Automated driving
Infrastructure perspective

Robbin Blokpoel – 25th May 2018

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Introduction

History

First idea: In the World's Fair of 1893 in New York, General Motors presented vision of "driverless cars".

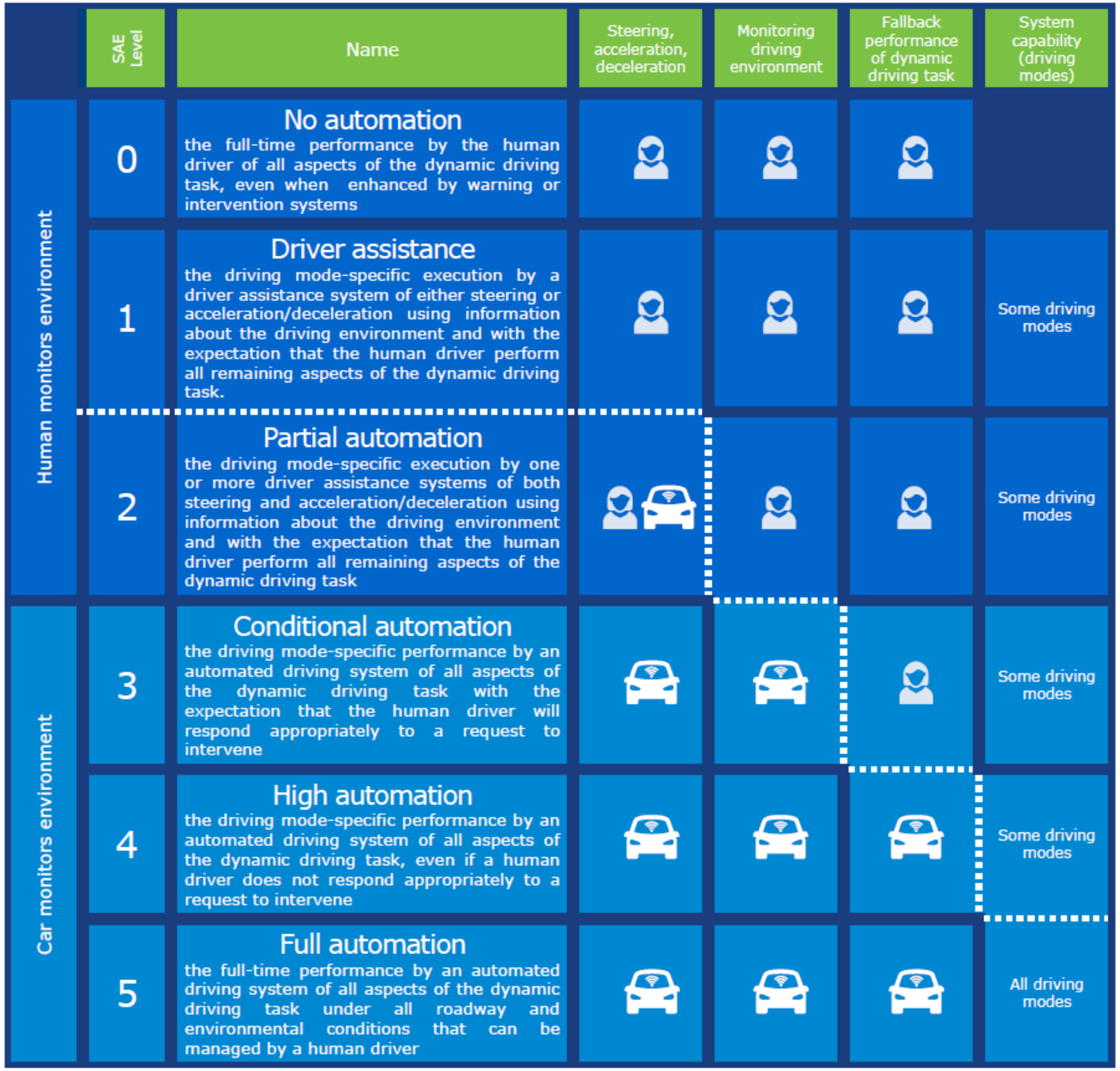
Three main stages of research:

