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Convention on Road Traffic (1968):

Automated driving

**Identification of new roles for humans acting
as physical or conceptual drivers**

Discussion paper on key human roles in the context of automated driving

Submitted by Finland

Discussion paper on key human roles in the context of automated driving

The purpose of this document is to describe discussions among the IGEAD members on “the driver/user roles in the context of evolving technical progress”. It also explores the work already done by various UNECE bodies relating to defining the human roles in the context of road transport automation.

Discussion paper:

Key human roles in the context of automated driving

9.9.2022/Kirsi Miettinen

IGEAD-21, 1.6.2022; IGEAD-22, 9.9.2022

Introduction and scope

1. In the 84th session of the Global Forum for Road Traffic Safety, the following was concluded, as regards IGEAD: “The Informal Group of Experts on Automated Driving (IGEAD) Chair provided an update on the informal Group’s work on the definition and role of the driver, driver education and training, as well as remote driving (Informal document No. 8). As a result, the WP.1 Chair invited IGEAD to continue to work following the mandate given by WP.1. In particular, to focus on the driver/user roles and driver education in the context of evolving technical progress; on remote operations; and to continue to collaborate with the World Forum for the harmonization of vehicle regulations (WP.29) and GRVA.” (ECE/TRANS/WP.1/179, Report from 84th session)

2. The scope of this paper does not cover fully automated vehicles used for public passenger transport (e.g. shuttle busses or robo taxis) or for freight transport. Human role inside such vehicles will be “the passenger”, and the role will basically remain the same as the passenger role in public transport services thus far. Human roles outside such vehicles relate to issues of remote operations, and need to be addressed properly in that context. This is because having separate and clearly focused discussions on such use cases will be helpful for structuring the discussions.

3. Purpose of this document is to conclude the discussions amongst the IGEAD members on “the driver/user roles in the context of evolving technical progress”. This paper also explores in a nutshell work already done by various UNECE bodies relating to defining the human roles in the context of road transport automation as a background.

Work done so far by the Working Parties

Short background

4. WP.1 oversees two binding legal instruments, the 1949 and 1968 Conventions on Road Traffic (the Geneva and Vienna conventions, respectively), including the recent amendment to the Vienna Convention (adding Art. 34 bis and the definitions for “dynamic control” and “Automated Driving System”, which entered into force 14.7.2022). Furthermore, WP.1 adopted a Resolution on the deployment of highly and fully automated vehicles in road traffic (later 2018 Resolution), as well as the recently initially agreed Resolution on the concept of activities other than driving, which is open for adoption at the WP.1 September meeting.

5. Under the Global forum for the Harmonization of Vehicle Standards (WP.29), FRAV (Functional Requirements for automated and autonomous vehicles) has outlined Guidelines and Recommendations concerning Safety Requirements for Automated Driving Systems (FRAV-30-05, which has been submitted to GRVA (Working Party on Automated/Autonomous and Connected Vehicles) as an informal document GRVA-12-23 on January 2022). This document is for informational purposes and should be read as a work-in-progress. It provides recommendations for ADS safety requirements intended to inform WP.29 discussions on future initiatives. This document contains definitions of all main terms in vehicle automation.

6. Under GRVA, a new Task Force on Advanced Driver Assistance Systems (ADAS) began work in January 2021. This task force was formulated to address systems up to the SAE level 2, with its main objectives to re-view UN Regulation No. 79 and consider, whether a new UN regulation was required to deal with new cases for ADAS. In their draft document

which is called “Uniform provisions concerning the approval of vehicles with regard to Dynamic Control Assistance Systems”, the task force has generated a new term and definition - DCAS, Dynamic Control Assistance Systems – for these new use cases that would be a subset of ADAS. According to the Task Force, DCAS can be defined as hardware and software collectively capable of assisting a driver in controlling the longitudinal and lateral motion of the vehicle on a sustained basis, and which requires the driver to be permanently engaged and to monitor the environment and vehicle system performance. This was to establish clearly that any DCAS feature should not allow the driver to disengage from driving the vehicle and that the driver remains fully responsible.

7. On the top of that, the revision of SAE J3016 was published April 2021 - Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles should be mentioned. As in the previous version, it provides a taxonomy describing the full range of levels of driving automation in on-road motor vehicles and includes functional definitions for advanced levels of driving automation and related terms and definitions. This document defines User - A general term referencing the human role in driving automation.

