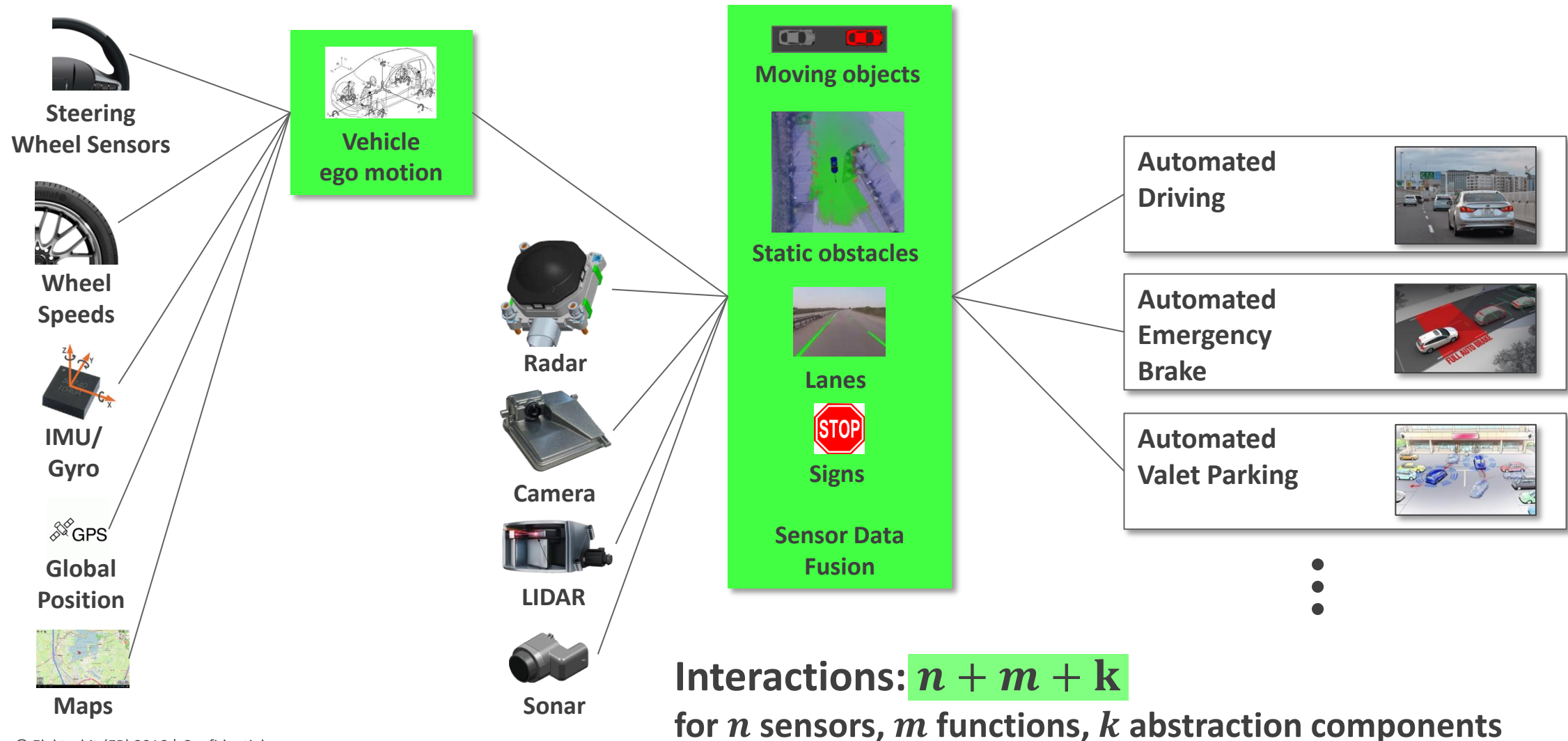**July 27, 2017**

A Driverless Car Developer's World in 2017
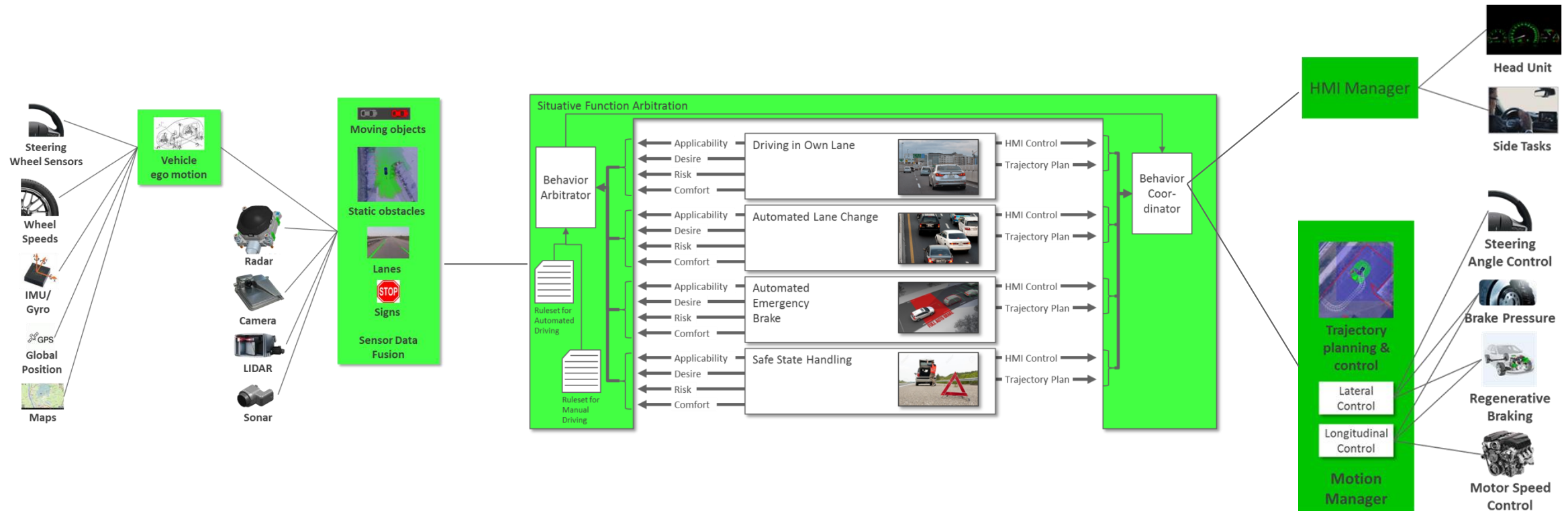
Radar
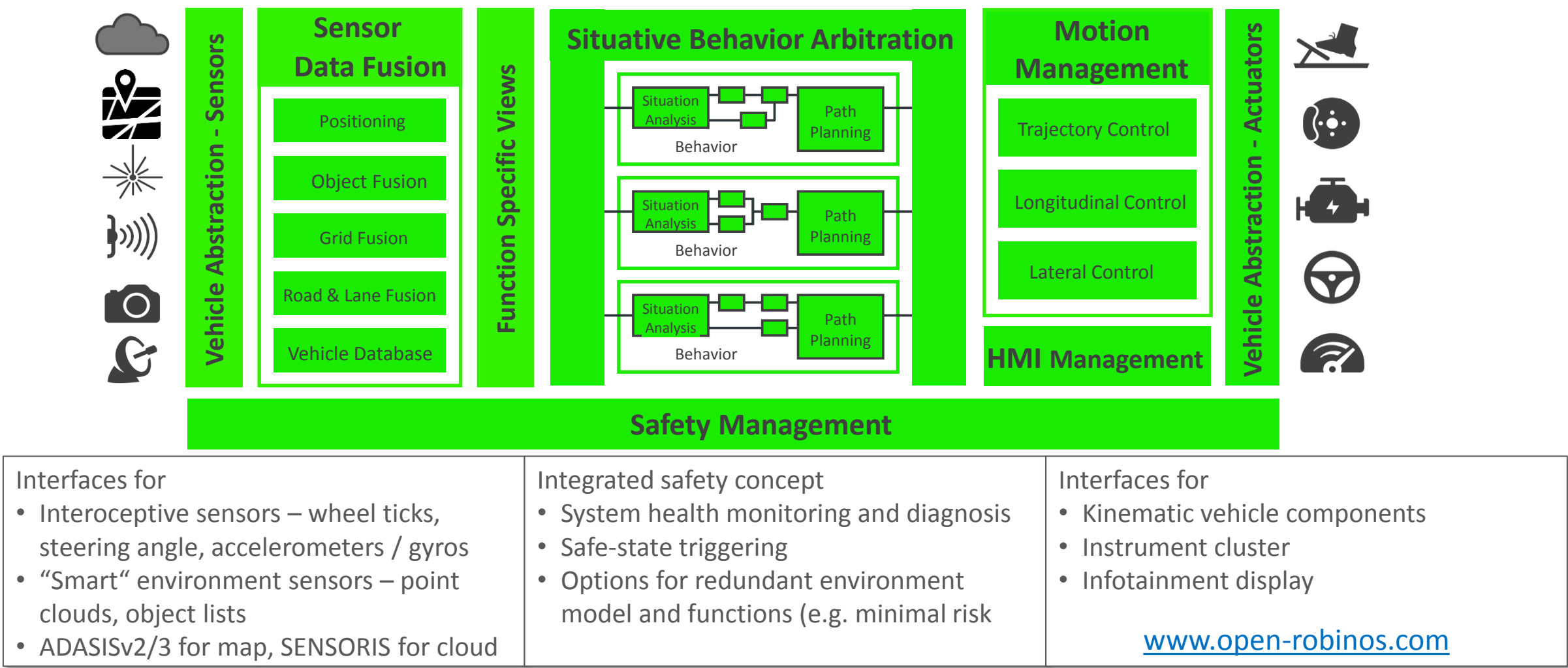
Camera

LIDAR

Sonar

Maps

Vehicle ego motion

Head Unit

Side Tasks

Functional safety

Redundancies

Items to specify

30					
25					
20					
15					
10					
5					
0	+ brakes	+ sensor fusion	+ GPS maps	+ steering	+ automatic steering
	2002	2004	2007	2010	2013	2015

1999:
Mercedes S-Class
Distronic

2002:
VW Phaeton
ACC

2005:
Mercedes S-Class
Distronic plus

2006:
Audi Q7
ACC plus / AEB

2010:
Audi A8
GPS-guided ACC

2013:
Mercedes S-Class
Dist.+ / Steering Assistant

2015:
Audi Q7
Traffic Jam Assistant

Items to specify: 24.