- 1980-2003 : University researchers developed AVs in two groups
    - Dumb vehicle, smart dedicated lanes - Vehicle relies on infrastructure
    - Automated vehicles
- From 2003 : DARPA Grand challenges boosted research
- Recently private companies and vehicle industries have advanced AVs

Introduction

Levels of automation

- Level 2 widely available on the market
- Level 3 is controversial due to unexpected transitions
- Most agree we should proceed directly from Level 2 to Level 4/5



Technology

Two paradigms for automated driving

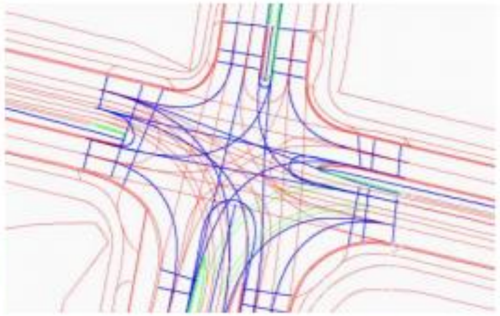
Situation assessment

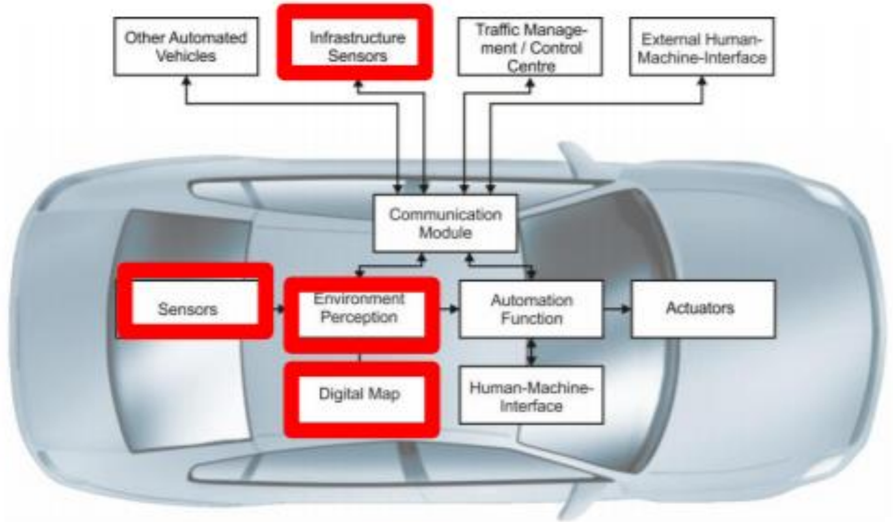
- In case situation *x* occurs, take action *y*
- Very predictable, easy to prove vehicle will respond well to pre-defined situations
- Problem may occur when unknown situation occurs

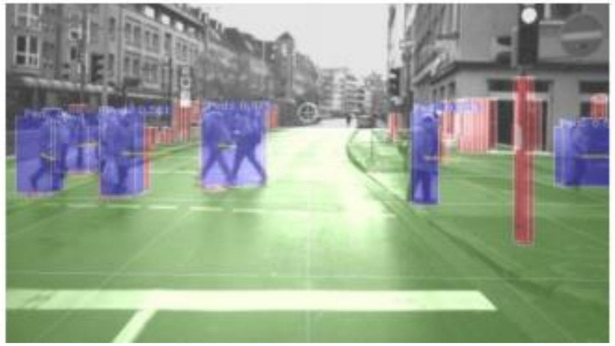
Data driven

- Learn from millions of hours of human driving footage
- Difficult to prove safety
- Vehicle will behave more naturally and should be robust against unexpected situations
- www.comma.ai

