Fabian Specka, IPG Automotive GmbH

12 MAY 22

FINAL EVENT

IMAGinE

Simulation Environments for Cooperative Systems

Simulation Environments for Cooperative Systems

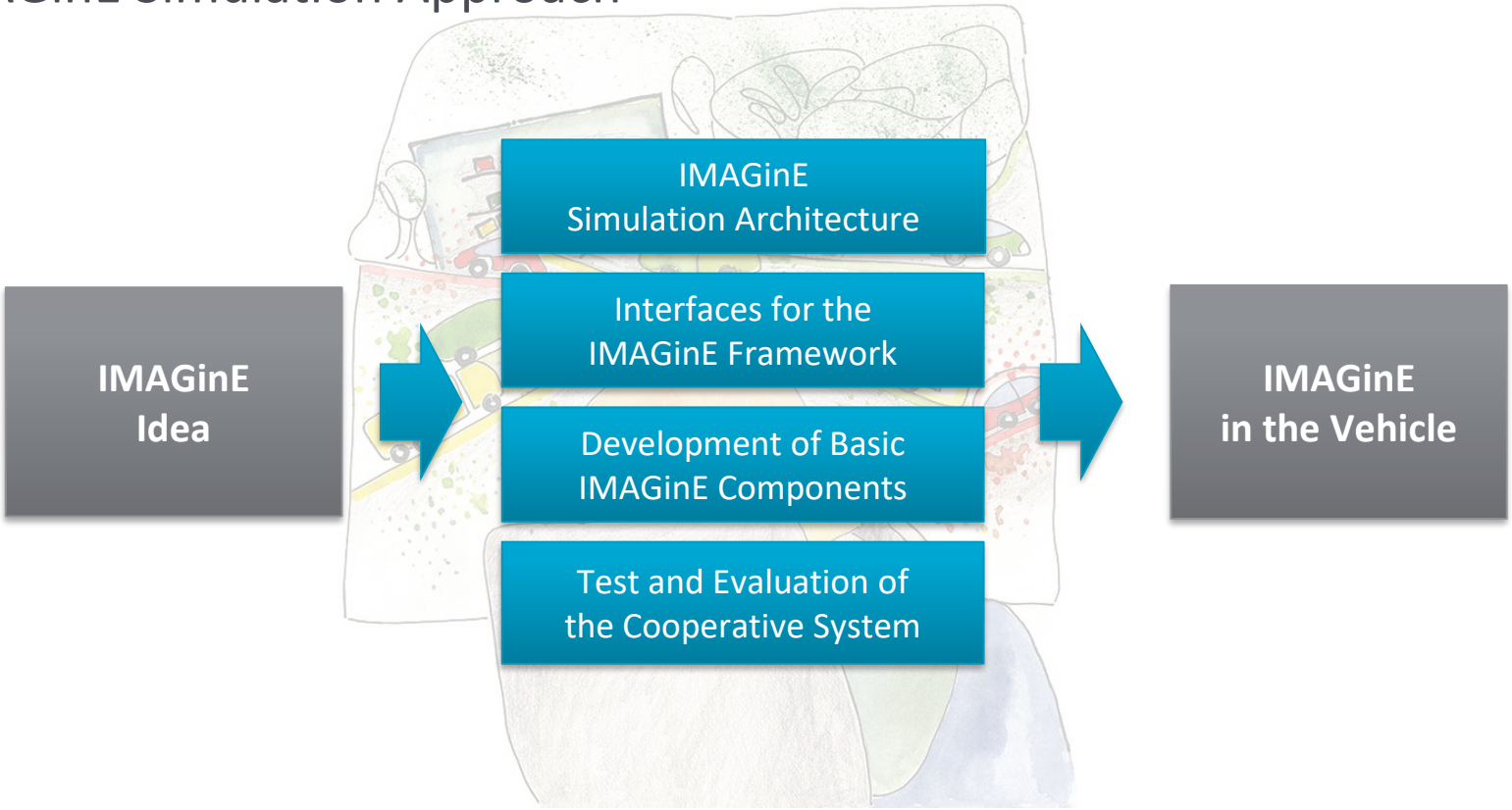
IMAGinE Simulation Approach

