CMC DemoEvent –
FT Application & Simulation

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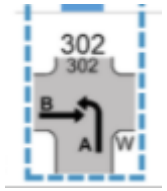
Demo Event
DEKRA Lausitzring, Germany
14th of September 2023

Use Case Driven Approach

Use case driven approach in CMC

1 Accident analysis

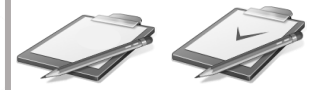


Detailed analysis of specific accident types

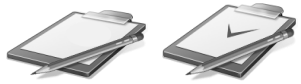
2 Definition use cases

Description of Use cases for V2X Application

3.1 Definition system-requirements



3.2 Definition application-requirements

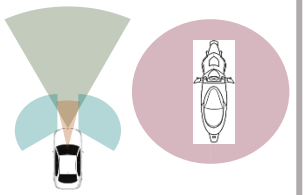


Description of requirements System and Application

4 Application

Develop Applications based on requirements

5 Simulation

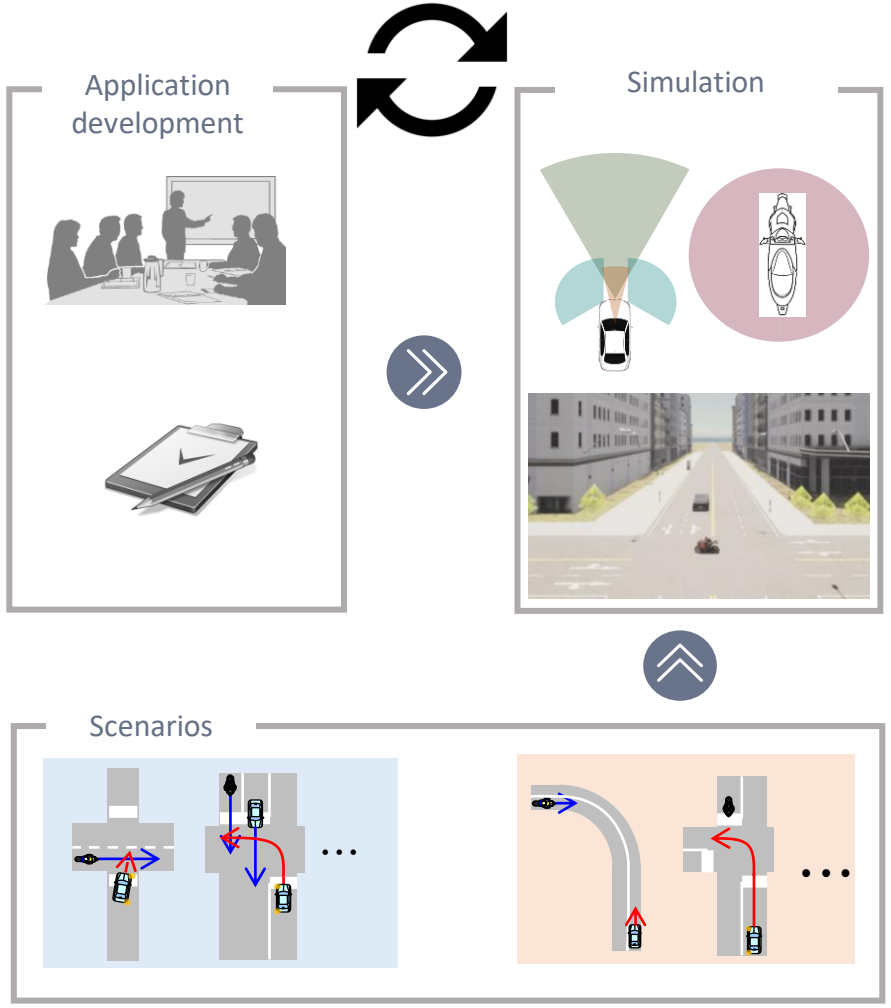


Simulate Applications in defined scenarios

6 Testing / Demo

Test Applications in real world environment

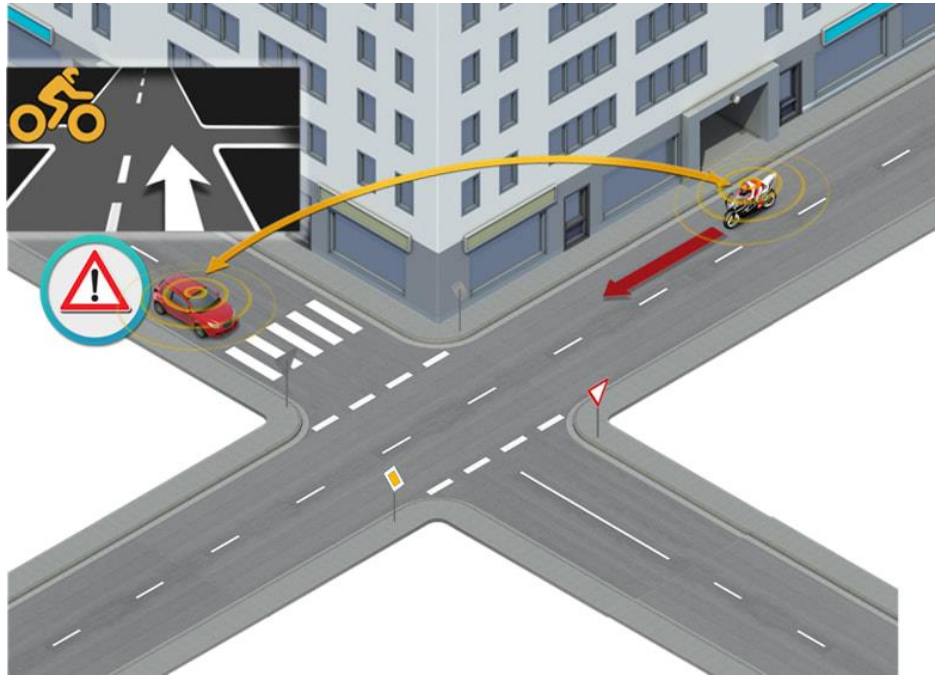
Interaction Between Application & Simulation



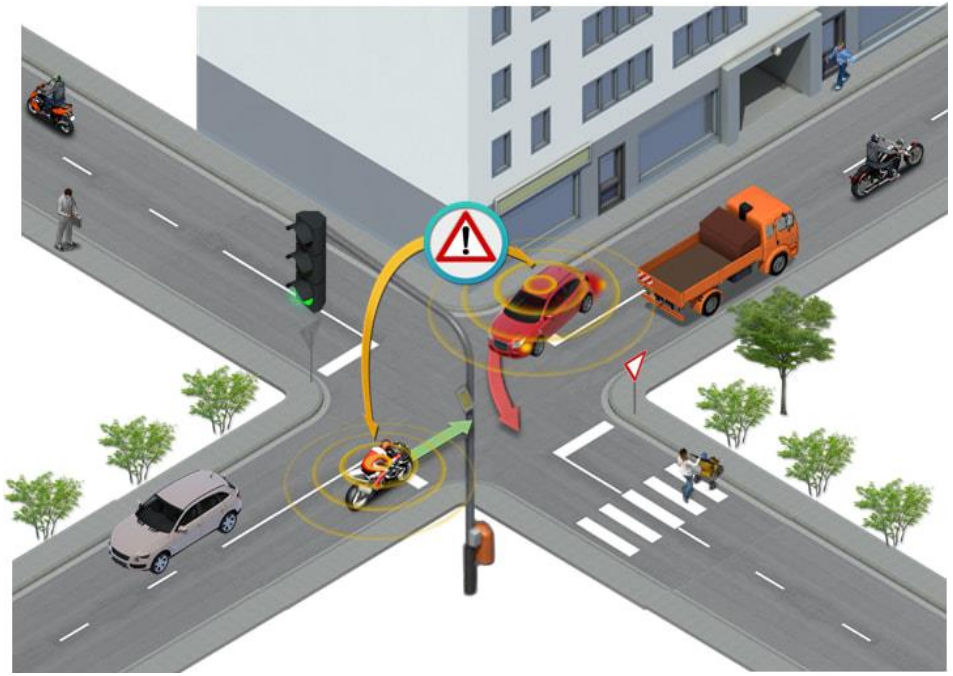
The application's development, validation, and simulation-based evaluation occur in iterative loops.

