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KO-FAS

Inter-Vehicle Safety by Transponder Based Localization

Fahrzeug-Fahrzeug-Sicherheit durch transponderbasierte Ortung

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Daimler AG

Supported by:

Federal Ministry of Economics and Technology

on the basis of a decision by the German Bundestag

Phases of Sensorrevolution

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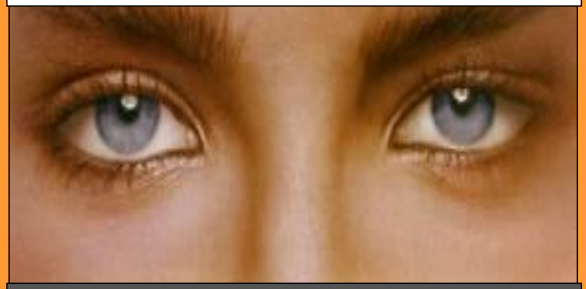
Phase I

Monitoring of vehicle and driver behaviour for risk assessment

“feel”

Phase II

Monitoring of the vehicles adjacencies to detect imminent dangers



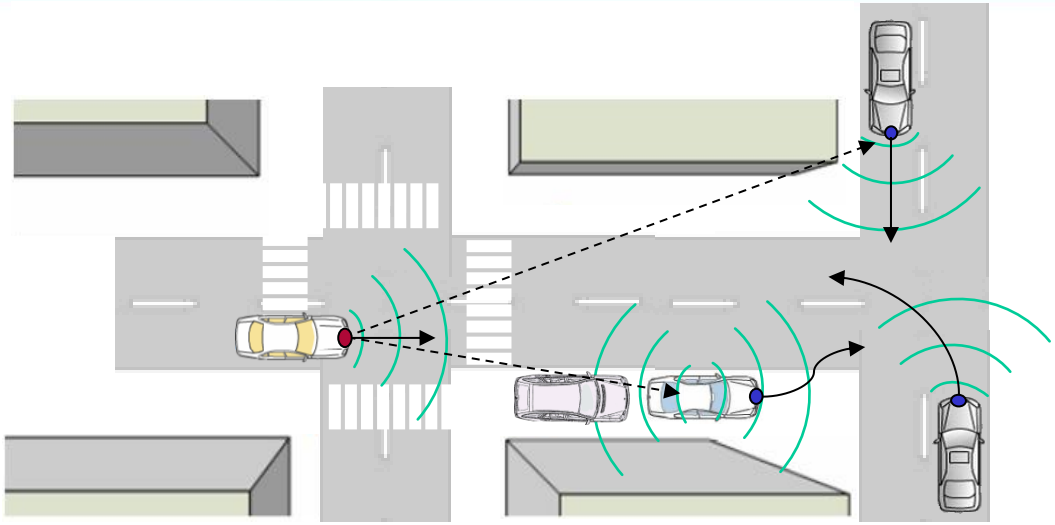
“see“

Phase III

Gathering of detailed information of the spacious environment to enhance the drivers awareness of imminent dangers

“communicate“

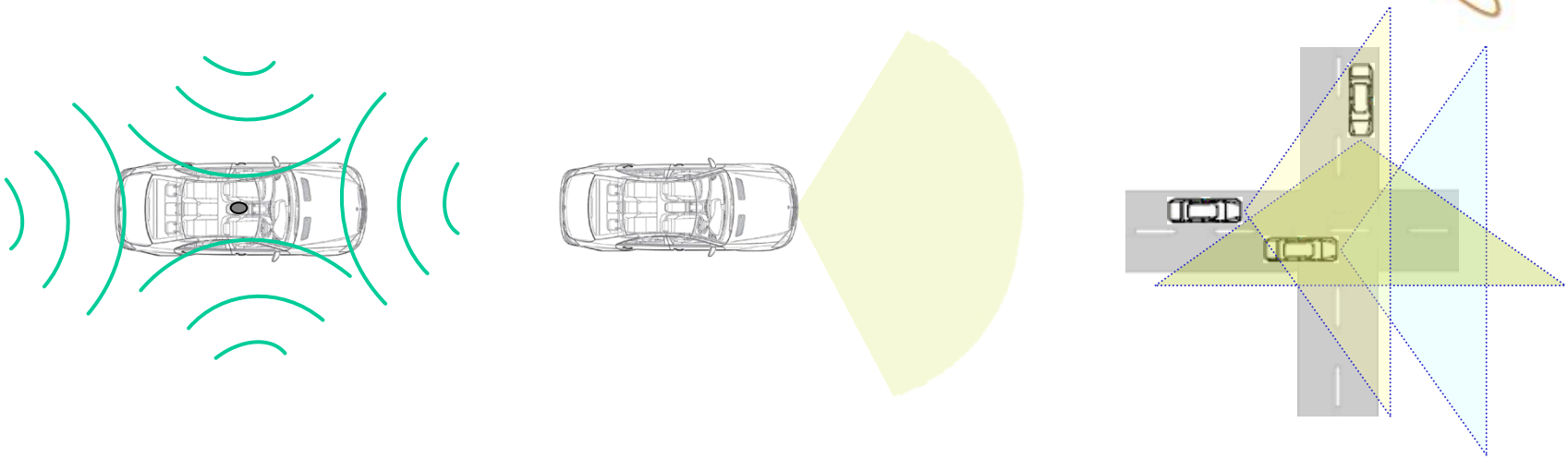
„All-Around Safety“ (AAS)
„Rundumsicherheit (RUS)“



