Centralized Infrastructure-Assisted Management for Mixed Traffic at Transition Areas

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2nd symposium on Management of Future motorway and urban Traffic Systems
MFTS 2018, 11-12 June 2018, Ispra (Italy)

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

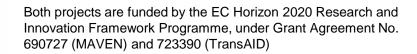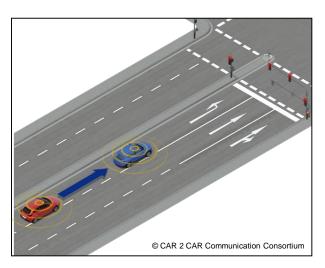 ✓ Seven partners from 6 countries: DE, UK, BE, NL, EL, ES
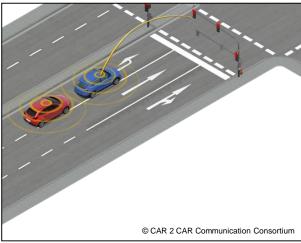
MAVEN use cases [1/2]

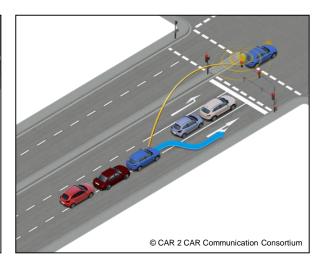1. **Platoon management**

   ✓ 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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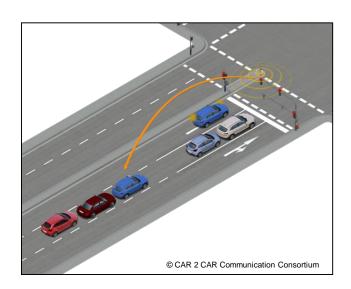
© CAR 2 CAR Communication Consortium
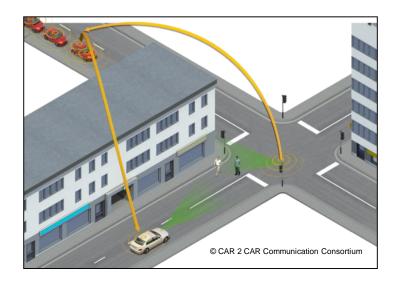
MAVEN use cases [2/2]

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

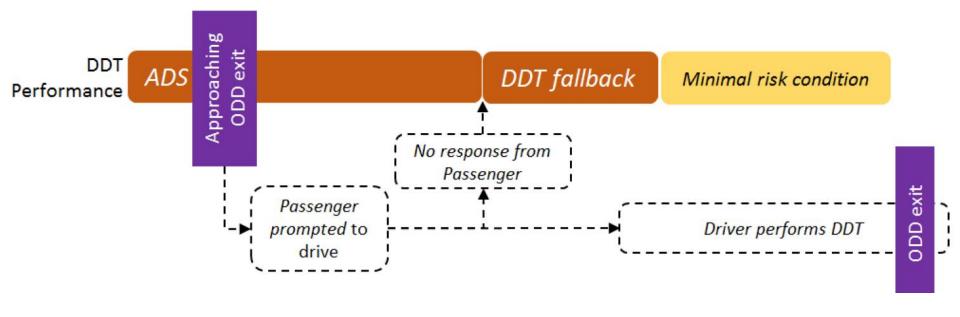❑ …what if your automated vehicle is not able to solve the situation ahead?

✓ …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
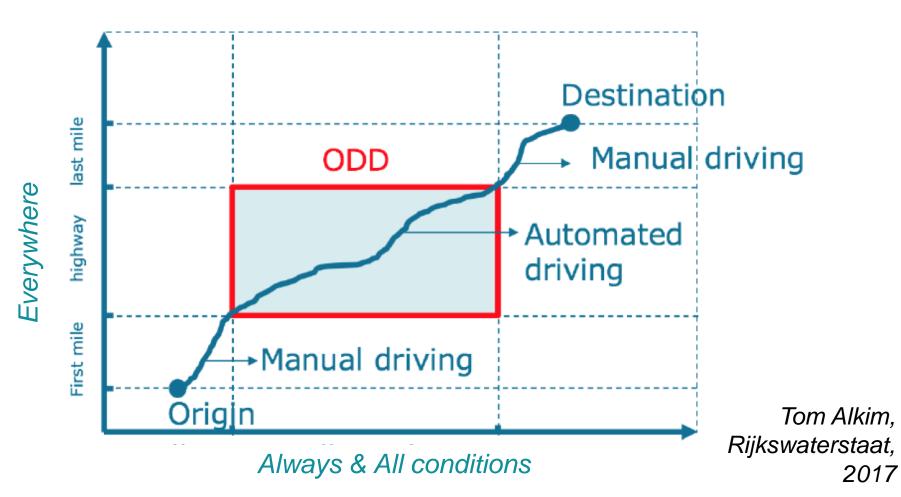
✓ Recommend solutions