What helps? Sensor Data Fusion

Steering Wheel Sensors

Wheel Speeds

IMU/ Gyro

GPS

Global Position

Maps

Vehicle ego motion

Radar

Camera

LIDAR

Sonar

Moving objects

Static obstacles

Lanes

STOP

Signs

Sensor Data Fusion

Automated Driving

Automated Emergency Brake

Automated Valet Parking

Interactions: $n + m + \mathrm{k}$

for n sensors, m functions, k abstraction components

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What helps? Architecture is Key to Managing Complexity

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Software Framework for ADAS and Automated Driving

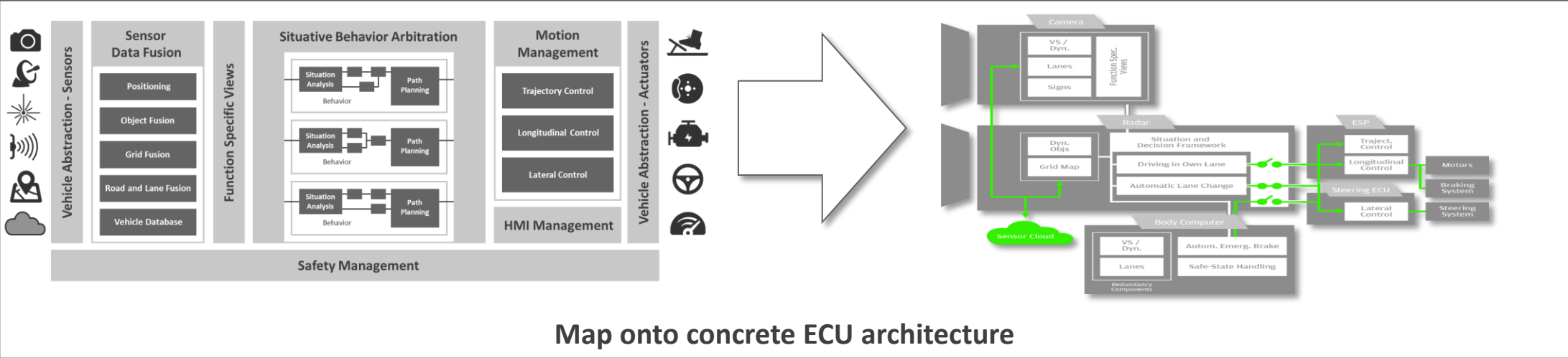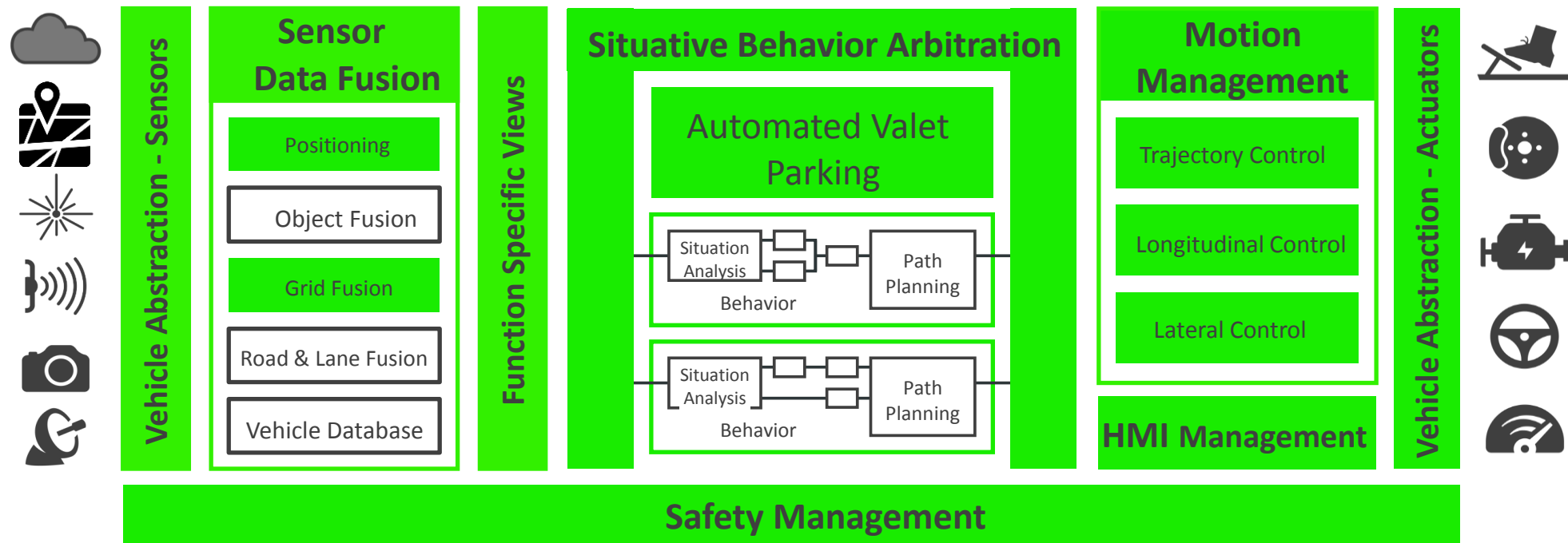| Interfaces for	Integrated safety concept	Interfaces for
• Interoceptive sensors – wheel ticks, steering angle, accelerometers / gyros • "Smart" environment sensors – point clouds, object lists • ADASISv2/3 for map, SENSORIS for cloud	• System health monitoring and diagnosis • Safe-state triggering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

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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

6

A Modular Software Framework Enables You to...