IMAGinE Idea

IMAGinE in the Vehicle

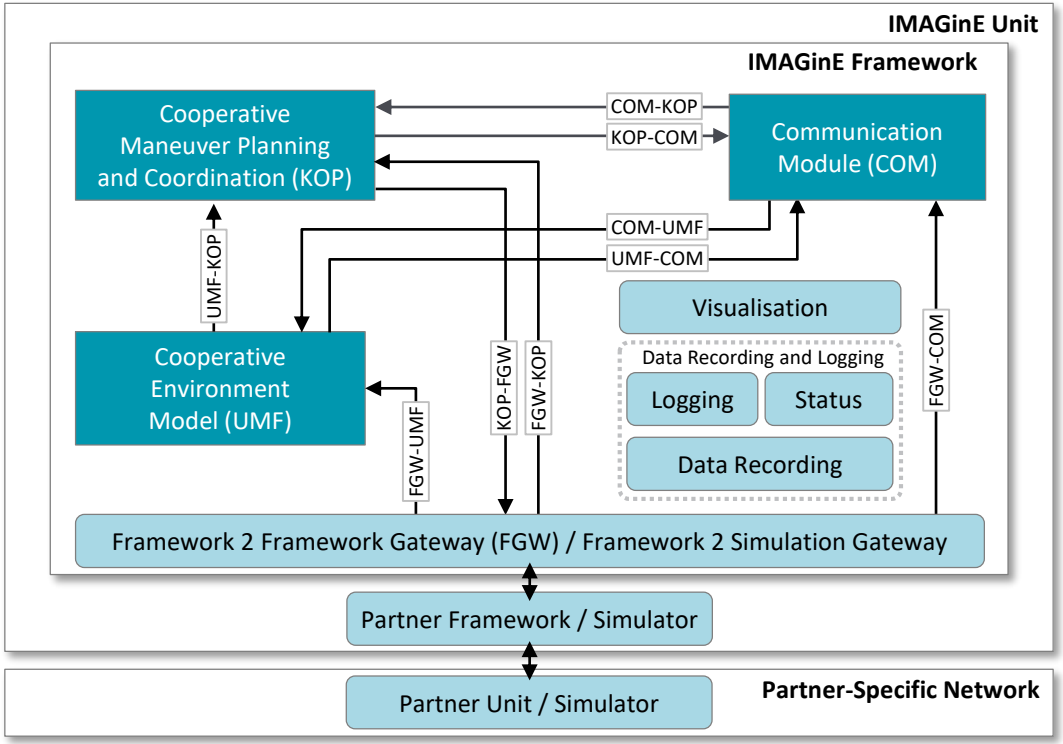
Simulation Environments for Cooperative Systems

IMAGinE Simulation Approach



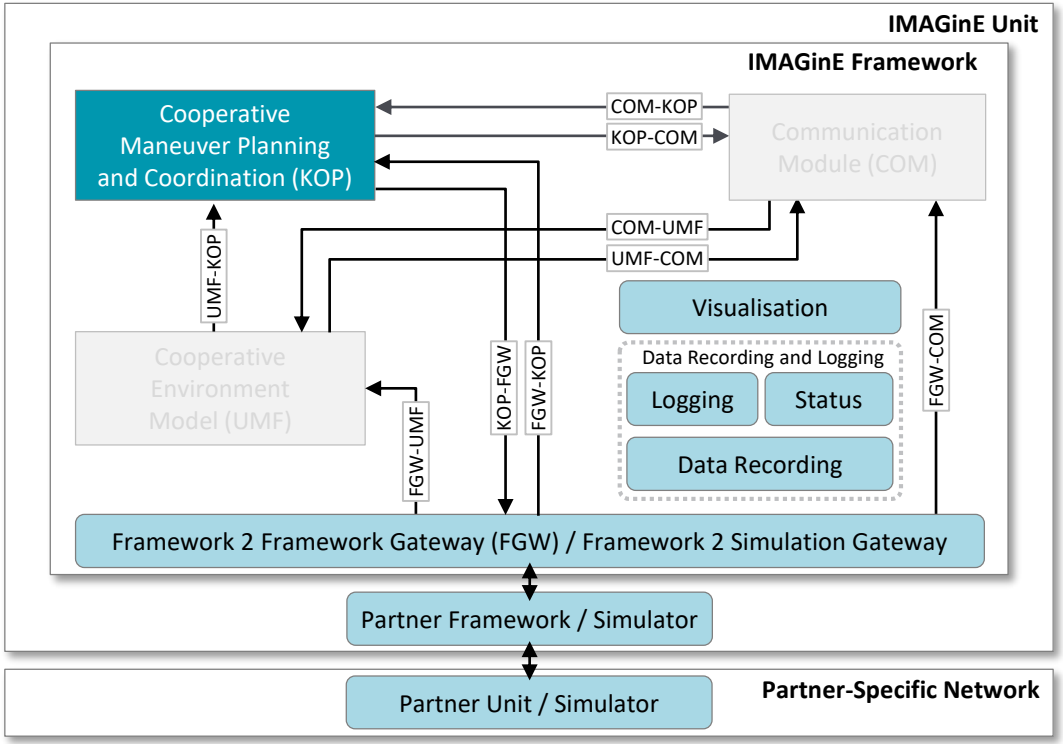
Simulation Environments for Cooperative Systems

