Enhancing intelligent urban road transport network and cooperative systems for highly automated vehicles

Newsletter No. 4 (October 2018)

Introduction

MAVEN (Managing Automated Vehicles Enhances Network) was launched on 1 September 2016. The project investigates future traffic management of connected, cooperative and automated transport. It will provide:

- management regimes for automated driving in urban areas;
- monitoring, support and orchestration of movements of road users to guide vehicles at signalised intersections; and
- further enhancement for ADAS (Advanced Driver Assistance Systems) and C-ITS (Cooperative Intelligent Transport Systems) applications.

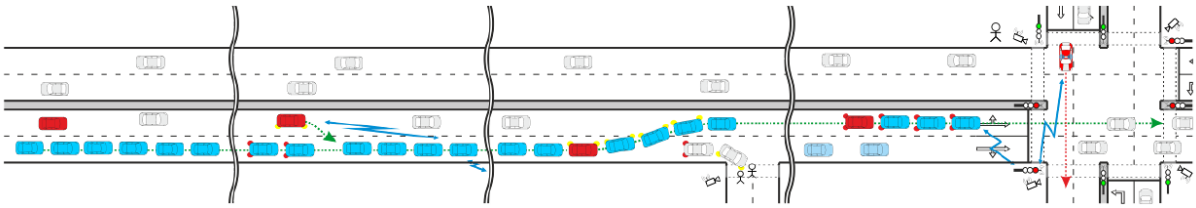
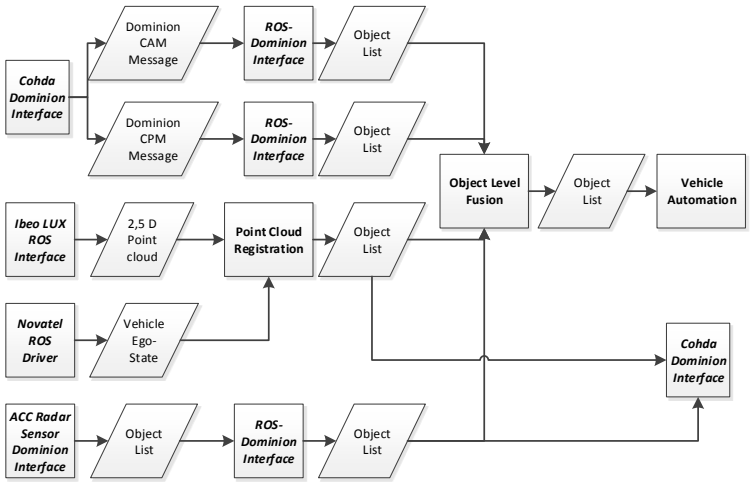


Illustration of MAVEN use cases

MAVEN achievements update

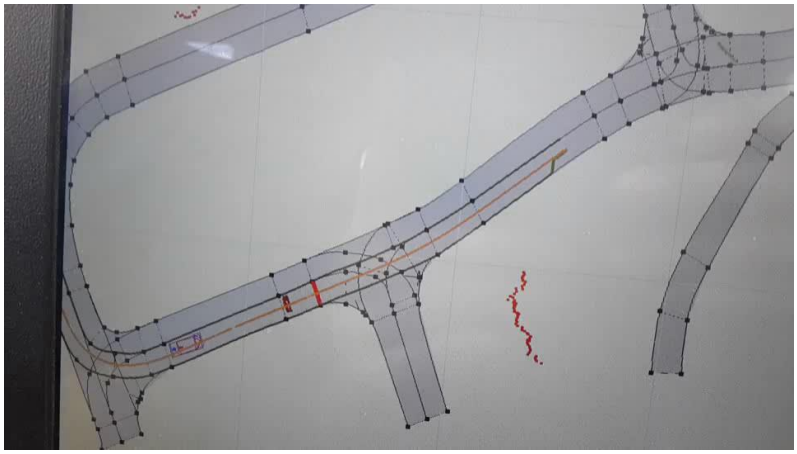
Vehicle automation

MAVEN has made further progress on the development of cooperative environment perception and of cooperative trajectory planning. The goal of cooperative environment perception for the Highly Automated Driving (HAD) vehicle is improving the range of the view on its environment. The environment model is composed of non moving obstacles and moving road users. The cooperative aspect means that in addition to the on-board LIDAR (Light Detection And Ranging), Radar and Camera sensors, CAM (Cooperative Awareness Message) and CPM (Collective Perception Message) are considered.