Application: Use Cases

IMA (Intersection Movement Assist)



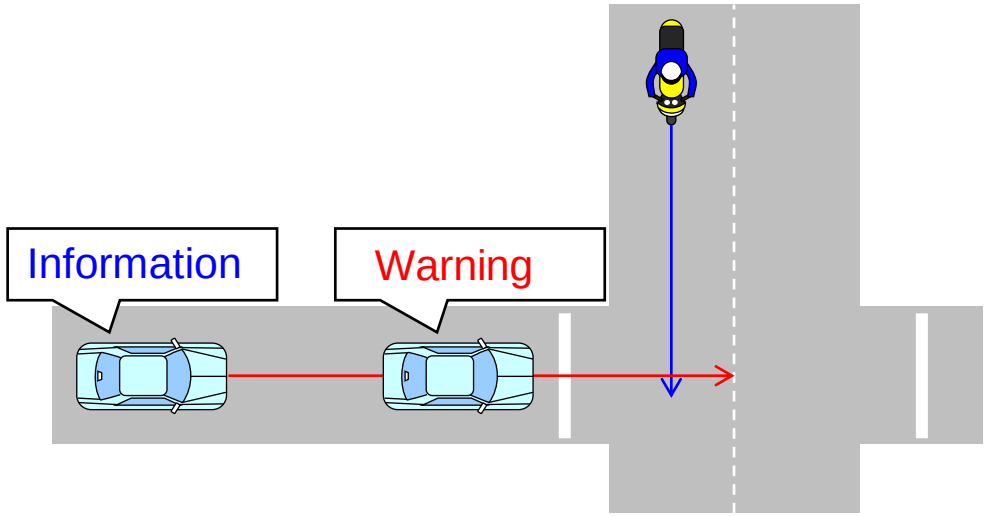
LTA (Left Turn Assist)



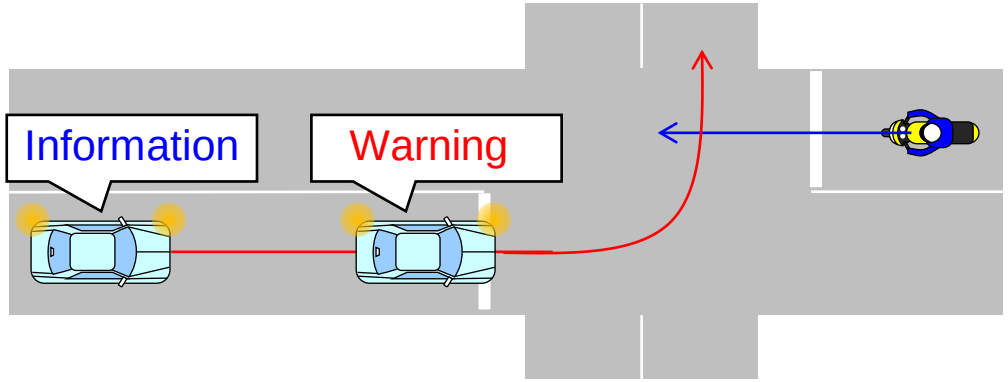
Based on accidentology study, use case IMA (Intersection Movement Assist) and LTA (Left Turn Assist) are defined for Application development and Simulation.

