Proceedings of 7th Transport Research Arena TRA 2018, April 16-19, 2018, Vienna, Austria

ICT Infrastructure for Cooperative, Connected and Automated Transport in Transition Areas

Meng Lu a*, Robbin Blokpoel a, Julian Schindler b, Sven Maerivoet c, Evangelos Mintsis d

[a] *Dynniq, Basicweg 16, 3821BR, Amersfoort, The Netherlands*

[b] *German Aerospace Center (DLR), Institute of Transportation Systems, Development of Vehicle Functions, Lilienthalplatz 7, 38108 Braunschweig, Germany*

[c] *Transport & Mobility Leuven, Data Enrichment Group, Diestsesteenweg 57, 3010 Leuven, Belgium*

[d] *Center for Research and Technology Hellas (CERTH) / Hellenic Institute of Transport (HIT), 6th km Charilaou-Thermi Rd., 57001 Thermi, Thessaloniki, Greece*

Abstract

One of the challenges of automated road transport is to manage the coexistence of conventional and highly automated vehicles, in order to ensure an uninterrupted level of safety and efficiency. Vehicles driving at a higher automation level may have to change to a lower level of automation in a certain area under certain circumstances and certain (e.g. road and weather) conditions. The paper targets the transition phases between different levels of automation. It will review related research, introduce a concept to investigate automation level changes, present some recent research results, i.e. assessing key performance indicators for both analysing driver behaviour and traffic management in light of autonomous vehicles, an initial simulation architecture, and address further research topics on investigation of the traffic management in such areas (called "Transition Areas") when the automation level changes, and development of traffic management procedures and protocols to enable smooth coexistence of automated, cooperative, connected vehicles and conventional vehicles, especially in an urban environment.

Keywords: automated driving; transition; cooperative; traffic management; traffic control

* Corresponding author. Tel.: +31-6-4505-4735; fax: +31-33-450-2211.
E-mail address: meng.lu@dynniq.com

1. Introduction

ITS (Intelligent Transportation Systems) aim to enhance comfort, safety, efficiency and effectiveness of public transport, freight transport and individual mobility. Main technologies in the ITS domain are sensor technologies, communication systems, information processing and control technology. Applications of these technologies are ranging from vehicle manufacturer dependent functions up to large-scale traffic management networks. (Zlocki, Fahrenkorg & Lu, 2016)

The foreseen step-wise introduction of automated vehicles in traffic will face a transition period where the coexistence of conventional and highly automated vehicles will have to be managed in order to ensure an uninterrupted level of safety and efficiency. ICT infrastructure will play a major role in managing this transition period through Vehicle Infrastructure Communication. The following three ongoing EU-funded projects under Horizon2020 handle part of this challenge.

1) The MAVEN project (MAVEN Consortium, 2017) aims to provide solutions for managing automated vehicles in an urban environment (with signalised intersections and mixed traffic). It develops algorithms for organising the flow of infrastructure-assisted automated vehicles, and structuring the negotiation processes between vehicles and the infrastructure for increasing traffic efficiency, improving utilisation of infrastructure capacity, and reducing emission. MAVEN also contributes to the development of enabling technologies, such as telecommunication standards and high-precision maps. A roadmap for the introduction of road transport automation is under development, to support road authorities in understanding potential future changes in their role and in the tasks of traffic management.
2) CoEXist (CoEXist Consortium, 2017) aims to increase the capacity of road authorities and other urban mobility stakeholders to get ready for the transition towards a shared road network with increasing levels of automated vehicles. CoEXist will develop an automation-ready framework for road authorities and traffic simulation tools. The tools will be tested in Helmond (NL), Milton Keynes (UK), Gothenburg (SE) and Stuttgart (DE), in order to assess the automation-readiness of their locally-designed use cases. The results of the project will enable road authorities to understand in detail the impact of increasing numbers of automated vehicles and to plan accordingly.
3) TransAID (Transition Areas for Infrastructure-Assisted Driving) (TransAID Consortium, 2017) targets the transition phases between different levels of automation, and, more specifically, investigates the areas (called "Transition Areas") where the switches between automation levels will happen. The project will develop and demonstrate traffic management procedures and protocols to enable smooth coexistence of automated, cooperative, connected (equipped) vehicles and conventional (non-equipped) vehicles, especially in Transition Areas, in an urban environment.

