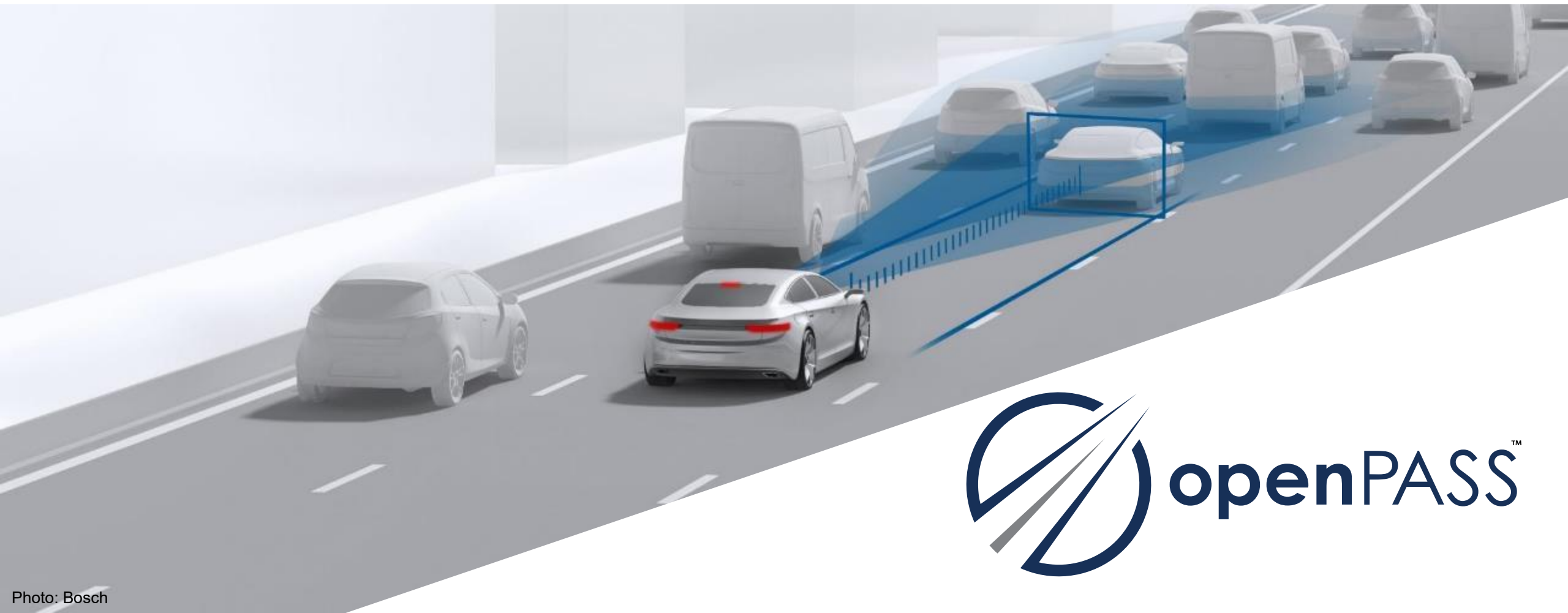


OPENPASS



TARGET OBJECTIVES



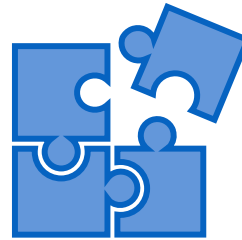
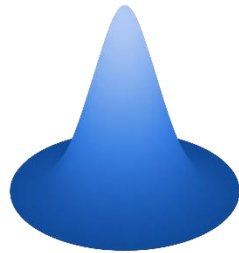
openPASS – open Platform for Assessment of Safety Systems

Harmonized and flexible platform for scenario-based traffic simulation of advanced driver assistance systems and automated driving systems



Traffic simulation

Stochastic variation



Modularity and flexibility

Reproducibility through determinism



Standardized interfaces

High level of transparency and acceptance through publicly available open source platform by using open standards and building up a modular ecosystem