Application: Two-step Notification

IMA: Intersection Movement Assist

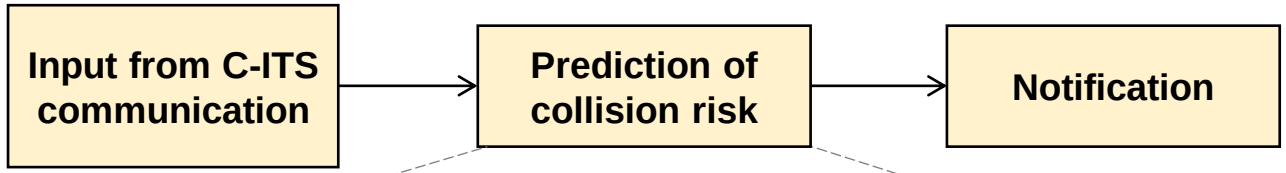


LTA: Left Turn Assist

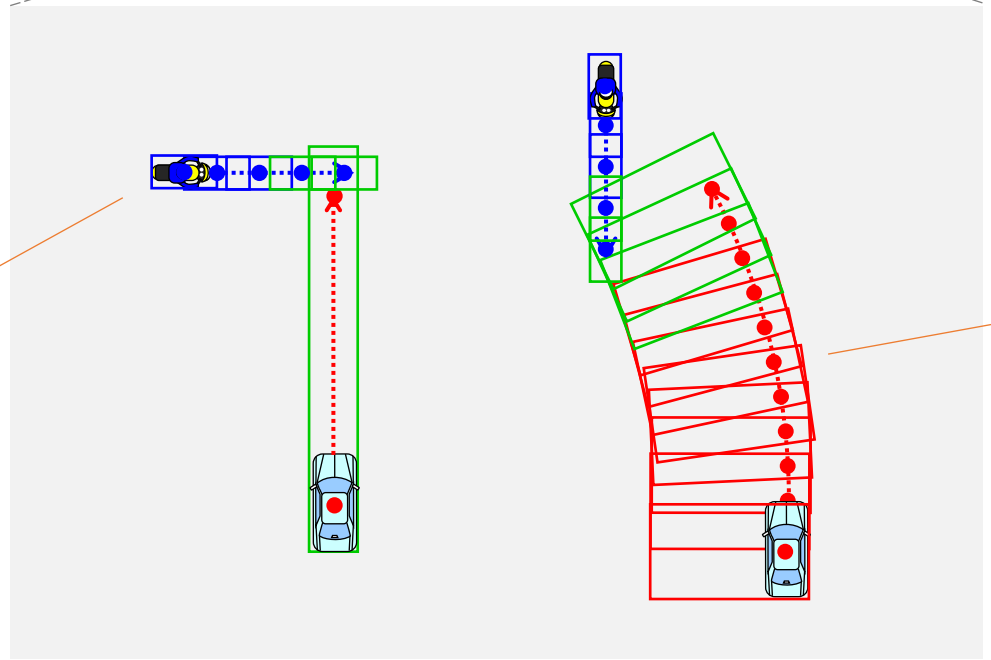


Based on the use cases and accident analysis results, alert conditions have been defined. Two-step notification (Information and Warning) was applied both to IMA and LTA.

Application: Process



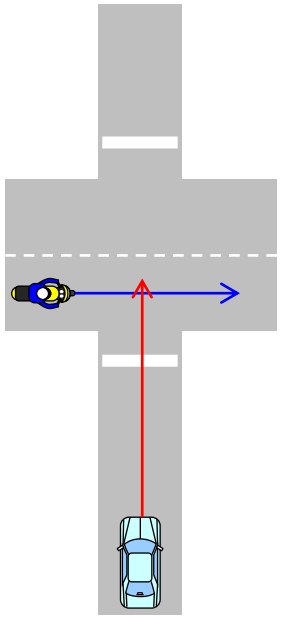
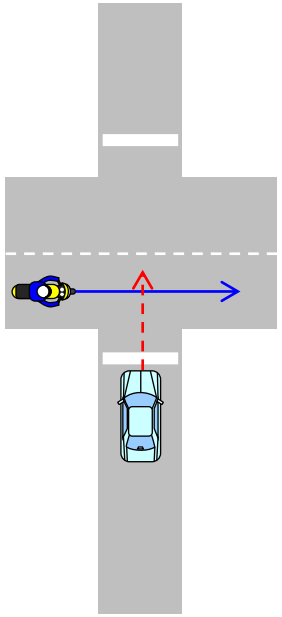
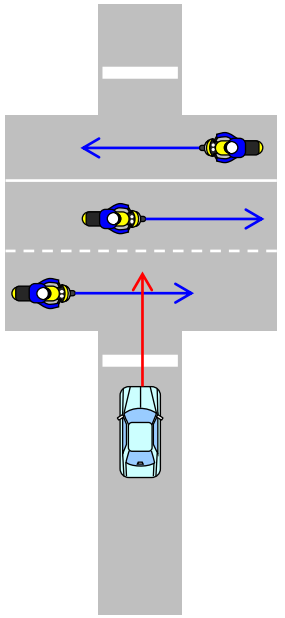
Vehicle information (Location, Speed, Heading etc.) can be obtained by C-ITS communication



