Managing automated vehicles at signalized intersections



Dr. Jaap Vreeswijk MAP traffic management, the Netherlands



Automated Vehicle Symposium 2017, 12 July 2017, San Francisco Breakout 21: Connected and Automated Vehicles in Traffic Signal Systems





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Safe and connected automation

H2020 call MG3.6a - 2015

Specific challenge: Automated and progressively autonomous driving applications in road transport, <u>actively interacting with their intelligent environment</u> could provide an answer to the EU objective of reconciling growing mobility needs with more efficient transport operations, lower environmental impacts and increased road safety.

Automation in road transport should <u>make best use of the evolution of Cooperative ITS</u> and the benefits made available by satellite navigation systems, such as the increased accuracy and robustness.

Novel <u>transport</u>, <u>service and mobility concepts</u> in real-life situations <u>enabled by automated driving</u> <u>and connectivity</u>. These services and concepts could benefit from cloud computing and data management and data aggregation techniques for road transport big data.





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Connected automation



Operates in isolation from other vehicles using internal sensors



U.S. Department of Transportation ITS Joint Program Office





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An intelligent environment with infrastructure

- Communication a precondition for highly automated driving
- Public' traffic management and control remains necessary
 - Safeguard societal interests
 - Setting constraints and rules
 - Intervene in case of oversaturated conditions
- Offers new possibilities for optimisation in traffic management and control
- Three operational perspectives:
 - Each vehicle individually (autonomous)
 - ✓ Vehicles part of a group process (e.g. platoon)
 - ✓ Vehicles part of a system process (e.g. intersection control)





Project overview

Project title:

- Managing Automated Vehicles Enhances Network
- Project period:
 - 01-09-2016 ~ 31-08-2019
- Funded by EC Horizon2020
 - Øudget: € 3.149.661,-
- Consortium
 - Nine partners from five countries: DE, NL, CZ, BE, UK





















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MAVEN project summary

- MAVEN will develop management regimes for highly automated driving in urban areas.
- Road infrastructure will be able to monitor, support and orchestrate vehicle and VRU movements to guide vehicles at signalized intersections and corridors in urban areas.
- Beyond the state-of-the-art of ADAS and C-ITS services like GLOSA, by adding cooperative platoon organization and signal plan negotiation to adaptive traffic light control.
- Develop suitable enables technologies, e.g. communication protocols, and test and validate via simulation and real-world prototype (ITS-G5 based).



Virtual traffic light controller







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Infra-initiated and/or infra-assisted

- Platoon management (group process)
 - ✓ Forming, joining, progression, leaving, breaking a platoon
- Infrastructure-to-vehicle interactions (system process)
 - Negotiation (signal timing vs. arrival pattern), speed advisory, lane advisory
- Traffic control optimization (and scheduling)
 - ✓ Signal optimization, priority management, queue estimation, green wave
- **Conventional traffic and vulnerable road users**
 - ✓ Detection of non-cooperative vehicles, VRUs, emergency situations



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High-level system decomposition



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Necessary V2X extensions

V2I – e.g. Cooperative Awareness Message (CAM)

- Planned manoeuvre (intention);
- Desired speed range;
- ✓ Platoon properties (size, length, roles, speed, headway, composition, etc.);
- Acknowledgments of intentions and compliance (negotiation).

I2V – e.g. Signal Phase and Timing Message (SPAT) or new message (?)

- Differentiated speed advisory;
- Lane advisory;
- Appropriate headway;
- Maximum platoon length or prohibition;
- Feasible level of automated driving.



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Transferability to Truck Platooning









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Transferability to transition areas



TransAID project (H2020)





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To conclude

Infra-assistance for highly automated driving

- Managing Automated Vehicles Enhances Network (MAVEN)
- Transition Areas for Infrastructure-Assisted Driving (TransAID)
- Truck Platooning (Real-Life Cases Program)

A necessity but also a new dimension of Traffic Management and Control

- Explicit intervention (control)
- Implicit response (inform)
- Any ideas and concepts, equal amount of questions: explorative research!

Great interest (local) road authorities in guidelines and broader city mobility context



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Visit me @ today's reception





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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





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