Infrastructure Supported Automated Driving in Transition Areas – a Prototypic Implementation

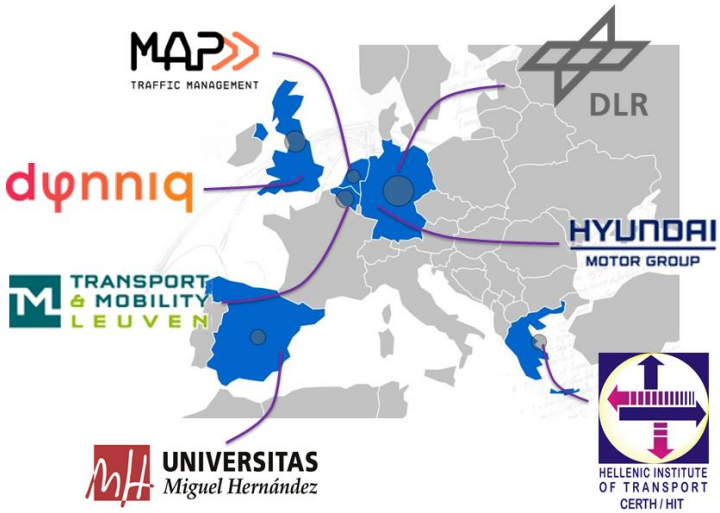
Julian Schindler

www.transaid.eu
@transaid_h2020
www.linkedin.com/groups/13562830/
www.facebook.com/transaidh2020/

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


DLR
Mercure HOTEL

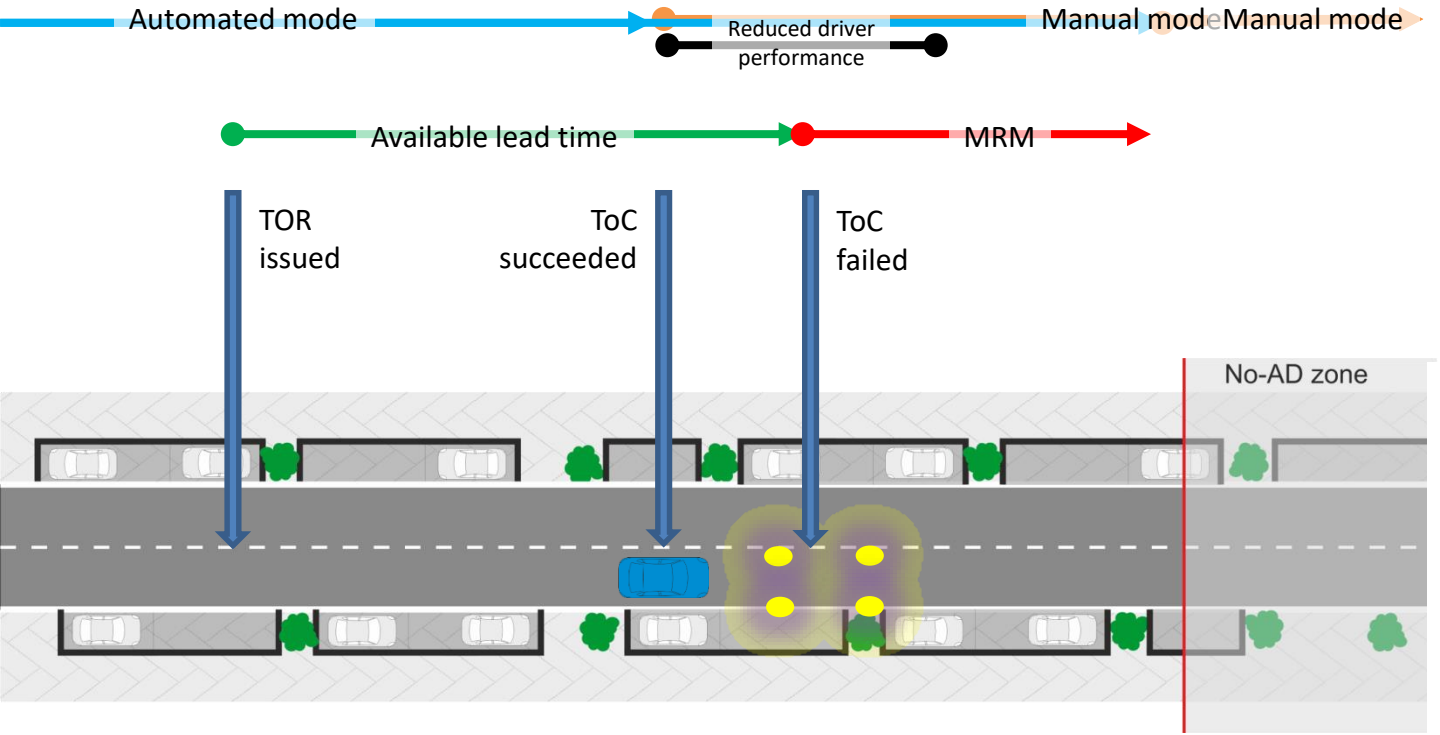
Transition Areas for Infrastructure Assisted Driving