Connected, cooperative and automated driving receives high attention from academia, industry and authorities due to the expected high benefits in terms of safety, traffic efficiency, energy efficiency and travel quality. Research has placed focus on the development of the motion planning of automated vehicles, the human-vehicle interactions during take-over requests (TORs) and the management of cooperative, connected and automated vehicles along automated road facilities. Katrakazas, et al. (2015) provided a detailed analysis regarding the methodologies that have been applied to control the motion of an automated vehicle with respect to selecting a path, identifying the safest manoeuvre, and finally determining the most feasible trajectory. Bishop, et al. (2014) described the results of a prototype test of a truck platooning application that could promote safety and generate energy savings pertaining to heavy truck operations. Lange, et al. (2015) introduced and approach for partially automated driving assuming that the driver continuously monitors the road environment and is in charge of the vehicle’s automation system. Hu, et al. (2017) developed a decision-tree based model for manoeuvre prediction in cut-in scenarios.

The constant evolution of the driver assistance systems of automated vehicles has raised serious concerns regarding the driver's response during a downward transition of automation level in safety critical situations. Zeeb, et al. (2015) used a simulator to assess the impact of driver's allocation of visual attention on take-over time and concluded that take-over time is mostly affected by driver's cognitive processes. Gold, et al. (2016) tested the take-over performance of seventy-two drivers under real-traffic conditions in order to estimate the influence of traffic density and verbal tasks on take-over time. Results indicated that higher traffic density increases take-over time and collision probability. Larsson, et al. (2014) found through a simulator study that the use of Adaptive Cruise Control (ACC) increases take-over time both for ACC-experienced drivers and ACC-amateurs. Stockert, et al.

(2015) evaluated the effects of a human-machine-interface that provides information about the automated vehicle's longitudinal state and actions on the driver's trust towards automated vehicle applications. Schieben et al (2011) elaborated on the effects of driver initiated transitions and their controllability tested in driving simulator studies performed at the FP7 project HAVEit. Lapoehn et al. (2016) tested how the performance of a take-over request can be enhanced by including nomadic devices in the HMI.

Research interest has been also placed on the management of automated vehicles along Automated Highway Systems (AHS). Baskar, et al. (2012) developed a model-based predictive control framework to implement speed control, lane allocation, and on-ramp metering in AHS. However, the authors did not account for the presence of non-automated traffic and its interactions with automated and cooperative vehicles in Transitions Areas. This study will enhance hierarchical traffic management for automated driving by assessing cooperative manoeuvring of automated, cooperative and conventional vehicles in areas where automation level transitions occur.

This paper targets one of the challenges of traffic management, i.e. automated vehicles in Transition Areas. The perspective is that infrastructure-based cooperative, connected and automated driving is an option for enhancing traffic safety, traffic efficiency and energy efficiency, and for reducing fuel consumption. Section 2 will provide definitions of the levels of automation and transition area. The concept and technical approach of TransAID are introduced in Section 3 and Section 4 respectively. Section 5 presents an initial simulation architecture. Finally, conclusions are drawn and further research is proposed.

2. Automation levels and automation level transition

The level of vehicle automation in the domain of ITS has been classified in different ways, e.g. BASt (Bundesanstalt für Straßenwesen) (updated to 5 levels) / VDA (Verband der Automobilindustrie) definition (Gasser, T. M. et. al., 2010), NHTSA (National Highway Traffic Safety Administration) definition (NHTSA, 2013), and SAE (Society of Automotive Engineers) definition (SAE, 2014).

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Copyright © 2014 SAE International. The summary table may be freely copied and distributed provided SAE International and J3016 are acknowledged as the source and must be reproduced AS-IS.

Fig. 1 Description of the levels of driving automation (SAE, 2014)

SAE is a global membership organisation for engineers in various industries, which is very active in the development of standards. TransAID adopts the definition of SAE, as it provides a classification system based on driver intervention and attentiveness, rather than vehicle capabilities. Within TransAID, the focus of automation is on the driver, and on how control is transitioned (if needed), as well as explicitly modelling this. The SAE definition has been widely adopted in the domain of ITS, inter alia by NHTSA. Fig. 1 presents the definition of SAE (2014).

3. TransAID concept and scope

High levels of automation, especially in urban traffic conditions will need to be supported by suitable road infrastructures in order to ensure an uninterrupted level of safety and efficiency. As shown in Fig. 2, there will be sectors and situations on the roads where high automation can be granted (A & C), but there will also be others, where highly automated driving is not possible or allowed (B) e.g. due to safety-criticality, lack of sensor inputs, etc. A rising number of automated vehicles will be forced to perform a switch of control back to the human driver when sectors of possible high automation end (A). On the other hand, many automated vehicles may switch to a higher level of automation when high automation is becoming available again (C). We refer to the sectors with a high number of vehicles performing automation level switches as Automation (Level) Switch Areas.