IMAGinE Functional Architecture



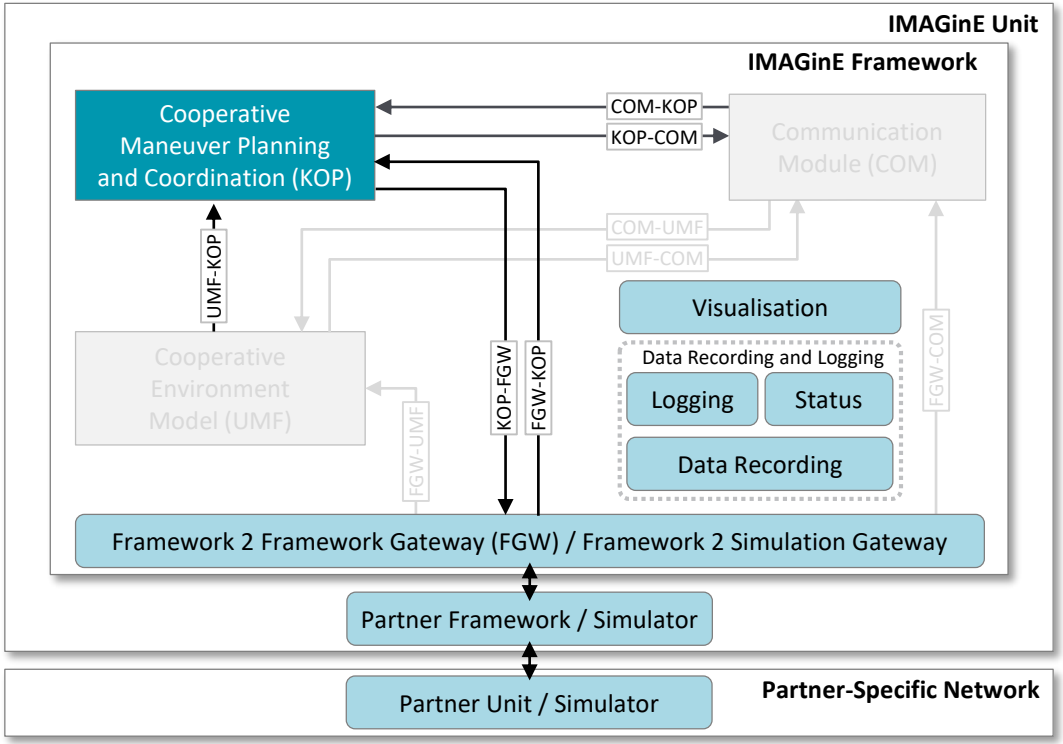
Simulation Environments for Cooperative Systems

System under Test: Cooperative Maneuver Coordination



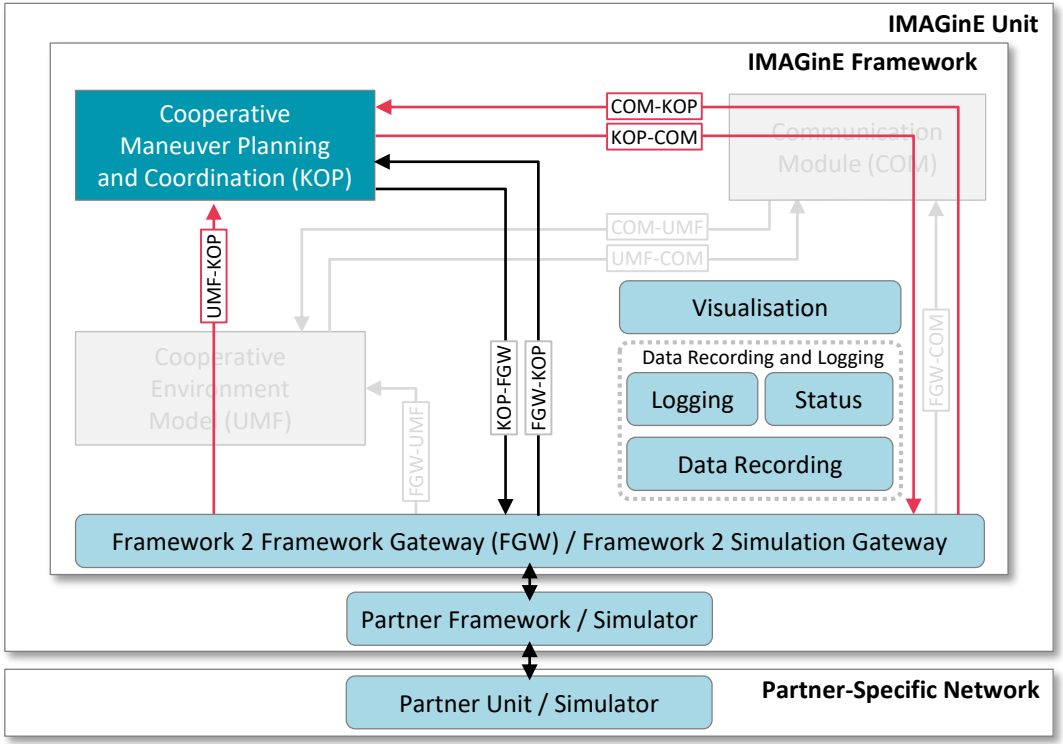
Simulation Environments for Cooperative Systems