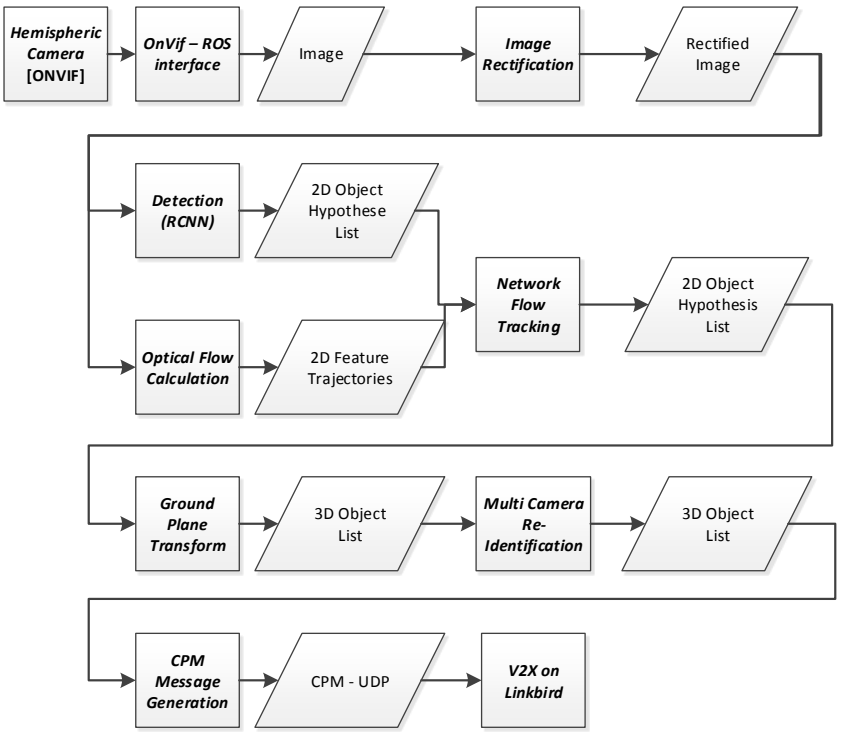


Cooperative Environment Perception

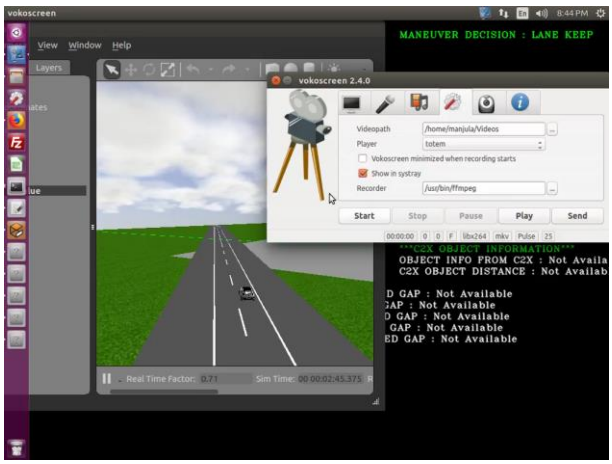
MAVEN is funded by the EC Horizon 2020 Research and Innovation Framework Programme, under Grant Agreement No. 690727