- Localization and tracking of visible and occluded objects
- Calculation of possible path of collision
- Driver information and driver warning
- Intervention into vehicle dynamics (partially/full autonomous braking)

➔ Driver assistance and collision avoidance in crossing traffic situations

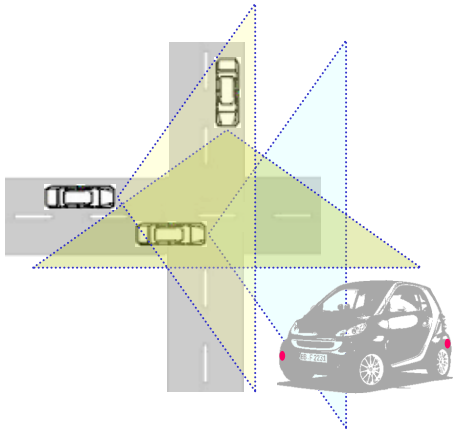
360°-Detectability (passive localization)

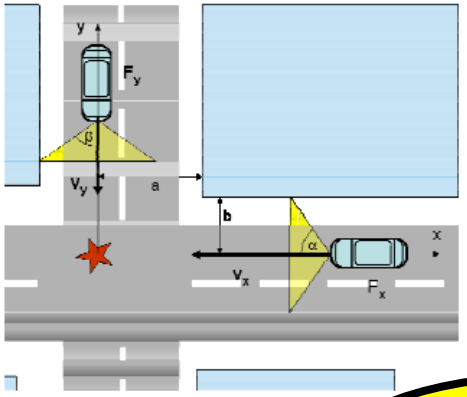


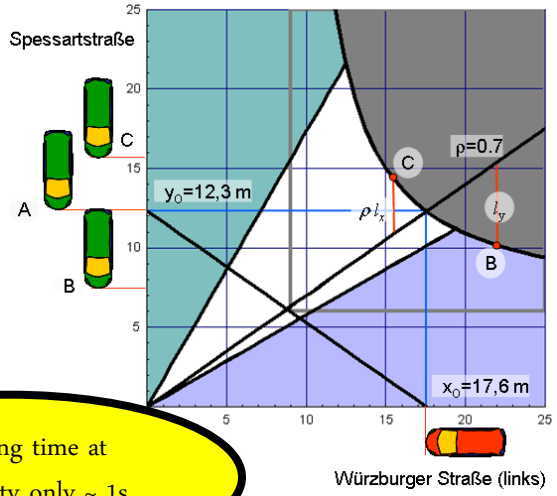
- Vehicle is detectable all-around
- Active localization only in forward direction
- Main intersection (accident-) scenarios addressable
- Basic system setup (localization unit, antenna, tags) same as VRU-Setup
- Vehicle integration effort identical to VRU system

Safety Measures

Driver warning, intervening systems







prewarning time at intervisibility only ~ 1s

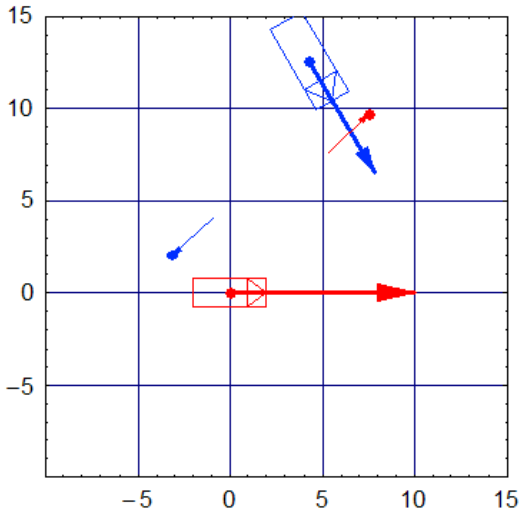
- Situational action plan required
- Reliable collision detection required
- Humans (often) reacts different to machines („sometimes it is better to speed up than to brake“)
- Wrong reaction could lead to disaster

Uncoordinated Actions

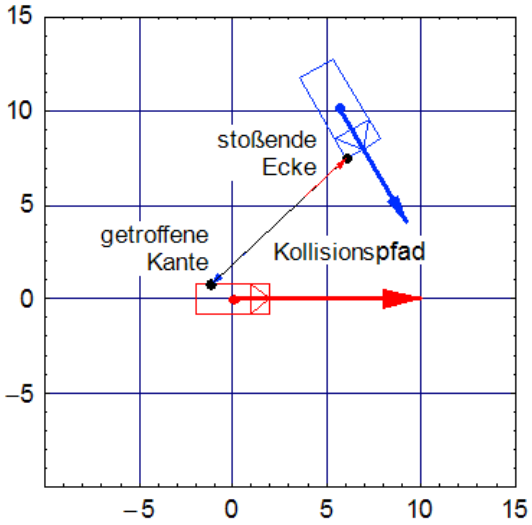
[Source: youtube.com]