European H2020 project

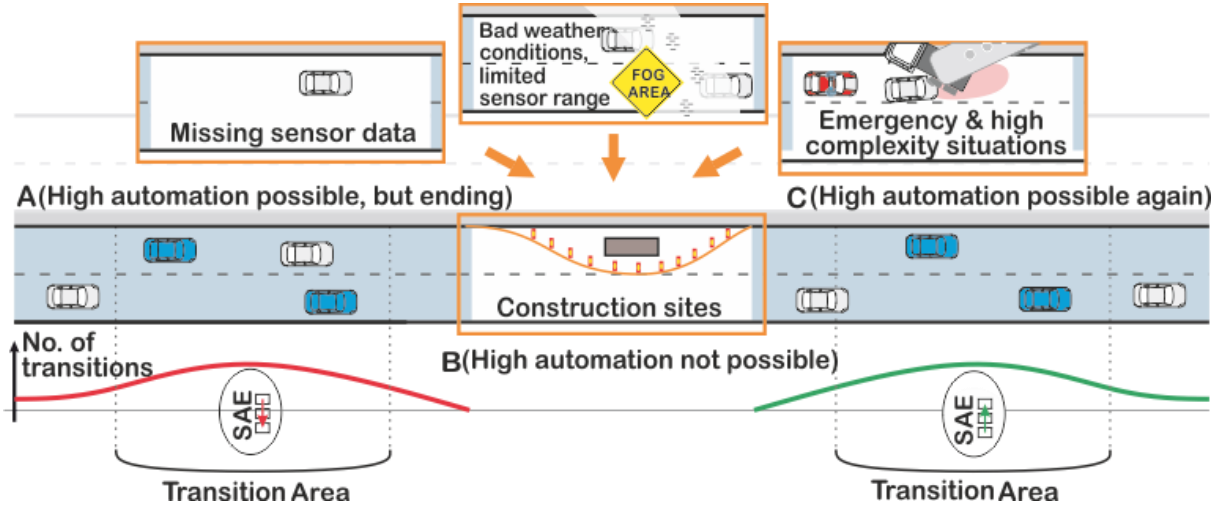
- ART-05-2016 - Automated Road Transport
- Period: 01-09-2017 ~ 31-08-2020
  COVID-19 Extension to 31-12-2020
- Budget: € 3,836,353
- 7 partners + 12 associated partners

Definition: ToC, TOR & MRM



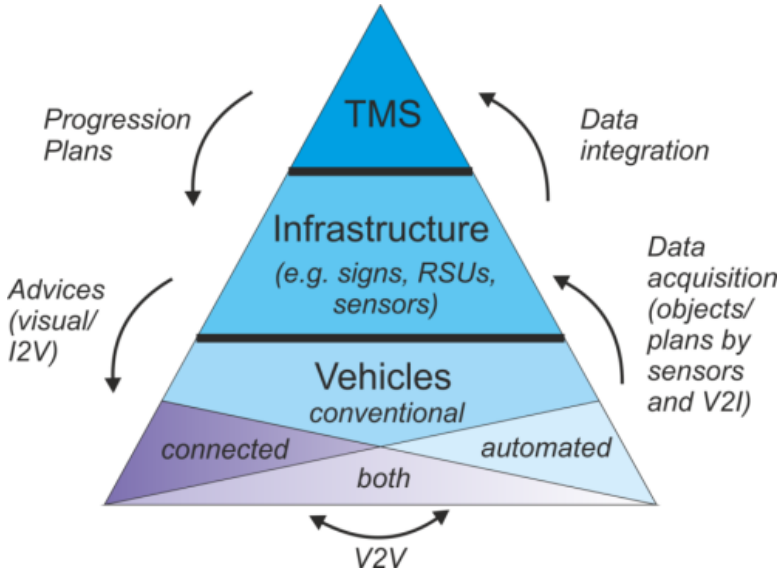
- ToC:
Transition of Control
- TOR:
Take Over Request
- MRM:
Minimum Risk Maneuver

Definition: “Transition Areas”



“Transition Areas” are areas on the road where many highly automated vehicles (blue) are changing their level of automation due to various reasons.