Fusion with CAM messages testing at the ADAC Übungsplatz test track

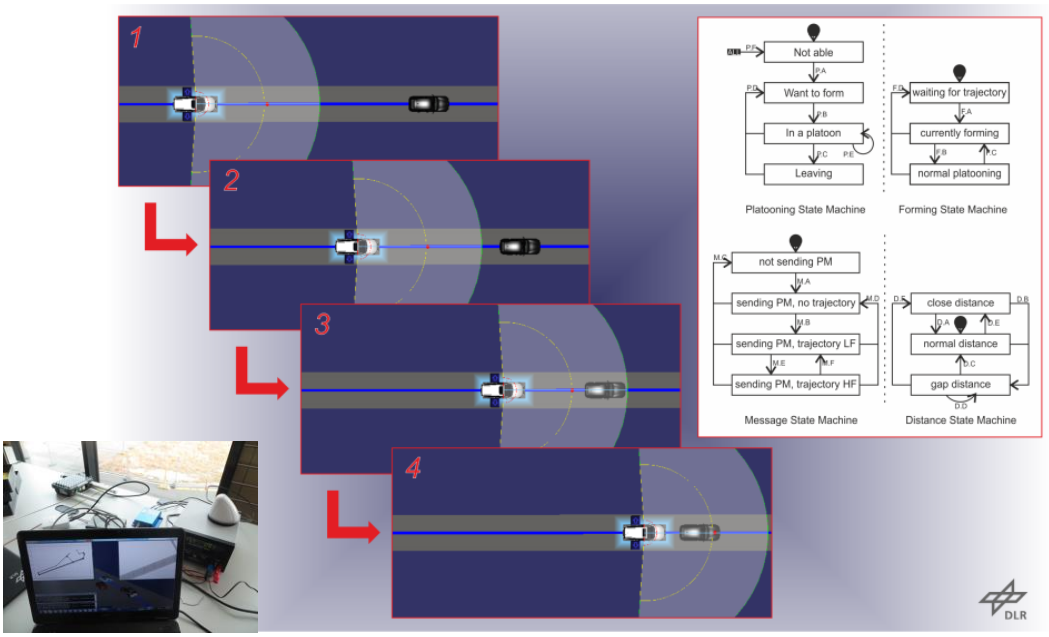


Cooperative Environment Perception

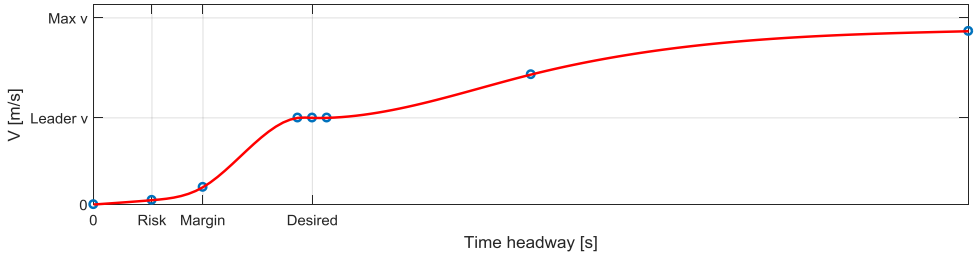


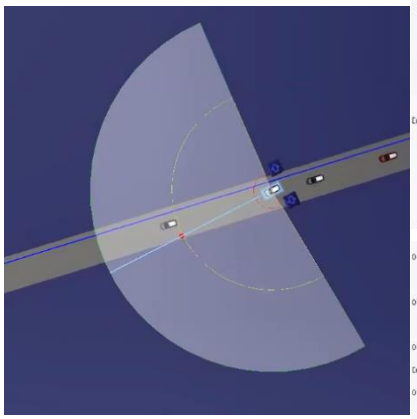
Hyundai developments - simulation of ADAS functions based on V2V CPMs