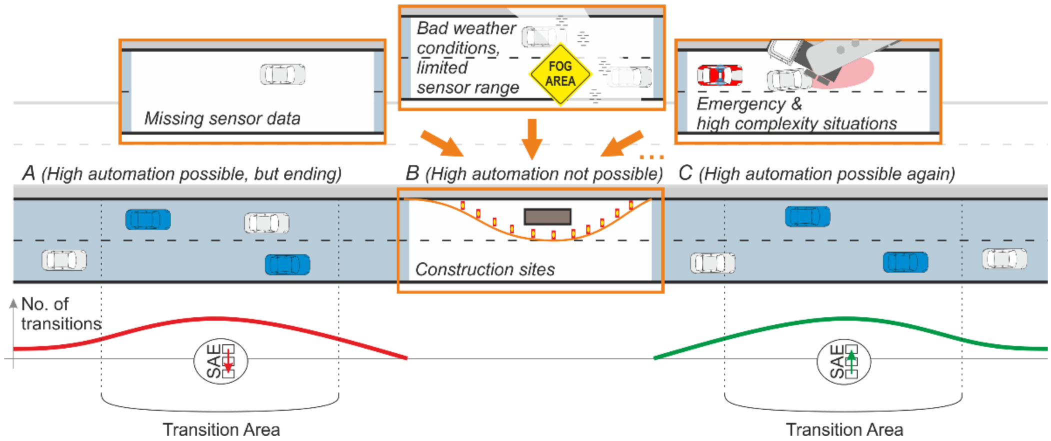


Fig. 2 An illustration of Transition Areas (marked in blue) [TransAID Consortium, 2017]

In the transition areas, many highly automated vehicles are changing their level of automation, for various reasons. TransAID will investigate the impact of different levels of vehicle automation on existing traffic systems, for different penetration rates per vehicle automation type, in accordance with expected near-future market shares. Several new concepts for hierarchical traffic management systems (TMS) are being developed that offer certain advantages in such circumstances:

1) Vehicles may ask the TMS how a transition of control can be avoided. The TMS may provide additional assistance for the risky areas.
2) Vehicles may ask the TMS about the best available options in case a Minimum Risk Manoeuvre has to be performed. The TMS may take into account the overall traffic situation to identify optimal solutions for both the requesting automated vehicle and for the other vehicles (automated and not automated) on the road.
3) The TMS may prevent larger impacts by proactively taking into account possible oncoming problems. The TMS may e.g. separate vehicles with risky types of automation from the other vehicles by temporarily setting up dedicated lanes, or may reserve parking spaces which can be used as destination in Minimum Risk Manoeuvres.

TransAID will identify promising solutions and will estimate the level of improvement based on simulation studies. The most promising solutions will be implemented as real-world prototype to demonstrate the feasibility of the approach. The results will be used to formulate a guideline for stakeholders concerning useful measures for assuring smooth coexistence of automated/connected and conventional vehicles during the phase of the market introduction of vehicle automation systems.

In TransAID some specific use cases will be investigated for optimising traffic flow, efficiency and safety in transition areas with regard to mixtures of conventional and cooperative, connected and automated vehicles (see Fig. 3).

