

Dr. Dieter Schuller, Opel Automobile GmbH



IMAGinE

12 MAY 22

FINAL EVENT



Conclusion and Outlook

OUTLINE

Conclusion

Outlook

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Outlook

IMAGinE at a glance

Conclusion

- **Objective:** Develop **cooperative maneuver coordination** on the basis of **collective perception**
- **Timing:** 2016/09/01 – 2022/05/31
- **Budget/Funding:** 38.2 M€ / 17.9 M€



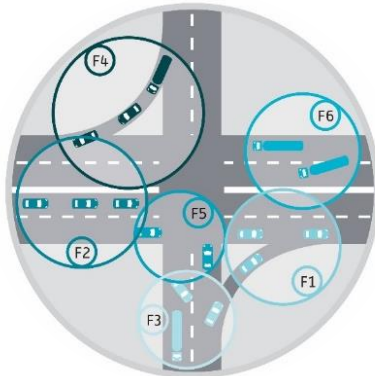
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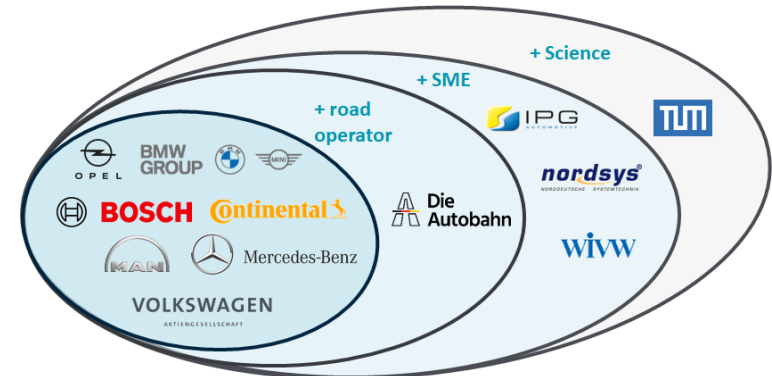
Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

6 cooperative functions



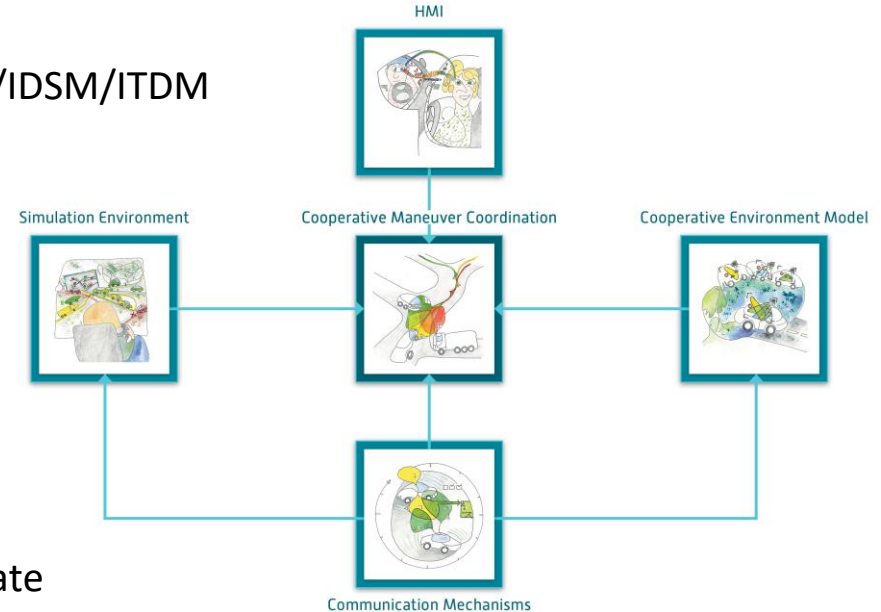
12 project partners



Conclusion

Core Innovations

- **Communication Mechanisms**
 - Exchange V2x Messages – CAM/CPM/MCM/IDSM/ITDM
- **Cooperative Environment Model**
 - Fusion of sensed and received objects
- **Cooperative Maneuver Coordination**
 - Negotiate and agree on maneuvers
- **Simulation Environment**
 - Simulate maneuvers and traffic flow
- **Human-Machine Interaction**
 - Interact with and motivate driver to cooperate