Collision Detection Calculations

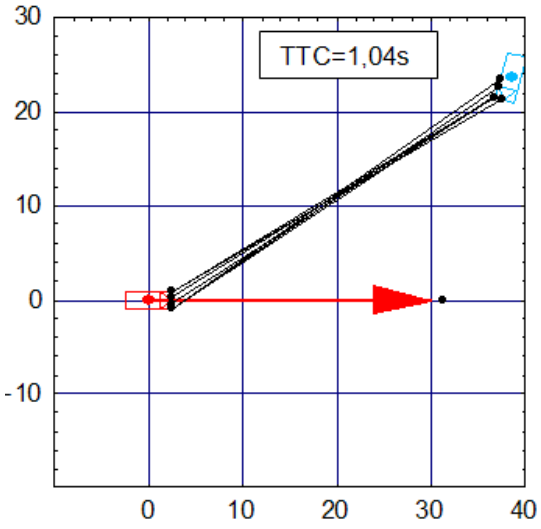
Closed approach



Collision detection



Speed variations (± 3 m/s)



Error	long.	across
Position	Δx	Δy
Velocity	$\Delta v \cdot \tau$	
Acceleration	$\Delta a \cdot \tau^2/2$	
Direction		$\Delta h_\varphi \cdot \tau \cdot v$
norm. steering angle		$\Delta y \cdot (\tau \cdot v)^2/2$

Differentiation between **closed approach** and **imminent collision** requires reliable **calculation of errors**

TTC – calculations (Time-To-Collision)

Trigger Algorithms

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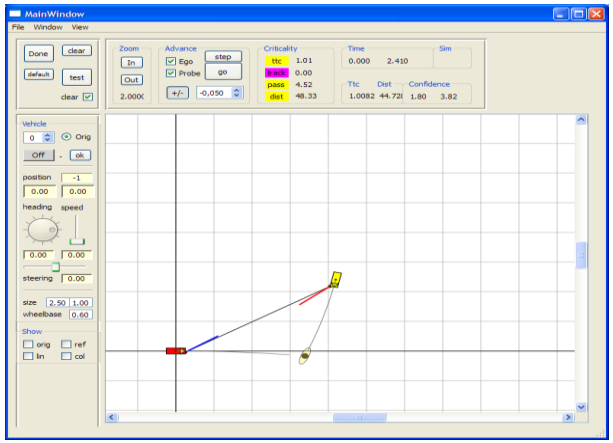
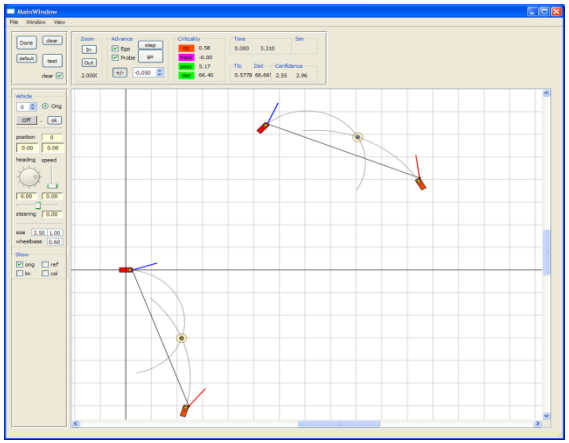
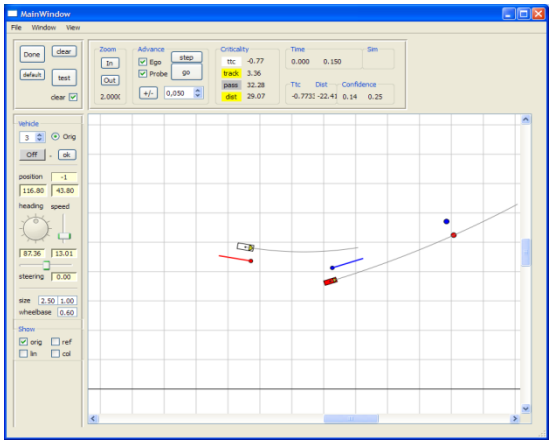
Crossroads scenarios



