CEDR TM4CAD 2nd workshop

ODD-ISAD architecture and NRA governance structure to ensure ODD compatibility

14th February 2022, 14:00 – 17:00 CET, Online

Workshop objectives:
1. Understand basic concepts and define common terminology associated with ODD definition
2. Present Distributed ODD Awareness (DOA) concept and relationship to ISAD
3. Discuss and validate results from the first work-package of the TM4CAD project

Target audience: (national) road authorities who are active in the field of vehicle automation, connectivity, traffic management and infrastructure readiness. Feel free to forward the invitation.

Annex: Pre-Read Material for CEDR TM4CAD 2nd workshop.pdf (available on project website)

Workshop agenda:
Presentations are available on the project website: https://tm4cad.project.cedr.eu/#workshops

14:00	Welcome, introduction to TM4CAD and research questions	Jaap Vreeswijk (MAPtm)
14:15	Basic concepts and terminology	Steve Shladover (independent)
14:35	Interactive part 1: *what did you learn from the presentation, what thoughts and expectations do you have on the subject matter and what else would you like to learn at this workshop?*	Ilkka Kotilainen (Traficon)
15:05	Distributed ODD Awareness (DOA) framework	Siddartha Khastgir (Warwick University)
15:25	*10-min break*	
15:35	Interactive part 2: *how do NRAs understand the DOA framework?*	Tom Alkim (MAPtm)
16:05	Translating DOA framework to ISAD and NRA roles & responsibilities	Risto Kulmala (Traficon)
16:25	Interactive part 3: *are your expectations met and / or what is still unclear?*	Sven Maerivoet (TML)
16:55	Conclusions	Jaap Vreeswijk (MAPtm)
17:00	End	

This project is funded by CEDR Call 2020 Impact of CAD on Safe Smart Roads.

Consortium partners: MAP traffic management (the Netherlands), Traficon (Finland), Transport & Mobility Leuven (Belgium), WMG Warwick University (United Kingdom), Steven Shladover (independent consultant, United States) and Keio University (Japan).

Representing TM4CAD:

Jaap Vreeswijk, MAPtm, the Netherlands

Tom Alkim, MAPtm, the Netherlands

Khastgir, Siddartha, WMG Warwick University, UK

Risto Kulmala, Traficon, Finland

Ilkka Kotilainen, Traficon, Finland

Sven Maerivoet, Transport & Mobility Leuven, Belgium

Steven Shladover, independent consultant, United States

Hironao Kawashima, Keio University, Japan

Workshop attendees (names removed in public version)

Highways England, UK

Transport Infrastructure Ireland

Finnish Transport and Communications Agency Traficom, Finland

Ministerio de Transportes, Spain

Slovenian Infrastructure Agency

Danish Road Directorate, Denmark

Danish Road Directorate, Denmark

Traffic infrastructure Ireland

Asfinag, Austria

Ministerio de Transportes, Spain

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CEDR DiREC project

Province North-Holland, the Netherlands

Rijkswaterstaat, the Netherlands

National Highways, United Kingdom

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AWV Flanders, Belgium

Netivei, Israel

Rijkswaterstaat, the Netherlands

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Workshop report

This chapter summarizes results from the TM4CAD and National Road Authorities (NRA) workshop on "ODD-ISAD architecture and NRA governance structure to ensure ODD compatibility" on 14 February 2022. The workshop had over 25 NRA participants from different European countries.

Workshop objectives and agenda included: 1) Understand basic concepts and define basic terminology associated with ODD definition, 2) Present Distributed ODD Awareness (DOA) concept and relationship to ISAD and 3) Discuss and validate results from the first work-package of the TM4CAD project. Between each agenda objective, three 30 min interactive parts with moderated discussion were held. Results presented here reflect these discussions and questions by the NRAs. Presentations and pre-read material are available on the project website.

Summary interactive part 1

Introduction

The following transcript of the TM4CAD workshop 2 Interactive part 1 summarizes the discussion with presented questions.

Before the interactive part 1 a following workshop objective was presented by Steven Shladover before the with an agenda title "Common ODD definition language": Understand basic concepts and define common terminology associated with Operational Design Domain (ODD) definitions.

Following is a summary of identified main topics, not presented in a timely order, from the questions and discussions during the interactive part 1. Discussion was started by presenting open questions by the moderator and then continued with questions by the workshop's National Road Authority (NRA) attendees.