WORKING GROUP

Eclipse Working Group openPASS

2014: Idea for openPASS within 



**BMW
GROUP**

Driver member
since 08/2016
(founding member)



BOSCH

Invented for life

Driver member
since 11/2018

Former
members



Service provider
since 08/2016
until 07/2022
(founding member)

TOYOTA

User member
since 06/2018
until 05/2023



Driver member
since 01/2018
until 12/2024

**Mercedes-Benz
Tech Innovation**

Driver member
since 08/2016
(founding member)

**VOLKSWAGEN
GROUP**

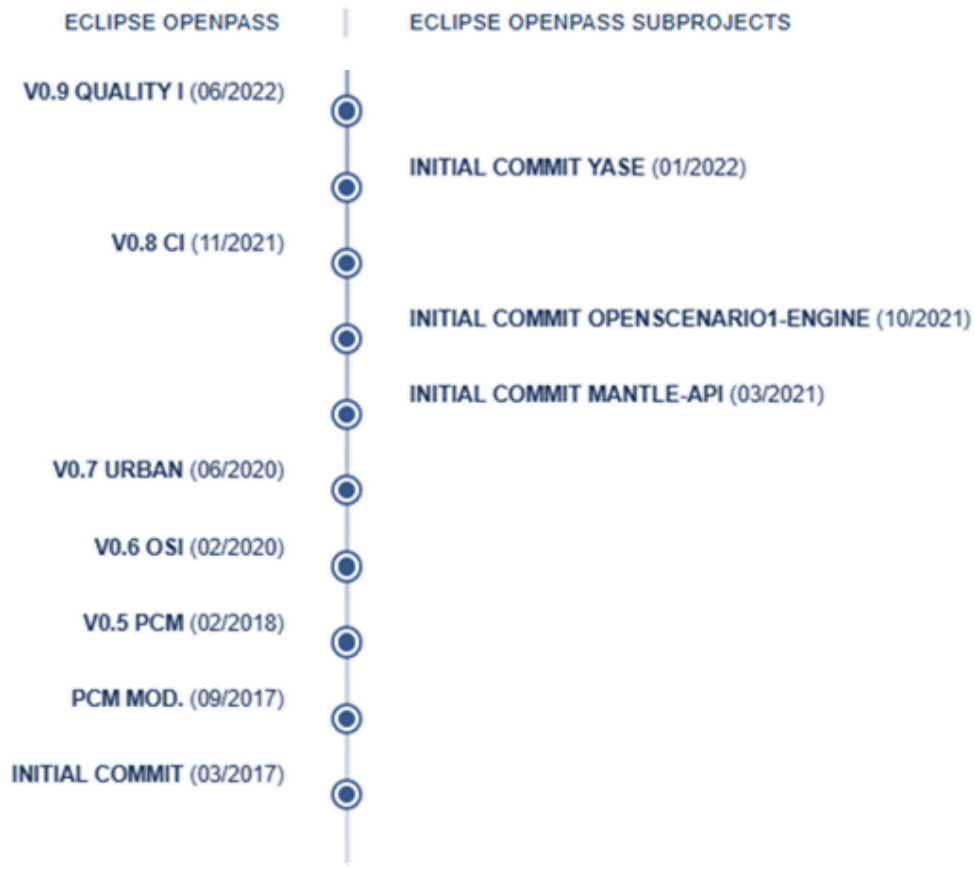
Driver member
since 08/2016
(founding member)



