Enhancements of Future Driver Assistance Systems

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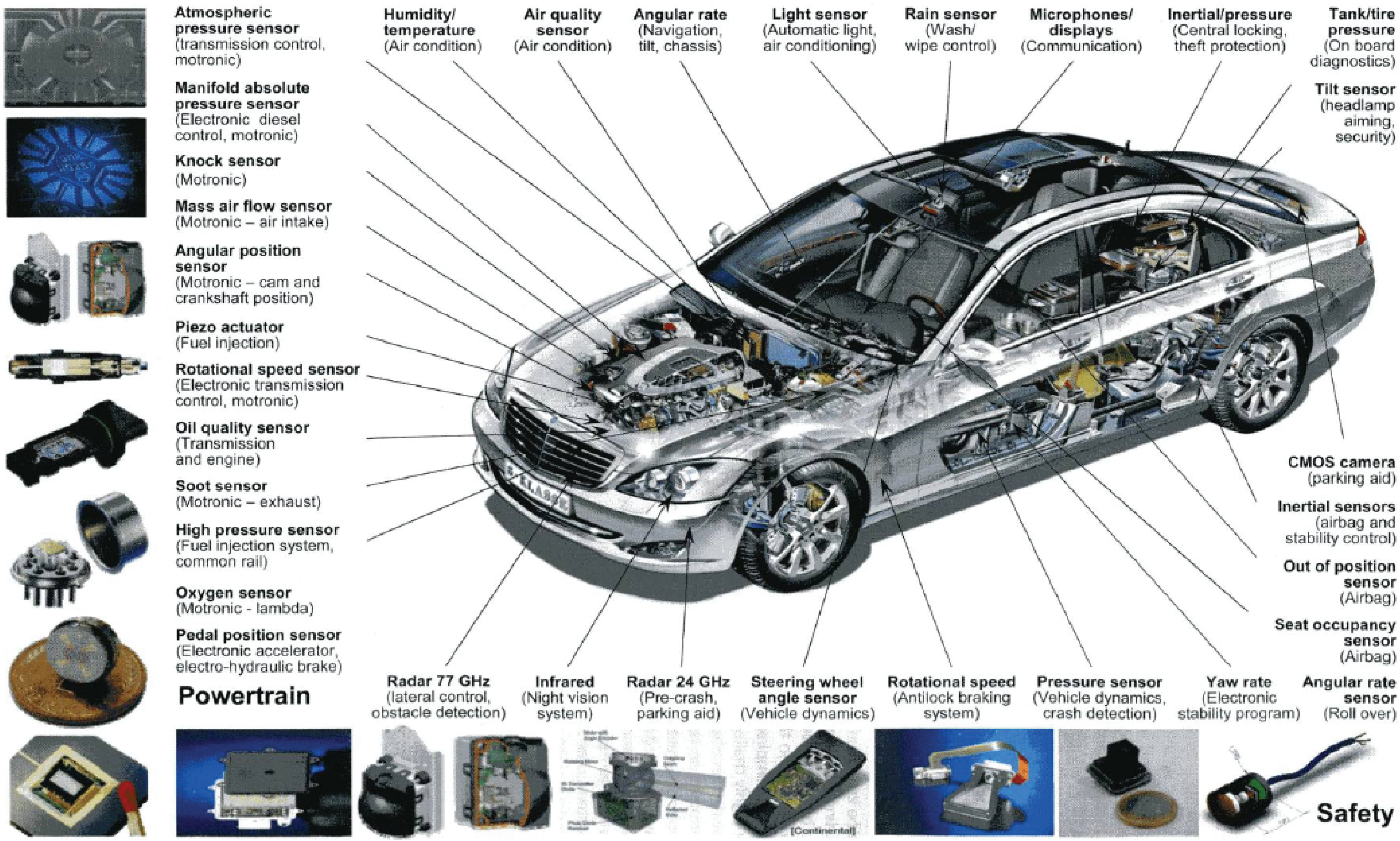
DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.

in der Helmholtz-Gemeinschaft

A modern car is full of sensors (and actuators)