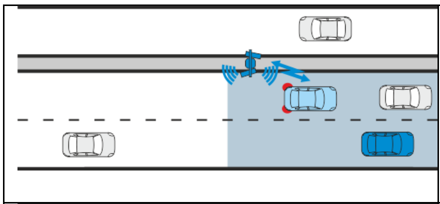
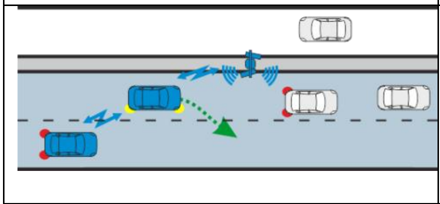
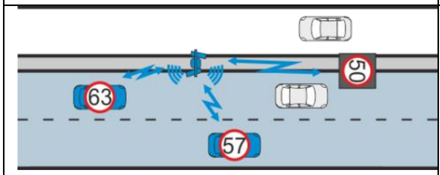
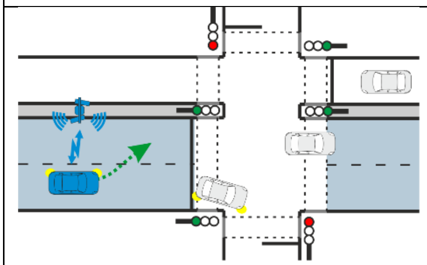
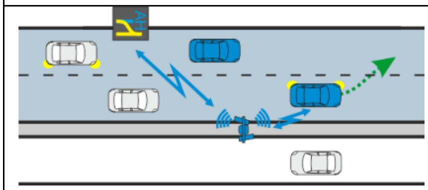
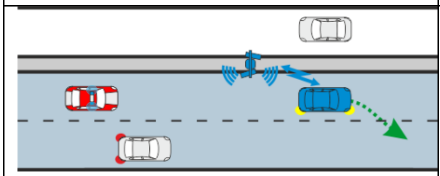
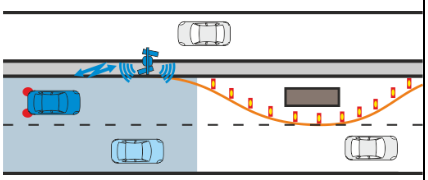
	**Transition to high levels of automation** The optimal behaviour and timing when switching to higher SAE levels is calculated by the infrastructure depending on the overall situation. This includes speed changes and probable joining of platoons.
	**Lane changes** Due to high traffic loads on certain lanes the traffic management might recommend certain vehicles to change lane or even to take an alternative route. V2X-communication or variable traffic signs are used to inform the driver and/or the vehicle automation system.
	**Speed changes** The infrastructure may optimise the traffic flow by changing the recommended speed for groups of vehicles. Connected/cooperative vehicles may get individual recommendations for a maximised impact.
	**Intersection handling** Intersections require special handling, as e.g. vehicles may be guided to other lanes due to turning manoeuvers. Signalised intersections are also used to influence the traffic flow when this is beneficial for downstream transition areas.
	**Traffic separation** In certain circumstances it may be beneficial to separate vehicles of specific automation levels into dedicated lanes, e.g. highly automated driving on the right, all others on the left. For certain roads this may also be introduced on a permanent basis.
	**Emergency situations** Arrival of emergency vehicles has a large impact on traffic situations. All other vehicles ought to give way, this is not different for automated vehicles. Traffic management can help both the traffic and the emergency vehicles to proceed safely, by deciding on optimal behaviour, especially in or near transition areas.
	**Transition to lower levels of automation** The infrastructure can provide support in the process of automated vehicles transferring back control to the driver, especially when reasons for the need of transition can be given (e.g. near construction sites). Also, the infrastructure can provide guidelines for the optimal behaviour and timing. In case of a failed transition, optimal types of Minimum Risk Manoeuvres can be suggested by the infrastructure.

Fig. 3 TransAID use cases [TransAID Consortium, 2017]

4. Technical approach and steps

To develop and demonstrate infrastructure-assisted traffic management procedures, protocols and guidelines for smooth coexistence between automated, connected and conventional vehicles especially in transition areas, an overall technical approach is proposed in TransAID (see Fig. 4).

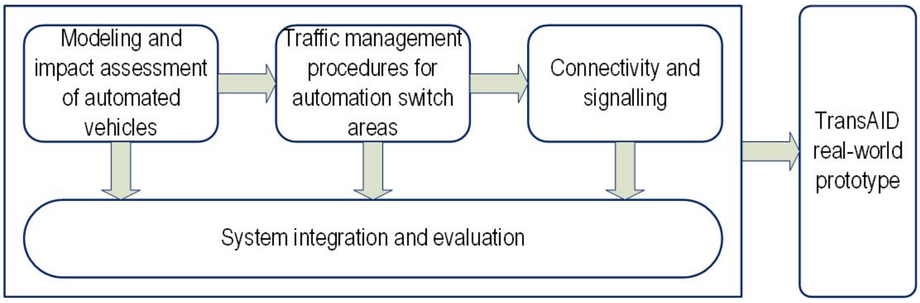


Fig. 4 An illustration of TransAID approach (Adapted from (TransAID Consortium, 2017))

Both implementation and impact assessment in simulation, and impelmentation and feasibility assessment in real-world situations will provide feedback for identifying measures in the realm of enhanced traffic management. Implmentation and feasibility assessment in real-world situtions will also provide feedback for modelling of individual automation and driver behaviour.

TransAID introduces an iteration concept. It will be carried out in two steps: Iteration 1 deals with scenarios of low complexity, e.g. at ring roads, without intersections, and/or with limited control possibilities (see Fig. 5 (the left ones)); iteration 2 refines the results and adapts to scenarios of high complexity, e.g. at intersections with mixed traffic and more detailed control possibilities (see Fig. 5 (the right ones)). The results of the first iteration are used to provide inputs for refinements needed for the second iteration dealing with high complexity scenarios. Both iterations will start with a baseline simulation showing the performance of automated systems without hierarchical traffic management. Then, traffic management procedures are developed and implemented in simulation, and their benefit is assessed. In parallel, the real-world prototype is developed, tested and demonstrated on the testing site.