System under Test: Cooperative Maneuver Coordination



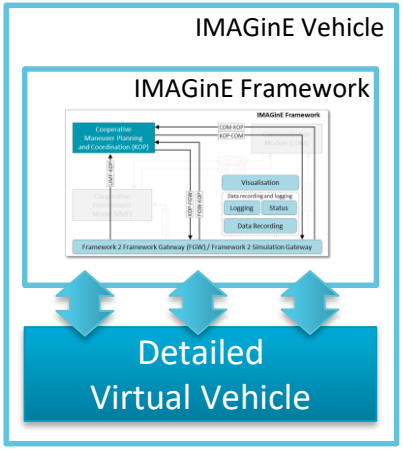
Simulation Environments for Cooperative Systems

System under Test: Cooperative Maneuver Coordination



Simulation Environments for Cooperative Systems

IMAGinE Simulation Architecture (Simplified)

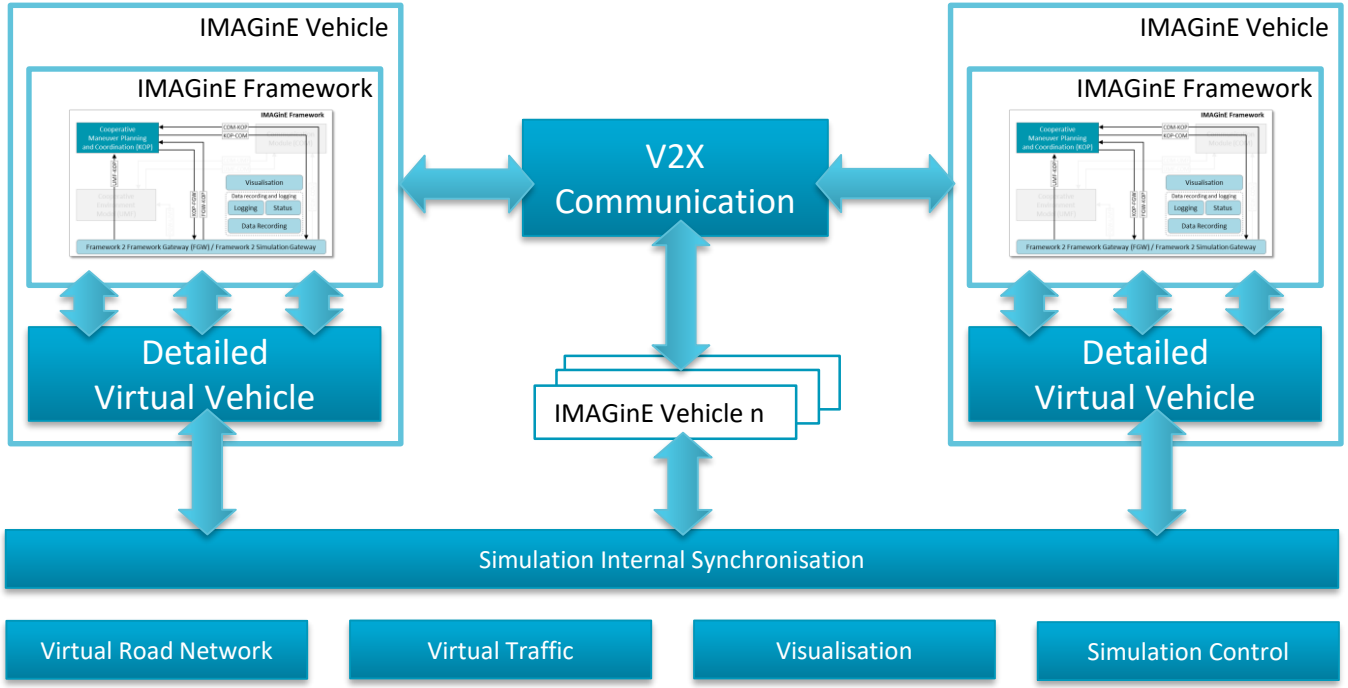


Virtual Models

- Vehicle dynamics
- Sensors for environment perception
- Motion control
- ...