✓ 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

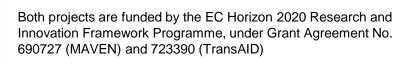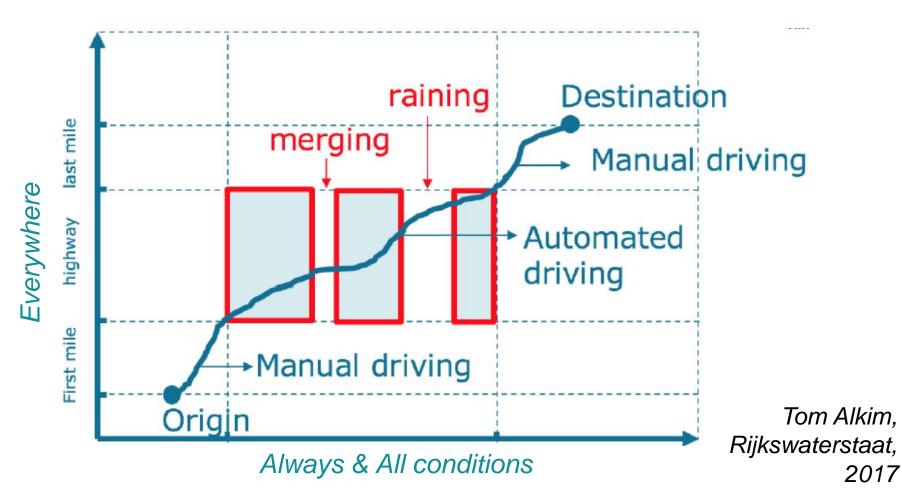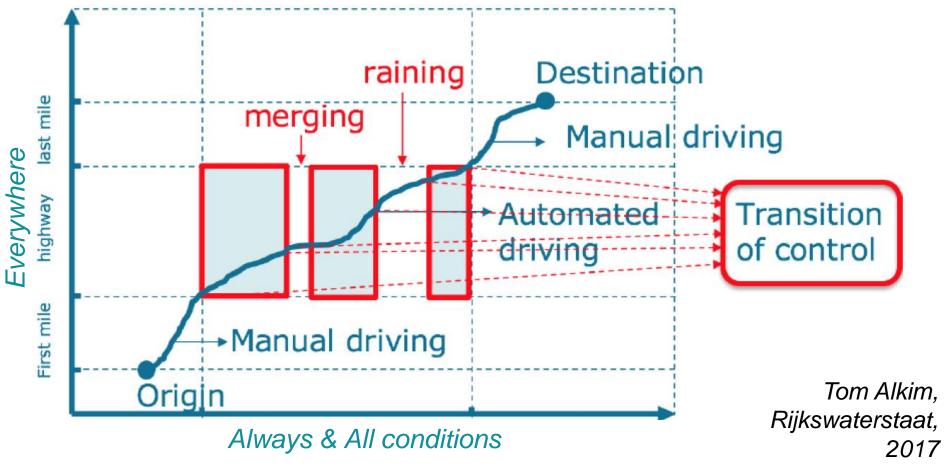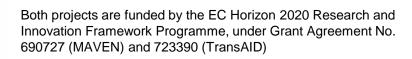# Considering Operational Design Domain (ODD)

Tom Alkim,
Rijkswaterstaat,
2017

Considering Operational Design Domain (ODD)

Tom Alkim, Rijkswaterstaat, 2017

Considering Operational Design Domain (ODD)

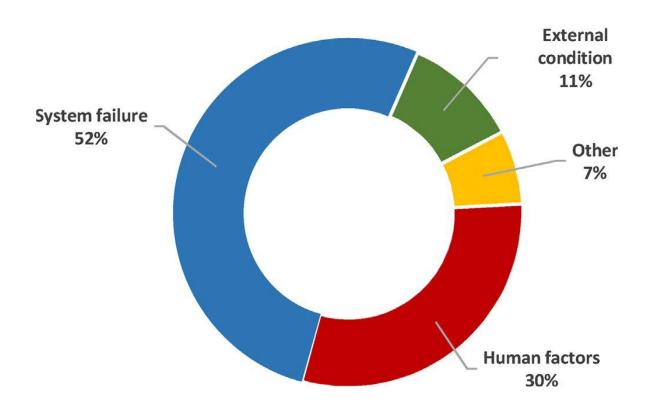*Tom Alkim, Rijkswaterstaat, 2017*
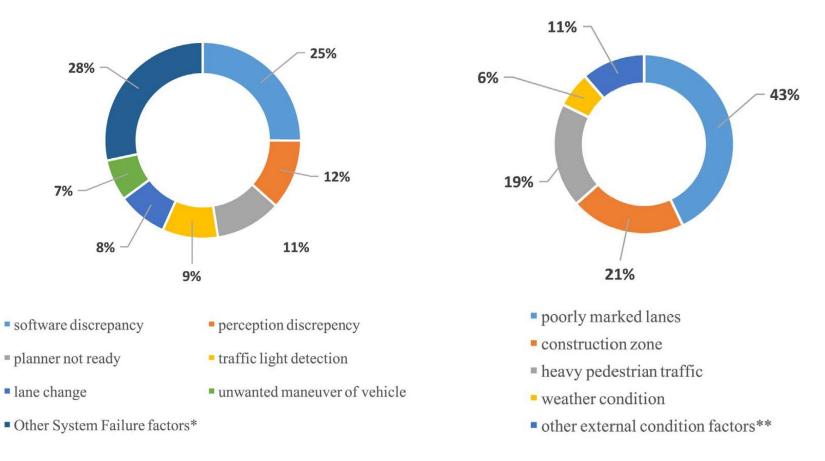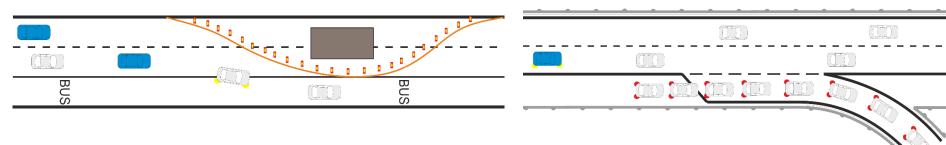
Disengagement reports 2017