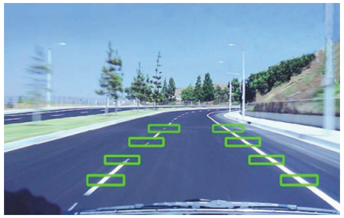
Intelligent Vehicles



Advanced Driver Assistance Systems (ADAS)

increasing safety, efficiency and comfort

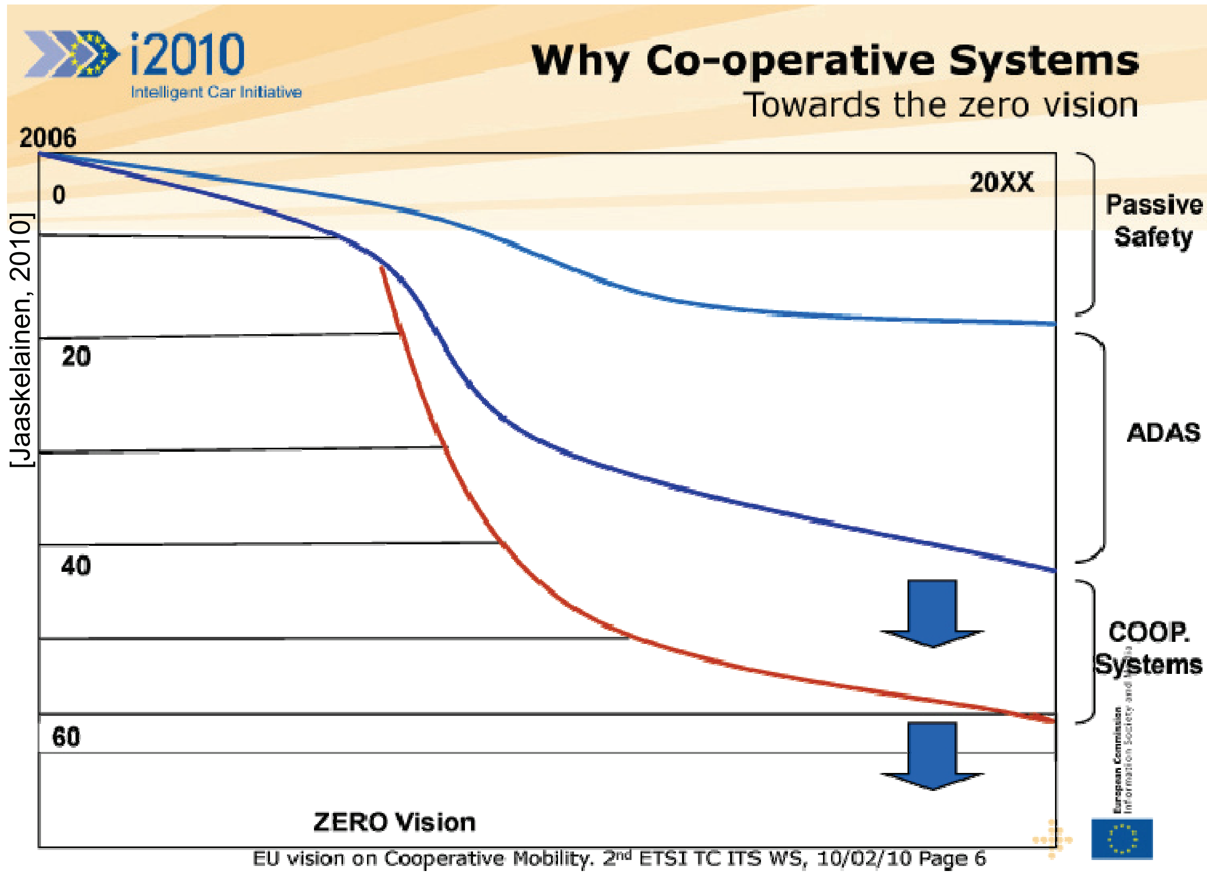
- ADAS are systems that support the driver in her/his task of driving a vehicle in order to increase safety, efficiency and comfort
- Detection of situational parameters by sensors and, if necessary, performance of appropriate measures by actuators:
  - Sensors: Devices that measure a physical quantity and convert it to a readable signal (e.g. odometer, thermometer, yaw rate sensor)
  - Actuators: Devices that transform a signal into an action in order to perform a certain effect (e.g. brake, steering column, HMI)
- Examples:
  - Electronic Stability Control (ESC)
  - Adaptive Cruise Control (ACC)
  - Lane Departure Warning (LDW)
  - …