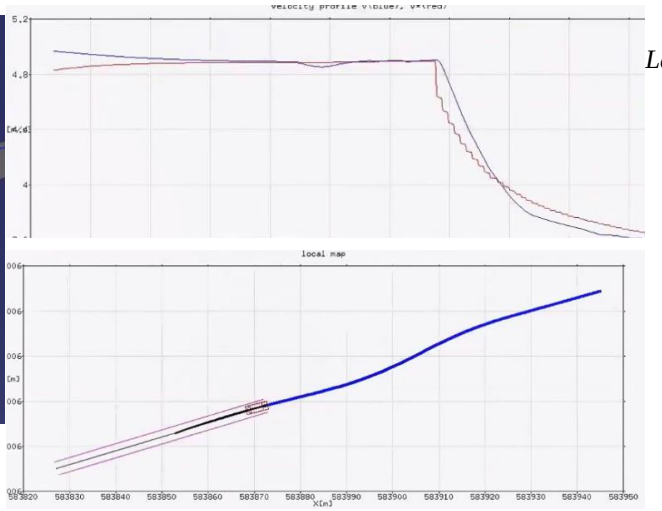
The main idea of cooperative trajectory planning, is that inputs received via V2X by other traffic participants and infrastructure are also considered in the planning algorithms. Results of cooperative trajectory planning are highlighted in the figures below.



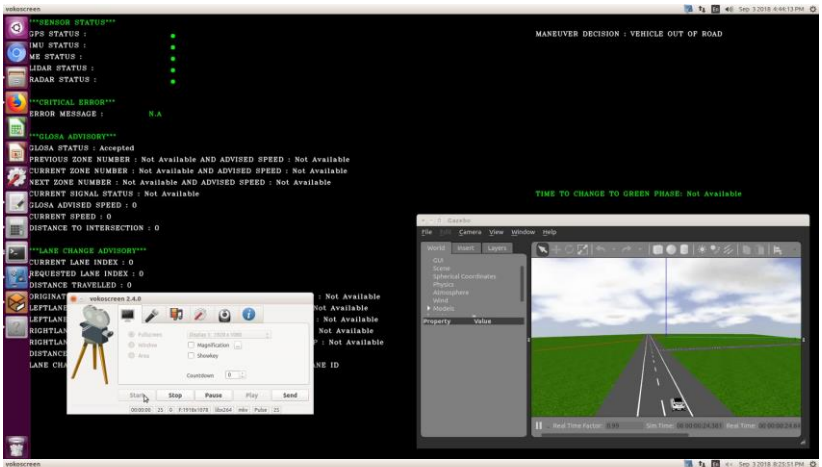
Cooperative trajectory planning



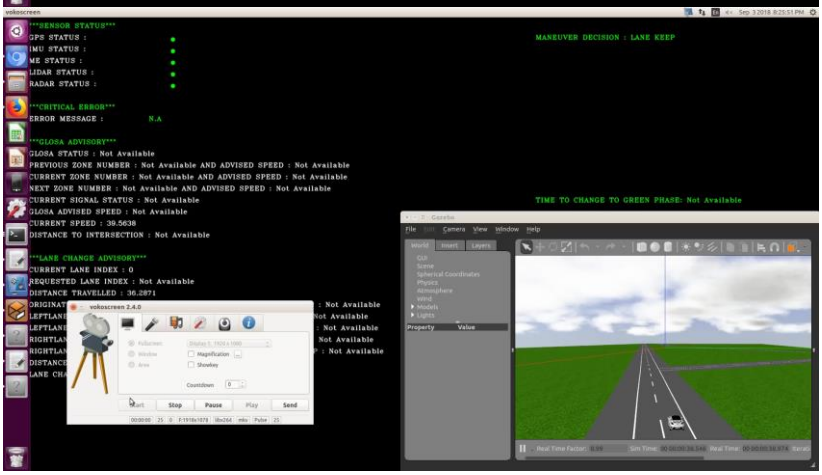




Lane change



Hyundai developments - Simulation of GLOSA on SPAT/MAP



Hyundai developments - Simulation of lane change based on LAM (Lane Advice Message)

Road automation

MAVEN has developed scheduling and signal timing strategy prototype and conducted three demonstrations:

1) Improved countdown stability of the adaptive traffic control algorithm. This has been tested in Groningen, in conjunction with XCycle, which has a special dynamic sign connected to display the countdown. XCycle (Advanced measures to reduce cyclists' fatalities and increase comfort in the interaction with motorised vehicles) is an EU-funded project under Horizon 2020 Research and Innovation Framework Programme.