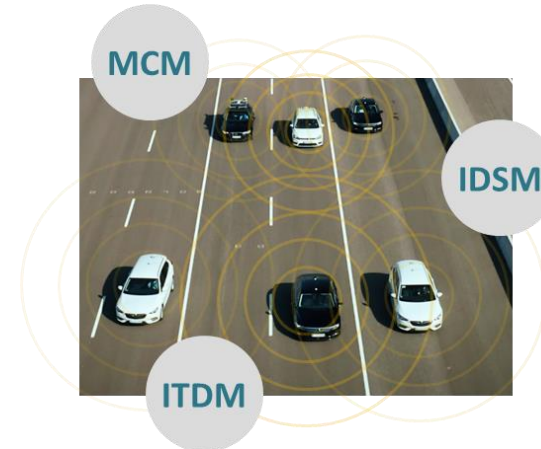
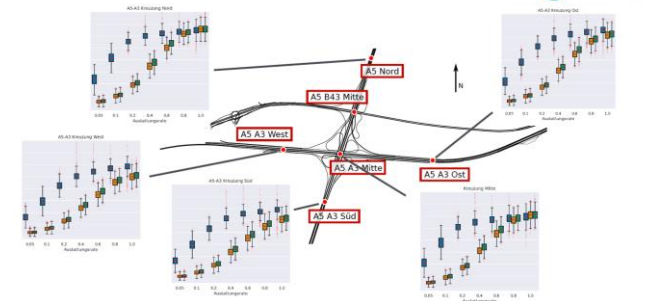


Conclusion

Communication Mechanisms

- Communication mechanisms have been set into place for cooperative maneuver coordination
- In particular, three new message types have been created and realized
 - MCM (Maneuver Coordination Message)
 - Used for maneuver coordination
 - IDSM (IMAGinE Driving Strategy Message)
 - Used by MAN for state machines
 - ITDM (IMAGinE Traffic Distribution Message)
 - Used by AdB for strategic traffic distribution

Average Channel Load

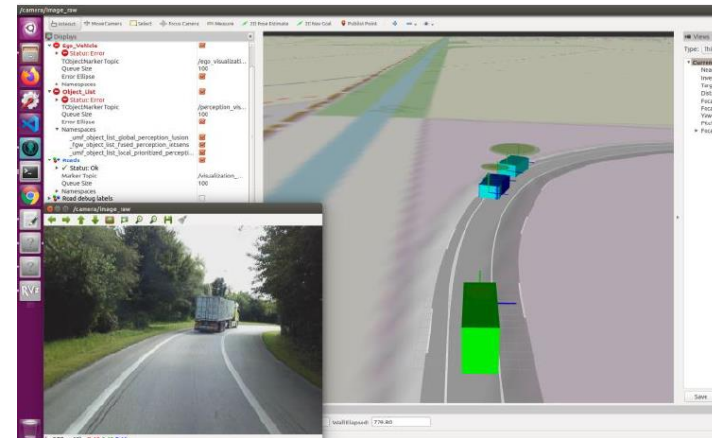
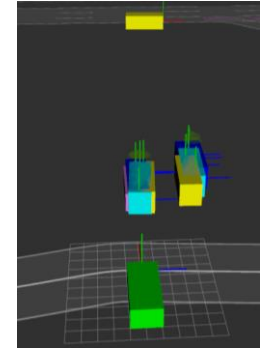