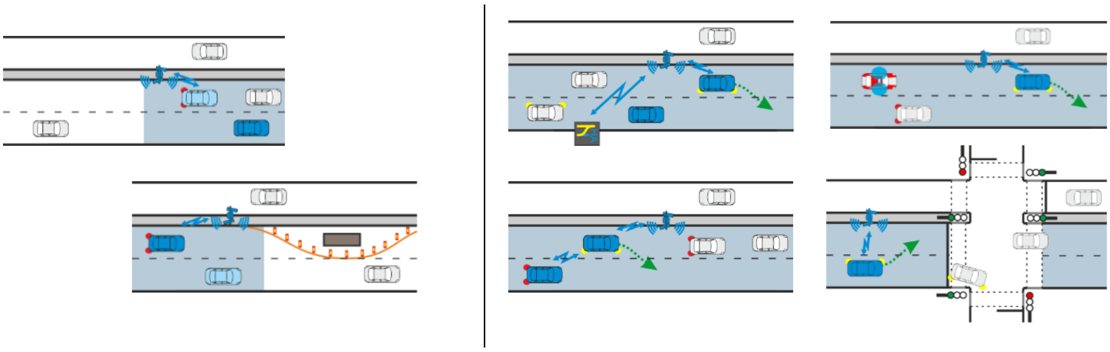


Fig. 5 Examples of the two iterations in TransAID (Left: Low complexity scenarios; Right: Higher complexity scenarios)

5. Assessing Key Performance Indicators (KPIs)

One of the main goals of TransAID is to understand how drivers behave with respect to an increase in the vehicle's autonomic capabilities, and what the conditions are for them to take over control in case this is required. In addition, TransAID aims to analyse how traffic management can have an impact on various traffic-related aspects, especially in the presence of autonomous vehicles. In order to accomplish successful management of traffic flows, we first need to be able to measure how various traffic management strategies will have their contribution and influence in certain scenarios.

To understand these different effects and impacts we propose to determine a set of Key Performance Indicators (KPIs) that touch upon the various aspects. A metrics will be established to help us to investigate what is required to achieve a certain level of traffic management. The KPIs will in first instance be based on those already defined for traffic management and intelligent transportation systems, such as mobility, reliability, operational efficiency, traffic safety and emissions, but where needed adapted for autonomous vehicles and Transition Areas. Therefore, in part, these KPIs will be adopted from earlier scientific and policy-driven projects which defined uniform metrics (e.g. the COLOMBO project) or standard key performance indicators (e.g. the CONDUITS project). Additional metrics will be added for assessing the (traffic) dynamics at Transition Areas specifically targeted by TransAID. Thus they will provide the TransAID project with a uniform quantification of safety and efficiency performance, and are also explicitly used during further detailed evaluations and interpretations.

In addition to the previously sketched approach, we will also define the appropriate indicators for assessing traffic safety. The main reason is that traffic safety itself can in principle not be directly observed. To circumvent this, we rely on other "proxy" measures such as the time/space gaps, speed and acceleration differences between vehicles, and many others. These measures are called "surrogate safety measures" (SSM), and – based on results published in literature – they give an indication of a safe, unsafe, or accident situation. SSMs are events that can be correlated with crash rates. SSMs could be used as indicators of accidents in safety evaluations. SSMs are in particular useful when testing for situations where no real or not enough accident data is available. SSMs can be used in the development of intelligent driver support systems (such as collision avoidance systems) bus also more advanced systems such as Automated Vehicles. SSMs can provide a very useful insight when mixed traffic occurs (not all vehicles are AVs). SSMs function as indicators and are linked with associated likelihoods to have accidents (collision risk) and accident outcomes (collision severity), given a number of assumptions (such as human driver, deceleration ratios, etc.). Consequently, once the outcome of a situation is known by means of its SSM, we can also have an estimation of the injury risk (which itself is based on literature research). Depending on what these SSMs represent (fatal / severe / slightly / almost wounded), we calculate the injury risk and possibly modify the interpretation of the SSMs specifically in light of AVs.

It needs to be noted that this use of SSMs is different from more traditional uses. Current uses of SSMs in the context of vehicle automation are limited to the analysis of an overall safety effect of the use of AVs in a mixed automation context or similar. For example, while AVs might accept small time gaps between vehicles to cross vehicle streams, this may cause problems for non-AVs which are within such a vehicle stream. Currently, the SSMs that are described are somewhat limited in truly assessing the safety impact of the introduction of AVs in (mixed) environments.

