Enhanced Traffic Management of Connected and Automated Vehicles in Transition Areas

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Transport & Mobility Leuven (TML)

- Founded in 2002 as a spin-off company (NV):
  – Catholic University of Leuven (50% shareholder)
  – TNO research institute (The Netherlands)

- Multidisciplinary team (27 people):
  – Transport, bio-, chemical, and environmental engineering
  – Economy, computer science, psychology

- Impact analyses for road, rail, public transport, IWW, air, …

- Network:
  – Board of Directors of ITS Belgium
  – Horizon 2020 / INEA: external experts
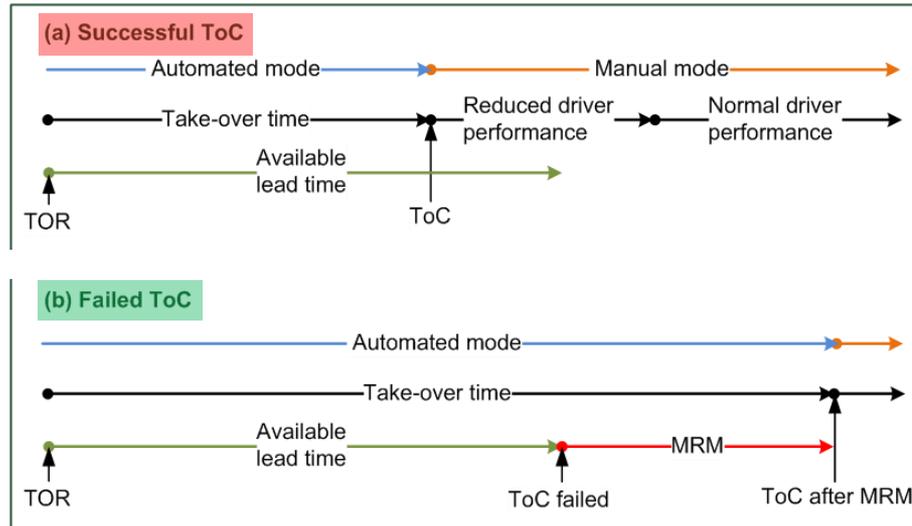 – Former expert in advisory council of 'Vlaams Instituut voor Mobiliteit' (VIM)

# Situations in which (C)AVs may struggle
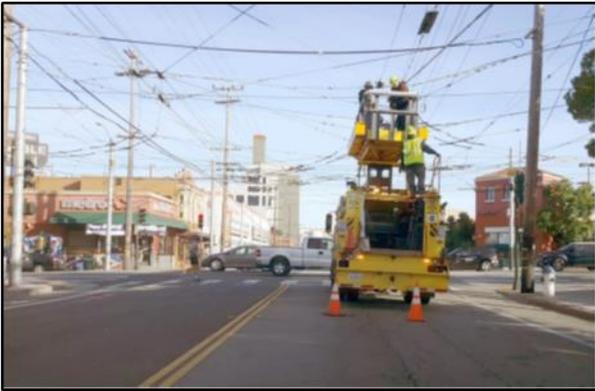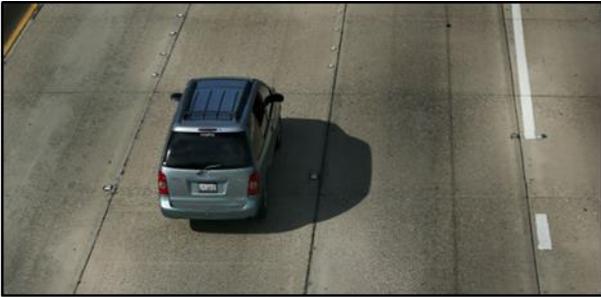
Sequence of events when AD disengages

- Take-over request (**TOR**) issued by the car
- Transition of Control (**ToC**) from car to driver
- Minimum-Risk Maneuver (**MRM**) by the car

Transition Areas for Infrastructure-Assisted Driving

- About the EC call:
  - Horizon 2020 ART-05-2016 (Automated Road Transport)
  - Grant Agreement nr.: 723390