[visual LDW]

[ACC by Delphi]

Cooperative Systems



- **Cooperation** mandates **Communications**
- **Intelligent Transportation Systems** build upon **robust and reliable communications**

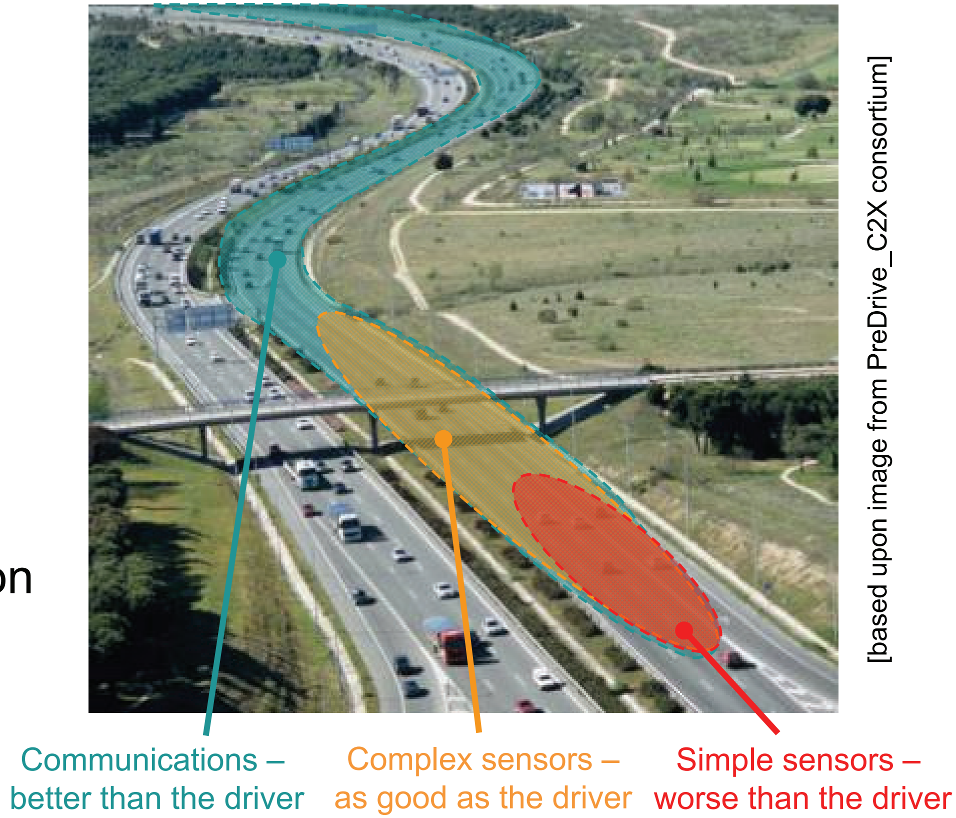
Interconnected Vehicles

Extending "sensor range" through communications:

- Beyond autonomous sensor range
- Beyond the driver's visual range
- With enriched details and quality

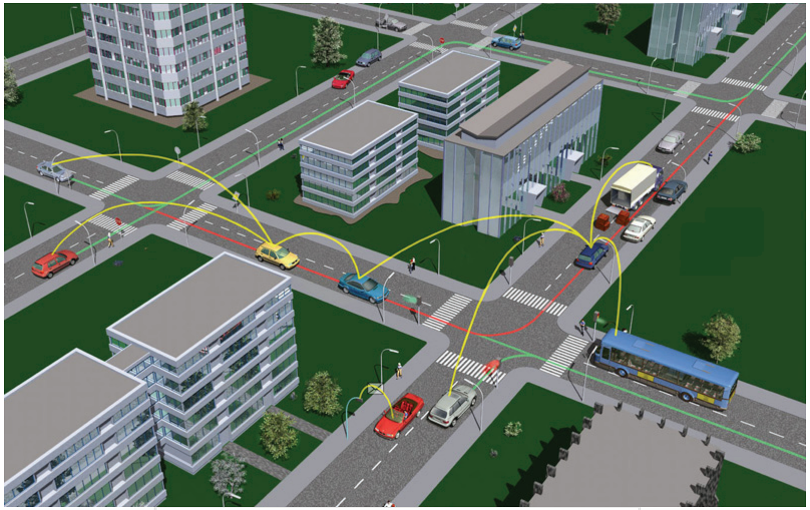
Creation of an "Information Horizon"