2) Complete MAVEN system deployed in Helmond. The key element is the external queue model interface and the response of the control algorithm to the new MAVEN inputs. This is demonstrated by equipping a vehicle with a V2X On-board unit communication module transmitting the new V2X messages designed in MAVEN to provide intended turn direction to the algorithm.

3) AGLOSA (Agent-based Green Light Optimal Speed Advisory) system. The algorithm is implemented in SUMO, and is directly running on the traffic control hardware on the street. Therefore vehicles in the SUMO simulation represent real vehicles detected by the road sensors and V2X communications. As a result of these detections, the RSU attached to the traffic light controller provides AGLOSA information to the approaching vehicles.

Please find more details in Deliverable D4.3 "Scheduling and signal timing strategy field prototype", which one can down load from the MAVEN web site.

Enabling technologies

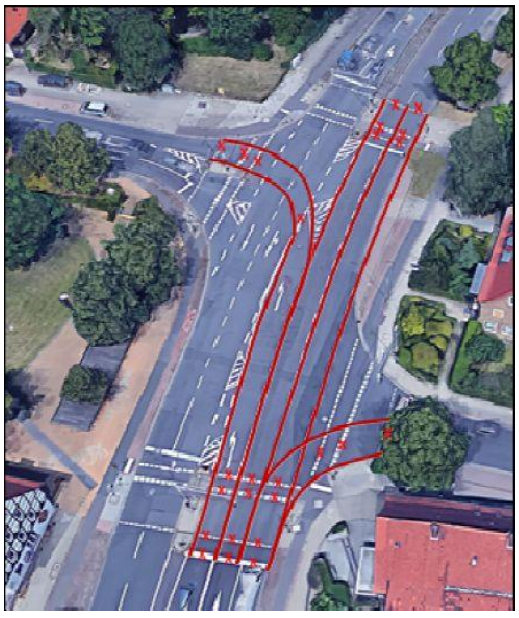
The MAVEN project has developed functions for protection of Vulnerable Road Users (VRUs) and drivers of cooperative automated vehicles. Two classes of solutions are considered in this regard:

i) Individual vehicle sensors data-assisted ADAS: when detection, classification, risk assessment, and reaction rely on information achieved from different sensors of the ego-vehicle only; and

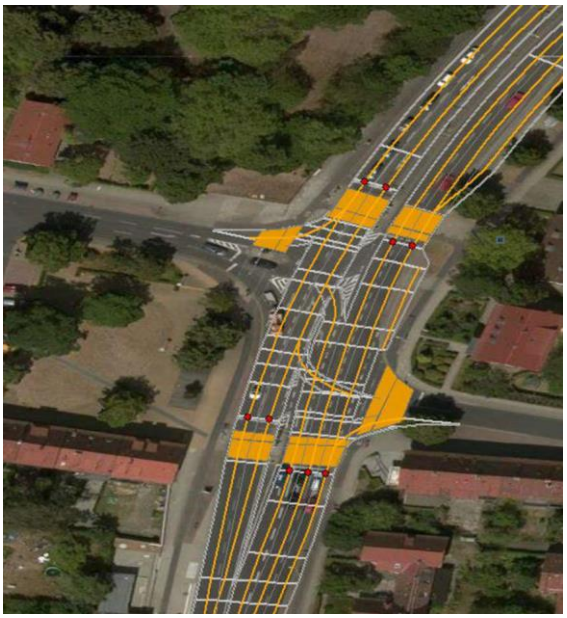
ii) Cooperative sensor data-assisted ADAS: when detection, classification, risk assessment, and reaction rely on V2X information received from other vehicles or infrastructure. The main results are presented in the table below.