Map onto concrete ECU architecture

Ensure differentiation, shorten time to market

Upgrade across models / Upgrade over time

Automated Valet Parking

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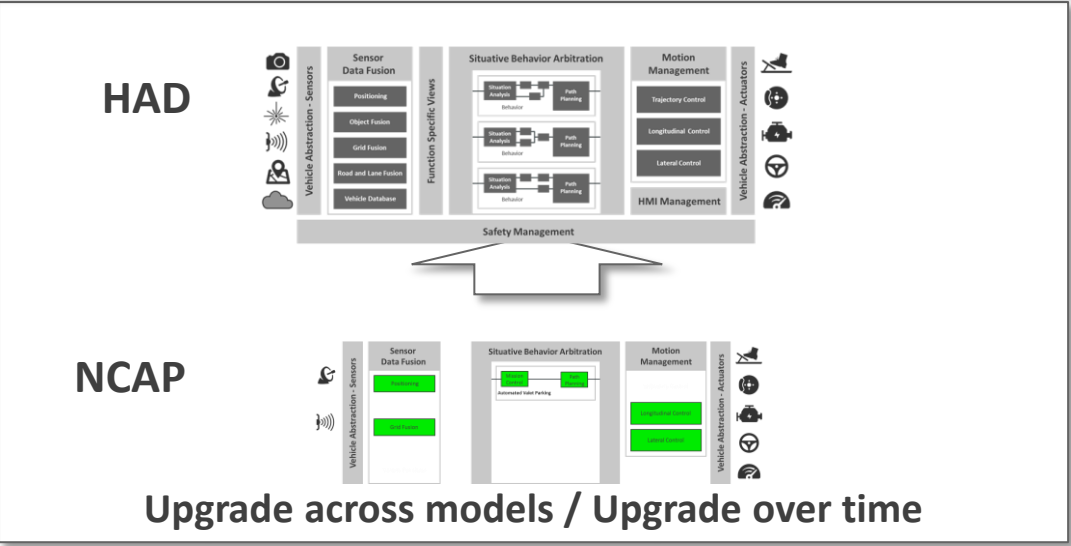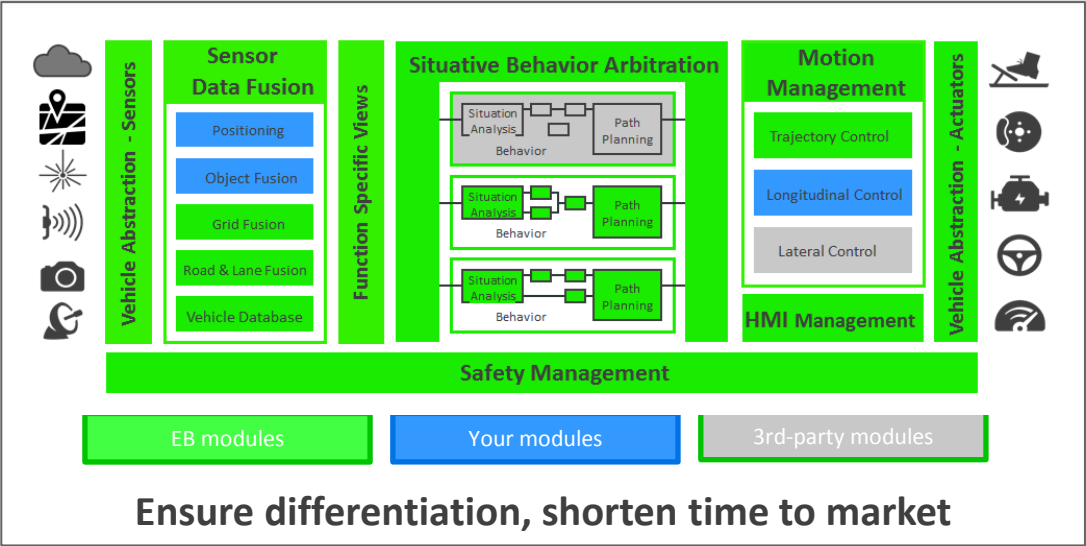
Application example: Automated Valet Parking from one to another one