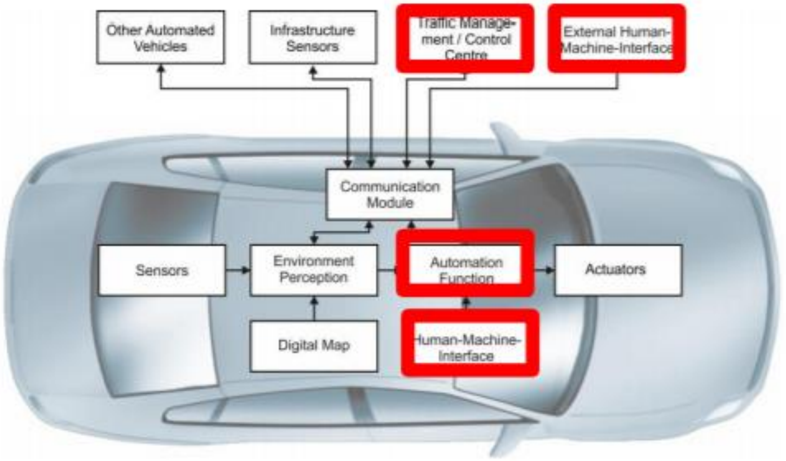
Technology – vehicle systems (1/3)

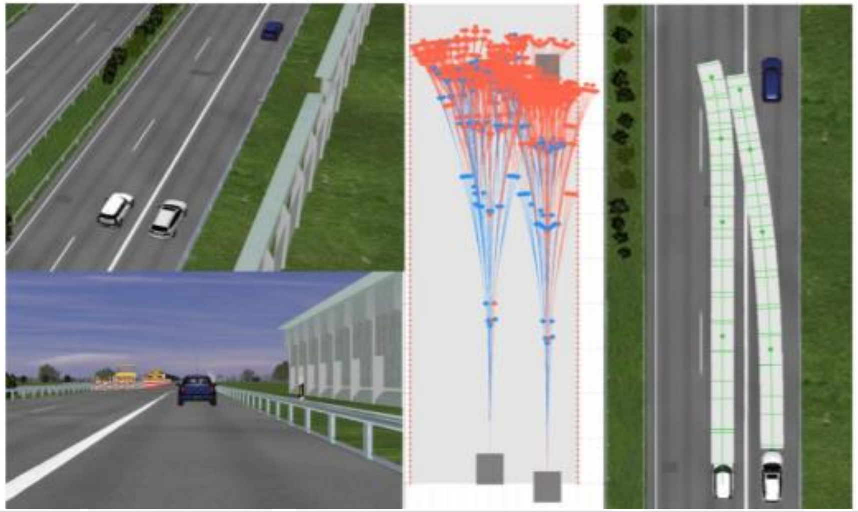




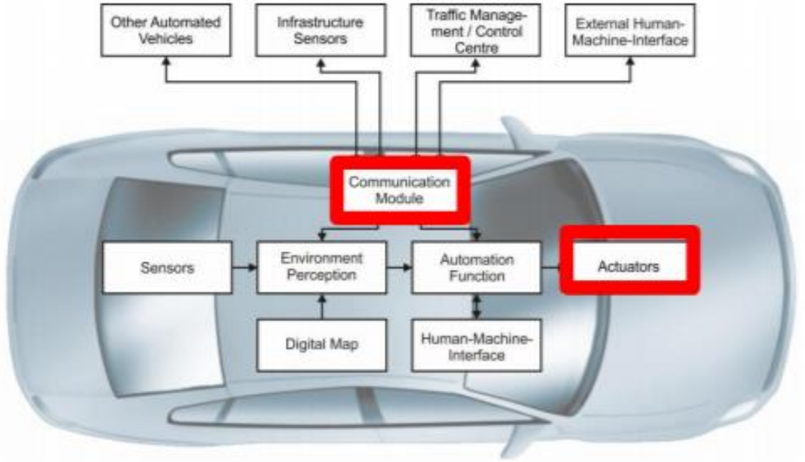


Technology – vehicle systems (2/3)





Technology – vehicle systems (3/3)



