Infrastructure-Assisted Management for Mixed Traffic at Transition Areas

Dr. Jaap Vreeswijk

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
When, where, why?
permanent - transient
static/dynamic - highly dynamic
Transition of control and ODD

- MRM minimum risk condition = stop or park safely
- Safety, capacity and traffic flow problems expected as the number of deactivations increase
- The ODD can be very limited
ODD as a geographical concept

- Limited
- ODD/use area
- Unlimited

- SAE L5
- SAE L4
- SAE L3
- SAE L2
- SAE L1

Increase automation level

Expand use area

Improbable path from no automation to full automation
ODD as a holistic concept

- **Vehicle automation capability SAE 1-5**
  - No automation (0), driver assistance (1) partial automation (2), conditional automation (3), high automation (4), full automation (5)

- **Scene**
  - Intersections (cross traffic yes or no), access (restricted, shared, open), behaviour (homogeneous or heterogenous, thereby predictable)

- **Physical infrastructure measures**
  - Road surface, shoulder or kerb, road markings, traffic signs, road furniture

- **Digital infrastructure support levels E-A**
  - Conventional (E), static digital information (D), dynamic digital information (C), cooperative perception (B), cooperative driving (A)

- **System operational performance**
  - Vehicle safety, travelling comfort, driving speed, stops, number of handovers of control and minimum risk manoeuvre
Why transition areas?

- Transition areas mark the boundaries of the ODD.

- What if an automated vehicle is unable to solve the situation ahead?
  - ...what if, this happens not to single vehicles only, but to several?
  - ...what if, it always happens on the same spot?
  - ...what if, this interrupts traffic flow, traffic safety, etc.

- TransAID aims to:
  - Identify potential risks
  - Recommend solutions
  - Coordinate movements

Xiao, L. et al. (2018)
The TransAID reasoning for I2V support

Vehicle automation capabilities (A)
\[ \times \]
Scene (B)
\[ \times \]
Traffic dynamics & situational variables (C)
\[ = \]
ODD

B + C = A \quad \text{ODD: OK}

B + C ≠ A \quad \text{ODD: NOK}

B + C = A + ? \quad \text{ODD: OK?}

? = digital infra measures
TransAID project overview

- TransAID (ART-05)
- Transition Areas for Infrastructure-Assisted Driving
- 01-09-2017 ~ 31-08-2020
- Budget: EUR 3.836.353,75
- Seven partners from 6 countries: DE, UK, BE, NL, EL, ES
- Website: www.transaid.eu
Identifying I2V / TM support measures

● Vehicle logic:
  – Sense and build environmental awareness
    ● Situational support: provide relevant information
  – Ability to determine action(s)
    ● Operational support: provide an (alternative) action
  – Ability to perform action(s)
    ● Tactical support: arrange favourable conditions
Report from the field

Favaro et al. (2017), Autonomous vehicles’ disengagements: Trends, triggers, and regulatory limitations, Accident Analysis & Prevention, Vol. 110, pp. 136-148
TransAID services and use cases [1/2]

Provide vehicle path information

Provide speed, headway and/or lane advice
TransAID services and use cases [2/2]

Routing & traffic separation

Orchestration, distribution and scheduling
TransAID areas of recommendation

- **Information services** for automated vehicles.
- **Traffic control measures** for automated driving.
- **Traffic regulations** for automated driving.
- **Spatial planning** for automated driving, MRM-havens specifically.
- Application of **V2X message sets** and proposed extensions.
- Requirements for **roadside equipment and signalling**, for all vehicle modes.
- **Urgency** of interventions based on market penetration (mixed traffic) forecasts.
- **Priority** of interventions based on situational characteristics.
- Actor **roles and interaction models** for automated driving and traffic management.
Questions

● What are typical causes for unplanned handovers when considering initial Level 3/4 AVs?

● Are the TransAID services meaningful services? And how will the compliance to such service be, e.g. considering trust issues?

● Should the ODD and/or disengagements of AVs be reported by OEMs?

● What will be the lead-time for taking over vehicle control for different levels of automation?

● Is connectivity a (regulated) pre-requisite for some levels of automation?

● Would automated driving require the support of some sort of remote support / back-end?

● Who should decide whether a specific road section is within the ODD of an AV?

● Will AVs be more conservative in terms of headway and lane change behaviour?
Thank you for listening

Dr. Jaap Vreeswijk  
MAP traffic management  
jaap.vreeswijk@maptm.nl

Evangelos Mintsis  
CERTH  
vmintsis@certh.gr

Dr. Sven Maerivoet  
Transport & Mobility Leuven  
sven.maerivoet@tmleuven.be

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