Hierarchical approach

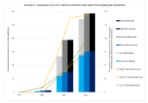


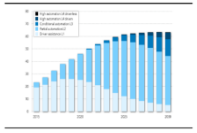
Service definition

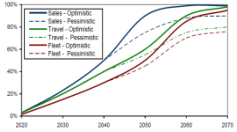
Performed literature studies, expert interviews and stakeholder workshops with surveys

→ Various parameters (environmental causes, vehicle behaviour, HMI, driver reaction, time …)

→ only limited data available







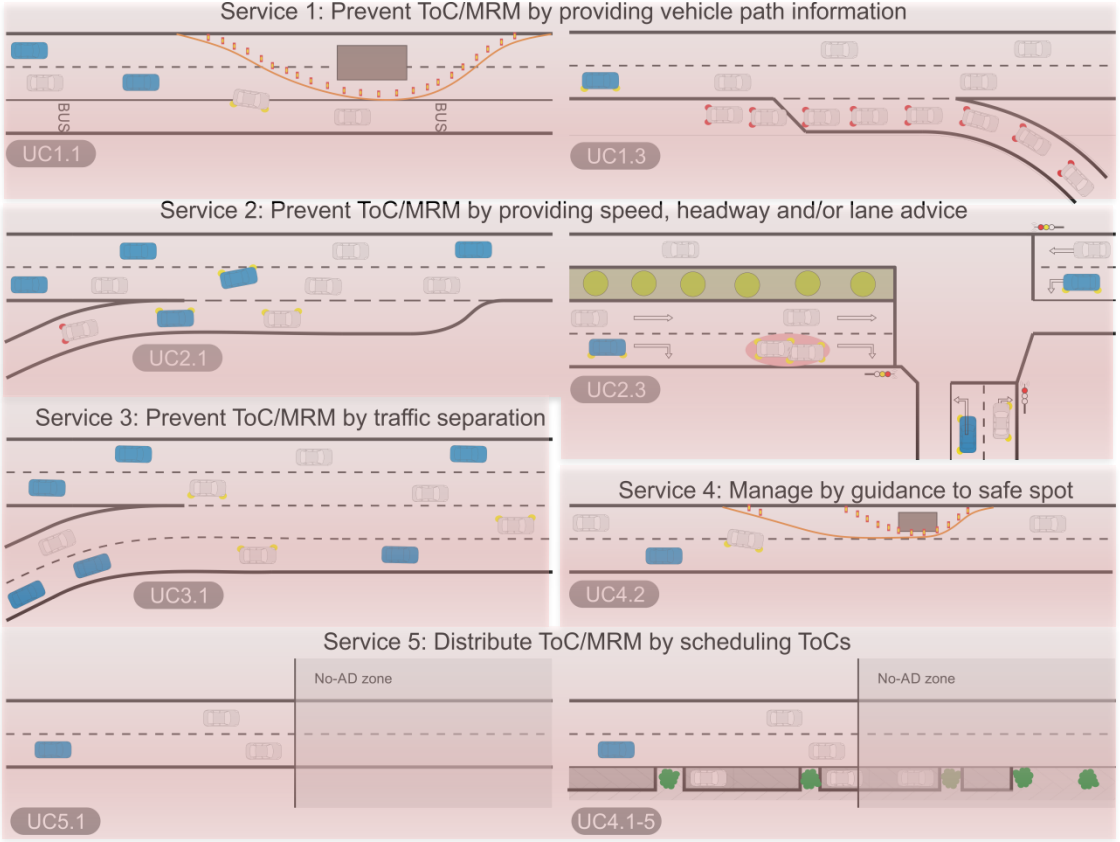
Prevent ToC/MRM

- By providing path information
- By providing speed / headway / lane advice
- By separating traffic