Simulation Environments for Cooperative Systems

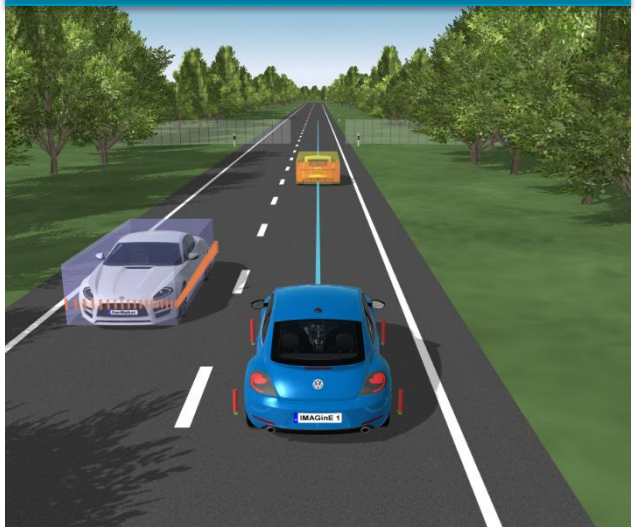
IMAGinE Simulation Architecture (Simplified)



Simulation Environments for Cooperative Systems

Simulation for Cooperative Maneuver Coordination

Simulation Environment

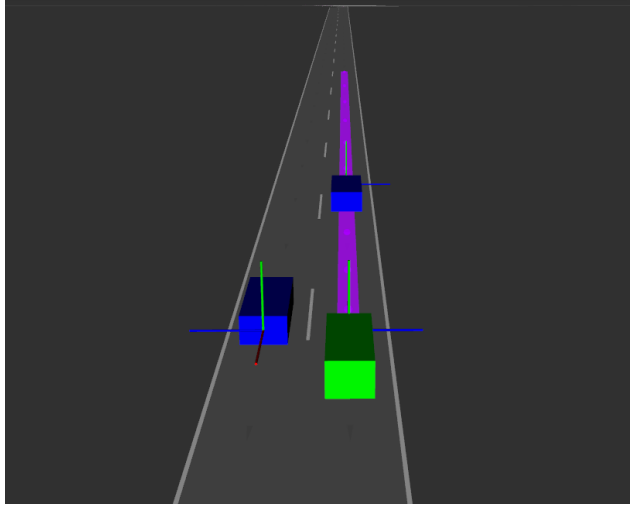


- Road representation
- Dynamic ego data, ...

- Reference trajectory
- System state, ...

- Object list based on internal vehicle sensors
- Position, velocity, ...

