Centralized Infrastructure-Assisted Management for Mixed Traffic at Transition Areas

Dr. Jaap Vreeswijk
MAP traffic management, the Netherlands

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Role of digital infrastructure in MG3.6a-2015 and ART05- 2016

… actively interacting with their intelligent environment … highly automated vehicles will have to be managed … road infrastructure will play a major role … electronic signalling and optical guidance … timely reaction … real-time warnings and information, traffic management plans, etc.

A form of traffic management and control to:

✓ Safeguard societal 'system' interests

✓ Setting constraints and rules

✓ Intervene in case of oversaturated conditions

Projects overview

❑ **MAVEN (MG3.6a)**

✓ Managing Automated Vehicles Enhances Network

✓ 01-09-2016 ~ 31-08-2019

✓ Budget: EUR 3.149.661,25

✓ Nine partners from five countries: DE, NL, CZ, BE, UK

❑ **TransAID (ART-05)**

✓ 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

MAVEN use cases [1/2]

1. **Platoon management**

   ✓ Forming, joining, progression, leaving, breaking a platoon

2. **Infrastructure-to-vehicle interactions**

   ✓ Negotiation (signal timing vs. arrival pattern), speed advisory, lane advisory

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MAVEN use cases [2/2]

3. **Traffic control optimization (and scheduling)**

   ✓ Signal optimization, priority management, queue estimation, green wave

4. **Conventional traffic and vulnerable road users**

   ✓ Detection of non-cooperative vehicles, VRUs, emergency situations

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A broader context: Transition of Control Areas

❑ …what if your automated vehicle is not able 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?

❑ TransAID aims to:

   ✓ Help to identify potential risks

   ✓ Recommend solutions

   ✓ Coordinate movements

Considering Operational Design Domain (ODD)

SAE 2016

- ❑ Case: level 4 vehicle

- ❑ DDT: Dynamic Driving Task

- ❑ ADS: Automated Driving System

- ❑ Minimum risk condition: stop or park safely

Considering Operational Design Domain (ODD)

Everywhere

Always & All conditions

Destination
Manual driving
ODD
Automated driving
Manual driving
Origin

last mile
highway
First mile

Tom Alkim, Rijkswaterstaat, 2017

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Considering Operational Design Domain (ODD)

Tom Alkim, Rijkswaterstaat, 2017

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Disengagement reports 2017

Favaro et al. (2017), Autonomous vehicles' disengagements: Trends, triggers, and regulatory limitations, Accident Analysis & Prevention, Vol. 110, pp. 136-148

Disengagement reports 2017

System failure

28%
25%
12%
7%
8%
9%
11%

- software discrepancy
- perception discrepency
- planner not ready
- traffic light detection
- lane change
- unwanted maneuver of vehicle
- Other System Failure factors*

External condition

11%
6%
43%
19%
21%

- poorly marked lanes
- construction zone
- heavy pedestrian traffic
- weather condition
- other external condition factors**

Favaro et al. (2017), Autonomous vehicles' disengagements: Trends, triggers, and regulatory limitations, Accident Analysis & Prevention, Vol. 110, pp. 136-148

TransAID use cases (1/3)

1. Prevent ToC/MRM by providing vehicle path information

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

TransAID use cases (2/3)

3. Prevent ToC/MRM by traffic separation

4. Manage by guidance to safe spot

TransAID use cases (2/3)

5. Distribute ToC/MRM by scheduling ToCs

Examples V2X extensions

❑ **V2I – Cooperative Awareness Message**

   ✓ Vehicle route at intersection (intention);

   ✓ Platoon properties (size, length, roles, speed, headway, composition, etc.);

   ✓ Acknowledgments of compliance to lane changes and speed advisory (negotiation).

❑ **I2V – Lane Advice Message**

   ✓ Suggests the lane a vehicle or platoon should change to at an intersection;

   ✓ Indicates target lane, distance to stop line, and time for starting the manoeuvre;

   ✓ Combined with lane-specific Green Light Optimal Speed Advisory (GLOSA).

❑ **V2X – Collective Perception**

   ✓ Sharing abstract descriptions of objects detected by vehicle or infrastructure sensors;

   ✓ Created improved awareness even with low market penetration.

Upcoming activities

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Dr. Jaap Vreeswijk

MAP traffic management
Ptolemaeuslaan 54, 3528 BP Utrecht, the Netherlands

E-mail: jaap.vreeswijk@maptm.nl
Phone: +31 6 4164 7985