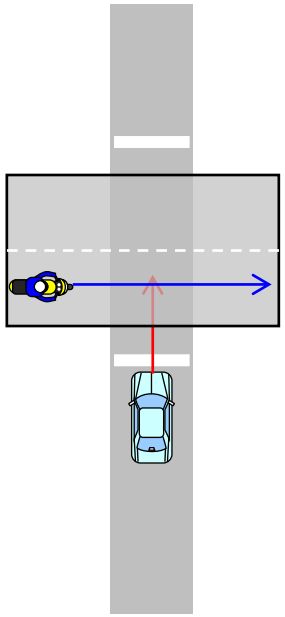
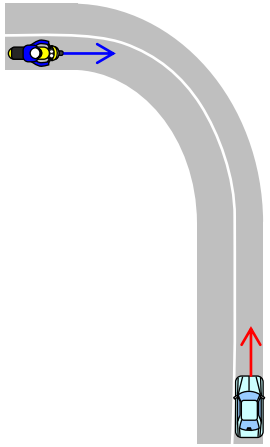
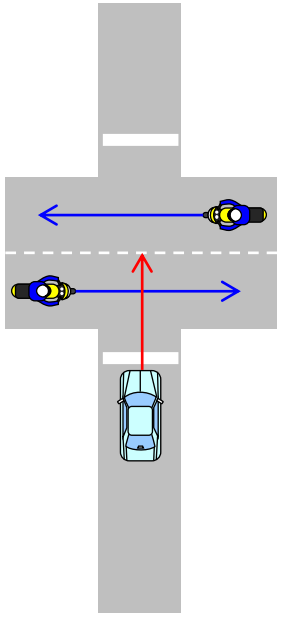
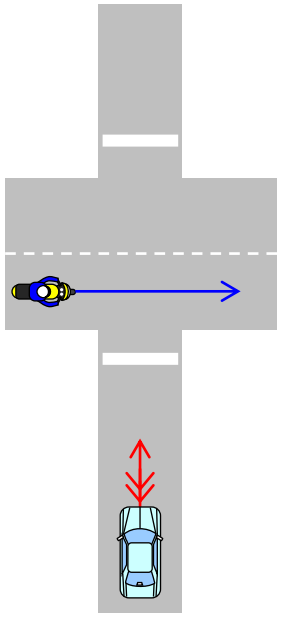
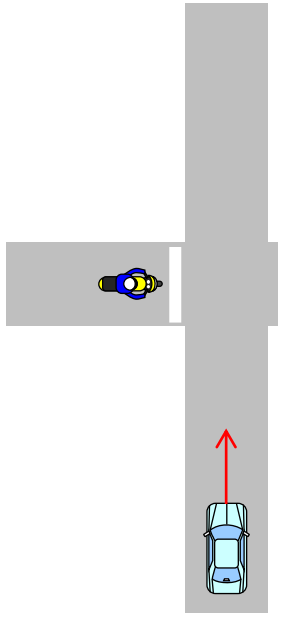
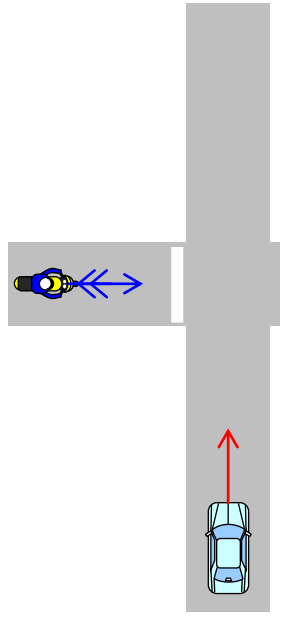
Trajectories of vehicles are predicted, and collision risk is calculated.

Collision risk is calculated based on the input from C-ITS communication.

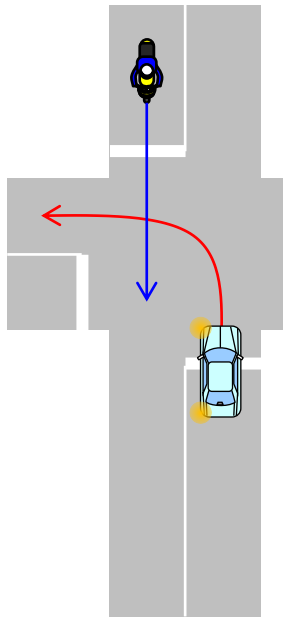
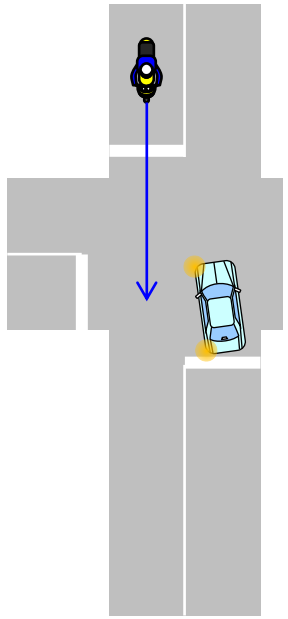
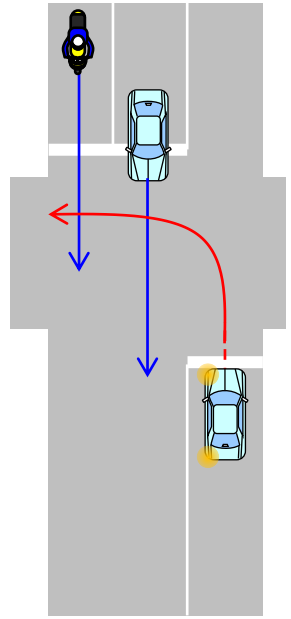
Scenarios: IMA operational

Use case	Car moving forward	Car starting	Intersection with multiple vehicles
Overview			
Individual requirement	IMA should be operated towards a vehicle approaching from left/right when moving forward with/without acceleration/deceleration.	IMA should be operated towards a vehicle approaching from left/right while car is starting (releasing the brake).	IMA should be operated at an intersection while multiple vehicles are approaching from left/right direction.