Circular driving



Contrive

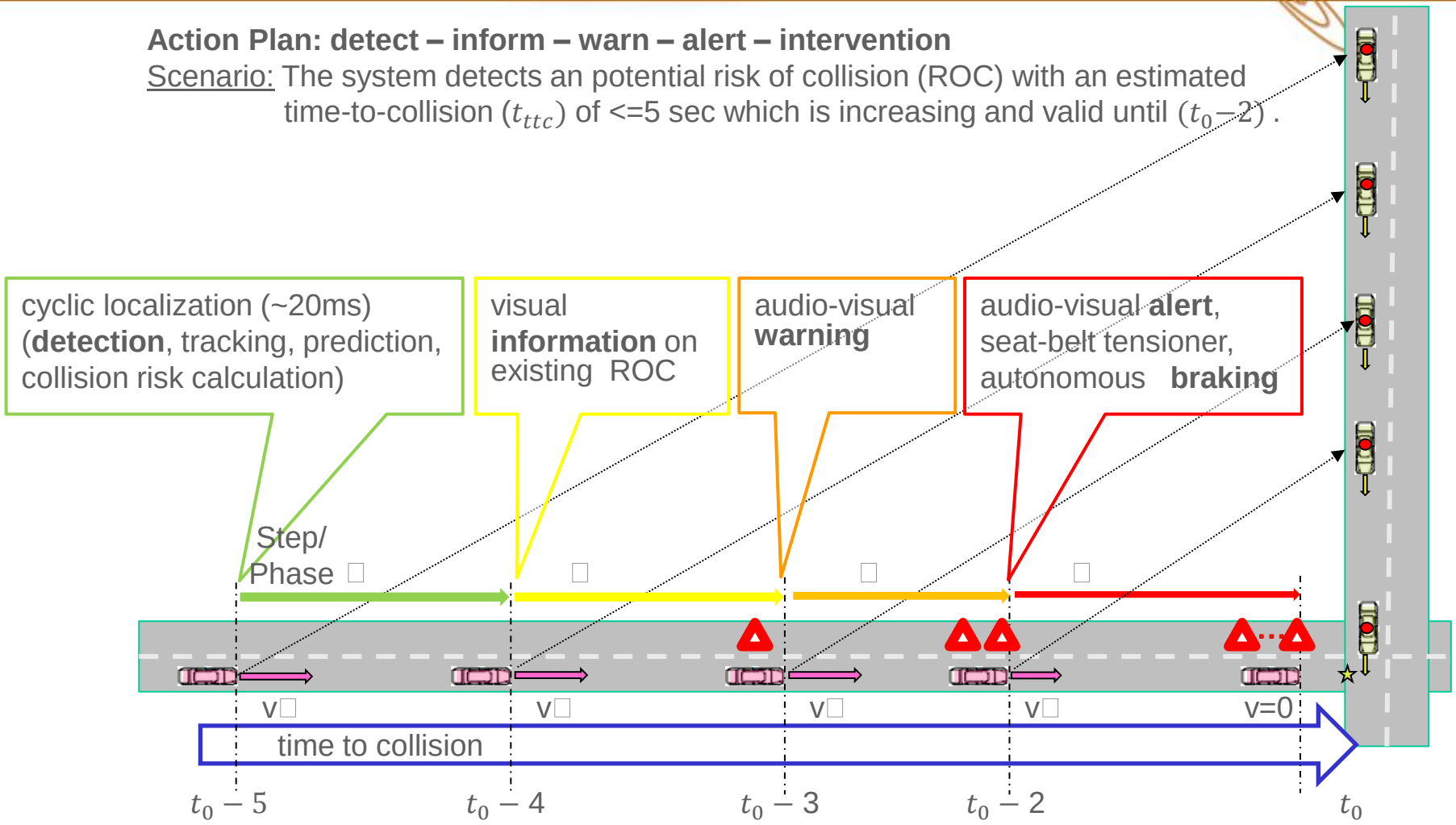


- Preselection of „endangered“ objects (TTC, closed approach)
- Tracking of critical vehicles
- Consideration of errors (positioning, motion) (if so with default values)
- If risk of collision (ROC) is stable
  ➔ triggering the action concept / warning strategy

Action Concept and Warning Strategy

Action Plan: detect – inform – warn – alert – intervention

Scenario: The system detects an potential risk of collision (ROC) with an estimated time-to-collision (t_{ttc}) of <=5 sec which is increasing and valid until ($t_0 - 2$) .



Real-Life Scenario

[Source: youtube.com]