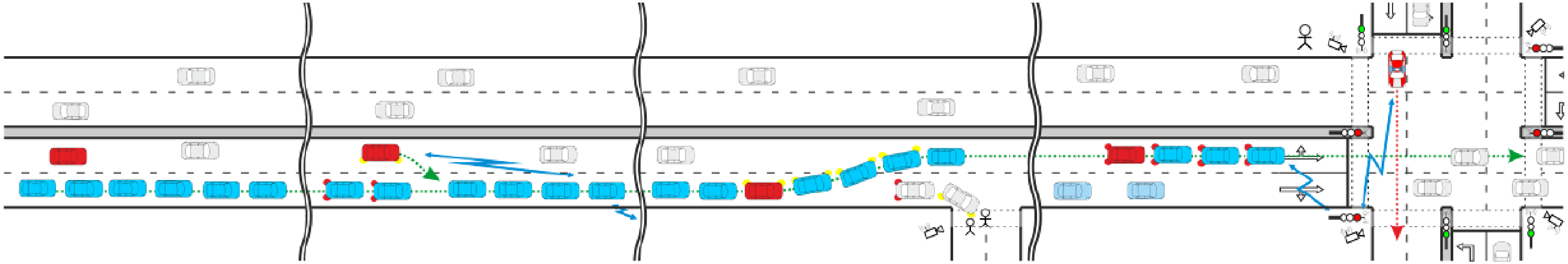
MAVEN project

- Website: www.maven-its.eu
- Duration: 01-09-2016 to 31-08-2019
- Funding: 3M€ under EC H2020 programme
- 9 partners from 5 EU countries:

MAVEN is funded by the EC Horizon 2020 Research and Innovation Framework Programme, under Grant Agreement No. 690727

Objectives

- Increase safety with collective perception (alternative: very slow driving)
- Increase efficiency by exploiting possibilities of automated driving



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Use Cases

Platooning	I2V	Infrastructure
UC1: Platoon initialization	UC7: Speed change advisory	UC11: Queue length estimation
UC2: Joining a platoon	UC8: Lane change advisory	UC13: Green wave
UC3: Traveling in a platoon	UC9: Emergency situations	UC14: Signal optimization alg.
UC4: Leaving a platoon	UC10: Priority management	
UC5: Platoon break-up	UC12: Local level routing	
UC6: Platoon termination	UC15: Negotiation	
	UC16: Detect non-cooperative road users	

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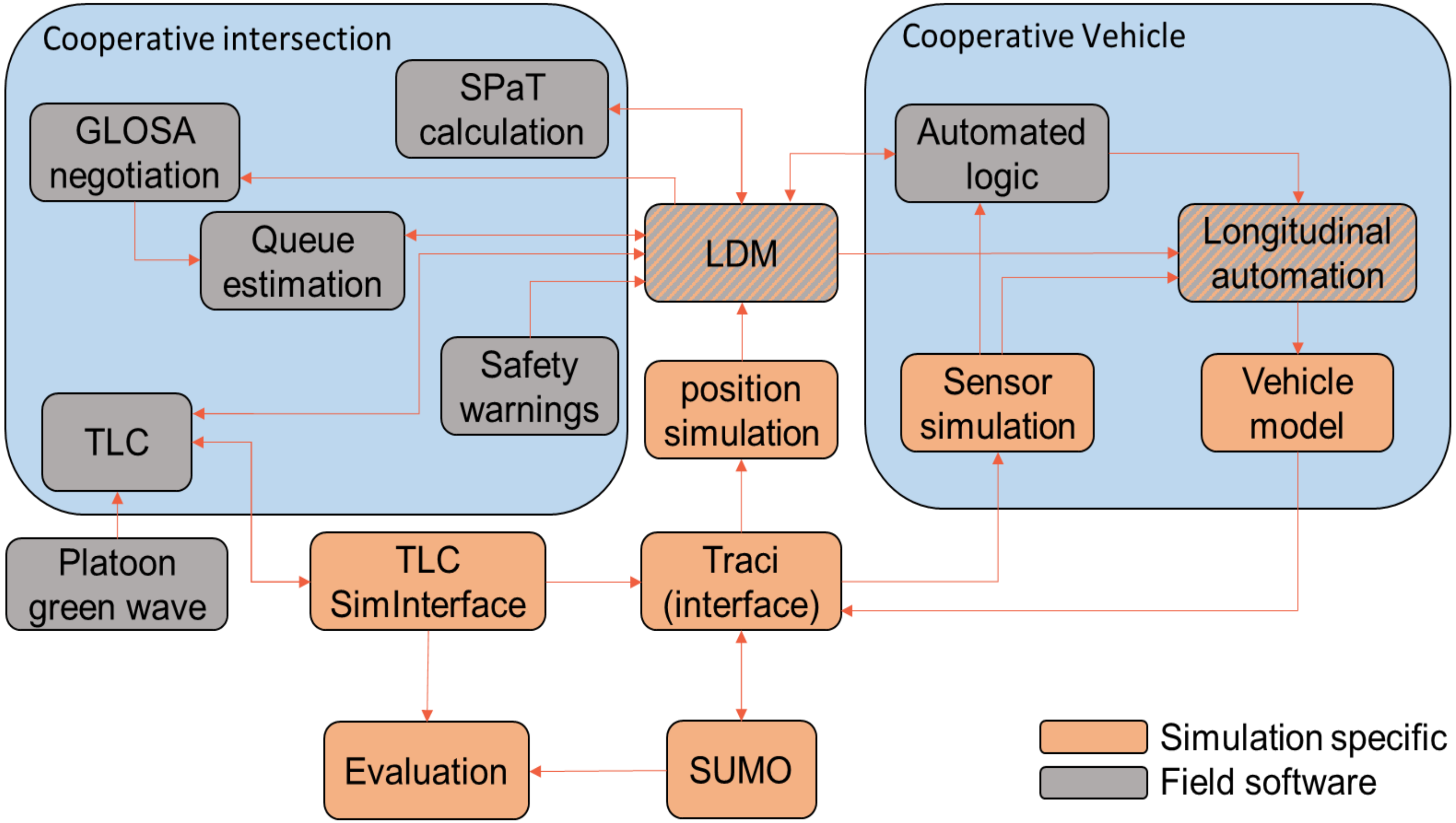
Architecture