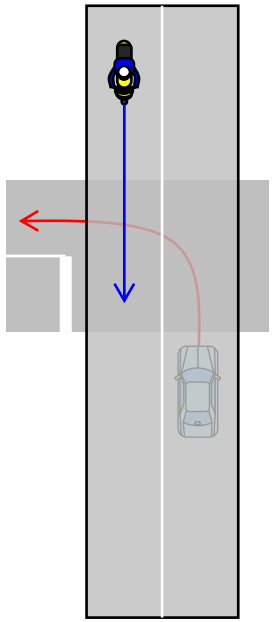
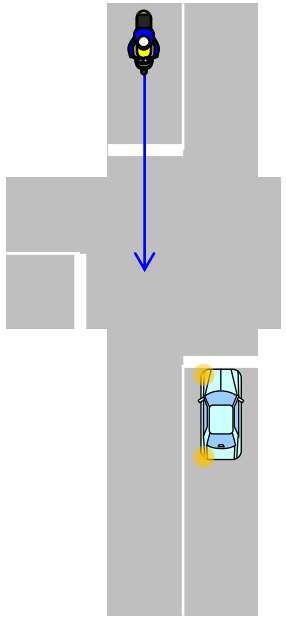
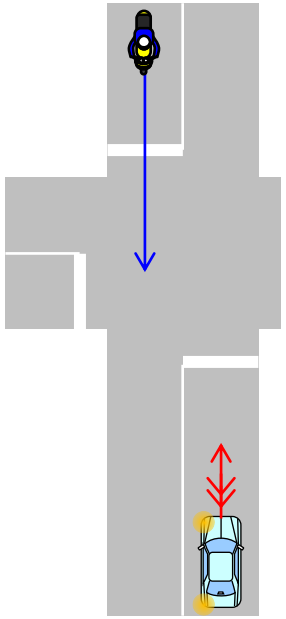
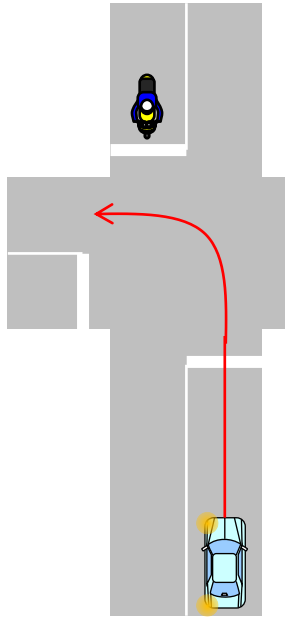
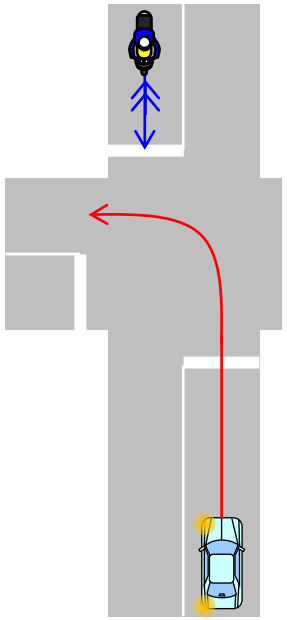
Scenarios: IMA non-operational

Use case	Overpass/Underpass intersection	Curved road	Car waiting	Car stops at the intersection	Other vehicle waiting	Other vehicle stops at the intersection
Overview						
Individual requirement	IMA should not be operated at an overpass/underpass intersection.	IMA should not be operated at a curved road.	IMA should not be operated towards a vehicle approaching from left/right while car is waiting (holding the brake).	IMA should not be operated towards a vehicle approaching from left/right if car attempts to stop before the intersection.	IMA should not be operated towards a vehicle waiting from left/right while car is approaching.	IMA should not be operated towards a vehicle which attempts to stop before the intersection from left/right while car is approaching.

Scenarios: LTA operational

Use case	Car turning left	Car starting	Intersection with multiple vehicles
Overview			
Individual requirement	LTA should be operated towards a vehicle approaching from ahead when turning left.	LTA should be operated towards a vehicle approaching from ahead while car is starting (releasing the brake).	LTA should be operated at an intersection while multi vehicles are approaching the intersection.