- The right information in the right situation to the driver
- Extends safety time margin
- Extends beyond the physical horizon



[based upon image from PreDrive_C2X consortium]

Vehicular Communications
Communication between …

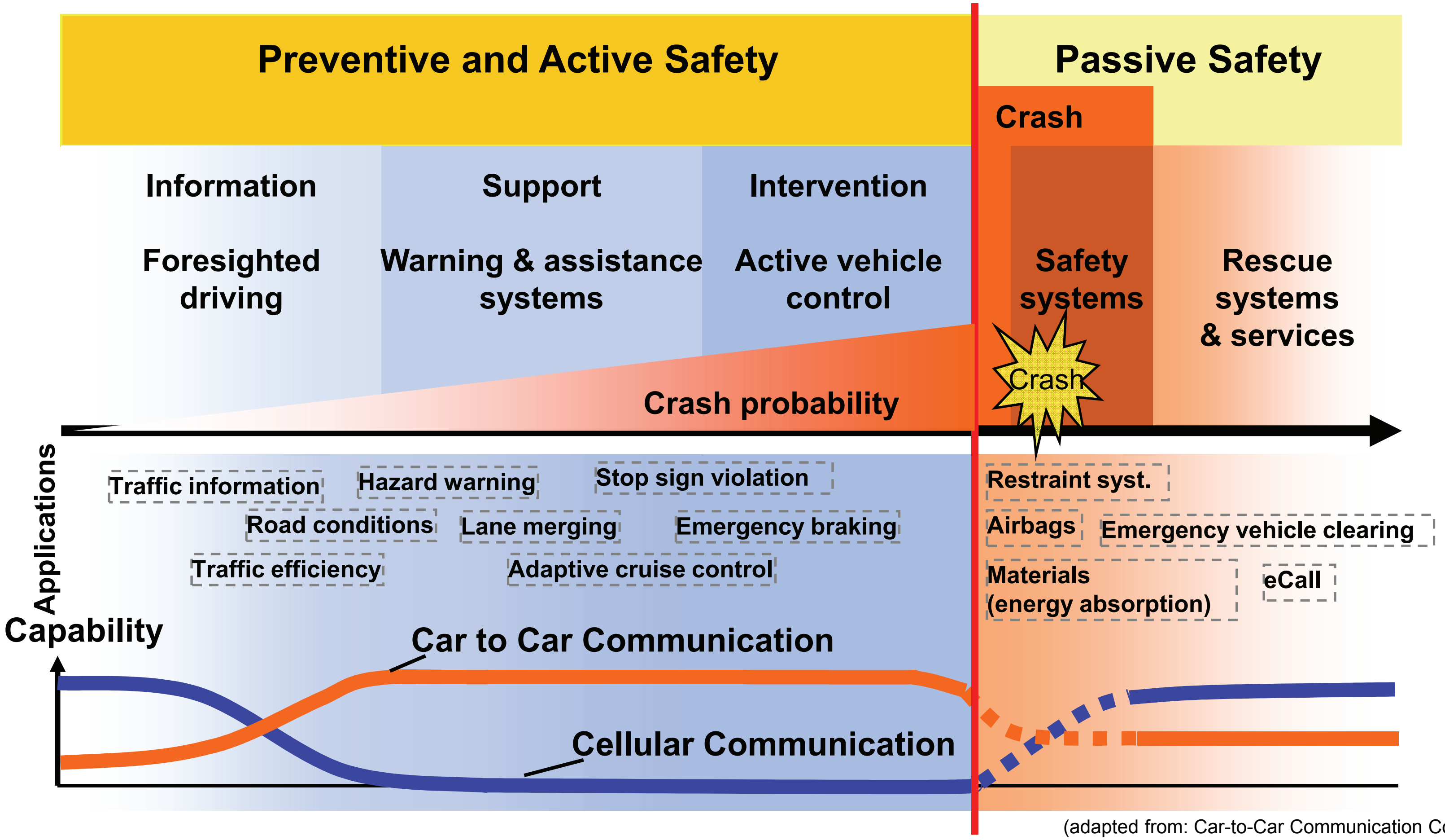


Source: Car-2-Car Communication Consortium

- Vehicles
  - Cars
  - Trucks
  - Buses
  - Motorcycles
  - optional:
    trains, trams, pedestrians, etc.
- Infrastructure and vehicle:
  - Road-side Units (RSUs): variable message signs (VMS), traffic light signals (TLS), portable infrastructure (intelligent cones), …
  - Broadcast systems: Digital Video/Audio Broadcast (DVB/DAB), RDS-TMC, TPEG, …