Manage or support ToC/MRM

Distribute (in time and space) ToC/MRM

Services and Use Cases



Each use case tested in several scenarios

→ Sum of approx. 50 scenarios

ITS-G5 communication as enabling technology

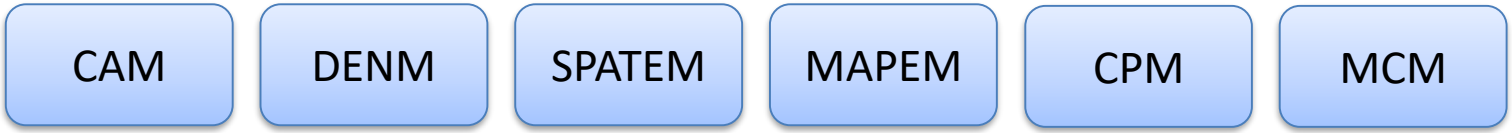
CAM | DENM | SPATEM | MAPEM | CPM | MCM

Cooperative Awareness Message

- Type
- Position
- Orientation
- Velocity

\+ Current automation level
\+ Currently performing ToC/MRM

ITS-G5 communication as enabling technology



Decentralized Environmental Notification Message

- Warnings and hazards
- Road works
- Broken down vehicles

ITS-G5 communication as enabling technology

CAM | DENM | SPATEM | MAPEM | CPM | MCM

Signal Phase and Timing Extended Message

- Traffic light phases

ITS-G5 communication as enabling technology

CAM | DENM | SPATEM | MAPEM | CPM | MCM

Map Extended Message

- For intersections
  - Topology
  - Lane types
  - Lane links

\+ Used also on standard roads
\+ E.g. Safe Spot definitions

ITS-G5 communication as enabling technology

CAM | DENM | SPATEM | MAPEM | CPM | MCM

Collective Perception Message

- Information about sensor
- Detected objects
  - Type
  - Position
  - Orientation
  - Velocity