120 LiDAR ● carPC ●
Sonar ● GPS + IMU ●

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

Software framework in action

Positioning

Grid Freespace Extraction

Highway Driving

Short/Mid-term Path Planning

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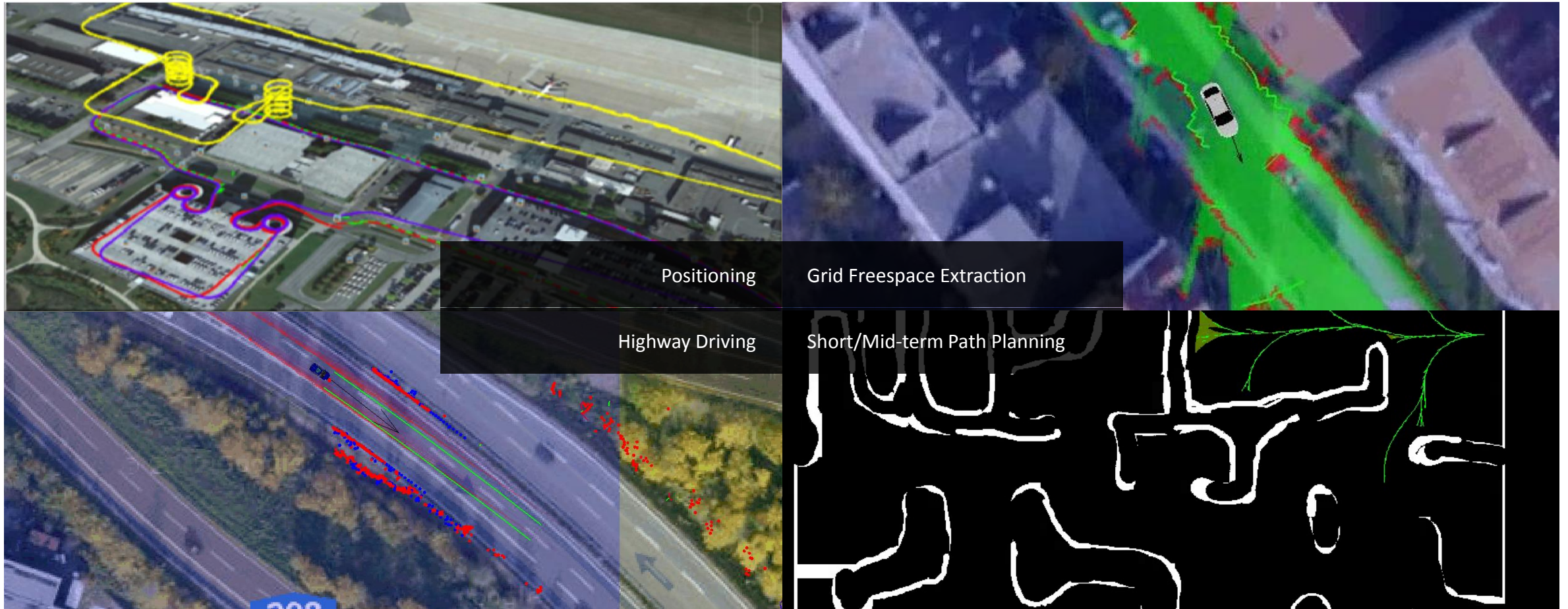
What about maps?
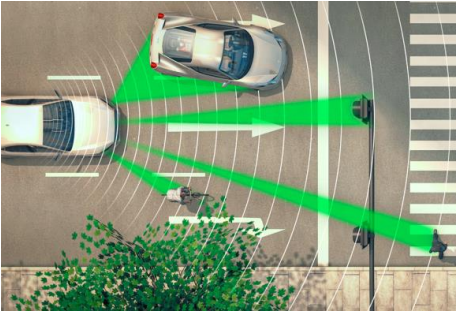
Range of ego sensors are limited