  - Cellular network infrastructure: GSM/UMTS/LTE, WiMAX, …

Driver Assistance Systems

Preventive vs. Active vs. Passive safety

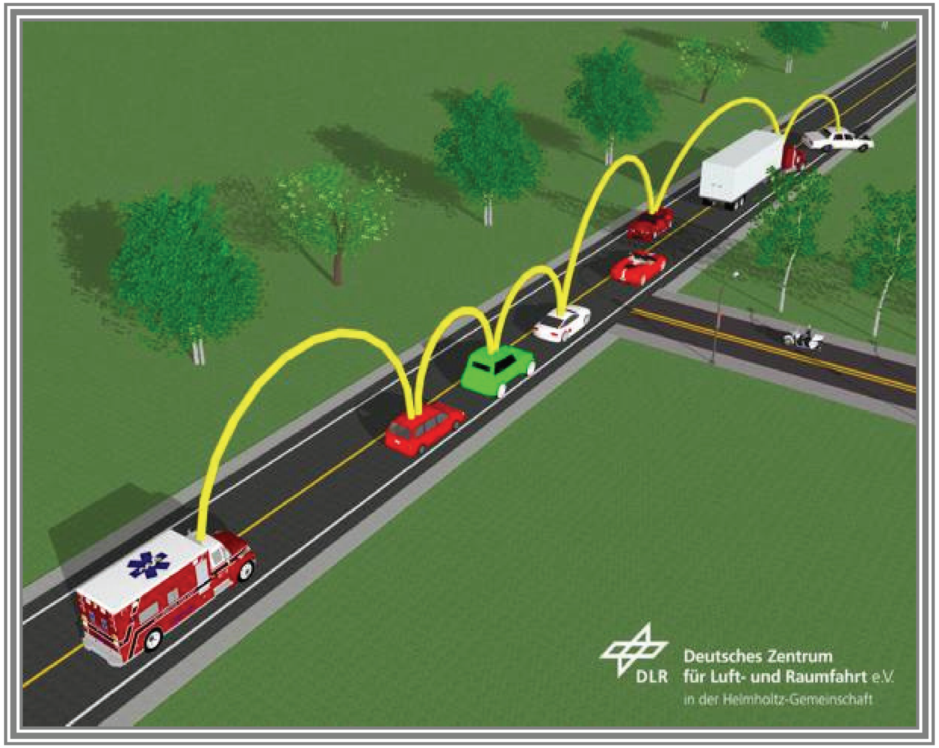


(adapted from: Car-to-Car Communication Consortium)

Car-to-Car Communications
Use cases

CAR 2 CAR
COMMUNICATION CONSORTIUM

- **Safety**:
  - Traffic Jam Ahead Warning
  - Curve Speed Warning
  - Intersection Assistance
  - Black Spot Warning
- **Efficiency**:
  - Decentralized Floating Car Data
  - Optimal Speed Advisory
- **Infotainment**:
  - Access Control
  - Point-of-Interest Notification



More than 120 potential use cases have already been identified,
about 5 of them do **not** require SatNav, many require **precise** positioning