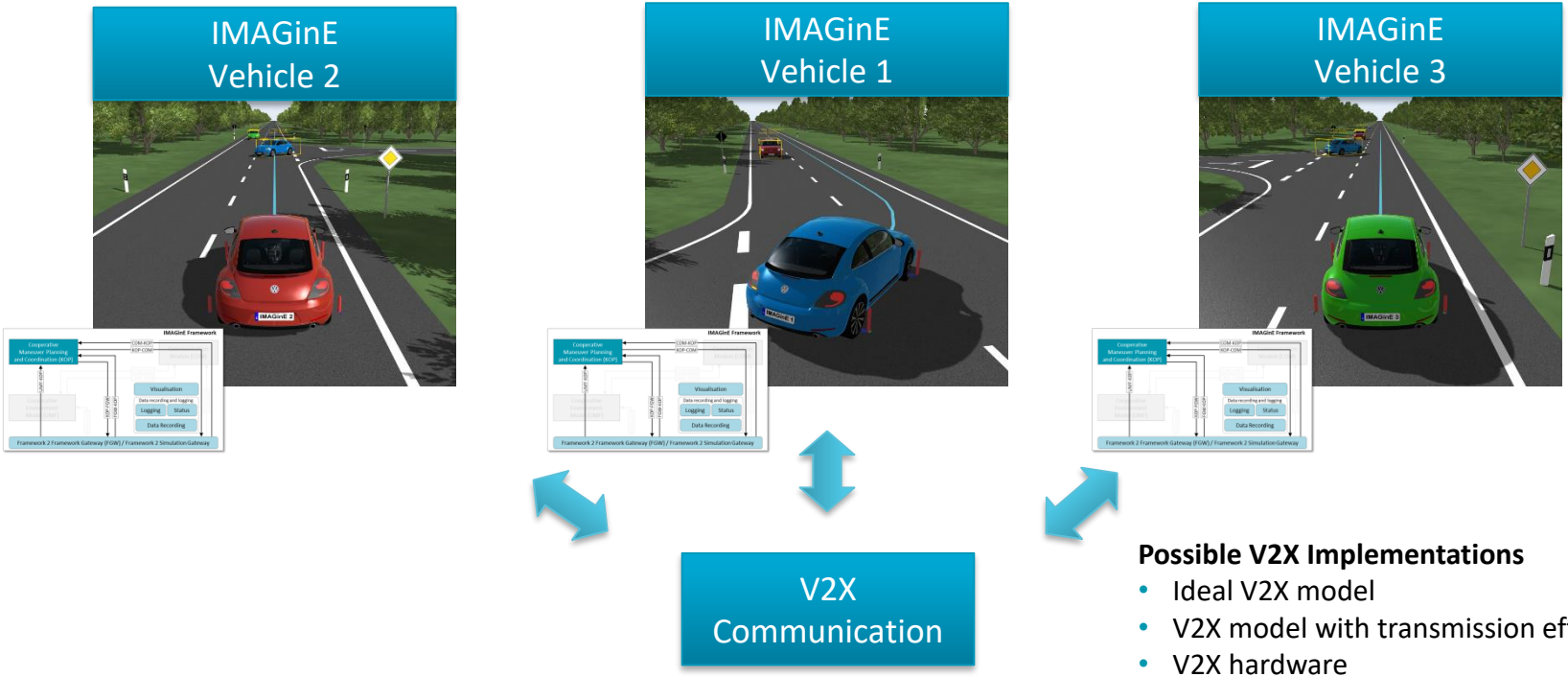
Cooperative Algorithm (Visualised in RViz)



Ego Vehicle
Reference Trajectory
Ego Sensor Objects

Simulation Environments for Cooperative Systems

Simulation for Cooperative Maneuver Coordination



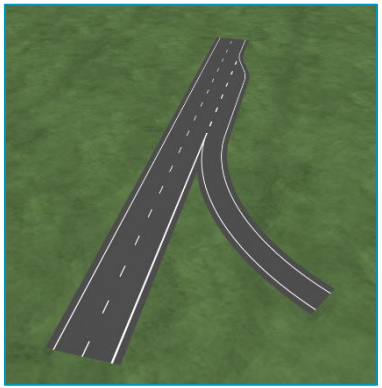
Possible V2X Implementations

- Ideal V2X model
- V2X model with transmission effects
- V2X hardware

Simulation Environments for Cooperative Systems

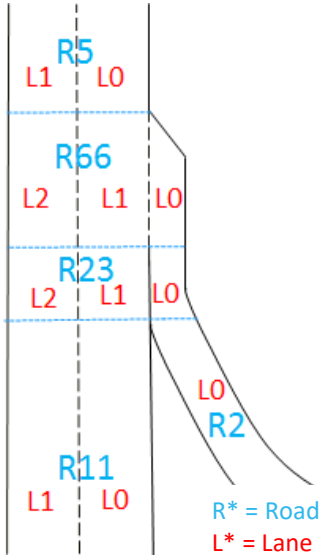
Detail: Road Representation for the Algorithms

Imported or Synthetic Road (Simulation Environment)

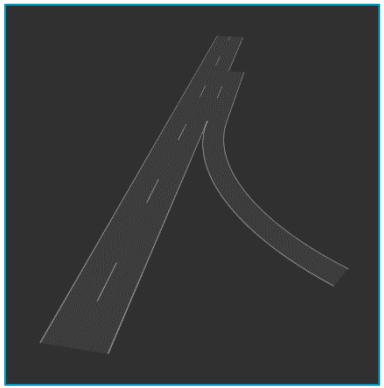


Cartesian Coordinate System

Decomposition (IMAGinE Road Rules)