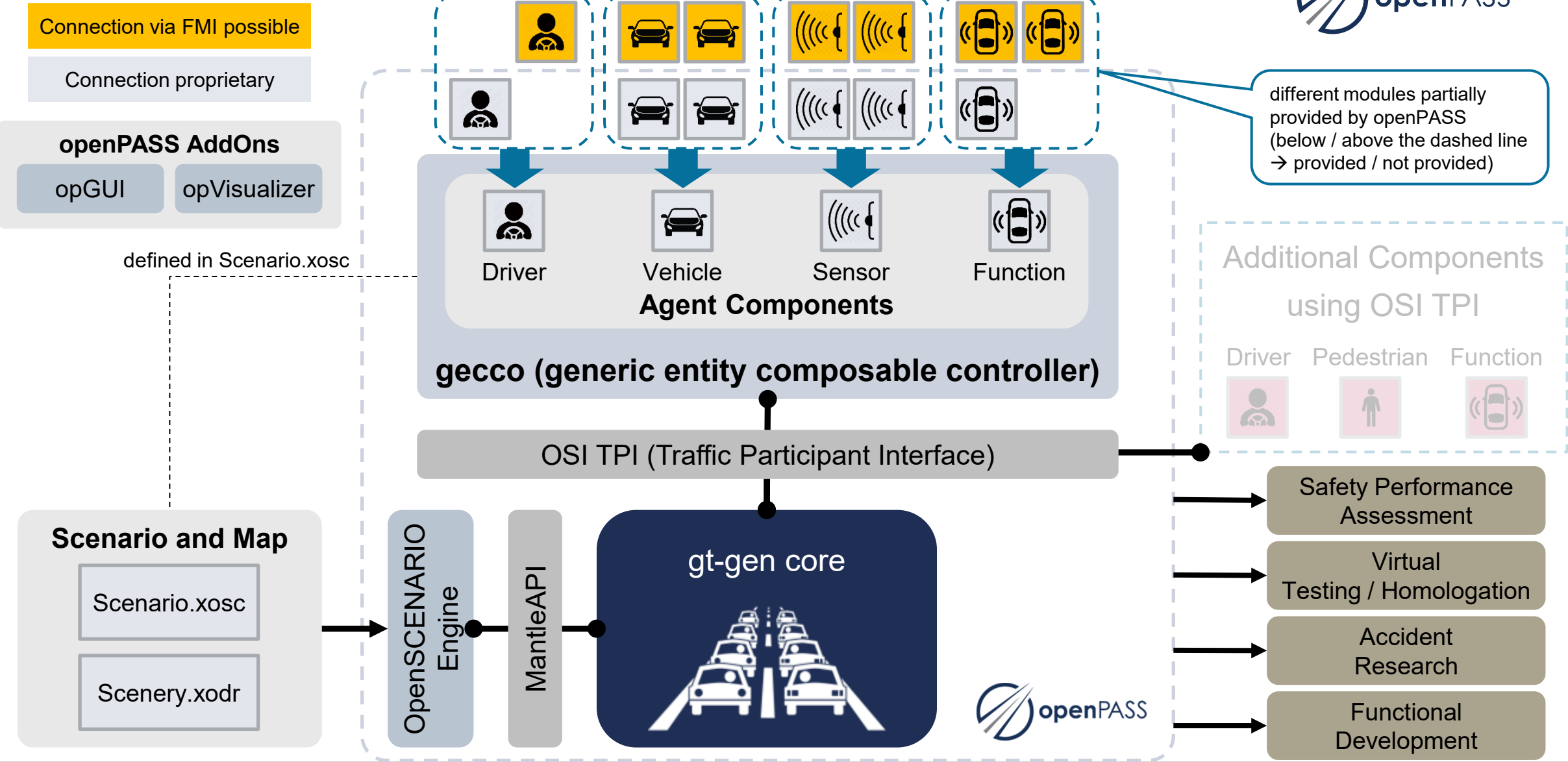
Eclipse Automotive Working / Interest Groups