Identified main topics:
- Levels of automation
- Operational Design Domain (ODD) and standardisation
- ODD and road safety
- Cooperative and Connected CAD systems

Questions and discussion

Topics: Levels of automation
Question: Does Level 4 automated vehicle at the end of an ODD have minimum risk manoeuvre (MRM) or does Level 4 automated vehicle also have an option for the driver to take over the driving task? How this differs in Level 3 system?
Discussion: Driver may take over, but it would not be required by the Automated Driving System (ADS), i.e., system can ensure safety even if the driver would not be in alert. This depends also on how the vehicle have been designed, for example if driving wheel is available, than solely on ADS. In level 3 MRM is an option, but not required and can be limited capability.

Topics: Operational Design Domain (ODD) and standardisation
Question: From an NRA perspective of possible issues, is the ODD designed by OEMs different for each manufacturer? Therefore, ODD capabilities and their attributes between OEMs will be different?
Discussion: Any manufacturers with low- and high-end vehicles (having different technologies) have difference on how they can operate, which road sections in which operating conditions will be feasible. If ADS not feasible to operate, then driver need to do the driving.
Question: Depends on how and what technology and services NRA's offer in the road network to support different ODD levels?
Discussion: Can vary between countries and road sections.

Question: role of standardization to enable automated driving and ODD in different countries?

Discussion: if same standards are not used, for example in communication, can cause issues and is a requirement for the operation.

Question: Vehicle manufacturers need to develop standardized road for their ADS to work?
Discussion: Manufacturers interest also to develop systems with minimum external support. Standardization groups have ongoing discussions of the development. Technology evolves and can change the need and role of road infrastructure to support automated driving.

Question: How can we standardize and define common ODD language as different brands. implementations and software variations? Would a common framework be needed? Can infrastructure support without one?
Discussion: Standards committee is working on this (ISO34503): ODD taxonomy, creating a high-level natural language definition. Aiming that manufacturer would use the same set of attributes, i.e., using same taxonomy when defining ODD. Also, high-level language to define ODD. Example of ASAM project of ongoing work using simulation-based definition of ODDs.

Topics: ODD and road safety
Question: Need for a regulatory framework to define safety attributes?
Discussion: Regulation requires that system can operate only when ODD conditions are satisfied. If conditions are not me, then driver needs to operate.

Question: Will the driver be informed if the ODD conditions are fulfilled?
Discussion: Expected that the driver will be informed if the ODD conditions are satisfied. Discussion ongoing in the standardization. When a driver presses a button to turn on the automation, the system would inform if it cannot operate. This can be part of the regulations.

Question: When MRM is initiated and driver takes back control of the vehicle, this information could be interesting for safety and ODD analysis for road users and possibly road authorities, for example warning other road users/vehicles. Would this be possible and/or discussed elsewhere?
Discussion: Technically should be possible and would require standardisation before requirements. Similarity in today's emergency situations.

Topic: Cooperative and Connected CAD systems
Question: How ODD responses in the future of cooperative and connected vehicles, for example platooning?
Discussion: depends on what technology and communication devices the surrounding vehicles are equipped to collaborate with each other.

Summary interactive part 2

Introduction

The following transcript of the TM4CAD workshop 2 Interactive part 2 summarizes the discussion with presented questions.

Before the interactive part 2, Siddartha Khastgir presented the "Distributed ODD Awareness (DOA) Framework" in order to better understand that concept and how it relates to the premise that road operators do not make automated vehicles, but they can help make it happen.

Following is a summary of identified main topics, not presented in a timely order, from the questions and discussions during the interactive part 2. The discussion was started by presenting open questions by the moderator and then continued with questions by the workshop's National Road Authority (NRA) attendees.
Identified main topics:
- Digital layers and time criticality
- Brand specific requirements
- Off board sensing and trust worthiness

- Minimal Risk Manoeuvres
- Uniform ODD descriptions and ODD attributes

Questions and discussion

Topic: Digital layers and time criticality
Question: What information is necessary for ADS to determine whether it's inside its ODD?
Discussion: necessary information for ADS to operate has a time critical element. As a form of implementation this can be done in a digital twin or in digital layers where the time criticality (and quality aspects) can be put on those layers. Either way, there will be investments associated where, as a rule of thumb, the costs are higher when the time criticality increases. The five different classes of time criticality can be helpful for investment decisions.

Topic: different requirements for different brands
Question: Do all ADS require the same information?
Discussion: The required information for an ADS to perform and to determine whether it's inside its ODD depends on the specific sensor set and vehicle capabilities. However, NRAs should focus on what they can offer and try to avoid fragmentation. Alignment with OEMs requirements for their ADS should follow.

Topic: off board sensing, trusted source of information?
Question: Will OEMs trust and use information from external sources?
Discussion: The manufacturers decide whether a vehicle is inside its ODD or not and will predominantly use the CAV's own sensors to do so. Continuous off board sensing in the direct vicinity of an ADS could provide useful complementary information that would extend the vehicle's e-horizon / contextual awareness and thereby enhance the driving performance in theory.