Functions for individual vehicle sensors data-assisted ADAS	- Automated vehicle functionality for safe consideration of VRUs and obstacles with application for automated detection and reaction when turning at road intersections. This functionality reduces the risk of collision with VRUs by performing a threat assessment that considers objects detected and tracked by the sensor fusion and crossed with information about drivable lanes and planned route outputs. In parallel, it calculates a feasible manoeuvre and accordingly plans a vehicle reaction in terms of lane change, deceleration or braking. - Automated vehicle functionality for safe handling of situations in which a non-cooperative manually driven vehicle tries to interfere in a platoon of MAVEN cooperative automated vehicles. This functionality allows safely managing such situations by estimating other vehicles' intention to change lane (by recognizing the indicator light setting, or a road topology with merging lanes) and reacts by controlling the safe distance at which a platoon vehicle should follow its preceding vehicle.
Functions for cooperative sensor data-assisted ADAS	- Improved CAV functionality for safe consideration of VRUs and obstacles, with application for automated detection and reaction when turning at road intersections based on V2V CPM receptions. - Improved CAV functionality for safe consideration of VRUs and obstacles, with application for automated detection and reaction at road intersections based on CPM receptions from the cooperative infrastructure - Cooperative intersection functionality for consideration of VRUs interfering with vehicles over an unprotected right turn. This functionality aims at increasing safety by reducing the probability of rear-end collision occurrences as a result of reducing the vehicles' stops when arriving along a lane where other vehicles are queued waiting for a pedestrian to cross. - Cooperative intersection functionality for limiting an uneven distribution of vehicles over parallel intersection-ingressing lanes. The safety advantage here is achieved by preventing large imbalance between parallel queues. - Cooperative intersection functionality for enhanced vehicle probing which supports the previous two functionalities. This new probing approach enhances original loop-based adaptive intersection control by relying on floating car data from MAVEN CAM extensions received from CAVs.

Another enabling technology further developed for the MAVEN objectives are HAD maps. For this purpose an iterative evaluation process has been run through which a suitable level of HAD map precision has been identified to support the MAVEN automated driving scenarios. Commercially available HAD map databases of the designated test sites, provided by TomTom, have been considered. Based on these databases, the requirements for MAVEN vehicle automation in terms of HAD map format extensions have been identified. In particular, the project has detected the need of a "corridor" representation for road intersections as a pair of "virtual boundary lines" that connect the boundary lane markings of inbound lanes to boundary lane markings of outbound lanes. This information is necessary to AD SW system implementations because it indicates the boundaries to respect to perform a given intersection crossing manoeuvre without invading zones where conflicting situations with other road users can occur. With the MAVEN extensions embedded in the reference HAD maps, an evaluation of the impact of the resulting HAD map accuracy on the AD vehicle trajectory and control calculation has been performed. By comparing the results obtained with the new MAVEN extended format with those obtained with the original format, this evaluation demonstrates that the resulting extended HAD maps are suitable for MAVEN automations as they permit trajectory calculation with sufficient quality. As complementary activity, a thorough investigation of the state of the art on HAD map standardization is performed. This investigation permits identifying the minimum set of generic requirements for HAD maps, as well as a comparison with the adopted MAVEN HAD map format and extensions. As a result of this comparison, the MAVEN extensions in terms of intersection corridor approach are identified to be a possible input for standardization.



Ideal MAVEN intersection corridor representation for the Braunschweig Tostmannplatz test site (visualized on GoogleMaps)



MAVEN extended HAD map format for the Braunschweig Tostmannplatz (visualized on GoogleMaps)

Please find more details in Deliverable D5.2 "ADAS functions and HD maps", which you can down load from the MAVEN web site.