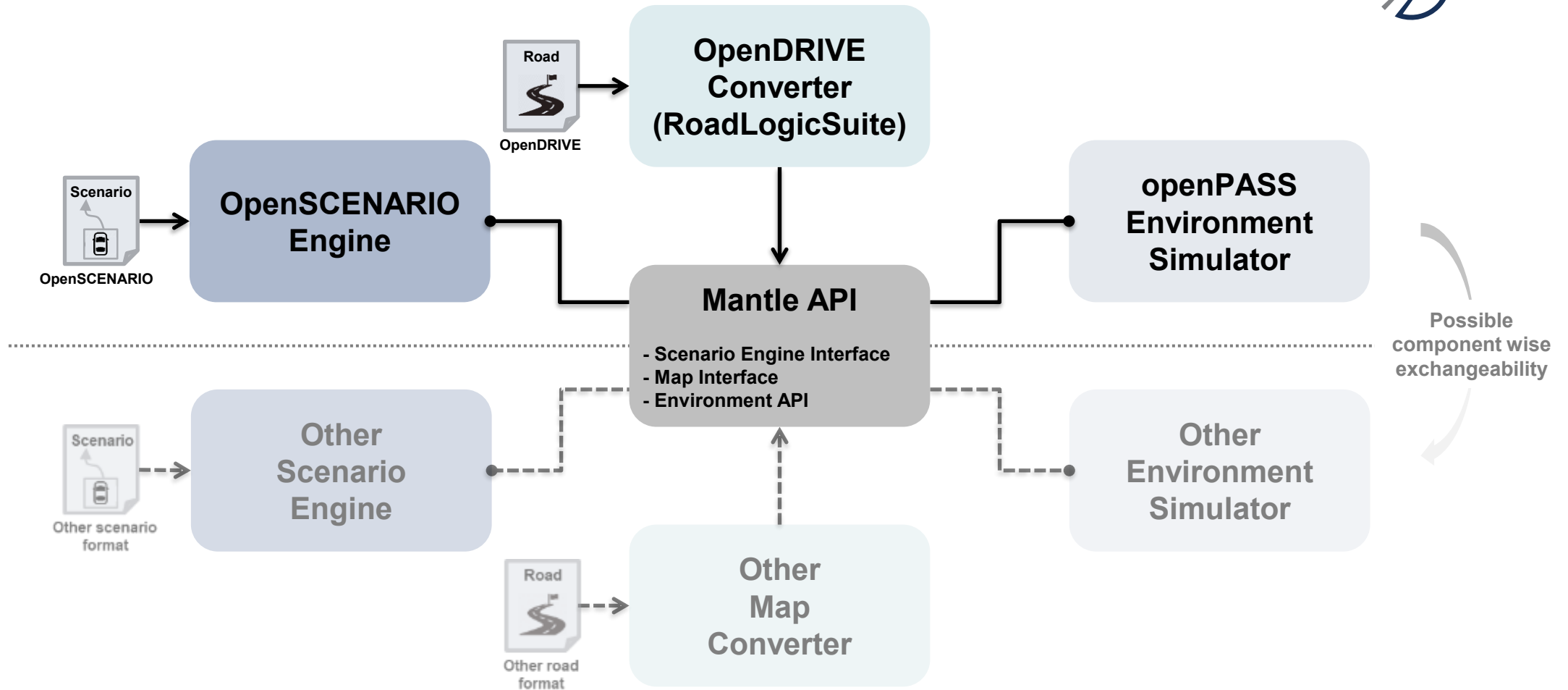
TIMELINE



ARCHITECTURE OPENPASS 2.0.0 – GECCO

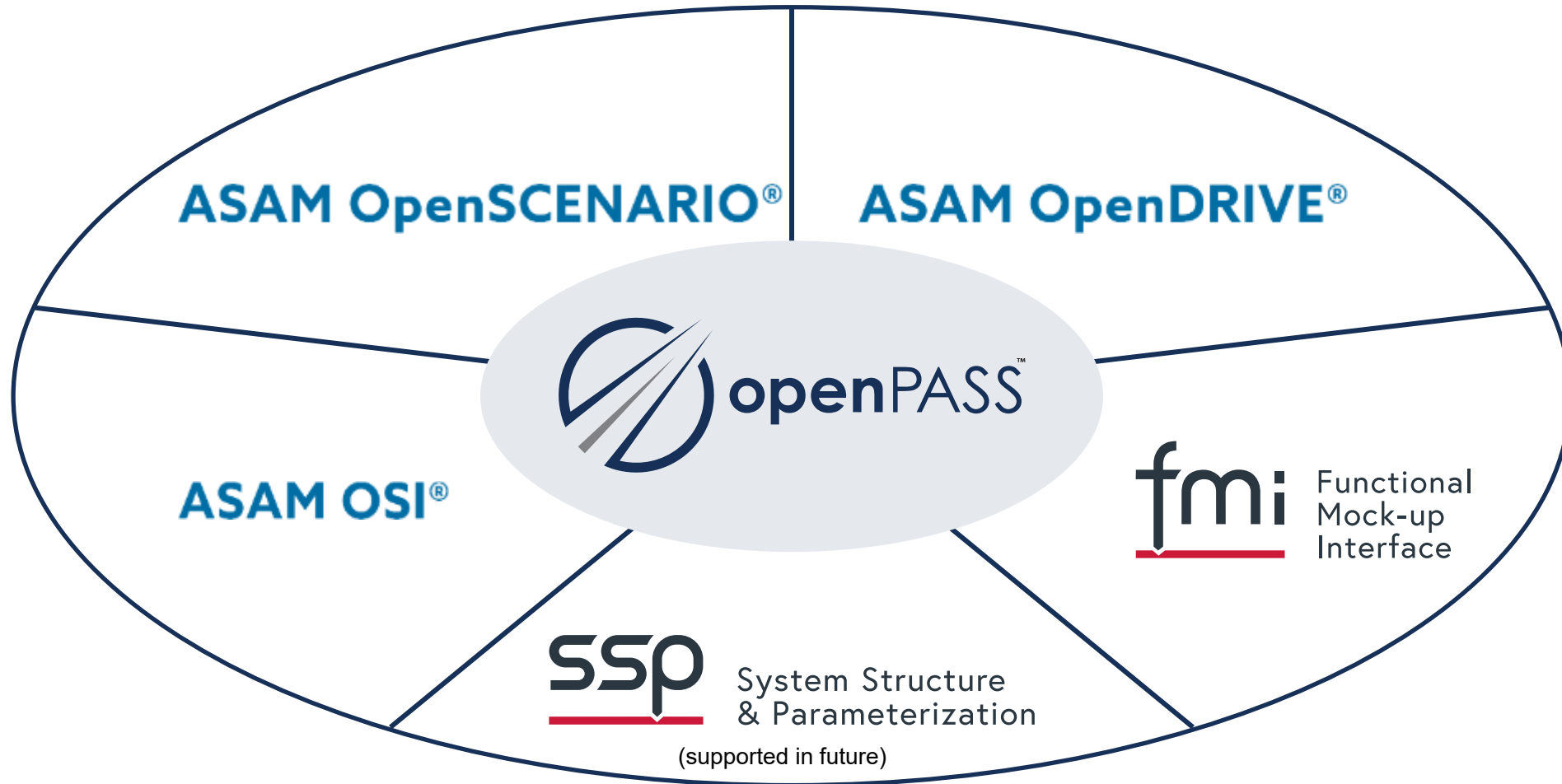


SCENARIO-BASED SIMULATION TOOLCHAIN

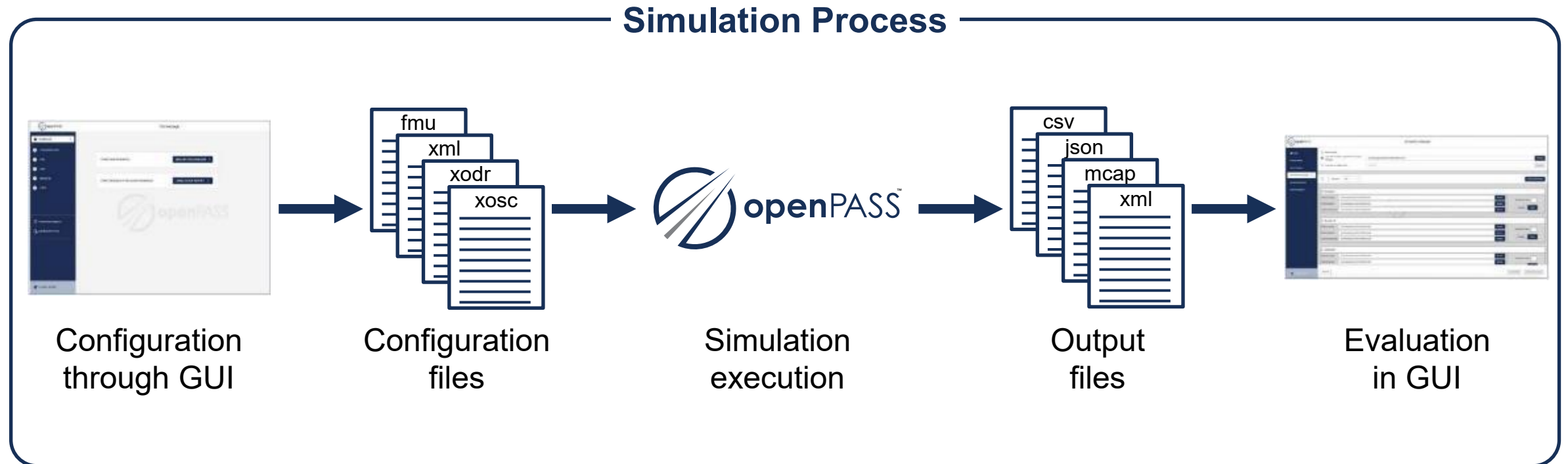


The modular architecture based on the Mantle API allows for the exchangeability of scenario engines, map converters and environment simulators.

SUPPORTED STANDARDS



SIMULATION PROCESS



SCENARIO MODELLING APPROACHES

Crash Re-Simulation

- Pre-specified behavior through trajectories
- Low degree of interaction
- Evaluation of driving systems in short, fixed scenarios



Event based scenario modelling

- Mixture of pre-specification and model based behavior
- Manipulative interventions to force certain behavior (e.g. Cut In)
- Longer and dynamically evolving scenario spaces

Stochastic Traffic Simulation

- Sophisticated behavior models
- No pre-specified behavior / manipulation in the scenario
- Strong, model based interactions between traffic participants
- Evaluation of driving systems in dynamically evolving (yet unknown) scenarios