- About the project:
  - Duration: 36 months
  - Start date: September 2017
  - Total budget: 3.8 M€
  - Consortium: 7 partners from 6 European countries
  - ICT infrastructure providers
  - Automotive industry
  - Academia
  - 12 associated partners
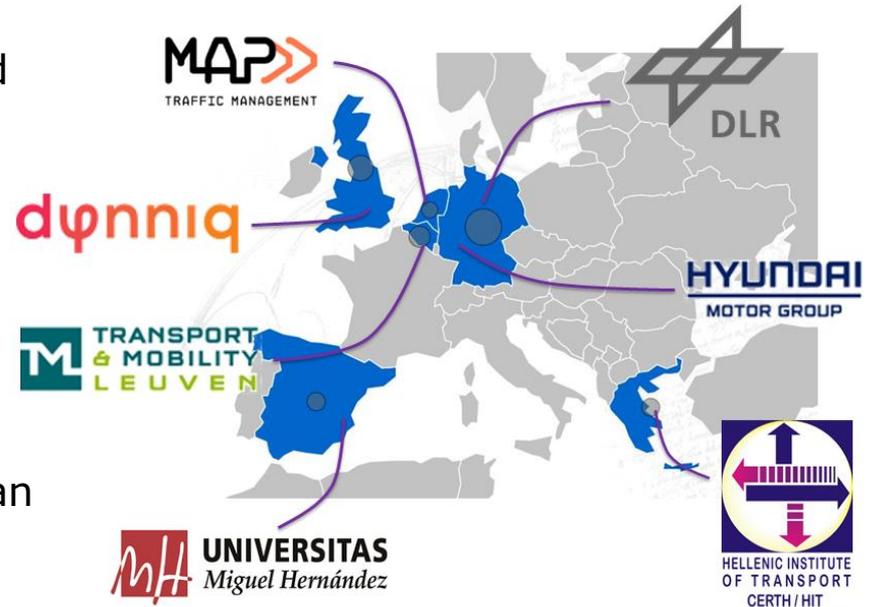
TransAID's simulation environment
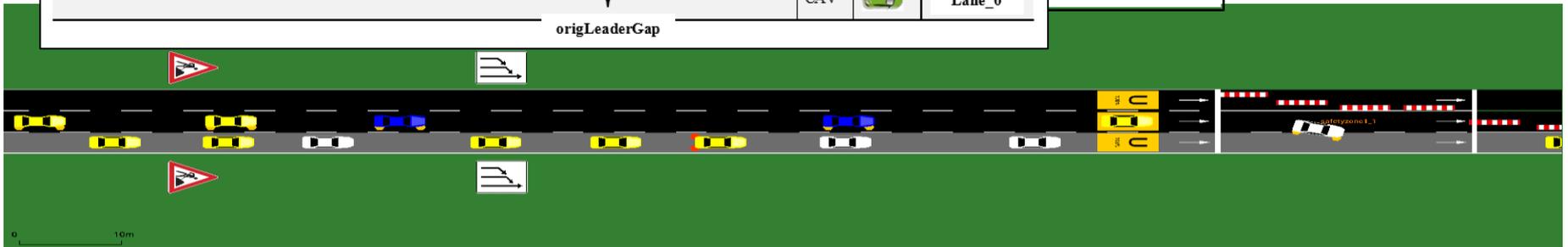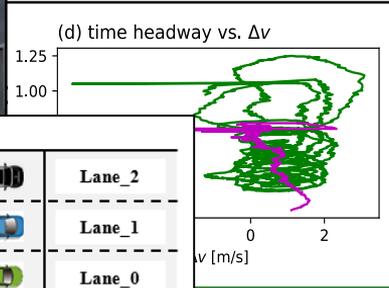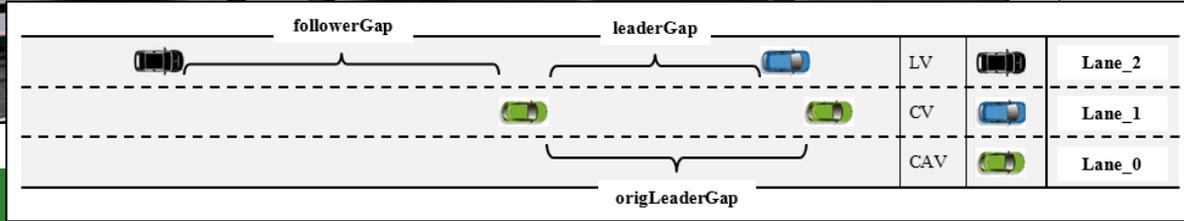
SUMO's cooperative adaptive cruise-control and lane-changing

Speed Control Mode
- ACC: Space headway < 120m
- CACC: Time headway > 2s

Gap-closing Control Mode
- ACC: Space headway < 100m
- CACC: Time headway < 1.5s

Gap Control Mode
- ACC: Space headway < 100m
- CACC: Time headway < 1.5s
- Gap deviation < 0.2 m
- Speed deviation < 0.1 m/s

Collision Avoidance Control Mode
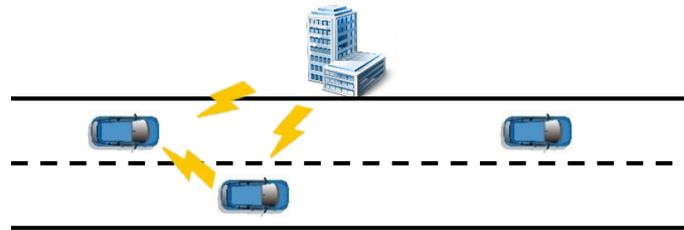- ACC: Space headway < 100m
- CACC: Time headway < 1.5s
- Negative gap deviation

Difference between platooning and clustering!