Standardization activities by TransAID

ITS-G5 communication as enabling technology

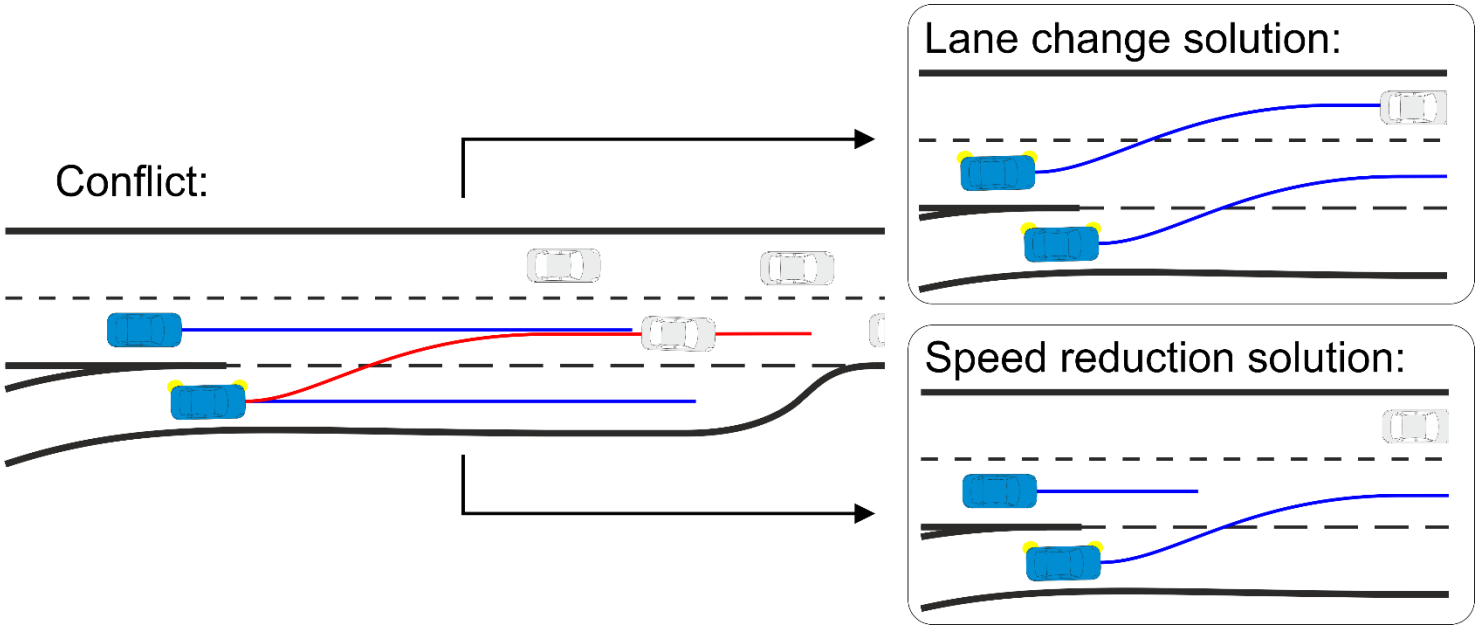
CAM | DENM | SPATEM | MAPEM | CPM | MCM

Maneuver Coordination Message

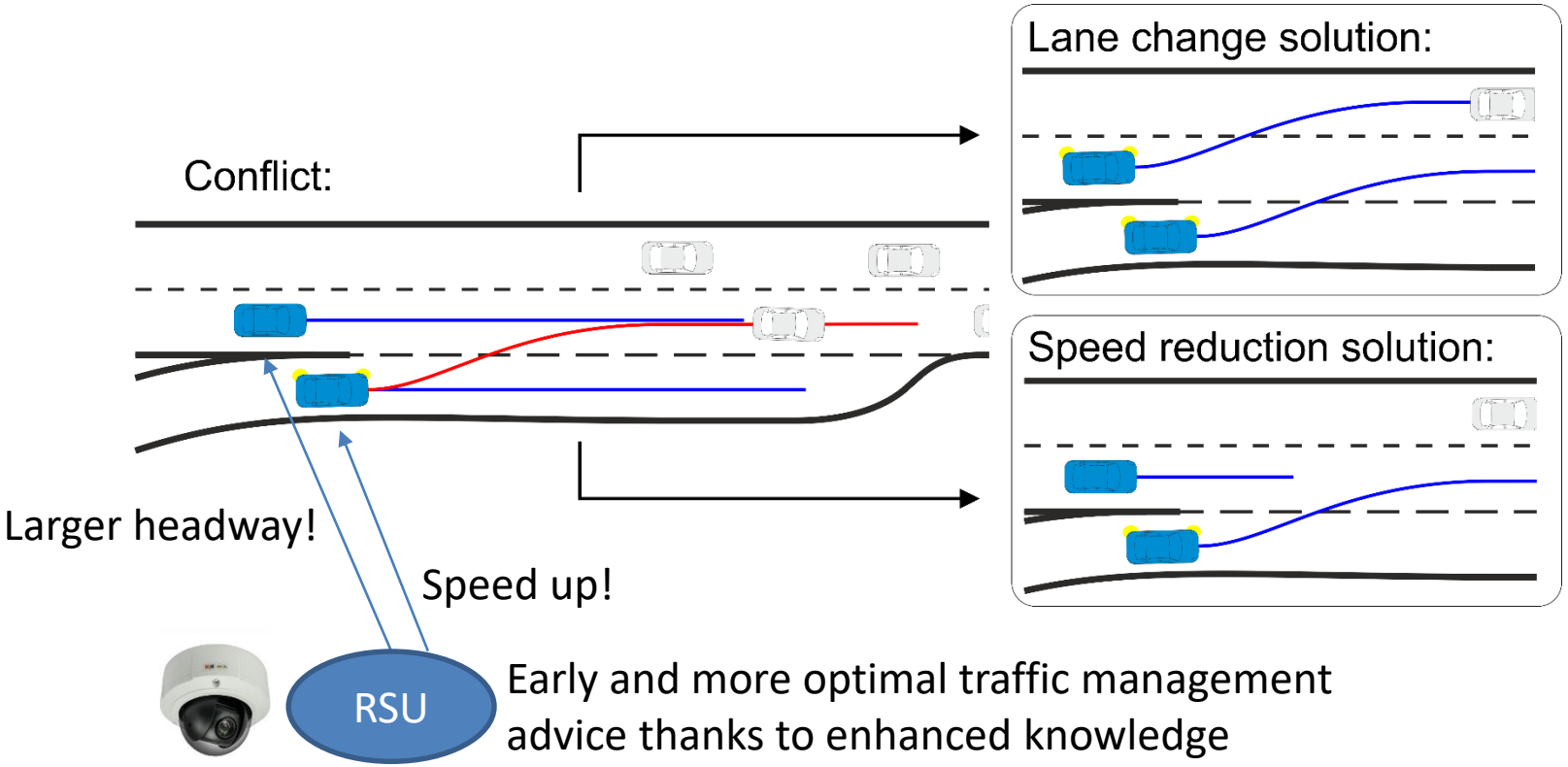
Standardization activities by TransAID

- V2V-Part
  - Current trajectories
  - Desired trajectories
- \+ I2V-Part