MAVEN expert-group meeting

MAVEN held an expert group meeting on 23 October 2018 in Greenwich (London), UK, to validate the MAVNE approach and results and to gather external expert input. Three topics are addressed:

1) Validation and impact assessment of cooperative and automated driving

Participants exchanged experience and best practices in impact assessment of cooperative automated driving, such as simulation tools, user involvement, verification, driver models, critical issues for simulating urban environment with mixed traffic, calibration of the simulation model, scenarios, and (especially safety related) KPIs (Key Performance Indicators).

2) Transition to the traffic management of connected and automated vehicles

The participants discussed the key dimensions to be considered in the phases of transition towards MAVEN from a city authority and traffic managers perspective (e.g. technological, organisational, legal/liability, cultural, financial, and policy), authorities involvement, ideal environment for implementing the MAVEN use cases (e.g. spatial, traffic characteristics, and policy), "low-hanging fruits" (i.e. technologies, use cases, governance models, requiring the least effort and showing a reasonable rate of return in the short-term), external factors to the city authorities that will influence the transition (e.g. vehicle penetration levels, legal framework, and user acceptance), and a scenario that city authorities do nothing

3) Management of connected, cooperative and automated vehicles in smart cities

The discussions under this topic focused on realistic use cases for remote management and control of automated vehicles in cities, new ways to balance demand and supply to manage scarce space and road capacity, new concepts for management of unmanned vehicles (e.g. goods and empty vehicles) and service vehicle (e.g. waste, cleaning and inspection), operationalisation of use cases (by considering pre-conditions, constraints, limitations, and ethics), transferability to passenger transport (including shared vehicles), impact on the shape and form of cities (e.g. land use and mobility), and further research and innovation activities.

Participants extensively discussed related projects, e.g. INTRAMIX, CO-EXIST and TransAID, related projects at Technical University of Delft and in the USA, as well as the further cooperation opportunities.

MAVEN expert group meeting on 23 October 2018 in Greenwich (London)

MAVEN stakeholder consultation workshop

MAVEN hosted the third stakeholder consultation workshop "Automated vehicles and urban traffic management" on 24 October 2018 in Greenwich (London), UK, which was a joint action together with related EU-funded projects TransAID, CoEXist, and INFRAMIX to gather the views and requirements of local authorities and other urban transport stakeholders.


The third MAVEN stakeholder consultation workshop on 24 October 2018 in Greenwich (London)

Mr. Trevor Dorling (Managing Director, Digital Greenwich) introduced Greenwich in the spotlight: Living Lab and MOVE-UK project. Prof. Matthew Barth (University of California) presented recent research results in the USA on traffic management through C-ITS and automated driving, deploying digital infrastructure, and impact assessment. The MAVEN partners provided information about MAVEN, an overview about how automation may change the shape and form of cities, as well as some preliminary results of a survey on impact assessment. In addition, three issues are discussed in parallel sessions:

1) Strategic planning for automated and connected vehicles.
2) The role of the traffic manager in an increasingly connected and automated transport system.
3) Do cities and regions need a traffic technology/ITS strategy?

Main upcoming (joint) events

The main upcoming (joint) MAVEN events are:

- Joint Workshop with TransAID, C-MobILE and IEEE 5G Initiative on "Cooperative and automated driving" at IEEE ITSC (Intelligent Transportation Systems Conference on 4 November 2018, Hawaii.
- Joint Demo with TransAID, in conjunction with European Congress on Intelligent Transport Systems on 3-6 June 2019, Eindhoven/Helmond. (TBC)
- Joint Workshop with TransAID on 9 June 2019, in conjunction with IEEE IV'19 (Intelligent Vehicles Symposium) on 9-12 June 2019, Paris.

MAVEN Consortium

Contact

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