Centralized Approach

- Enhanced Perception
- Global Coordination
- Optimal Performance
- V2X Communication

Main observations about state-of-the-art

- General approaches
  - Coordinated network-wide traffic management
  - Using KPIs, hierarchical controls via layered architectures, TMaaS
- Cooperative systems
  - V2X / VANETs / C-ITS
- Machine learning techniques (AI)
  - Traffic light control and congestion / queue length predictions

- **Conclusion**
  - No (readily available) implementations of more advanced TM schemes
 - Focus on solving partial problems with specific measures

Initial selection of services / use cases

1. Prevent ToC/MRM by providing vehicle path information

2. Prevent ToC/MRM by providing speed, headway and/or lane advice

3. Prevent ToC/MRM by traffic separation

4. Manage MRM by guidance to safe spot
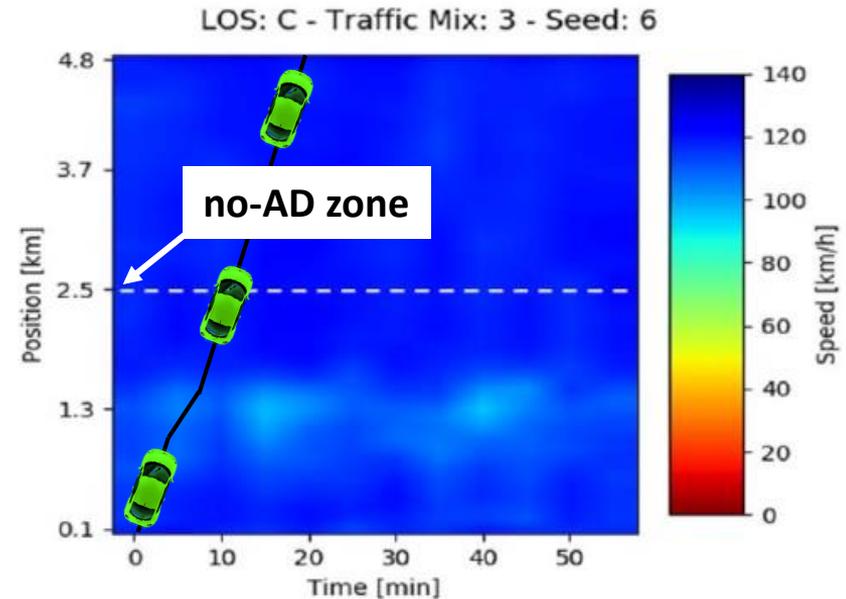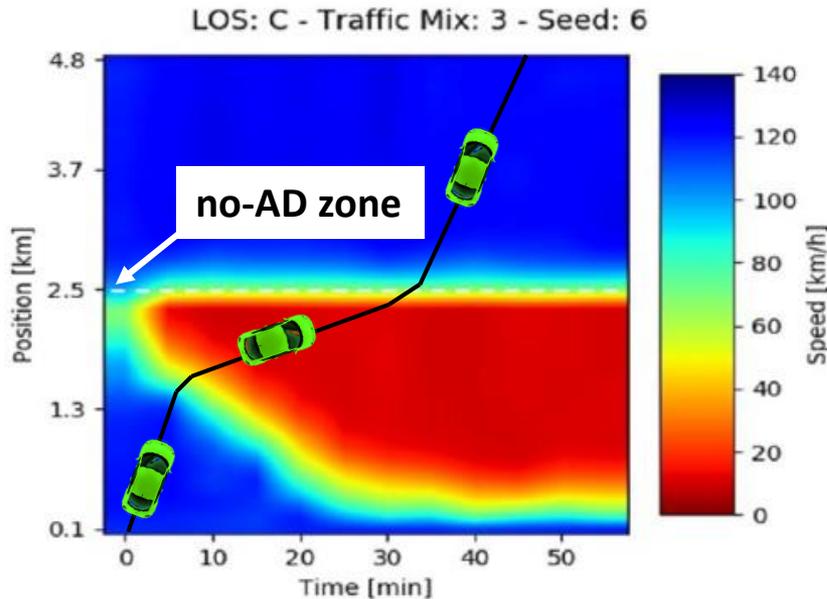
5. Distribute ToC/MRM by scheduling ToCs