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

External condition

System failure legend:
- software discrepancy — 25%
- perception discrepency — 12%
- planner not ready — 11%
- traffic light detection — 9%
- lane change — 8%
- unwanted maneuver of vehicle — 7%
- Other System Failure factors* — 28%

External condition legend:
- poorly marked lanes — 43%
- construction zone — 21%
- heavy pedestrian traffic — 19%
- weather condition — 6%
- other external condition factors** — 11%

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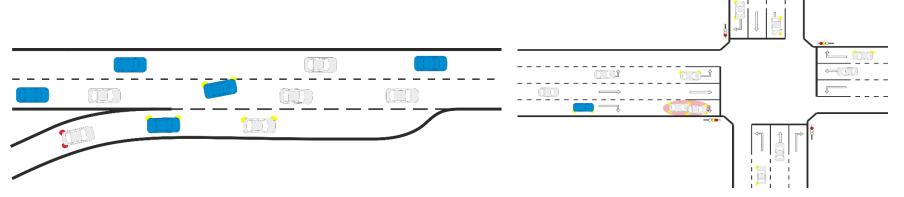
TransAID

MAVEN

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TransAID use cases (1/3)

1. Prevent ToC/MRM by providing vehicle path information
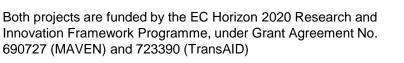

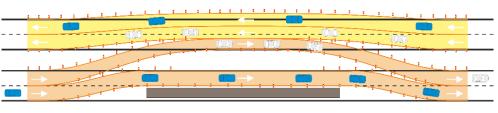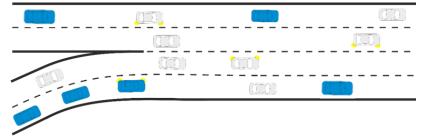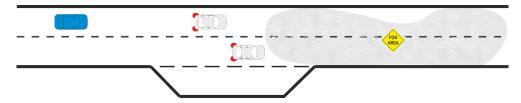2. Prevent ToC/MRM by providing speed, headway and/or lane advice

TransAID use cases (2/3)

3. Prevent ToC/MRM by traffic separation
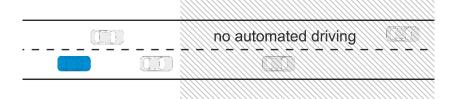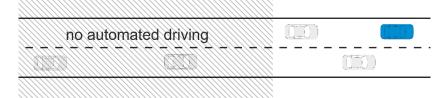

4. Manage by guidance to safe spot

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).
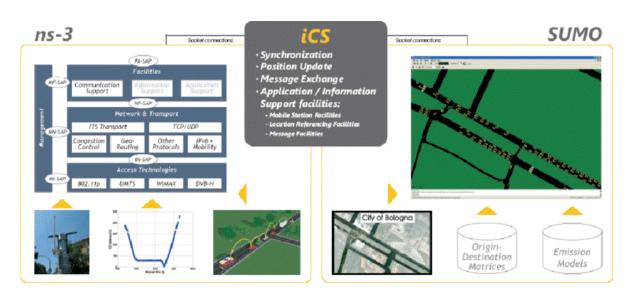
❏ **V2X – Collective Perception**

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

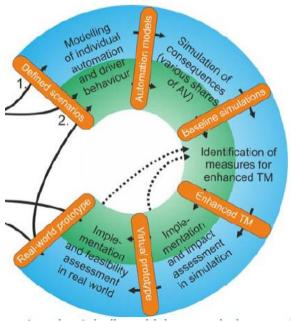✓ Created improved awareness even with low market penetration.

Upcoming activities

Centralized Infrastructure-Assisted Management for Mixed Traffic at Transition Areas

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