  - \+ ToC advice
  - \+ Lane advice
  - \+ Speed/Headway advice
  - \+ Safe Spot advice

MCM V2V Communication

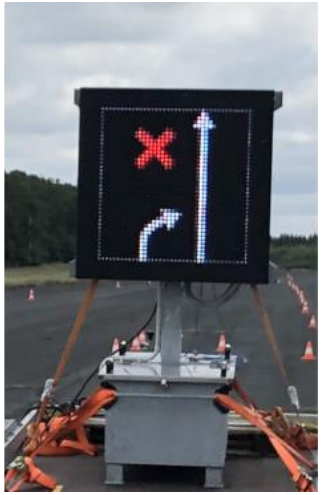


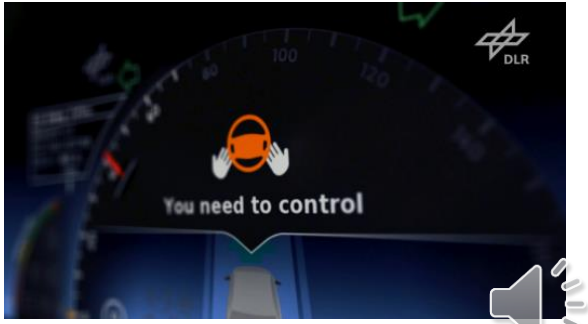
MCM Communication with infrastructure support



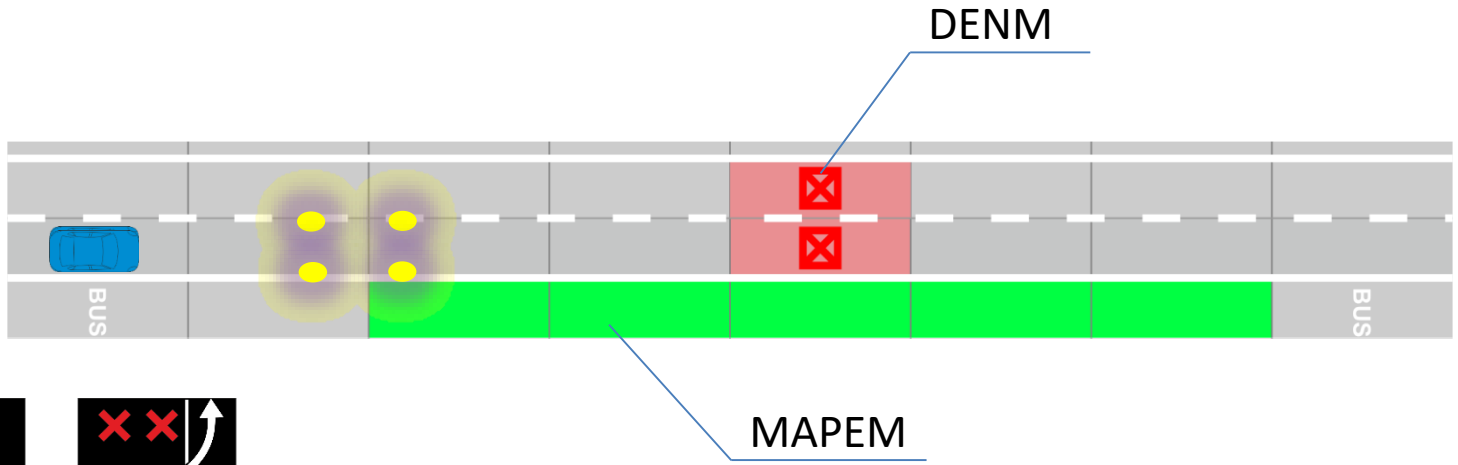
Early and more optimal traffic management advice thanks to enhanced knowledge