The aim is that all these developed indicators will work on both a higher, more traffic management-oriented, level, and a lower level, wereby we focus more on the individual driver-vehicle combination. For example, knowing the impact of certain traffic management schemes is important for assessing the (gained) throughput and the (decrease in) emissions on the one hand, and to understand how this translates into (more) driver and vehicle safety on the other hand.

All the KPIs will be collected and analysed within the various simulation trials during the project (i.e. for assessments ranging from individual driving behaviour to the performance of traffic management schemes). In addition, they will also be used – to the degree that it is possible – during the analysis of the real-life pilot trials. To than end, we will consider measurability, both in simulation and the field, to ensure that data can actually be obtained. The resulting safety and efficiency metrics will be used for systematic quantification of findings throughout the project.

6. TransAID initial simulation architecture

It is important to keep the simulation as accurate as possible, but also interoperable with real-world systems for ease of use. Compared with previous research (Blokpoel, et al., 2017), an added complexity in TransAID is that vehicles have to shift between different driver models: automated, transition and regular manual driving. Calibration of these models will be part of the work. The planning and control of the motion of automated vehicles will be modelled in detail. Various transition cases are distinguished, for example expected and unexpected transitions, varying by the state of the vehicle, and the situation it is in. In addition, for the regular driving mode, the interaction with automated vehicles also requires a specific model.

Simulation speed is another important requirement for impact assessment. Fast simulation allows for more extensive evaluation of scenarios, and in general traffic engineers expect at least 10x real time speed for a network with 5 complex intersections on a contemporary desktop PC. For this reason, it will not be feasible to simulate each vehicle with several separate processes as in a real vehicle. This would result in over a number of individual processes communicating with each other and running in parallel. In addition, V2X messages for communication are ASN.1 UPER encoded. This means values can start and end halfway a byte. Encoding and decoding are therefore quite computationally intensive.

Fig. 6 presents the simulation architecture, based on selecting required components from the hardware architecture and adding new ones specifically required for simulation.

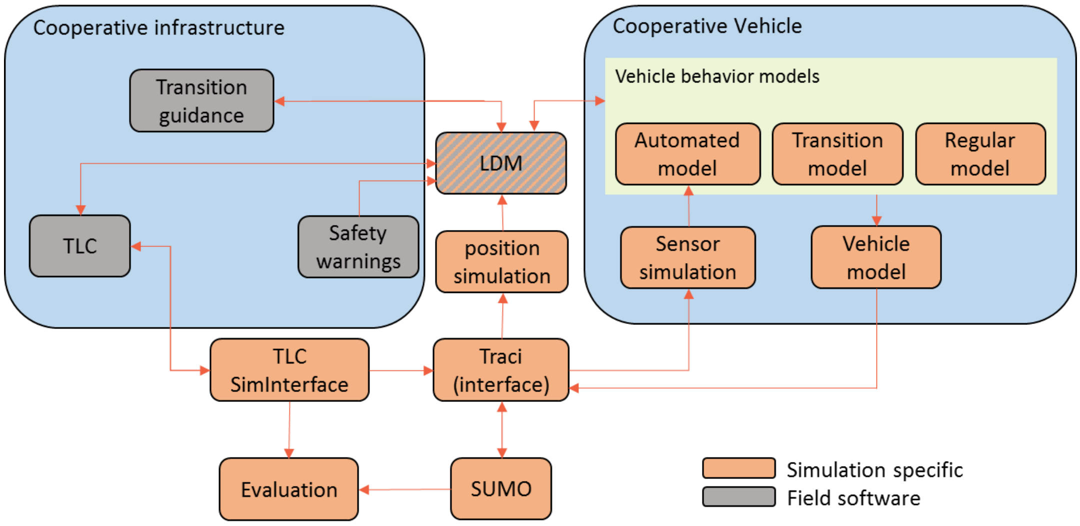


Fig. 6 High level simulation architecture

For interoperability analysis, the components that are identical to the real-world implementation are shown in grey, while simulation-specific components are shown in orange and one adapted element in grey/orange striped. Important for the striped element is that the interfaces to the grey elements should stay the same. Both the vehicle and the intersection have a shared LDM now. This is because the communication units have been removed, as these would require large amounts of computational time for encoding and decoding messages. Systems connected to this LDM will not notice a difference; the same data is still present in the same format.