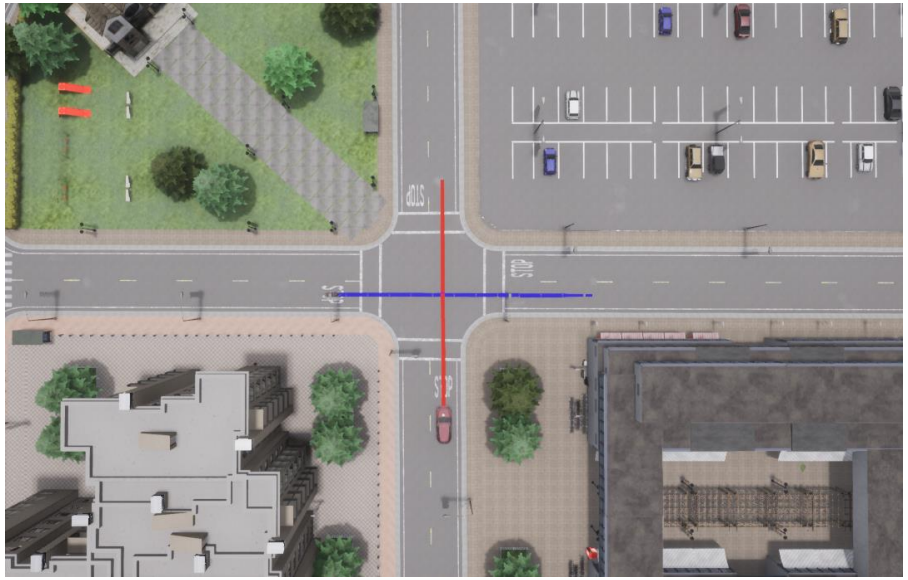
Scenarios: LTA non-operational

use case	Overpass/Underpass intersection	Car waiting	Car stops at the intersection	Other vehicle waiting	Other vehicle stops at the intersection
Overview					
Individual requirement	LTA should not be operated at an overpass/underpass intersection.	LTA should not be operated towards a vehicle approaching the intersection while the car is waiting (holding the brake).	LTA should not be operated towards a vehicle approaching the intersection if the car attempts to stop before the intersection.	LTA should not be operated towards a vehicle waiting at the intersection while the car is approaching and turning left.	LTA should not be operated towards a vehicle which attempts to stop before the intersection while the car is approaching and turning left.

Simulation: Simulation Environment

This picture comes from the blog of Irida Shyti: What is CARLA and How to Use it To Simulate Autonomous Driving | Rocketloop