Conclusion

Common Environmental Model



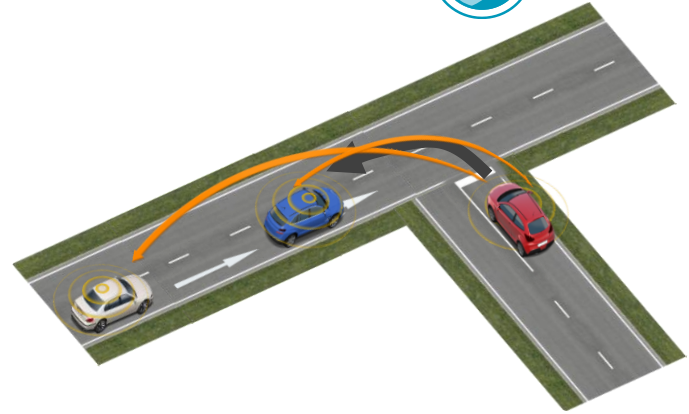
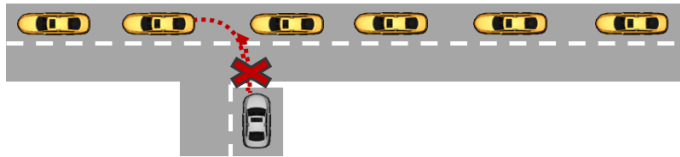
- An approach realizing a cooperative environment model has been implemented
- In particular, with the implemented cooperative environment model, we could enhance perception
 - “see/detect” objects beyond the own sensing capabilities
 - view on larger environment
 - share the environment with others achieving a common view on a (traffic) situation



Conclusion

Cooperative Maneuver Coordination

- Approaches for Cooperative Maneuver Coordination have been realized – both, in simulation and in vehicles
- The realized cooperative Maneuver Coordination approaches enable
 - Maneuver negotiation and agreement among different vehicle producers
 - Increasing traffic safety and efficiency



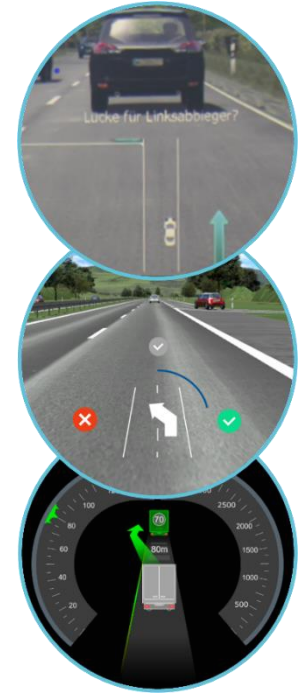
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Conclusion

Human-Machine Interaction

- Various approaches for Human-Machine Interaction have been realized and evaluated conducting participant studies in driving simulation as well as tests in real vehicles
- In particular, with the realized Human Machine Interaction approach, we could enhance
 - Acceptance for cooperative driving (system)
 - Willingness/motivation to cooperate
 - Traffic safety



Conclusion

Simulation Environment

- A simulation architecture has been developed for cooperative maneuver coordination along with application-specific simulation environments for testing and evaluation
- In particular, the simulation environment enabled
 - Significantly reduced time to develop and realized the chosen cooperative maneuver coordination approaches
 - Avoiding to drive kilometers for realizing cooperative maneuver coordination



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Research Challenges – Cooperative Environment

- Enhance collective perception
 - Account for Vulnerable Road Users in urban scenarios
 - Consider high velocities on winding highways
- Enhance reliability of exchanged data
 - Trustworthines is yet not clarified (cybersecurity, SOTIF)
 - ETSI / Focus Groups on Collective Perception Service have worked / work on prediction & safety topics

Outlook



Research Challenges – Cooperative Maneuver Coordination

- Research on cooperation mechanisms for generalization into further scenarios
 - Identify the requirements to be standardized for the interoperability of vehicle systems
- Account for safety & security aspects regarding cooperative maneuver coordination
 - Malicious injection of „false“ maneuver coordination messages
 - Malicious external influence on vehicles
 - Enhance anticipatory assisted/automated driving
 - Overtaking at high velocities on highways

Outlook

Research Challenges – Simulation & HMI

- Enhance application of simulation
 - Increase level of automated testing
 - Evaluation of more complex and critical scenarios
 - Algorithm tests for cooperative automated driving
 - Scenario catalogue for cooperative, automated driving applications
- Enhance Human-Machine Interaction
 - Combined study of cooperative assistance with other relevant assistance functions, e.g., navigation system or blind spot detection
 - Considering further use cases, e.g., turning in urban areas

THANK YOU

Dr. Dieter Schuller

Opel Automobile GmbH

dieter.schuller@stellantis.com

www.imagine-online.de

Images: IMAGinE, CAR 2 CAR Communication Consortium

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