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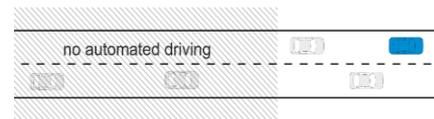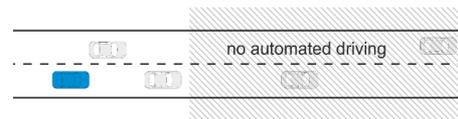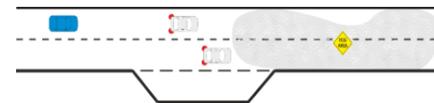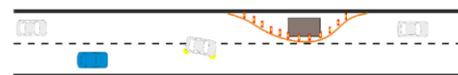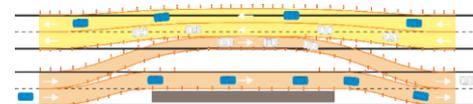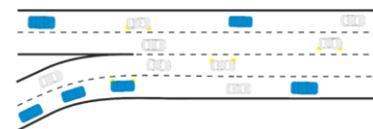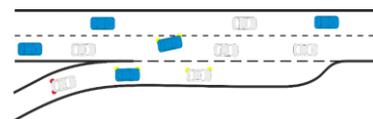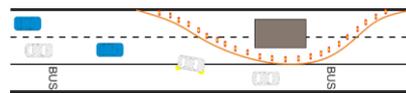
Example use case 5.1 (local speeds)

Distribute the TORs within a dedicated TOR area
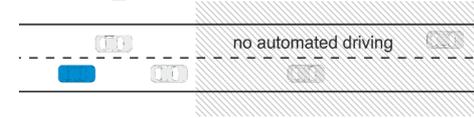
Without traffic management

With traffic management

LOS: C - Traffic Mix: 3 - Seed: 6

no-AD zone

LOS: C - Traffic Mix: 3 - Seed: 6

no-AD zone

Designing suitable V2X message sets

- Cornerstone for I2V-assisted traffic management

- Suitability strongly depends on:
  - Reuse of existing standards (interoperability)
  - Backwards compatibility
  - Reasonable use of radio resources (QoS)