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Architecture

New Data Element	Applicable scenario
Number of occupants	Intersection priority management.
Distance to following vehicle	Queue estimation. This information can improve queue model accuracy, leading to more optimal solutions for GLOSA negotiation and signal timing
Distance to preceding vehicle	
Platooning state	Signal optimization and intersection priority
Desired speed	Queue estimation and GLOSA negotiation
Current lane	Lane advice, multiple lanes for a certain direction
Route information	Queue estimation, signal optimization and GLOSA

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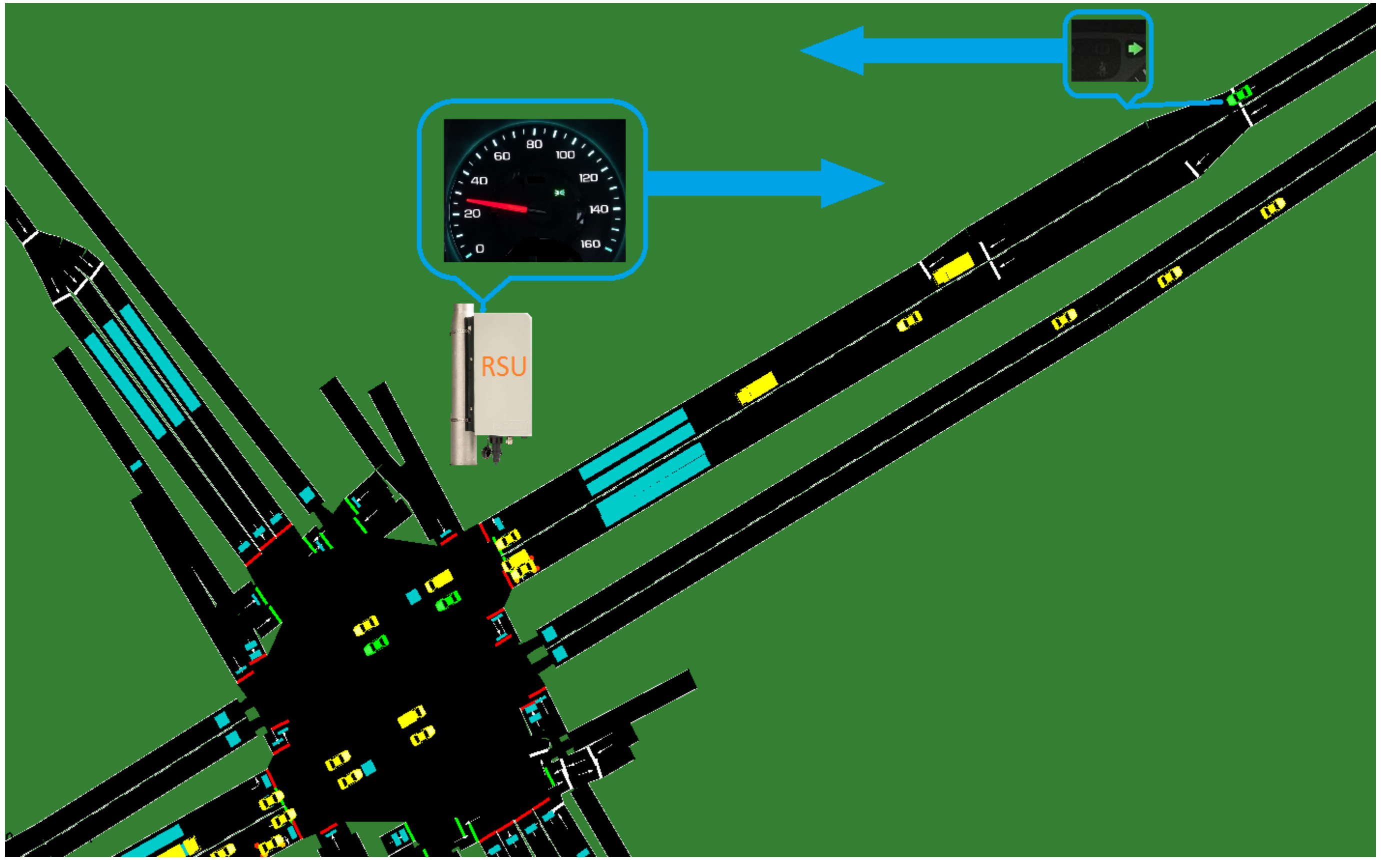
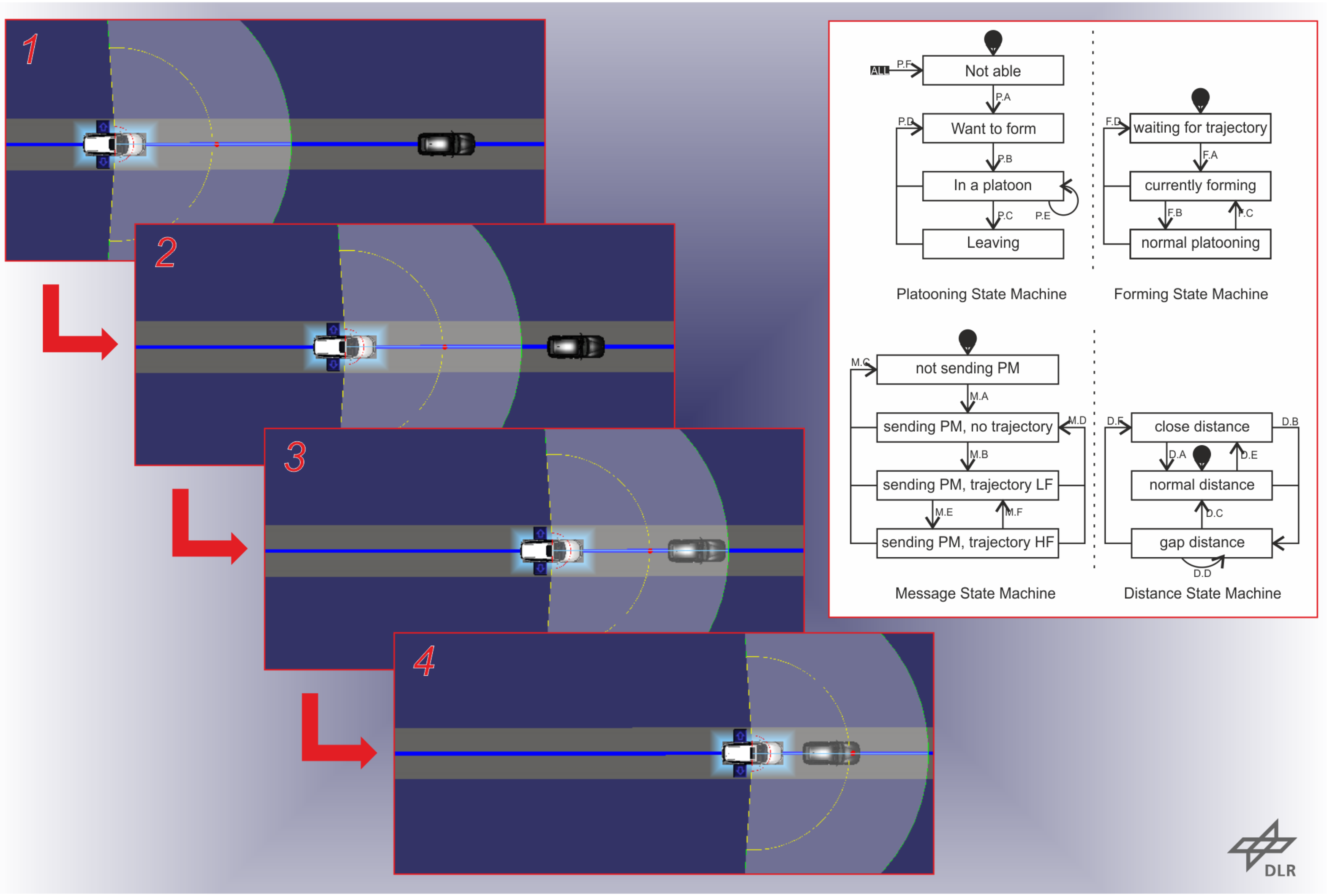
Application: GLOSA negotiation