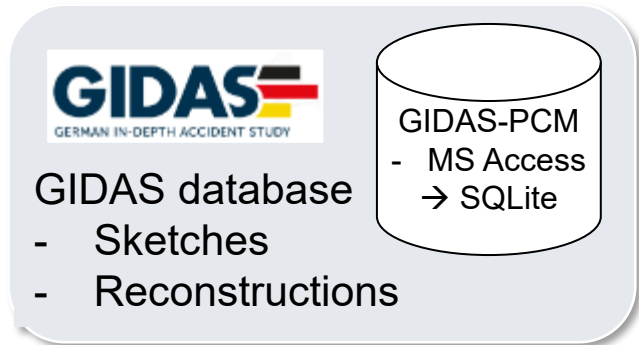
Low

Medium

High

Level of interaction between traffic participants

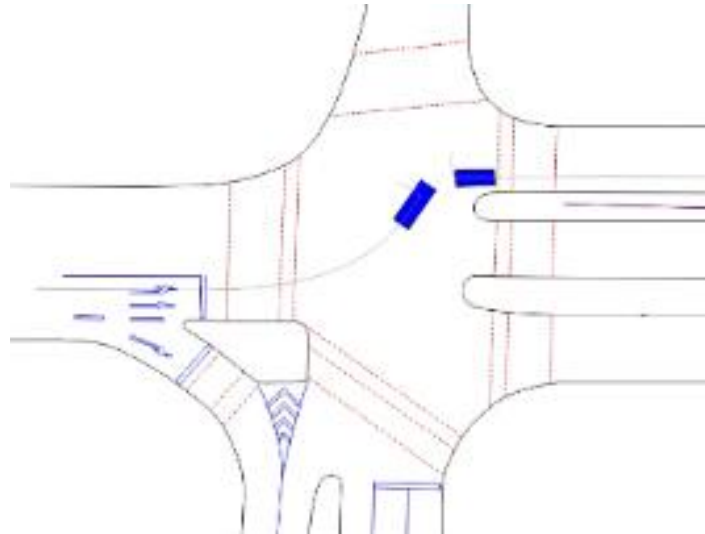
EXAMPLE FOR CRASH RE-SIMULATION



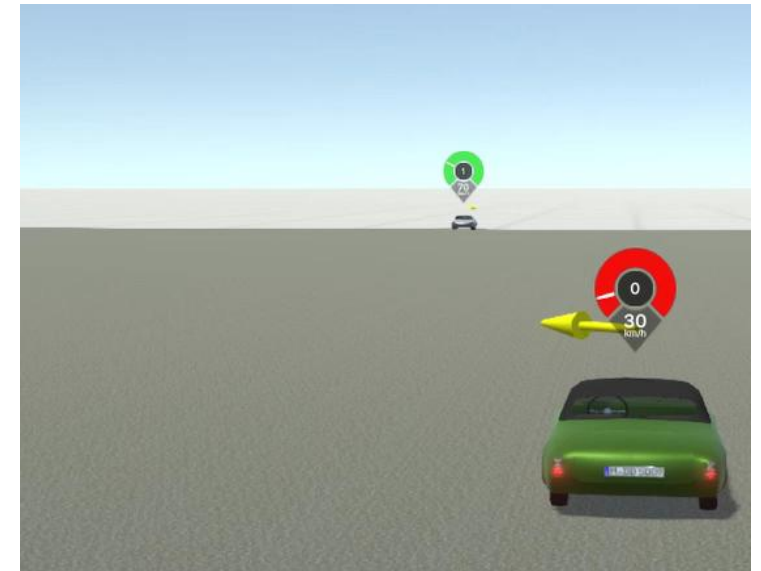
Tool-based
conversion to
OpenSCENARIO

OpenSCENARIO
defining the traffic
participants and their
behavior

- Re-simulation of recorded / reconstructed trajectories from real-world scenarios
- Extension to “what-if simulation” e.g. with user-specific AEB system
- Evaluation of impact without and with safety systems
- Outlook “Replay2Sim”: conversion of any trajectory to OpenSCENARIO



GIDAS sketch of accident



Simulation with openPASS

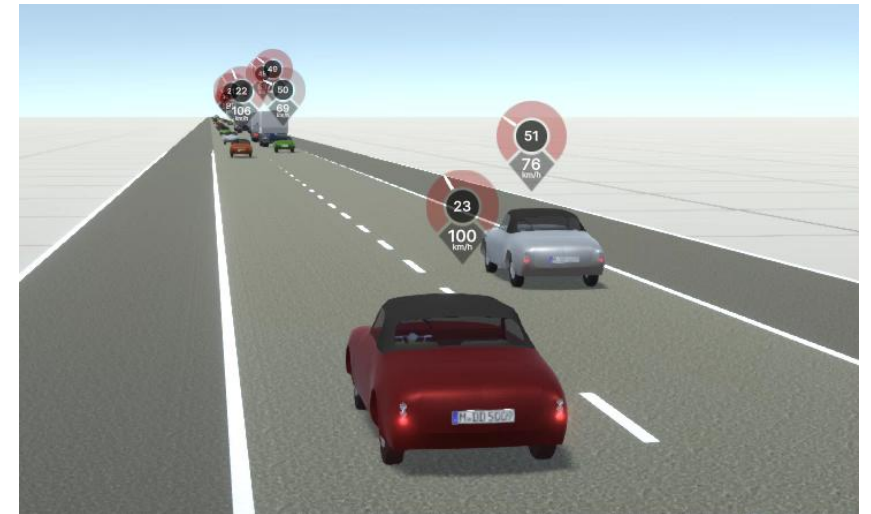
EXAMPLE FOR STOCHASTIC TRAFFIC SIMULATION