Feasibility assessment in real world



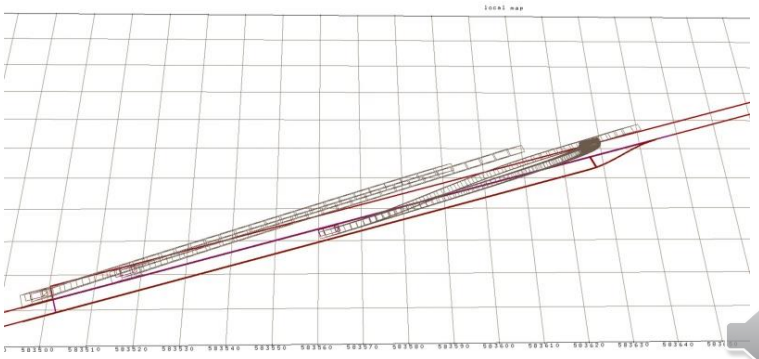


Service 1 example: Provide path information



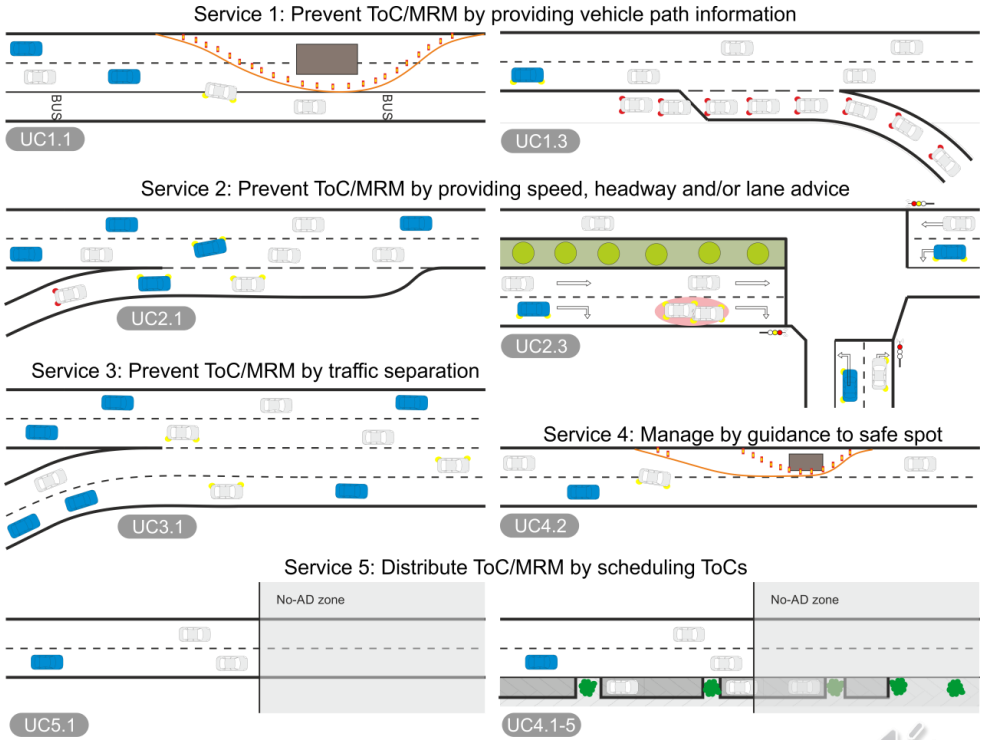
Service 2 example: Cooperative Lane Change and Merging

- Infrastructure gives early speed advice to on-ramp vehicle
- and early ToC advice in case of impossible merging
- V2V cooperation when CAVs meet:
  - If possible, highway vehicle changes lane
  - If not, gap opening



Feasibility results

- Tested 5 services in approx. 50 scenarios
- All traffic management measures could be applied with ITS-G5 communication
- Developed messages suitable for solving critical vehicle automation behaviour
- Infrastructure is able to provide information for more smooth and comfortable driving



TransAID

Julian Schindler
DLR
julian.schindler@dlr.de

www.transaid.eu
@transaid_h2020
www.linkedin.com/groups/13562830/
www.facebook.com/transaidh2020/

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