Vehicle Integration

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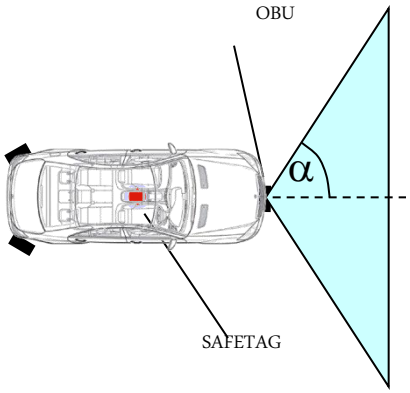
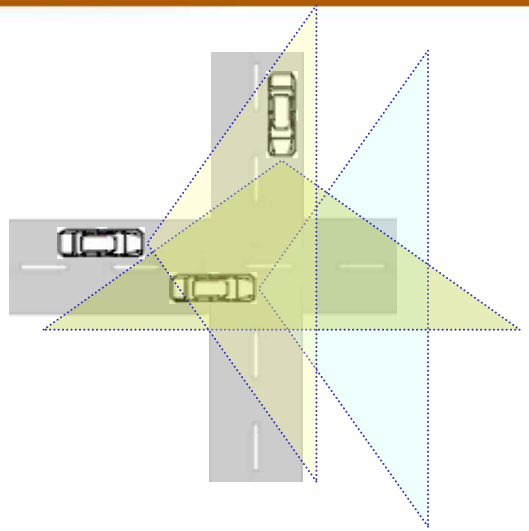
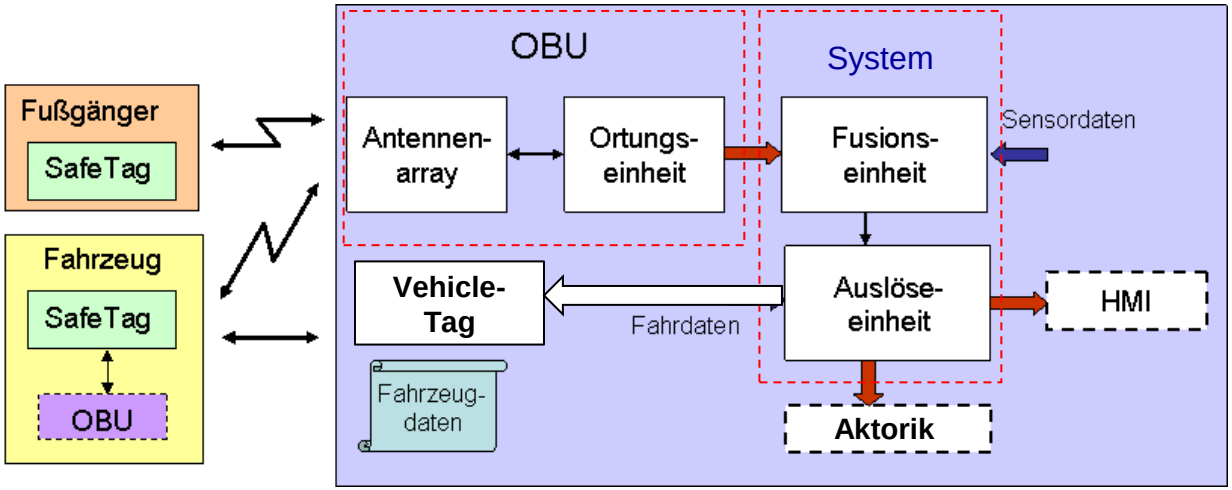
Test vehicles : S-Class (W221), smart (MC451)

- Hardware and software architecture development
- Identification of necessary interfaces
- Realization