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

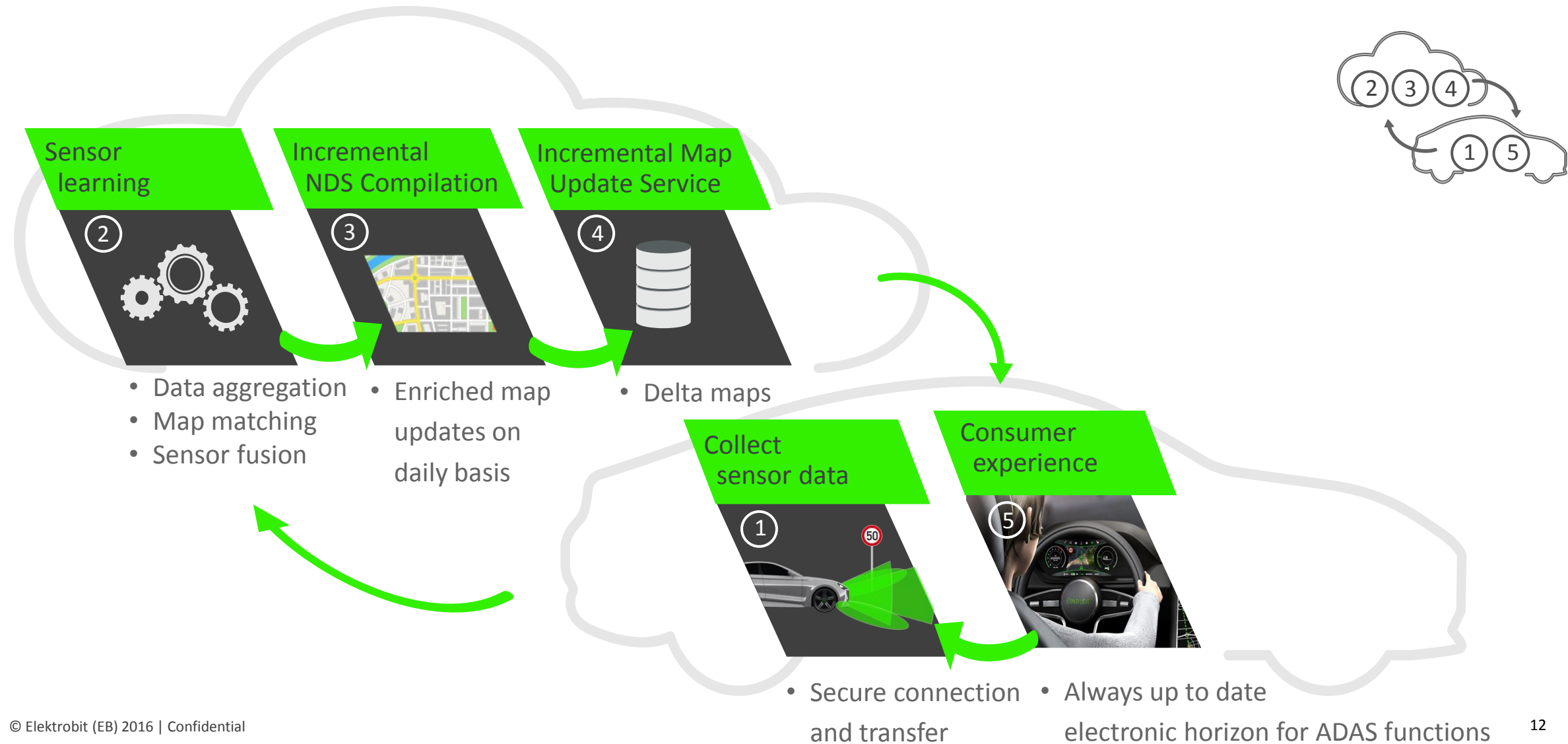**Recognition algorithms are limited**

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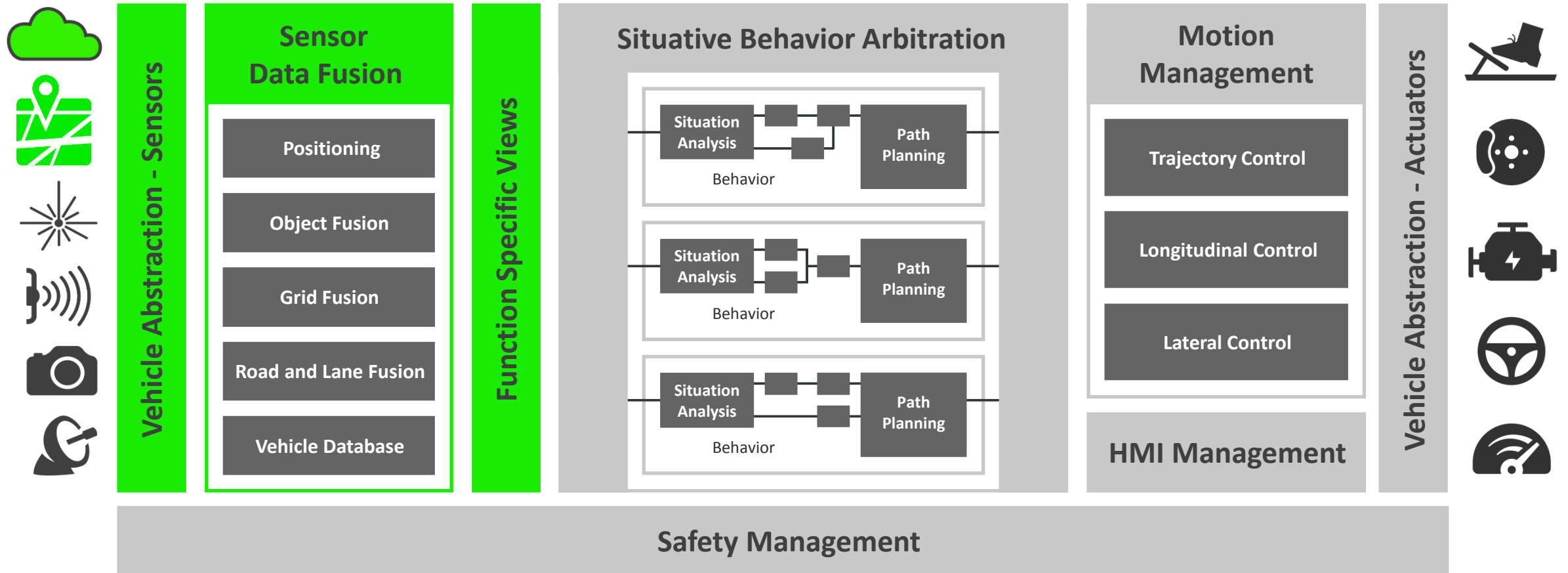- Accuracy of a recognized sign can be improved by multiple observations