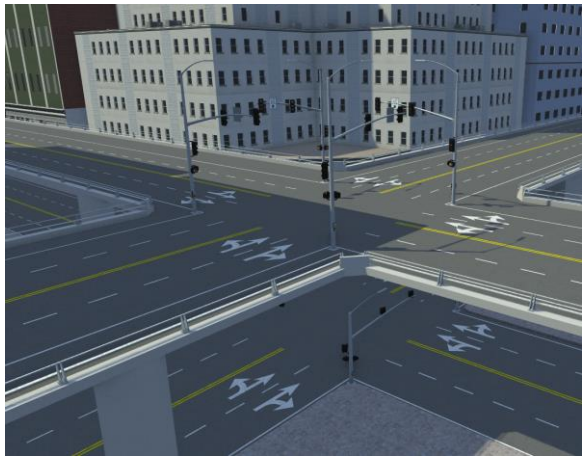
Simulation: Application Integration



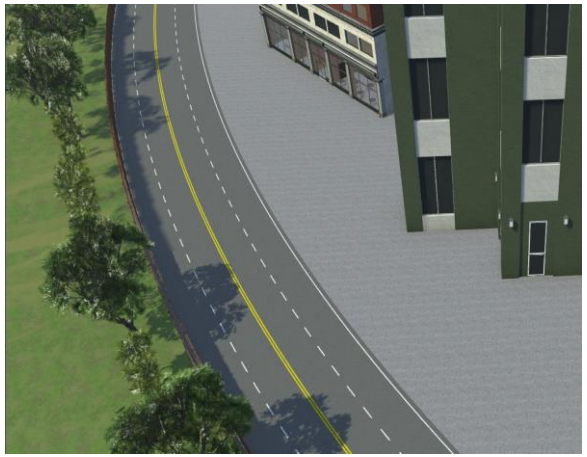
Trajectories in the simulation

Notification triggering in the simulation

Simulation: Map Integration



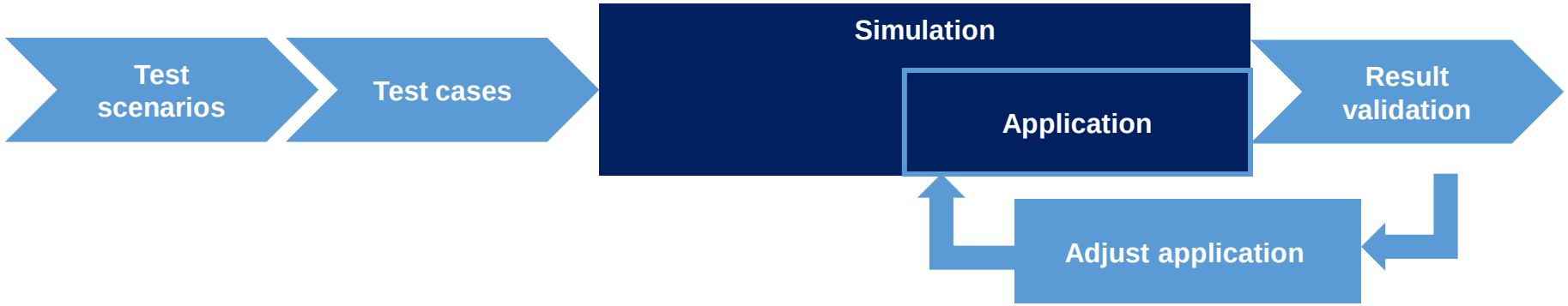
Over-/underpass



Curved road

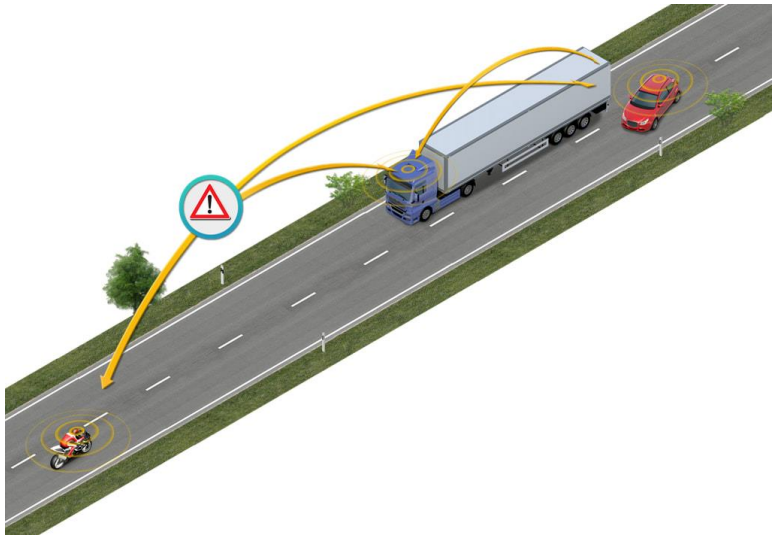
4-lane intersection

Simulation: Evaluation Workflow

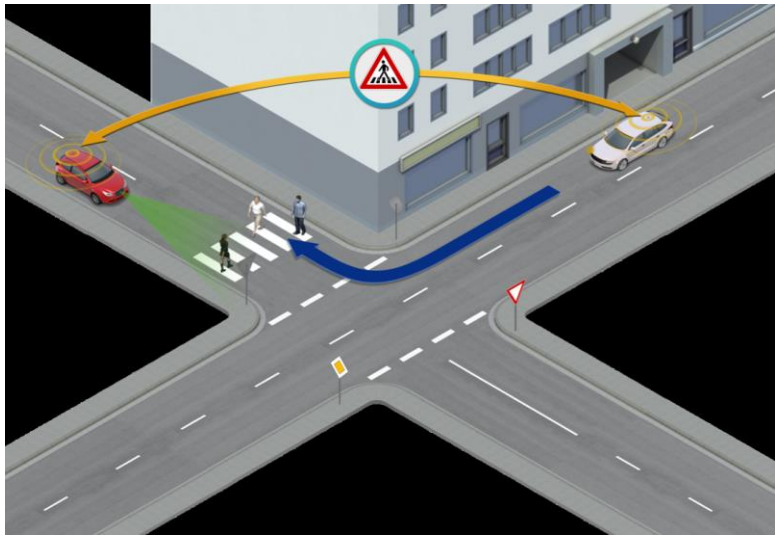


Outlook

- More Day1-Applications such as DNPW etc.
- Models of driver/rider reaction
- Day2-Applications



Example of the Day1-Application use case



Example of the Day2-Application use case

Connected Motorcycle Consortium

Thank you for your attention

BMW MOTORRAD

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HARLEY-DAVIDSON

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