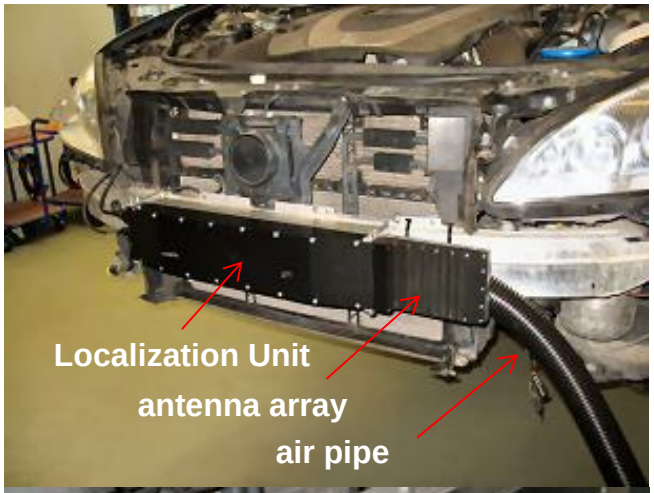
Guard System for All-around Safety

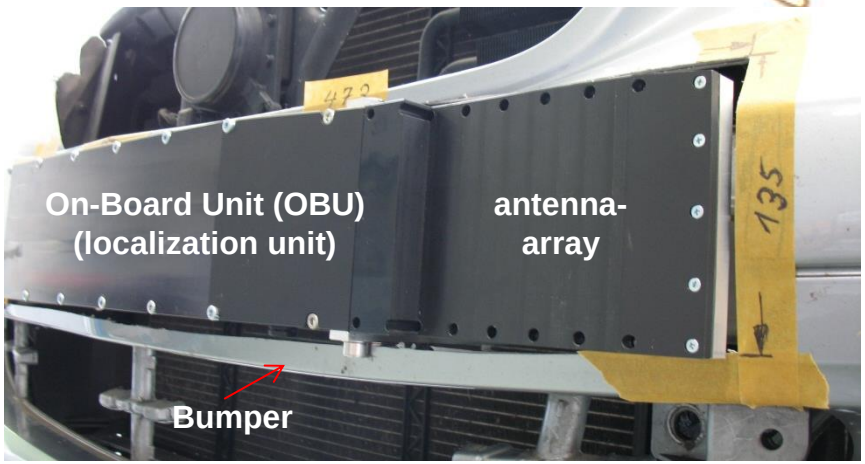


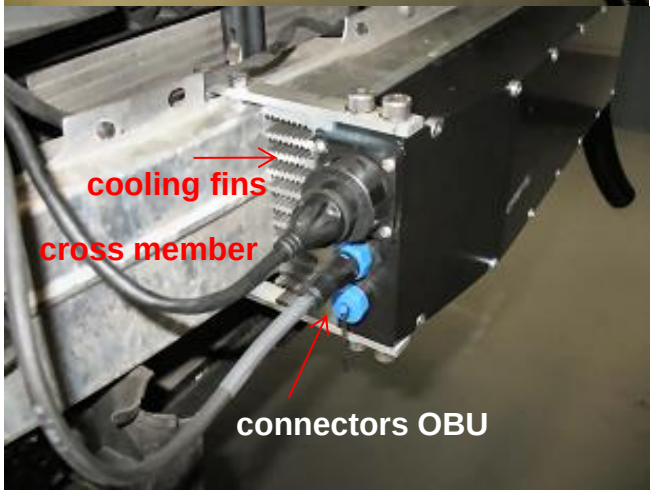


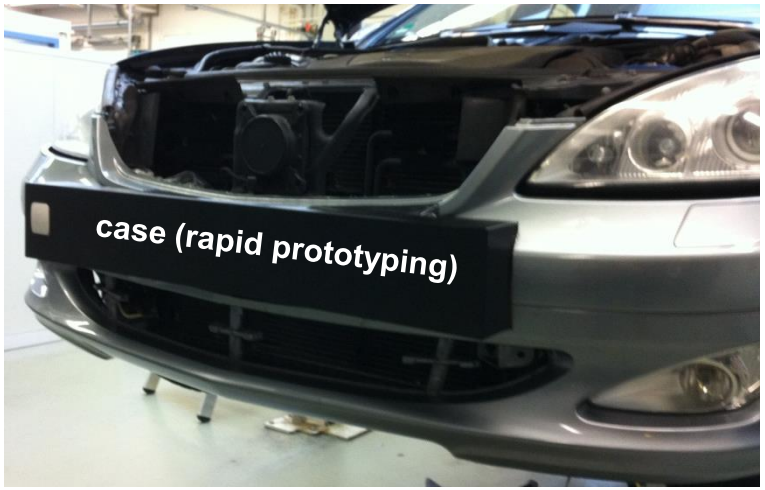


Vehicle Integration Localization Unit (OBU)