Topic: Minimal Risk Manoeuvre (MRM)
Question: will CAVs communicate their MRMs?
Discussion: according to the basic safety information it's a requirement to do so when an MRM is initiated. It's very relevant for road operators to know, for instance for incident management purposes. The question is to what extent the nature of the manoeuvre and what level of detail will be shared.

Topics: How to uniformize ODD descriptions
Question: How can ODD descriptions be uniformized?
Discussion: different manufacturers may use different descriptions that are related to their ADS' capabilities and thus might be brand specific and even confidential. There's also a difference between ODD attributes and available (real time) information on those attributes

Interactive part 3

The following transcript of the TM4CAD workshop 2 Interactive part 3 summarises the discussion with presented questions.

Interactive part 3 followed after explanations of the basic concepts and terminology adopted in the TM4CAD context, as well as an elaborate insight into the distributed ODD awareness (DOA) framework. In addition, the workshop participants were also introduced to how we could translate the DOA framework to the ISAD levels and roles & responsibilities of national road authorities (NRAs). During these sessions, we took note of the different questions that were asked and discussions that were held.

This allowed us to go further into several topics, thereby trying to find an answer to whether or not the audience's expectations were met and if there were still aspects that remained unclear to them.

Ultimately, the main goal was for us to be able to answer the following currently relevant research questions:

- **RQ1**: Should NRAs set requirements on the desired behaviour of (partly) automated vehicles on where and how they should drive?
- **RQ2**: Do brokers between traffic management centres and vehicles/OEM back ends add value in this interaction?
- **RQ3**: How does CCAM support the work of traffic management centres and how can traffic management centres support and facilitate the deployment of CCAM?
- **RQ4**: What kind of information is to be transmitted in the interaction (in both directions) between a traffic management centre and vehicle?
- **RQ5**: Which information is to be provided by the NRA/roadside and which information can be obtained by the sensors of the moving vehicle itself?

We noticed that RQ1, RQ4, and RQ5 were discussed by the participants, but that no concrete enough information was provided for RQ2 and RQ3. Given that the audience consisted mainly out of researchers and NRAs, the general consensus was that in order for us to be able to obtain answers to RQ2 and RQ3, we would have to consult with the vehicle manufacturers (OEMs) themselves.

Regarding the active discussions, we noted the following:

- **Levels of automated driving:**
    - Should we allow L3 vehicles on the road?
        - ⇨ We should first define requirements on the safety of their implementations
    - What about transitions of control (ToCs) for L4 vehicles?
        - ⇨ Make the difference between: driver takeover is an <u>option</u>, not a <u>requirement</u>
    - How should we deal with different levels of vehicle technology?
        - ⇨ Determine which sections of the road network will be feasible for a vehicle's abilities
    - What about the requirements that different NRAs have?
        - ⇨ Strive for cross-border compatibility/interoperability (cf. RUC as an example)

- **Aspects that will automatically be 'taken care of':**
    - Safety
        - ⇨ This is automatically regulated by having all ODD conditions satisfied
    - V2V (e.g., platooning)
        - ⇨ This is <u>not</u> ODD-related but rather deals with compatibility with other (nearby) vehicles

- **The flow of information:**
    - NRAs want information on accidents, queues, etc. immediately/as soon as possible
    - What about the initiation of minimum-risk manoeuvres (MRMs)?
        - ⇨ This is actually interesting information for the NRAs to have regarding traffic management purposes
        - ⇨ However, the <u>standards</u> are not well-enough developed/adopted yet

- **Time/information criticality:**
    - Alignment with OEMs is required
        - ⇨ Cf. NRAs supporting automated lane-keeping systems (ALKS: an NRA needs to know which information categories are required to support a certain advanced driver assistance system (ADAS)

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- o This may clash with the NRA's perspective: a solution would be to start considering this from the point of view of <u>different digital layers</u> and then put the time criticality factor on top of these

Some general remarks were also made, as the audience further understood the workings of the DOA:

- There are a lot of risks involved
  - o It may look scary from an NRA's perspective
  - o There is a high flux in the market
  - o OEMs go in different directions
  - o NRAs try to catch up with the OEMs

- It is not about how the vehicles respond
  - o But more about how drivers respond (which may impede automated driving evolutions)
  - o Custom driver training will be a requirement in order to be able to cope with ADAS and L3+ vehicles (think about the case of hire-cars: would you be able to drive them? Are you even allowed to? Given that you may or may not have received training for it)
  - o What about HMI (guidelines)?

- The market will probably want value-added services first, and only then infrastructure support second

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