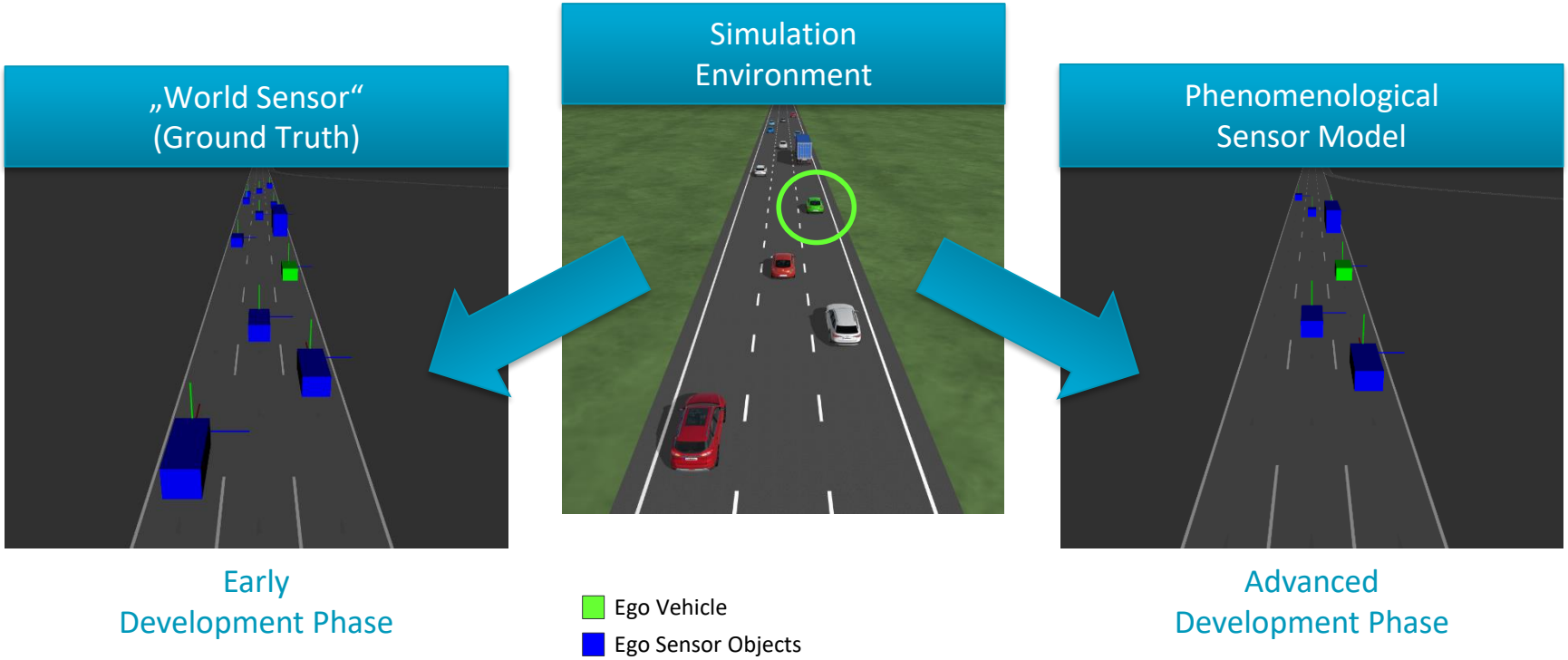
Road Representation for the Algorithms



UTM/Frenet Coordinate System

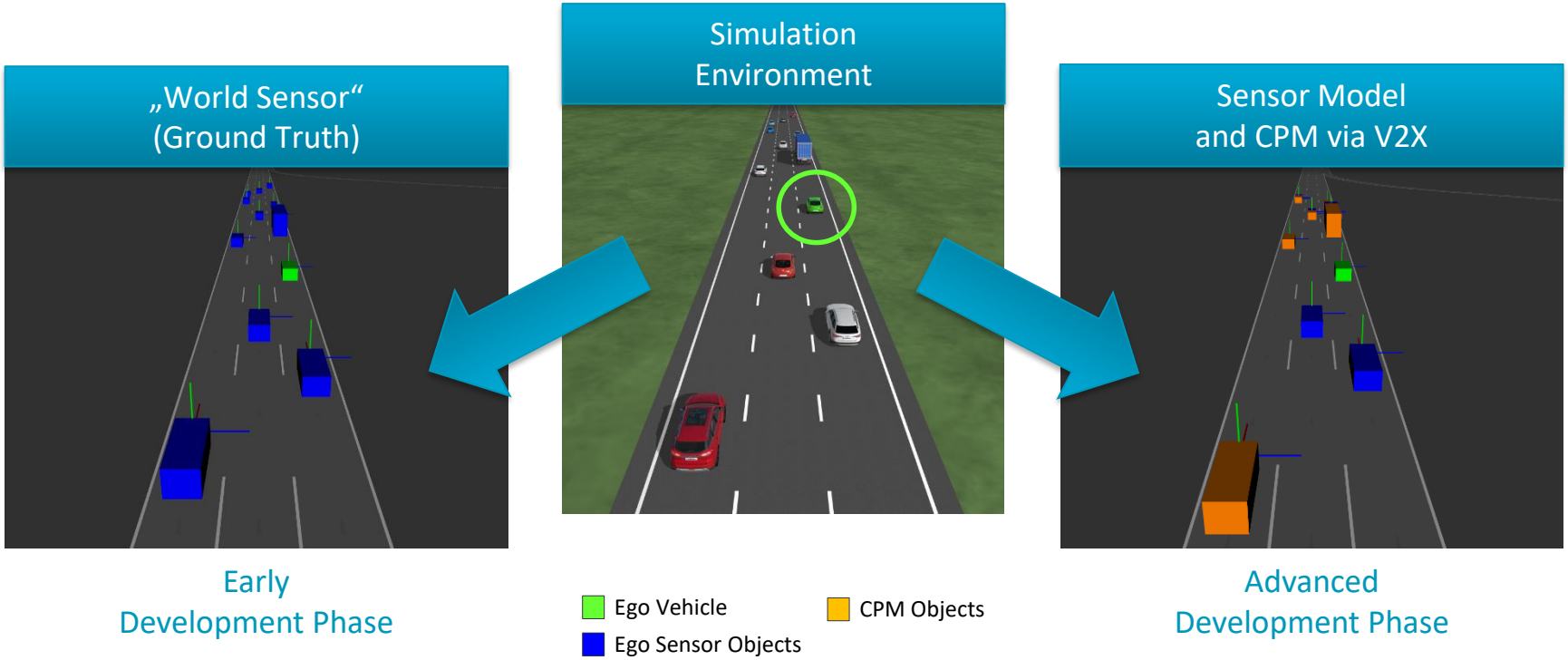
Simulation Environments for Cooperative Systems