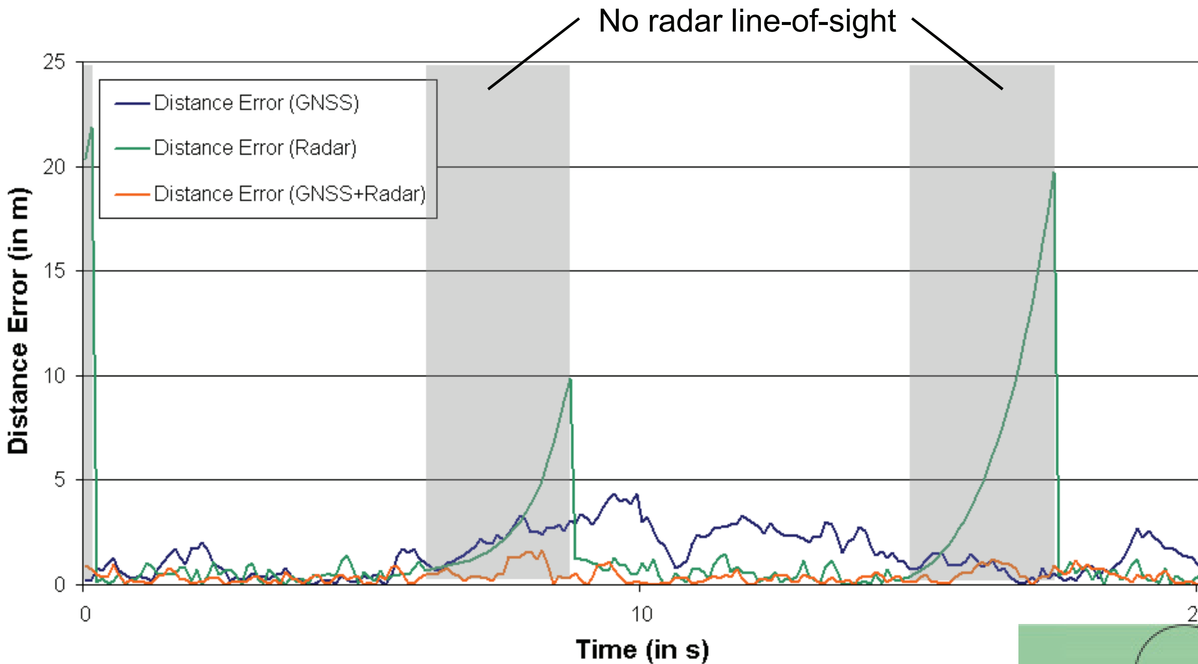
Next Generation Driver Assistance Systems
Example: Cooperative Adaptive Cruise Control (CACC)

- Automatic longitudinal gap keeping assistant based on V2V Communication
- Exchange of speed, heading, position, brake/acceleration action, vehicle type, etc.

- \+ Improved safety (timely & reliable reaction)
- \+ Improved traffic efficiency (closer safe gaps)
- \+ Improved comfort (less unnecessary deceleration)
- \+ Improved energy and material usage (e.g. use of engine brake or recuperator instead of service brake)

CACC: Ranging accuracy

Distance (between ego & target vehicle) error



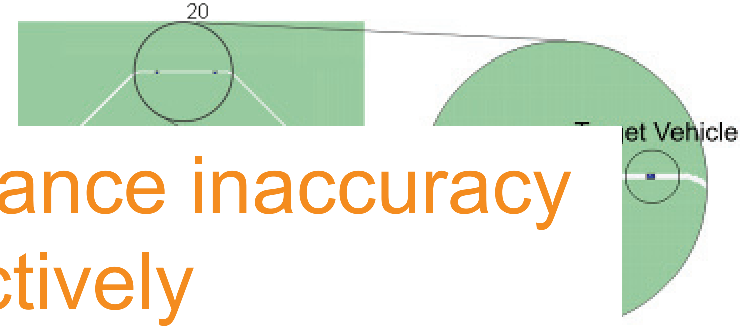
Ego vehicle sensors:

- GNSS
- Odometer
- Compass
- Radar

Target vehicle sensors:

- GNSS
- Odometer
- Compass

} Distributed via V2V communications



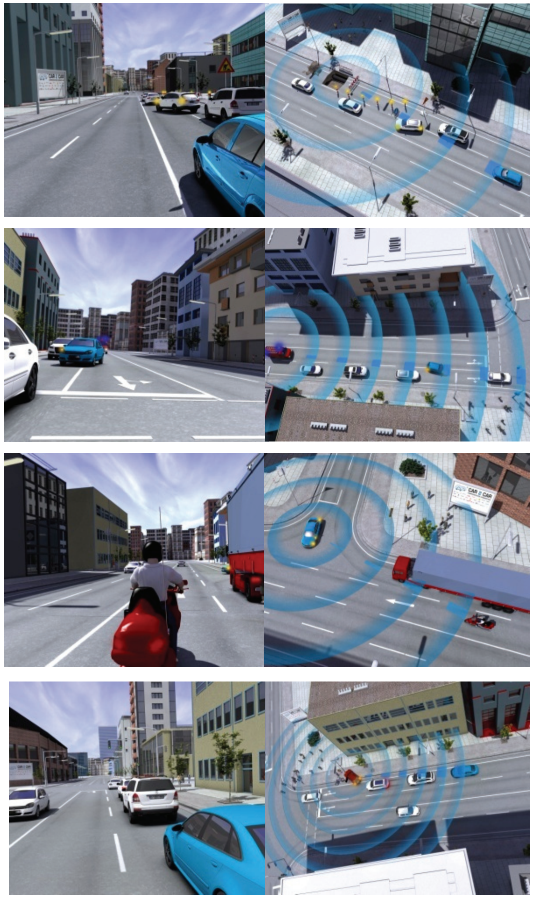
Sensor fusion reduces distance inaccuracy by ~40% and ~80% respectively

Car-to-Car Communication Consortium
Dudenhofen Demo in October 2008

CAR 2 CAR
COMMUNICATION CONSORTIUM

Objectives where to show…

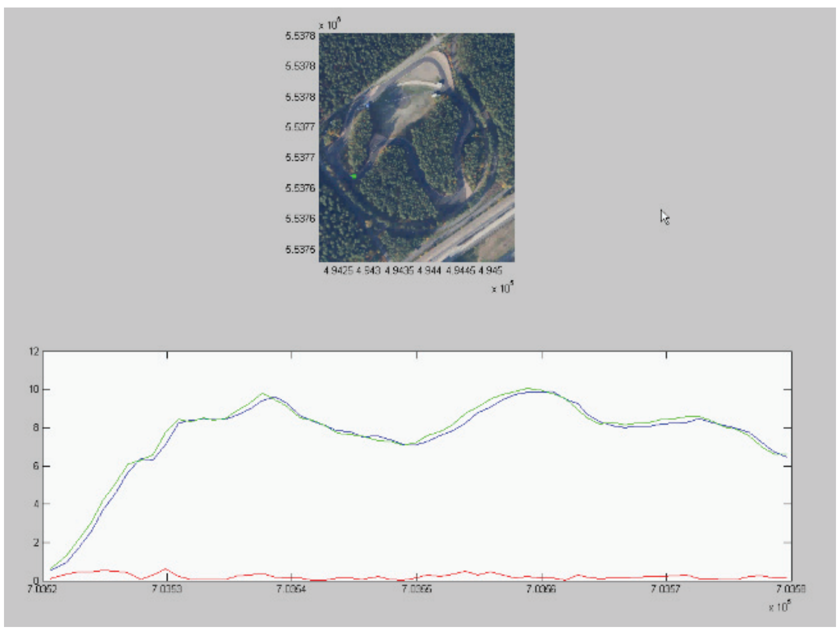
- **functionality** of CAR 2 CAR Communication Consortium system with 4 selected use cases
  - Warning of road works
  - Emergency vehicle
  - Broken down vehicle
  - Motorcycle use case / intersection scenario
- **interoperability** between different comm. platforms
  - 9 vehicle manufacturers (Opel, BMW, Daimler, Volvo, Renault, Fiat, Volkswagen, Audi, Honda, …)
  - 4 communication supplies (NEC, Hitachi / Renesas, Delphi, Denso)
  - 1 after market supplier (Alpine)
- **impact** of vehicle-to-x communication to press, managers and VIPs, and researchers from the research field