The simulation architecture contains several new components shared between the vehicle and the intersection. The most important one is SUMO, an open source traffic simulation software package (Krajzewicz, et al., 2012). In principle any other simulation package could be used as well. The interface towards SUMO is called Traci and can be used to retrieve at any time data of relevant parameters of the simulation, e.g. vehicle speed, position, route, detector status, vehicle ID on detector. The interface can also be used to change parameters during the simulation, e.g. signal head status, vehicle speed, vehicle route. Positioning simulation replaces the actual positioning sensor of the vehicle. As Traci offers a precise position, it is not realistic to use this for simulations. The results of this simulated position are used to replace the regular CAM messages received by the LDM. A separate TLC interface for simulation is moved out of the cooperative intersection to emphasize that for simulation several additional functionalities had to be added. Signal heads, infrastructure sensors and traditional priority have been integrated with this interface as the actual hardware is not present and it has to connect to Traci for this. Evaluation is a new component required for impact assessment, TLC and SUMO logging is used for this. Lastly, the platoon green wave component from the TMC connects directly with the TLC using the same interface as in the real world (just like the LDM and queue estimation components).

The cooperative vehicle can select from several different vehicle behaviour models. The main, as already introduced, are automated, transition phase and regular manual driving. Within these models, several sub-models can exist. For transition phase driving, these are expected and unexpected handovers; and for manual driving, the environment is a key influential factor.

Apart from this the vehicle model has been simplified. Positioning and other sensors have to be replaced by sensor simulation, which then acquires its data from Traci. The simulation software mostly simulates one-dimensional movement and lateral lane positions. Lane changes are simulated using discrete sub-lanes. The decision whether to change lanes is evaluated based on positions of vehicles in the other lane. This means the automation functionality also has to focus on the longitudinal dimension, while modelling the lateral speed of a lane change is needed to determine the sub-lane correctly. As the automation functionality has no actuators to interact with, a vehicle model is required to translate the outputs of real-world automation into speed, lane and route information for Traci. These vehicle models should include variation between individual vehicles to simulate a realistic spread in, for example, acceleration capabilities.

Looking at the cooperative infrastructure functionality, the grey boxes indicate that the components are the same as on the street. Simulation-specific functionality is only included in the TLC SimInterface. Important requirements are that this interface should be in charge of the timing, and that the controller should be able to run with variable clock speed, to allow the simulation to run as fast as the computations permit. Since the project still has to elaborate and more precisely define the use cases, some extra infrastructure systems may be added that may need sensor simulation (like for the automated vehicles).

7. Conclusion

TransAID (Transition Areas for Infrastructure-Assisted Driving) aims to develop infrastructure-based traffic management procedures, guidelines and protocols for a smooth coexistence between automated, connected and conventional vehicles during the market introduction phase of ICT technologies for automated driving. It focuses on transition areas in urban and rural environments (e.g. arterial roads with signalised intersections). The paper targets one of the major challenges of traffic management with respect to automation, i.e. automated vehicles in transition areas. An initial TransAID simulation architecture is proposed, which will be further developed during the project.

Further research includes, for instance:

1) Evaluation and modelling of automation prototypes.
2) Assessment of the impacts of transition areas on safety, traffic efficiency and environment.
3) Development of ICT infrastructure management procedures and protocols to control connected, automated and conventional vehicles at Transition Areas.
4) Definition of V2X message sets and communication protocols for the cooperation between connected / cooperative / automated vehicles and the road infrastructure.
5) Development of procedures to enhance the detection of conventional vehicles and obstacles on the road and to inform and/or influence drivers of conventional vehicles.
6) Integration, testing and evaluation of the TransAID infrastructure-based traffic management protocols and procedures in a simulation environment, as well as validation and demonstration of the protocols and procedures by means of a real-world prototype.

Acknowledgements

The paper presents some preliminary results of the EU-funded project TransAID (Transition Areas for Infrastructure-Assisted Driving) under the Horizon 2020 Framework Programme, Grant Agreement No. 723390. The initial architecture will be further developed during the project. The authors especially thank the TransAID consortium partners for their kind support, especially those who have substantially contributed to writing Part B of the DoA (Description of Action).

8. References

Baskar, L. D., De Schutter, B., Hellendoorn, H., 2012. Traffic Management for Automated Highway Systems Using Model-Based Predictive Control. *IEEE Transactions on Intelligent Transportation Systems*, 13, 838–847.

Blokpoel, R., Lu, M., Pribyl, O., Dariani, R., 2017. Interoperable Architecture between Simulation and Pilots for Cooperative and Automated Driving. In Proceedings: European Congress on Intelligent Transport Systems, Strasbourg.