Important definitions

8. According to new Art. 1(ab) of the Vienna Convention, “*Automated driving system*” refers to a vehicle system that uses both hardware and software to exercise dynamic control of a vehicle on a sustained basis.

9. According to new Art. 1(ac) (ac) “*Dynamic control*” refers to carrying out all the real-time operational and tactical functions required to move the vehicle. This includes controlling the vehicle’s lateral and longitudinal motion, monitoring the road, responding to events in the road traffic, and planning and signalling for manoeuvres.

10. According to Para. 3(c) of the 2018 Resolution “*Operational design domain*” (ODD) refers to the environmental, geographic, time-of-day, traffic, infrastructure, weather and other conditions under which an automated driving system is specifically designed to function.

11. GRVA-12-23 includes the following concepts (note that the paper is still informal):

“*Automated Driving System (ADS)*” means the hardware and software that are collectively capable of performing the entire DDT on a sustained basis.

“*Dynamic control*” means the real-time execution of operational and tactical functions required to operate a vehicle based on perception, information processing, and decision making.

“*Dynamic Driving Task (DDT)*” means the real-time operational and tactical functions required to operate the vehicle.

Discussions in the IGEAD

Driver vs. user?

12. The introduction of vehicles equipped with automated driving systems capable of exercising dynamic control during at least part of a journey puts pressure on the broad concept of “driver” that is central in the existing international Conventions on Road Traffic. The definition of “driver” is directly linked to clear and numerous responsibilities concerning dynamic driving tasks defined in the Conventions, which the human inside the vehicle is not capable of performing when he/she has delegated the dynamic control to the ADS. However, there are also responsibilities of the driver which do not relate to the dynamic control itself, which must remain with a dedicated human inside the vehicle, as the ADS is not capable of performing such duties (like seat-belts of the minors, loading the vehicle).

13. In the Vienna Convention on Road Traffic, the driver is defined in Article 1(v) as follows: “Driver means any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or herds, or flocks, or draught, pack or saddle animals on a road.” According to Article 8(5), every driver shall at all times be able to control his vehicle or guide his animals. Driver Assistance Systems were acknowledged to be in conformity with

Article 8(5) and with paragraph 1 of Article 13 Art under certain conditions by adding new paragraph 8(5 bis) to the Vienna Convention a few years ago.

14. In the ongoing discussions in FRAV, it is proposed that the concept of “the driver” would mean that the human individual may have full control, assisted control or supervisory control at the tactical and/or operational level of the driving task. The current definition of FRAV states that the driver is a human being who performs in real time part or all of the DDT and/or fallback for a particular vehicle. Task Force on DCAS considers that if someone is required to monitor the driving task, they are a driver.

15. The 2018 Resolution already recognized the role of “the user” in the context of highly and fully automated vehicles, even though it does not define the concept. The Resolution covered a range of driver roles without having to specify what each role and associated responsibilities should be. In the discussions of FRAV, the concept of “the user” seems to be a general term and the term “driver” a sub-term linked to the certain user roles. In this discussion, “the user” is or may directly (= in real-time) be involved in the execution of the driving task.

16. One thing seems clear, namely that the human becomes “the driver” in the traditional sense when the ADS is not engaged, e.g. when the transition phase is finished. As already expressed in the FRAV-work, a single person can switch user roles during a drive, depending on the available automation. Hence, the dynamic control can switch from the human to the ADS and back along the journey, and the human can also be in a role of traditional driver.

17. It was advocated by the IGEAD chair, that it would be beneficial to clearly separate “the user” and “the driver”. In the discussions of IGEAD-21 in June, the group did not see any fundamental clarifying value for separating these terms, especially since the simple term “the user” might also cause confusion. Furthermore, there seems to exist already some pieces of national legislations or proposals for legislations using varying terminology. However, the need to clarify developing human roles in the context of automated driving is commonly acknowledged.

Varying human roles in the context of varying automation systems

Driver assistance systems (ADAS, CDAS)

18. Vehicles equipped with such automation systems that are designed to assist “the driver” seems to be quite clear. The human inside the vehicle is “the driver” and has either full, assisted or supervisory control of the vehicle at all times. The traditional driver responsibilities remain basically intact.

19. However, there are also number of issues to be discussed relating to driver assistance systems, such as the possible overreliance on such systems, and the need to educate drivers on the appropriate use of these systems, as well as effects of the most advanced driver assistance systems on the drivers, especially from the human factors perspective. That kind of discussion deserves separate context with clear concentration on such matters.