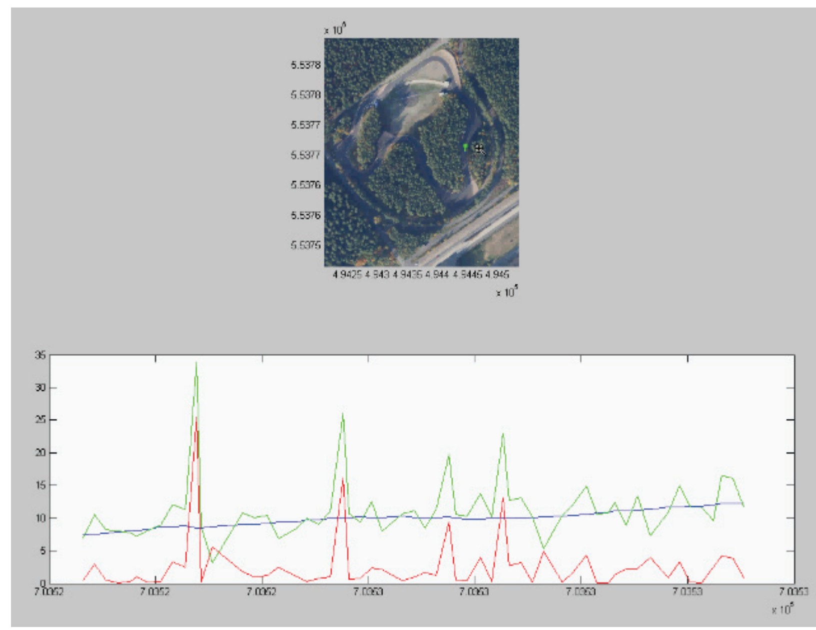
Why position accuracy does matter…

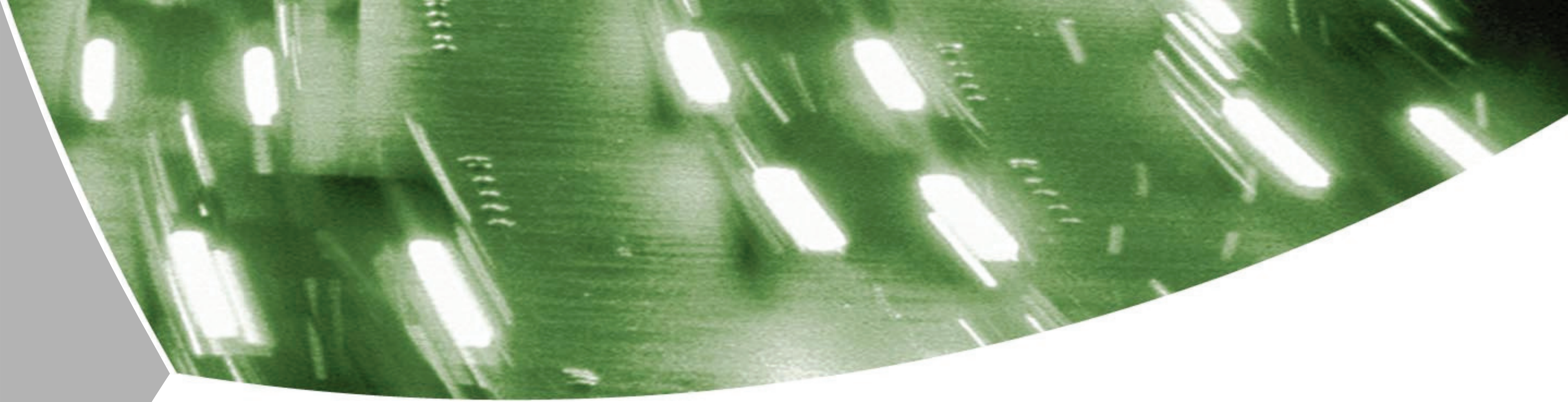
- Data from the Dudenhofen Demo in Oktober 2008
- No „ground truth“ available, but…

Vehicle A



Vehicle B





Thank you

for your attention!

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The DLR

German Aerospace Research Center
Space Agency of the Federal Republic of Germany

Key areas

- Aeronautics
- Space
- Space Agency
- Transport — today‘s topic
- Energy