Vision and Roadmap towards Fully Automated Driving

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Agenda

- Vision
- Roadmap
- Technical building blocks for Automated Driving
- Conclusion
Do you really want to...

...drive yourself?? Always??
Vision and Roadmap

Source: Günter Radtke, 1974

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Vision and Benefits of Automated Driving

- Relaxed driving even in dense traffic
- Reduction of travel times and fuel consumption
- Injury and accident-free driving
- All age ranges remain mobile
- Time on the road becomes more productive
Roadmap: Main Criteria

- Level of automation
- Complexity of environment
- Duration and dynamics of automated maneuvers
- Options of behavior
Automated Driving Roadmap

Options of behaviour:
- Traffic Jam Assist: Partly Automated
- Highway Pilot: Fully Automated
- Commuting: Fully Automated

Duration and dynamic of automated maneuvers:
- ACC: Assisted
- LKS: Not automated

Complexity of environment:
- 1 Sensor
- Sensor Data Fusion
- 360° field of view

Customer Benefit:
- System permanently supervised by driver
- Reduced driver supervision of system

Automation Level

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Technical building of AD

Perception
- Sensors
- Sensor Data Fusion

Localization
- Navigation
- Localiza
- Weather
- Traffic Data
- Connected Vehicle
- Backend Services

System Engineering
from Driver Assistance to
Automated Driving

Brain & Nerves
- ECU
- Driving Functions

Motion
- Braking & Steering
- Vehicle Motion Control

System Design & Integration

Customer Benefits
- Assisted
- Partly Automated
- Fully Automated

Automation Level
Perception

- **360°** surround view
  - **3D** information
  - **Shape and surface** measurement
  - High **reliability**
  - Low sensitivity to **weather and light**
  - Physical **redundancy**

- Knowledge of **driver state**
  - Take over maneuver
  - “Safe Stop” in case of driver disability
Environment Model

Local, on Board
Radar / (Stereo-)Video

Traffic in near vicinity
Preview: Few Seconds

Reactive/Tactical Driving:
Speed/Distance Keeping, Emergency Manoeuvres

Global, connected
Dynamic local map

Situation ahead the route
Preview: Several Minutes

Strategic Driving:
Speed Adjustment, Risk Avoidance, Energy Mgmt, Eco Driving, Automation

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Brain & Nerves

- **Reliable decisions** based on dynamic and uncertain information:
  - Interpretation of sensor information
  - Decision making
  - Trajectory planning

- Increased requirements on **Hardware & Software**
  - Connectivity, Data flow
  - ECU (Power, Connectivity, Reliability)
  - Communication (Bandwidth, Protocols, Redundancy)
  - Energy supply (Reliability, Backup)
Precise motion control
It must be ensured that the vehicle follows the generated trajectory at all times

Safe State
The vehicle must be brought into a safe state even without driver intervention at the unlikely event of a system failure

- Redundant actuation
- Emergency operation mode
- Energy backup for vehicle detention
Conclusion

- Automated Driving is becoming a reality offering benefits for safety and relaxed driving

- Stepwise implementation starting with Highway Driving functions

- The trend towards Automated Driving is generating new technical challenges for sensors, actuators and E/E architecture