Expert knowledge,
scenario databases &
standards (e.g. ALKS)

Manual modelling
/ script based
generation of
scenarios

OpenSCENARIO
defining the traffic
participants and behavior
models as external
controllers

- Strong stochastic influence on many levels:
 - Initialization of traffic (e.g. positions, velocities, system equipment)
 - Scenario parameters (e.g. traffic volume)
 - Stochastic agent behavior models (e.g. Stochastic Cognitive Model)
- Interaction between traffic participants in a realistic manner
- Evaluation of system behavior and traffic safety
- Discovery of new, yet unknown critical scenarios



Simulation with openPASS

EXAMPLE USAGE OF OPENPASS IN PUBLIC PROJECTS - I



Project duration:

- 09/2017 – 10/2021

Project objectives:

- Largest European project on automated driving at the time
- Piloting, collecting data and conducting impact assessment for automated driving

Application of openPASS:

- Simulation of different scenarios concerning typical motorway situations

Project duration:

- 06/2018 – 11/2021

Project objectives:

- Analysis of occupant vehicle safety requirements for HAVs
- Prediction of remaining crashes / future ODD-specific relevant crash configurations

Application of openPASS:

- Simulation with motorway traffic model including human imperfection
- Realistic collision frequency to validate motorway test case

Project duration:

- 03/2019 – 10/2022

Project objectives:

- Simulation-based engineering and testing for automated driving
- Standardization of interfaces

Application of openPASS:

- Embedding of simulation models (e. g. pedestrian, driver, automated driving system, ...)
- Exemplary application for running a criticality analysis

Project duration:

- 07/2019 – 12/2023

Project objectives:

- Development of a methodical approach to proof safety for HAVs in urban environment
- Significant shift from real-world testing to simulation

Application of openPASS:

- Using openPASS as an exemplary simulation tool for the criticality analysis
- Scenario-based simulation with openPASS

EXAMPLE USAGE OF OPENPASS IN PUBLIC PROJECTS - II



Project duration:

- 09/2021 – 08/2025

Project objectives:

- Develop technology to enable a longer and less defragmented automated drive (follow up of L3Pilot)
- Code of practice & evaluation

Application of openPASS:

- Simulation of different scenarios for the safety impact assessment (motorway and urban)

Project duration:

- 10/2022 – 09/2025

Project objectives:

- Safety assessment framework by simulation
- Covering different safety solution (in-vehicle, infrastructure, behavioral)

Application of openPASS:

- Application in at least one use case

PARTICIPATION IN THE WORKING GROUP



The company should be at least an Eclipse Solution Member

- Networking and learning
- The annual membership fee for Solutions Members is tiered based on revenue



Working Group participation agreement

- Contribution in development of openPASS
- Discussion of the roadmap
- Active collaboration with the working group

Privilege	Driver Member	User Member	Service Provider Member	Project Manager
Steering Committee	X	Elected	Elected	-
Architecture Committee	X	-	-	X
Quality Committee	X	Elected	Elected	X
General Assembly	X	X	X	-

For more information, look at the openPASS charter:

<https://www.eclipse.org/collaborations/working-groups/explore/#wg-openpass>

COMMUNICATION WITH THE WORKING GROUP



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For more information, contact us or subscribe to the public WG mailing list:

<https://accounts.eclipse.org/mailling-list/openpass-wg>