- Intersection shares SPaT
- Vehicle sends extended CAM (speed, direction, platooning)
- Intersection recalculates SPaT
- Vehicle acknowledges advice
- Intersection stabilizes control plan



Platooning

- Distributed algorithm
- Vehicle-centric
- Infrastructure can steer on high level
- Consists of 4 state machines
- Relies on new messages



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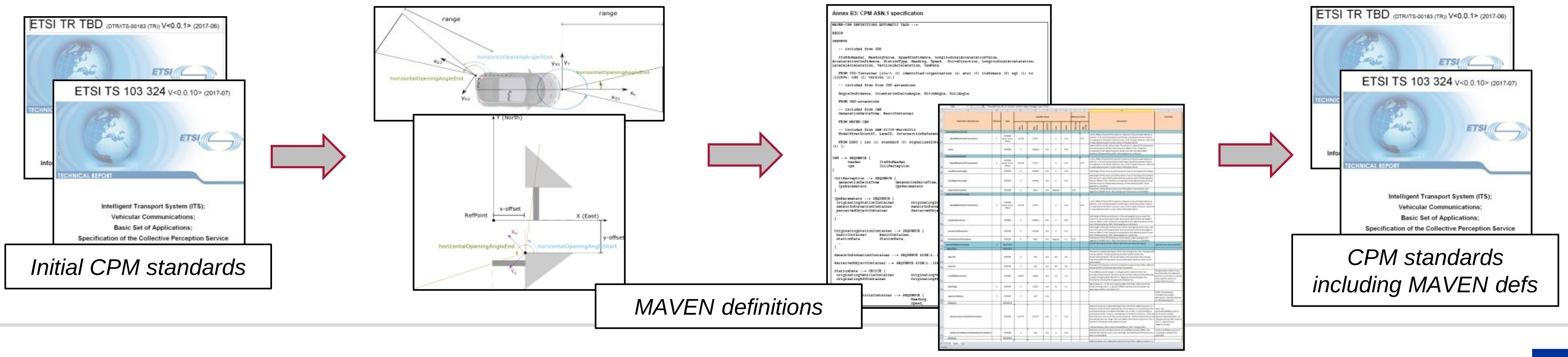
Message sets

- Extended CAM for automation and negotiation
- Profiled MAP/SPaT for lane specific GLOSA
- New LAM (Lane Advice Message)
- Extension to CPM (Collective Perception Message)
  - RSU detections can be included as well
  - Possibility to link to MAP message topology for efficiency