CAM   DENM   MCM

CPM   MAPEM / SPATEM   IVIM
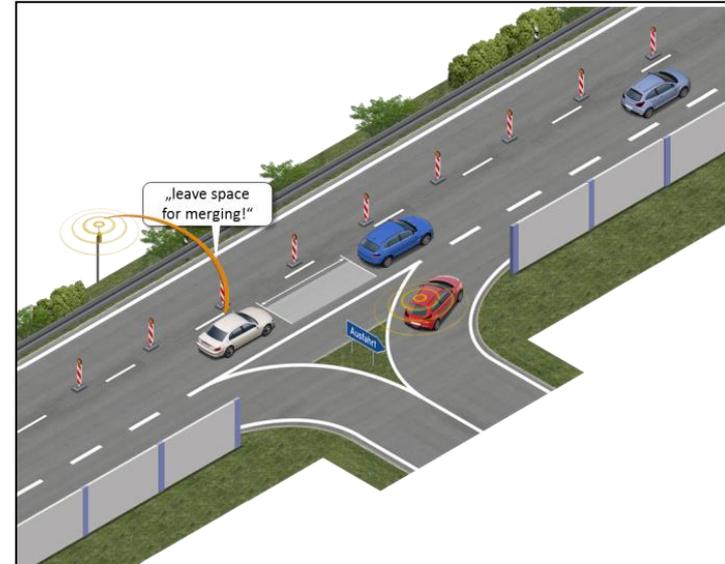
TransAID

V2X message sets to facilitate TM for automated driving

- Contributed to the standardisation of:
  - ETSI V2X messages / IEEE 802.11bd / ETSI Technical Report 103 562
- Evaluation and evolution of ETSI collective perception
- TransAID services have been validated with realistic modelling of communications (ns-3)
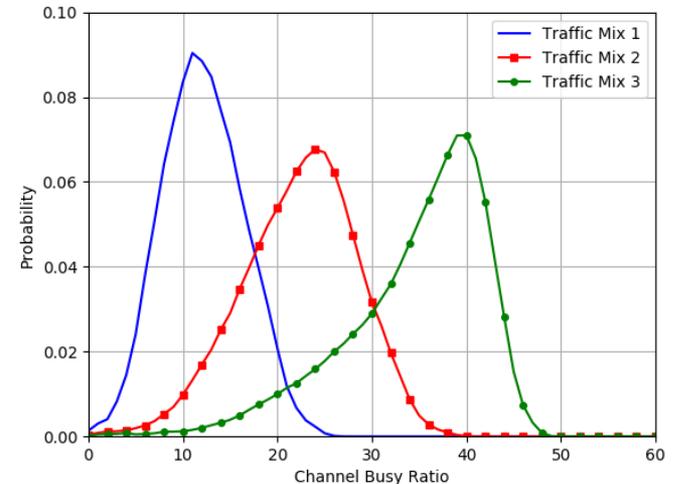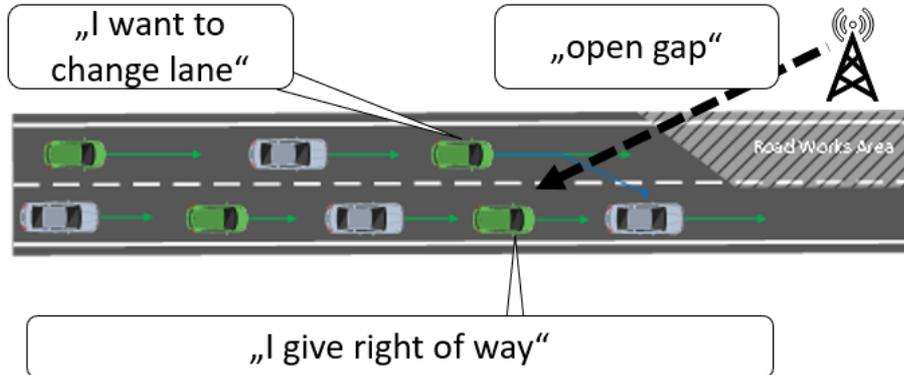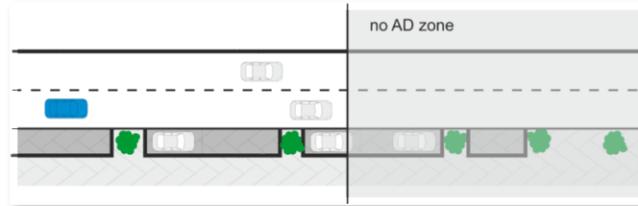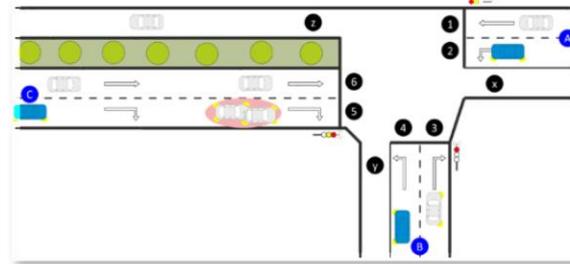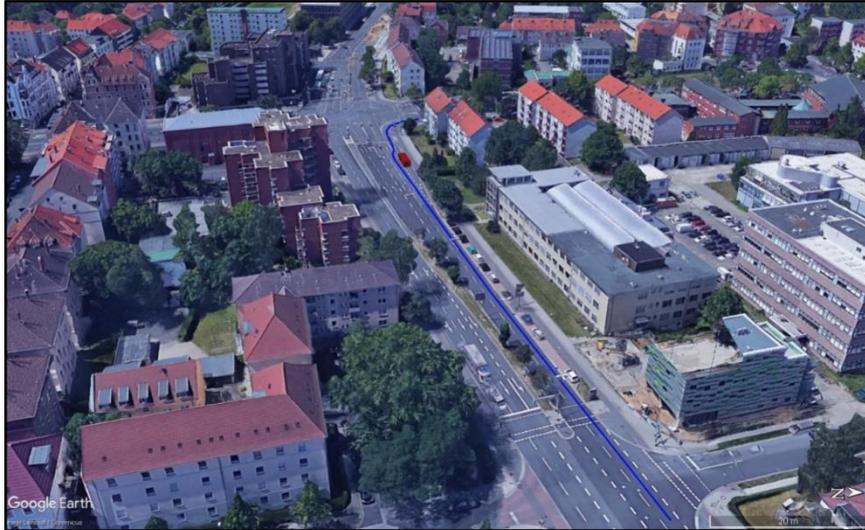
Real world integration:
First iteration testing (07/2019)

Real world integration
Planned public road tests (07/2020)

TransAID

Let's stay in touch

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  SAVE THE DATE: TransAID Final Event (30 June 2020, Delft, The Netherlands)

- Social media:
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