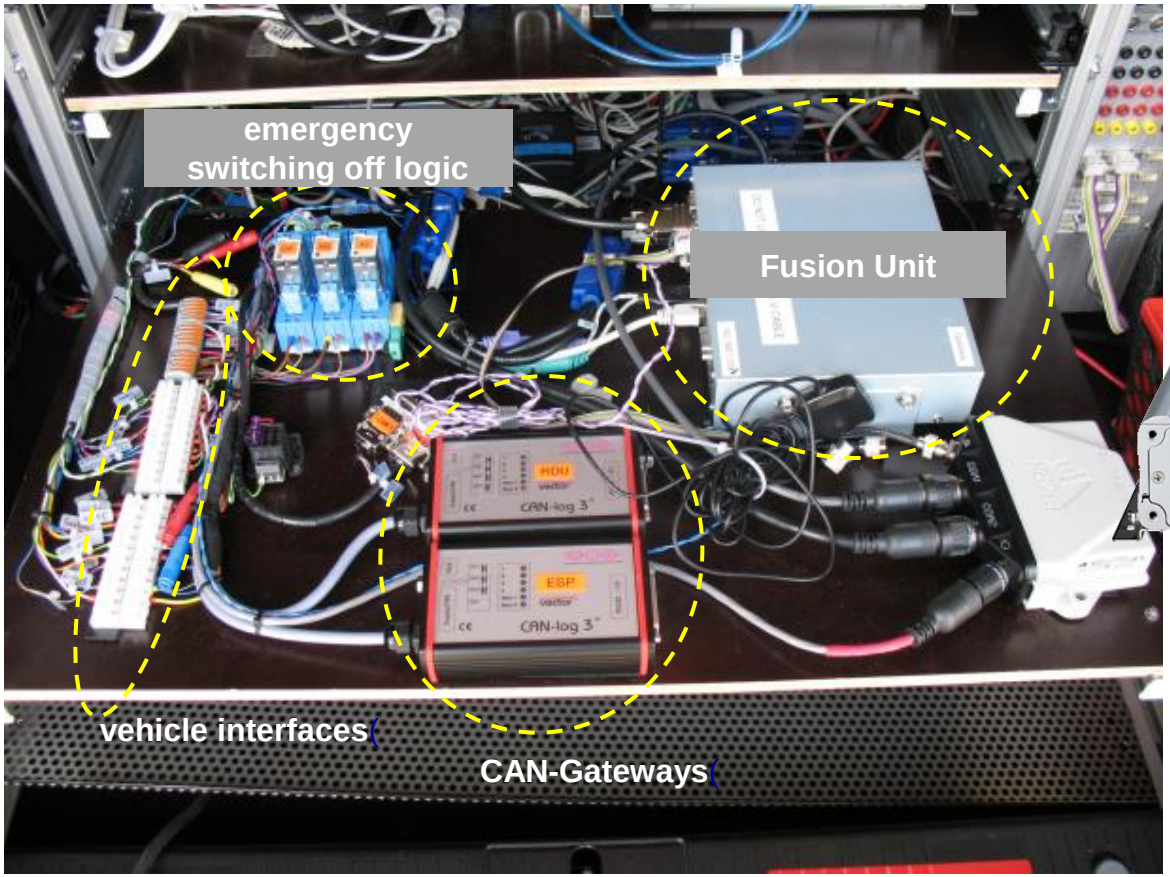






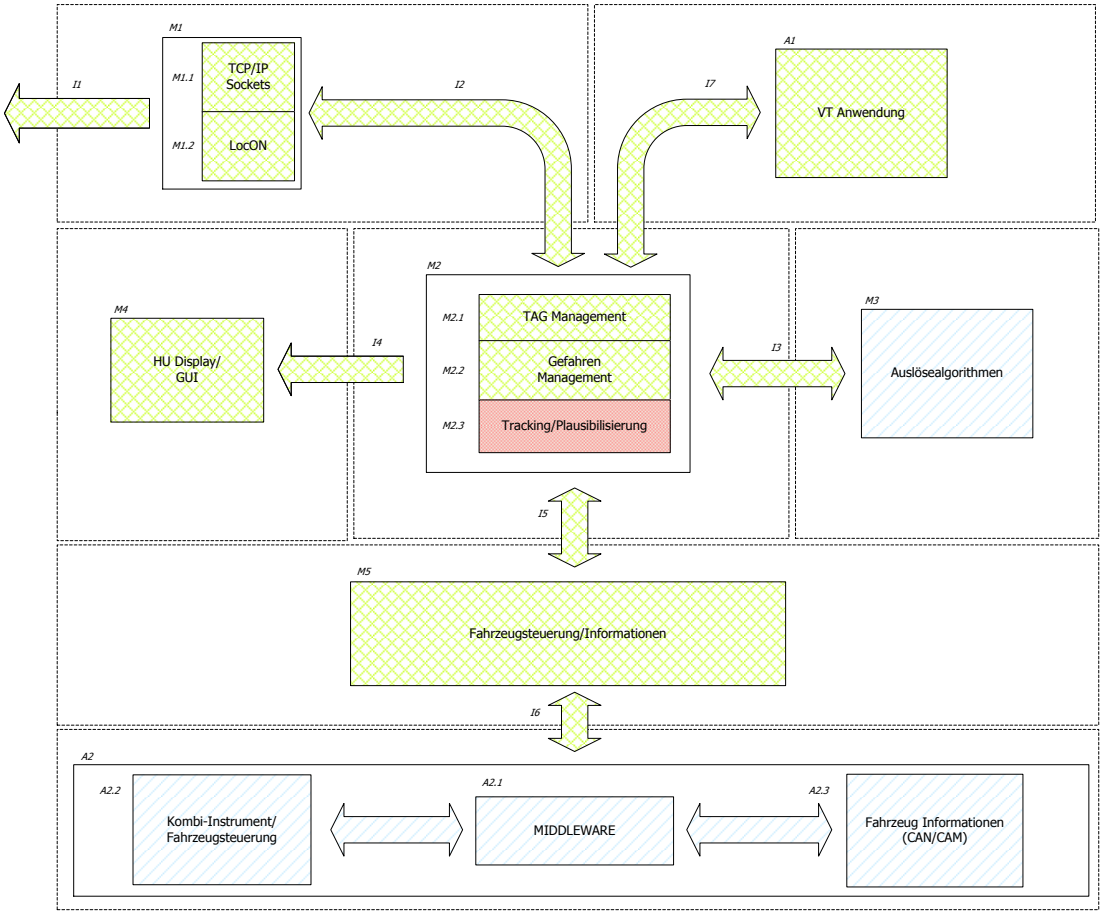


Vehicle Integration
Vehicle Control Components



Vehicle Integration
Human Machine Interface (HMI)