Not all information needed can be derived from sensor observations

- Which country specific traffic rules apply to the vehicle in its current position? E.g. left hand driving vs. right hand driving (safety critical!)
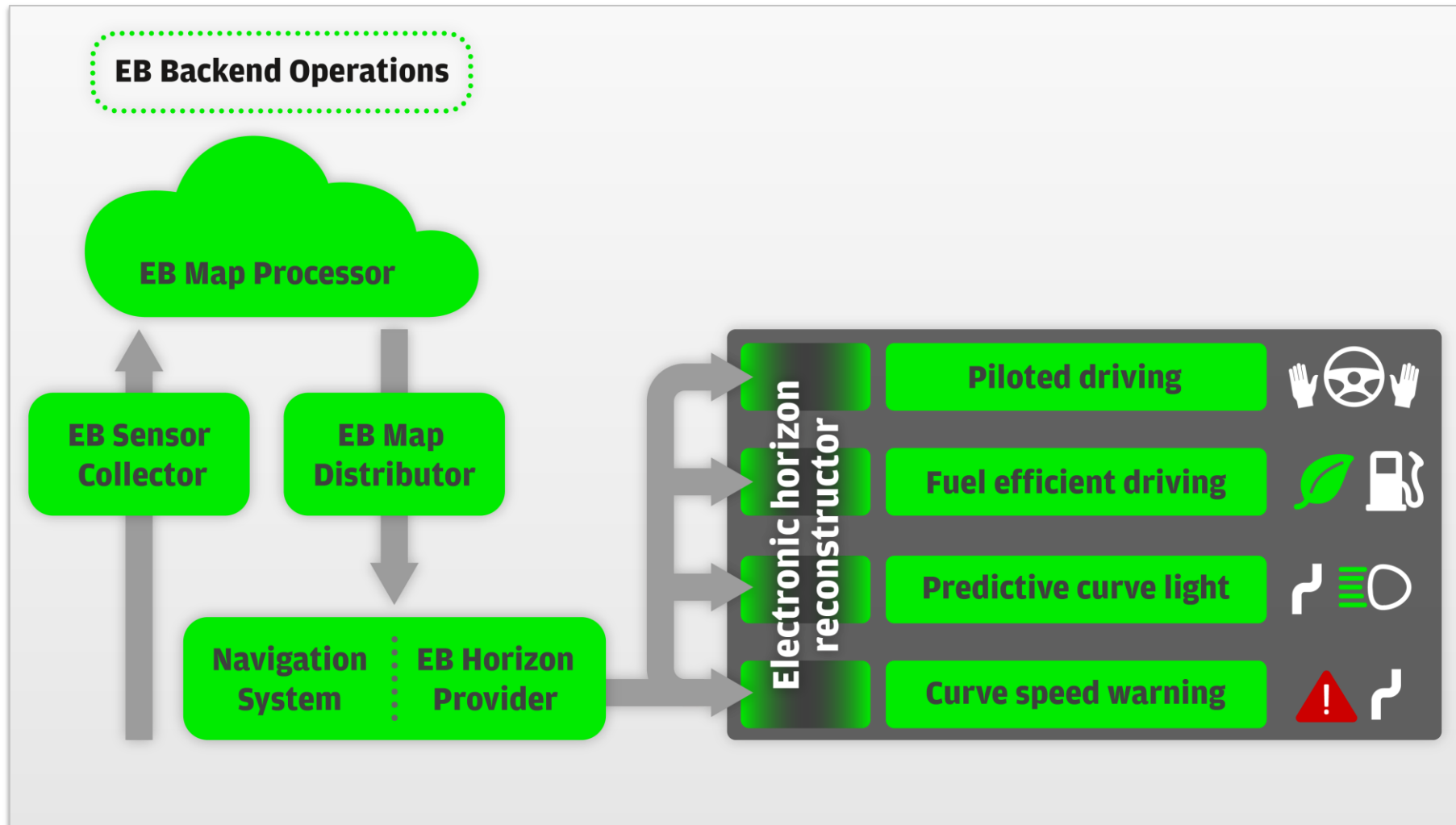
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Sensor-based Learning for Predictive Driving

Sensor learning

②

- Data aggregation
- Map matching
- Sensor fusion

Incremental NDS Compilation

③

- Enriched map updates on daily basis

Incremental Map Update Service

④

- Delta maps

Collect sensor data

①

- Secure connection and transfer

Consumer experience

⑤

- Always up to date electronic horizon for ADAS functions

EB Elektrobit

Sensor-based learning for predictive driving

Boosting ADAS and Automated Driving

 Elektrobit

DNA for Automated Driving and NVIDIA

EB robinos

EB Assist ADTF

EB tresos

Rapid prototyping

C, C++, Model based

Rapid embedding

C, C++

Automotive grade software

PC

Evaluation hardware

ECU

EB Elektrobit

EB robinos + NXP BlueBox

Software for highly automated driving

+ automated driving development platform
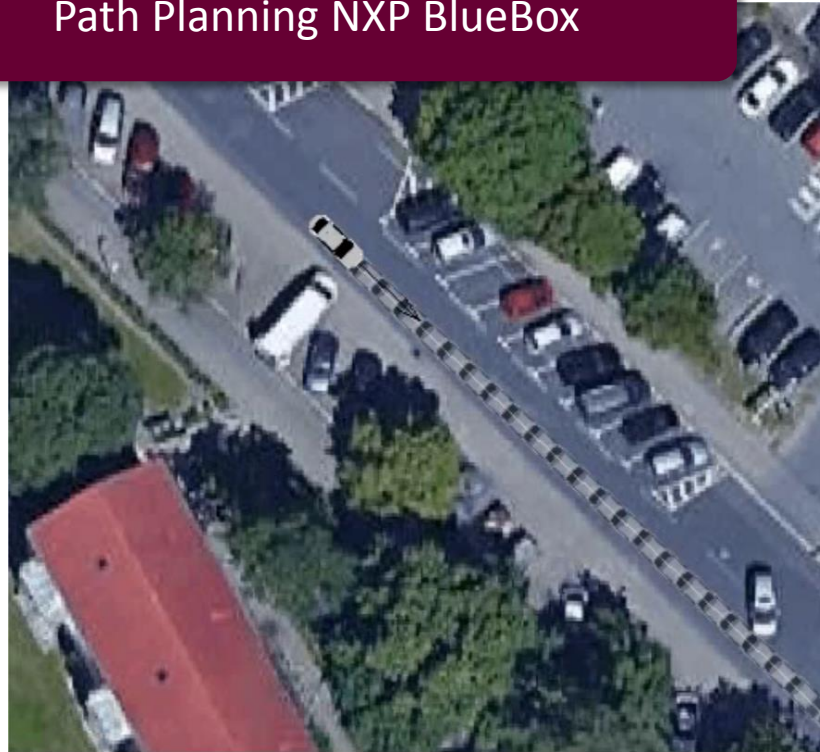
EB Elektrobit

