Technology Enabler for Automated Driving

Dr. Eckard Steiger
Robert Bosch GmbH
TECHNOLOGY ENABLER FOR AUTOMATED DRIVING

DR. ECKARD STEIGER
ROBERT BOSCH GMBH
Technology Enabler for AD

HAD and FAD Use Cases (1st Expected Series Launches)

- Highway pilot (2020)
- Urban pilot (>2020)
- Parking pilot (2018)
In-Vehicle Technology Enabler

Autonomous Evolution and Mobility Revolution

PC - Privately Owned Passenger Cars

- ICE + eDrive coexistence
- Improve automotive electronics, scaleability
- Mechatronic
- Joy of driving
- Scalability, safety, cost
- Vehicles

SAEC – Shared Autonomous Electric Vehicles

- Powertrain
- eDrive
- Electronics
- Enable high end CE / modularity
- Core-Competence
- IT, SW
- USP
- UX, connectivity, mobility
- Focus
- Speed, availability, maintainence, interchangeability
- Business
- Data, mobility

Incremental Change

Individual / privately owned

Shared / fleet use

Carsharing Movement

Source: Mercedes-Benz

Source: google.com

Focus

Business

Driver

Assist

Automated

Autonomous

Breakthrough Evolution

Carsharing Movement

Source: Mercedes-Benz

Source: google.com

USP

Joy of driving

Scalability, safety, cost

Vehicles

Mechatronic

Powertrain

Electronics

Core-Competence

IT, SW

UX, connectivity, mobility

Speed, availability, maintainence, interchangeability

Data, mobility

© Robert Bosch GmbH 2017. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Technology Enabler for AD
Automated Driving - Core Activities and Technologies

**sense**
- data fusion
- redundancy
- perception
- localization
- electronic horizon
- radar
- lidar

**think**
- vehicle computer
- data analytics
- planner
- prediction
- decision
- safety
- security

**act**
- actuator management
- braking
- steering
- motion control
- fail operational
- driverless

**map**
- sensors

© Robert Bosch GmbH 2017. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.
Technology Enabler for AD

Key Enabler

System Architecture
- redundancies for sensing, ECUs, and actuation (fail operational)

Reliability and Security
- protect against technical failure and deliberate cyber attacks

Surround Sensing
- highly robust in all use cases

Legislation
- global standards and clear liability

Localization
- maps: always precise and up-to-date

System Intelligence
- interpret the situation, plan, decide and execute

Validation & Release Process
- safeguarding automated vehicles and systems
Chassis Systems Control | CC/PJ-CAD | 06/16/2017
ITS European Congress June 21st 2017
© Robert Bosch GmbH 2017. All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights.

Technology Enabler for AD
Surround Sensing

Challenges:
- Robust, complementary and highly reliable sensors under all conditions
- Satisfy reliability requirements by using redundant technologies for each area

Enabler:
- 360° surround sensing by combination of different sensor technologies
- Migration from prototype to mass production sensors
Bosch AI Car Computer

- Powered by NVIDIA® Xavier GPU
- AI Supercomputer for highly Autonomous Vehicles
- 30 Trillion Deep Learning Operations / Second
In-Vehicle Technology Enabler

Bosch AI Car Computer

Closed Loop Learning

Occupancy Grid

Bosch AI Car Computer

Car Control
# Technology Enabler for AD Localization

## HD Map
- **1. Planning Map**
  - “Your lane ends at position $x \ y$”
  - Accurate road geometry, dm accuracy

## Localization Map
- **2. Localization Map**
  - “You are currently at position $\xi \ \psi$”
  - Landmarks
  - △ Green
  - □ Red

## Decision Algorithm
- **3. Decision Algorithm**
  - “Merge right within the next 150 meters”

---

**HD map needed for**
- situation analysis
- path planning
- decision making
- accurate vehicle localization
Technology Enabler for AD Localization - HD Map: Required for Automated Driving

- OEM cloud
- Map partner cloud
- Bosch Road Signature Cloud

Integrated HD map with Bosch Road Signature

Partner HD map layers

Video Road Signature Data

Radar Road Signature Data
Technology Enabler for AD
Validation and Release Process

Expenditure for validation will increase by a factor of $10^6$ to $10^7$
- Traditional statistical validation not suitable for higher degree of automation
- Highly automated systems require completely new release strategies

Potential for reduction by combination of statistical validation with new qualitative design and release strategies
Technology Enabler for AD
Connected Validation

- Reduced data complexity by using event triggered data recording. Shorter development iterations due to immediate data analysis.

Diagram:
- Event Trigger
- Record
- Upload
- Database
  - Radar, Video
- Data Analytics

Roles:
- Data Analyst
- Fleet Manager
- Developer
Excellence in system expertise – key to cope challenges in automated driving