Detail: Application-Specific Environment Perception



Simulation Environments for Cooperative Systems

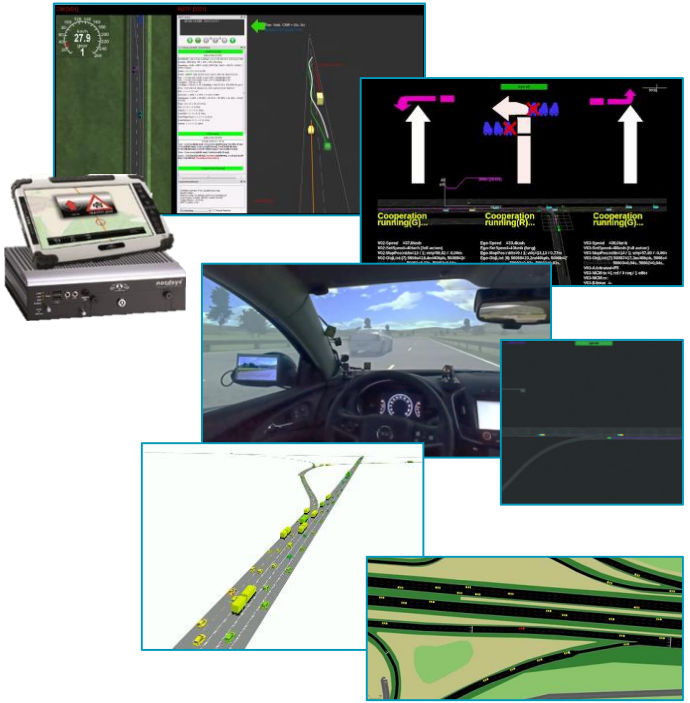
Detail: Application-Specific Environment Perception



Simulation Environments for Cooperative Systems

Variety of Simulation Setups

- Vehicle simulations and data replay for the development of cooperative components and overall system
- Connection of hardware components to support the integration into the real vehicles
- Co-simulation with driving simulators for user experience without the real vehicle
- Traffic flow simulations to analyse the traffic impact and channel load



Simulation Environments for Cooperative Systems

IMAGinE Development Process

IMAGinE Idea

Functional Architecture

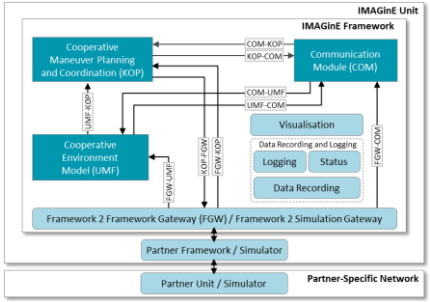
Development of Basic Components

Cooperative Maneuver Coordination

Integration with Communication Hardware

Vehicle-in-the-Loop

IMAGinE in the Vehicle



THANK YOU

Fabian Specka

IPG Automotive GmbH

www.imagine-online.de

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

Images: IMAGinE, Unsplash