System Vehicle Integration
SW-Architecture

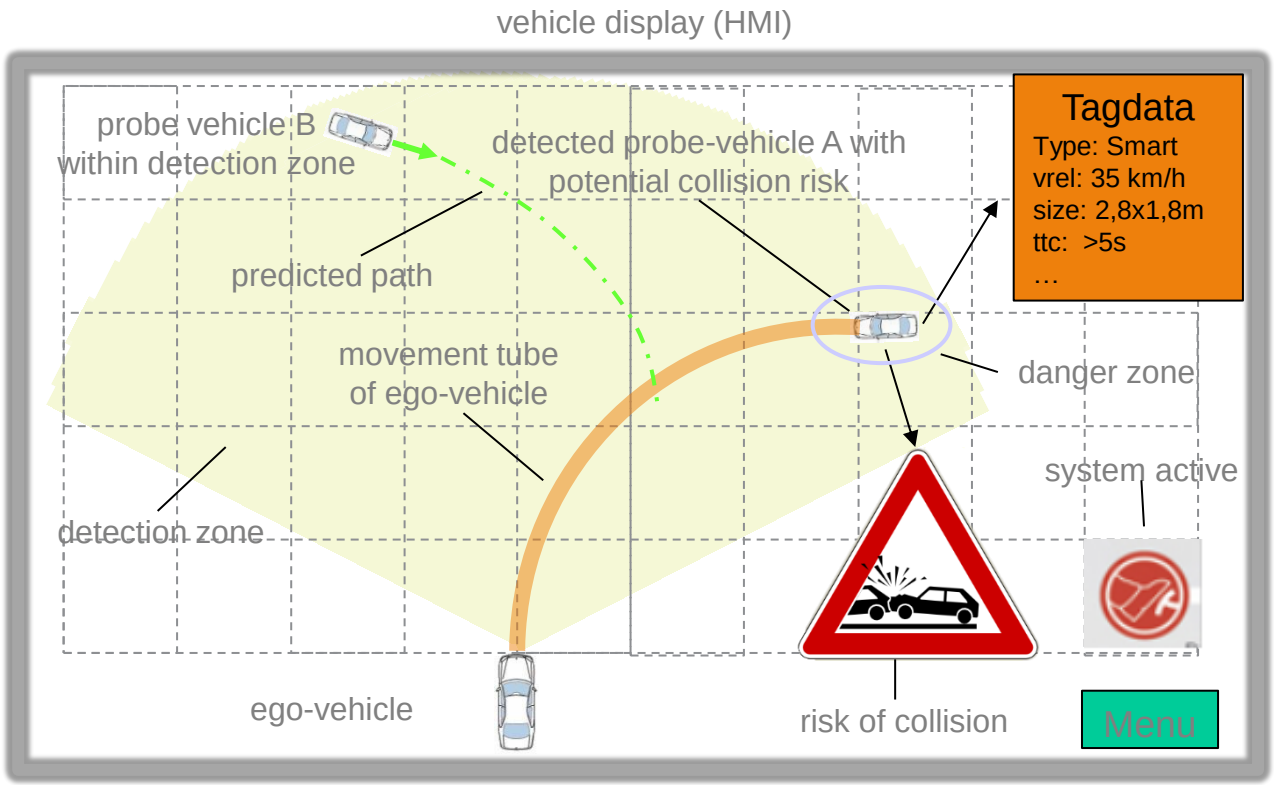


Mx Modul Nr. x

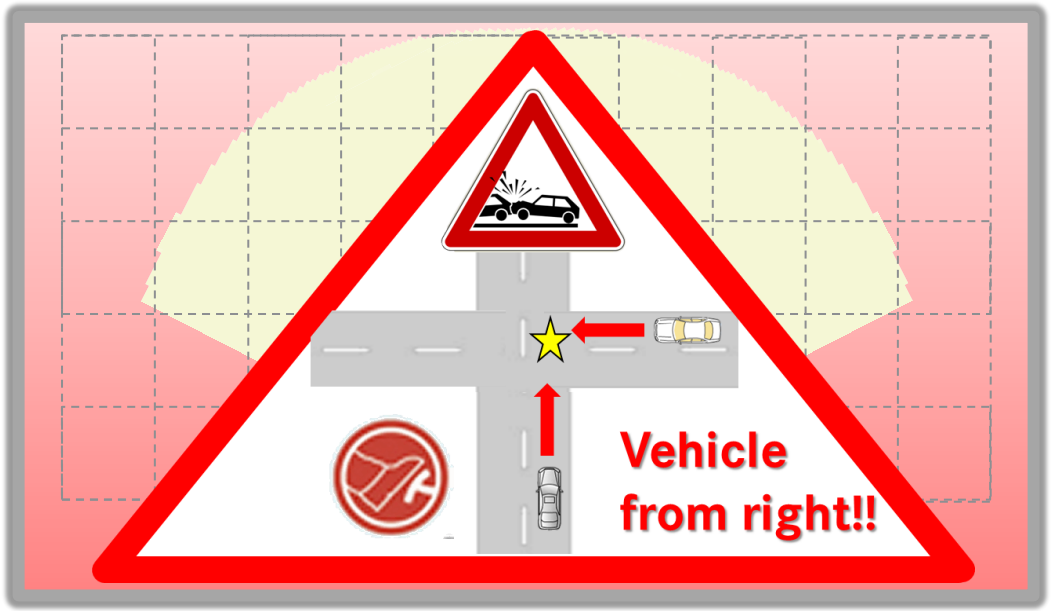
Ix Interface Nr. x

- TAG-Management
- Risk management
- Trigger algorithms
- Tracking
- Vehicle control (CAN)
- HMI

System Vehicle Integration
User Interface



Conclusion



➔ System for „All-Around Safety“ realized in S-class test vehicle

➔ Join our demo tomorrow


Thank you
for your attention!
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