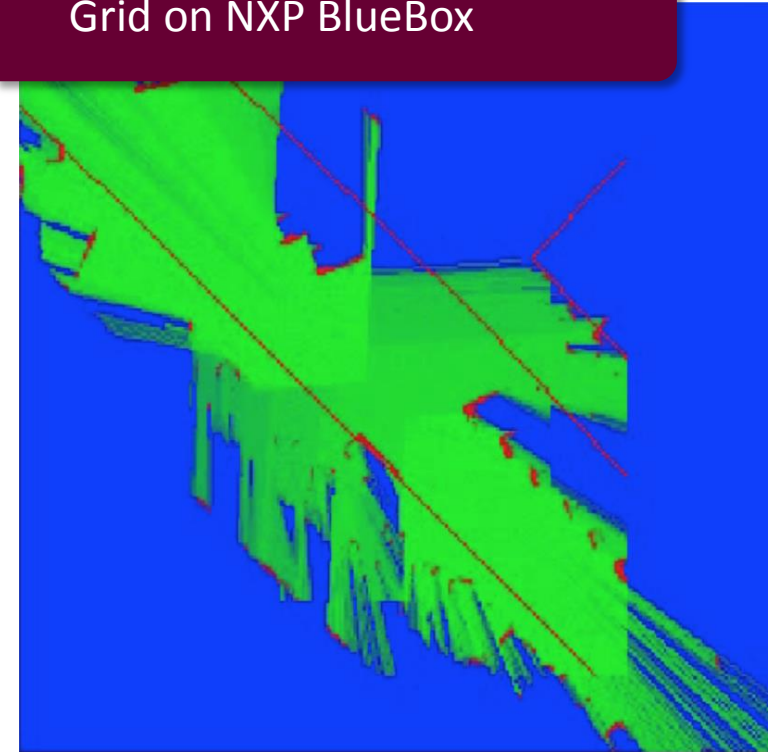# EB robinos Processing Recorded Data

Sensor: IBEO Lux Gen4 at 12.5Hz

Board: NXP BlueBox

Runtime Environment: EB robinos Linux Environment

Path Planning NXP BlueBox

Grid on NXP BlueBox

EB Elektrobit

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

Join the community!

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

robinos

Software for development and embedded prototyping

Software modules for series production

Open robinos specification
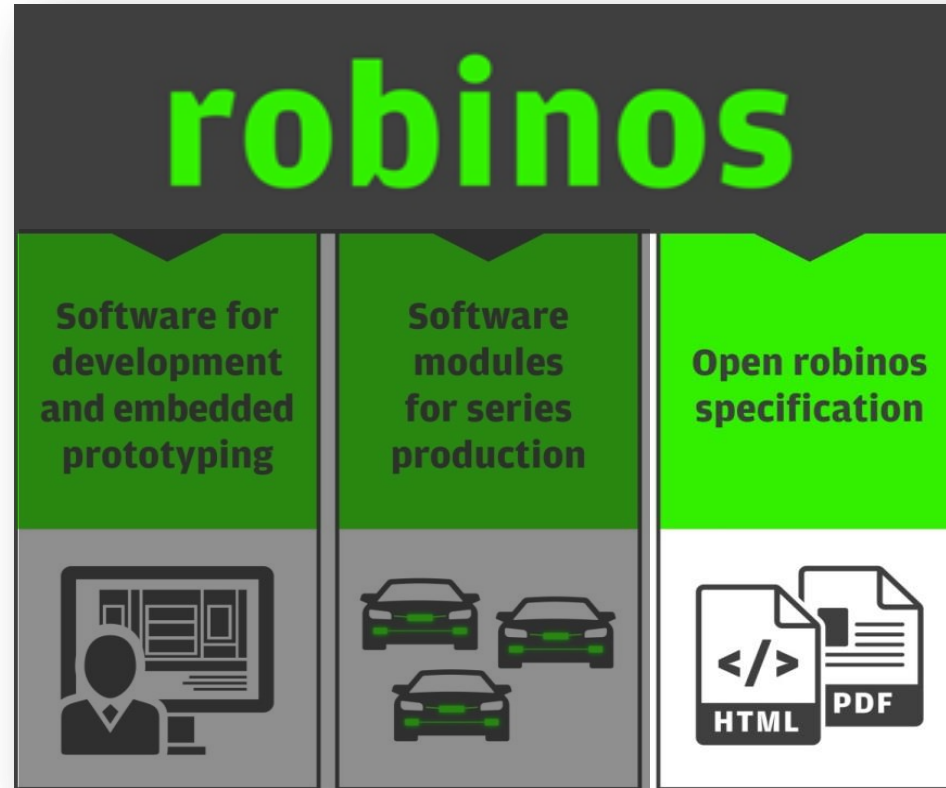
Download the open robinos specification

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**

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Conclusion

The problem is not difficulty but complexity.

Software frameworks and functional architectures help to address complexity

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

EB robinos
Highly automated driving architecture and software

AUTOSAR Basic Software

Safety Processor

Performance Processor

Get in touch!

Jared.combs@elektrobit.com
www.try-eb-robinos.com