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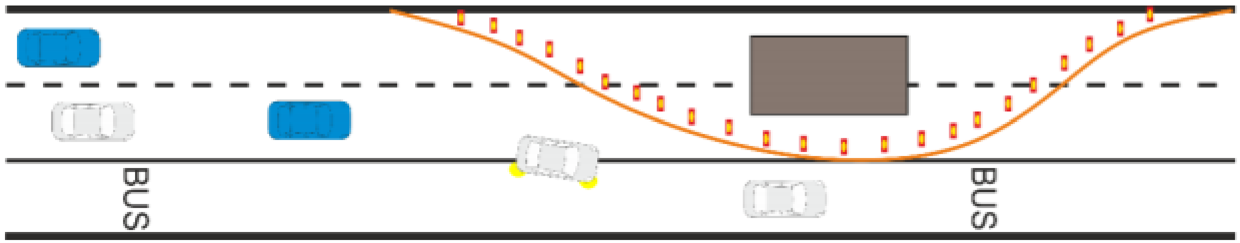
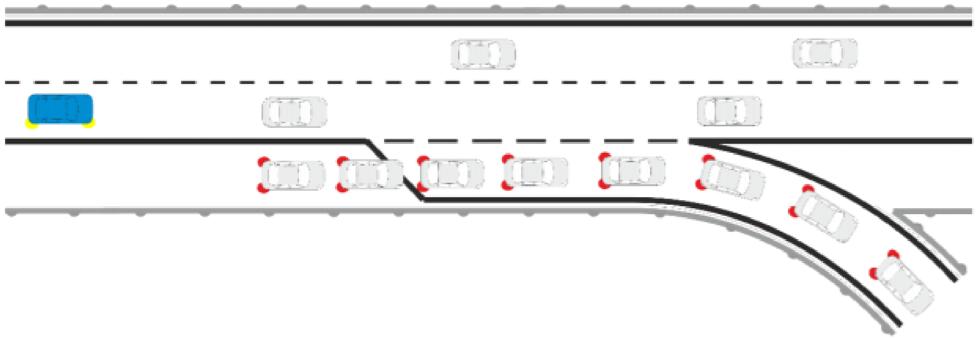
TransAID project

- Transition Areas for Infrastructure-Assisted Driving
- 01/09/2017 ~ 31/08/2019
- Budget: EUR 3,836,353.75
- Seven partners from 6 countries: DE, UK, BE, NL, EL, ES

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 723390

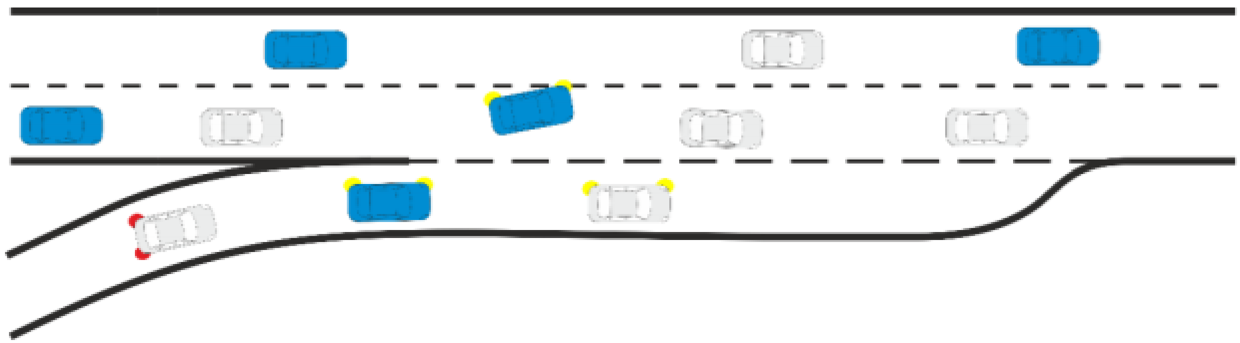
TransAID use cases





Strategies:

- Spread Transition of Control (ToC)
- Advice to prevent ToC and increase efficiency
- Manage Minimum Risk Maneuvres (MRM)



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Questions?

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