Bishop, R., Bevly, D., Switkes, J., Park, L., 2014. Results of Initial Test and Evaluation of a Driver-Assistive Truck Platooning Prototype. In Proceeding: IEEE IV (Intelligent Vehicles Symposium), June 2014, 208–213.

CoEXist Consortium, 2017. CoEXist Description of Action. CoEXist Consortium, Brussels. (restricted)

Gasser, T. M., et. al., 2010. Die "Projektgruppe Automatisierung": Rechtsfolgen zunehmender Fahrzeugautomatisierung, 11. In Proceedings: Braunschweiger Symposium AAET, Publisher: Intelligente Transport- und Verkehrssysteme und –dienste Niedersachsen e.V., ISBN 978-3-937655-23-9, Braunschweig.

Gold, C., Körber, M., Lechner, D., Bengler, K., 2016. Taking over Control from Highly Automated Vehicles in Complex Traffic Situations: the Role of Traffic Density. Human Factors, 58, 642–652.

Hu, M., Liao, Y., Wang, W., Li, G., Cheng, B., Chen, F., 2017. Decision Tree-Based Maneuver Prediction for Driver Rear-End Risk-Avoidance Behaviors in Cut-In Scenarios. Journal of Advanced Transportation, Article ID 7170358, 1–12. https://doi.org/10.1155/2017/7170358

Katrakazas, C., Quddus, M., Chen, W.H., Deka, L., 2015. Real-Time Motion Planning Methods for Autonomous On-Road Driving: State-of-the-Art and Future Research Directions. Transportation Research Part C: Emerging Technologies, 60, 416–442.

Krajzewicz, D., Erdmann, J., Behrisch, M., Bieker, L., 2012. Recent Development and Applications of SUMO - Simulation of Urban Mobility, International Journal on Advances in Systems and Measurements, 5,128–138.

Lange, A., Albert, M., Siedersberger, K.H., Bengler, K., 2015. Ergonomic Design of the Vehicle Motion in an Automated Driving Car. Procedia Manufacturing, 3, 2761–2768.

Lapoehn, S., Dziennus, M., Schieben, A., Utesch, F., Hesse, T., Köster, F., Dotzauer, M., Johann, K., 2016. Interaction Design for Nomadic Devices in Highly Automated Vehicles. In Proceedings: Mensch und Computer 2016, http://muc2016.mensch-und-computer.de/

Larsson, A. F., Kircher, K., Hultgren, J.A., 2014. Learning from Experience: Familiarity with ACC and Responding to a Cut-In Situation in Automated Driving. Transportation research Part F: Traffic Psychology and Behaviour, 27, 229–237.

MAVEN Consortium, 2016. MAVEN (Managing Automated Vehicles Enhances Network) Description of Work. MAVEN Consortium, Brussels. (restricted)

NHTSA, 2013. Preliminary Statement of Policy Concerning Automated Vehicles, National Highway Traffic Safety Administration (NHTSA), Washington, D.C.

SAE, 2014. Taxonomy and Definitions for Terms related to On-Road Motor Vehicle Automated Driving Systems. Standard J3016, issued 2014-01-16. Society of Automotive Engineers (SAE).

Schieben, A., Flemisch, F., Temme, G., Köster, F., 2011. What Happens When I Push the Accelerator Pedal? Exploration and Proposal for the Design of Driver-Initiated Transitions between Different Automation Modes in a Highly Automated Vehicle. In: VDI Berichte 2134: Der Fahrer im 21. Jahrhundert, VDI Verlag GmbH. ISBN 978-3-18-092134-1

Stockert, S., Richardson, N. T., Lienkamp, M., 2015. Driving in an Increasingly Automated World–Approaches to Improve the Driver-Automation Interaction. Procedia Manufacturing, 3, 2889–2896.

TransAID Consortium, 2017. TransAID (Transition Areas for Infrastructure-Assisted Driving) Description of Action, TransAID Consortium, Brussels. (restricted)

Zeeb, K., Buchner, A., Schrauf, M., 2015. What Determines the Take-Over Time? An Integrated Model Approach of Driver Take-Over after Automated Driving. Accident Analysis & Prevention, 78, 212–221.

Zlocki, A., Fahrenkorg, F., Lu, M., 2016. History and Deployment of ITS (Intelligent Transport Systems) Technologies and an Outline of the Book Chapters. In Lu, M. (Ed.). Evaluation of Intelligent Road Transport Systems: Methods and Results. Publisher: IET (Institution of Engineering and Technology). ISBN 978-1-78561-172-8 (print), ISBN 978-1-78561-173-5 (eBook).