Automated Driving Systems (ADS)

20. The 2018 Resolution on highly and fully automated vehicles defines such vehicles so that they operate without the need for human intervention as a fall-back to ensure road safety. In the French Degree No. 2021-873, this is defined even in a somewhat clearer manner, stating that such vehicles are “able to respond to any traffic hazard or failure, without exerting a demand for takeover during a maneuver performed (unofficial translation).

21. According to Informal paper GRVA-12-23 ADS vehicle is a vehicle equipped with an ADS, which means the hardware and software that are collectively capable of performing the entire DDT on a sustained basis.

22. The human inside the vehicle could be better described something else simple “driver”, when the ADS is engaged, because the vehicle must be capable of handling all kinds of traffic situations without asking the human to interfere, which should make even supervising/monitoring activities by the human unnecessary. The role of the driver while the

ADS is engaged would need a definition that could indicate that there is a clear difference to the traditional driver role or to the driver using driver assistance systems.

23. In the UK, the Law Commission proposes the use of term “the user-in-charge” (UIC). When the ADS is engaged, the UIC would be the person in the vehicle with access to the controls and have obligations to be qualified and fit to drive. The UIC has two main responsibilities: 1) to be receptive to a transition demand for systems that issue them (enabling completion of a journey by becoming a driver at the end of the transition demand, taking over dynamic control), and 2) to take care of duties of drivers that do not arise from dynamic control such as duty to carry details of the vehicle’s registration, ensuring children wear safety belts and responding to road incidents. UIC would have immunity from dynamic driving offences, when the ADS has the dynamic control according to the Law Commission’s proposals.

24. Using a new term, e.g. “user-in-charge”, would be a descriptive concept, and it would also make the difference when compared to simple term “user”, which can be used as a more general level term. Adding “in-charge” instead of e.g. “fall-back” or “fall-back ready” would indicate that 1) human intervention is not needed in order to guarantee traffic safety, and 2) “user-in-charge may have responsibilities that cannot be taken care of by the ADS, even when the ADS has the dynamic control. In this scenario, it would be quite logical that when the ADS is engaged, the human would not need to have any supervisory/monitoring responsibilities, but only be responsive only to the (possible) transition requests which may be made by the ADS.

25. Engaging the ADS should open the way for the humans to take use of the time not needed for any kinds of driving-related responsibilities to do actual other activities. Otherwise the benefits for the user experience would remain rather limited. There may be need for national variations for allowing such activities, but the users of automated vehicles also need clear indication what is allowed and what is not allowed.

Partial/conditional automation?

26. In the French decree No. 2021-873 there is also the definition for partial automation. According to it, a partially automated vehicle is equipped with an automated driving system exercising dynamic control of the vehicle in a particular operational design domain, having to request control to respond to certain traffic hazards or certain failures during a maneuver carried out in its operation design domain (unofficial translation).

27. IGEAD Chair presented in IGEAD-21 meeting to the group a question concerning the possible usefulness of defining more clearly the concept of conditional/partial automation. The majority in the group seemed to be of the opinion, that there should only be the division between driver assistance systems ADAS and Automated Driving Systems ADS. However, there seemed to be common understanding in the group, that there will be some differences in the performance of the forthcoming ADS. There were also views in the group referring to SAE Levels arguing that of SAE 3 level systems, some could be regarded as ADAS, whereas some other systems could be regarded as ADS. It also seemed that the majority saw that the Automated Lane Keeping Systems ALKS as defined by WP.29 in its Regulation 157 could be regarded as ADS, but there might also be differing interpretations on this.

28. One further conclusion that seemed to gain support in the group is that the basic performance requirements for ADSs to enable the driver to delegate the driving-related responsibilities to it could be established clearly (on a legal level?). These requirements could include at least the following:

- ADS must be able to comply with traffic rules (as already stated in the 2018 Resolution),
- ADS should issue a transition demand when appropriate, in an effective manner with sufficient lead time for the driver to safely assume dynamic control (as already stated by the draft resolution on activities other than driving, but it could be added that the ADS must issue only this kind of transition demands),
- There is no need for (constant) human monitoring either of the traffic environment or the system’s performance, while the ADS is engaged,

- ADS must be able to cope with all kinds of traffic situations without the need for the human to intervene (if necessary e.g. by turning to minimal risk maneuver).

Some key human roles in the context of automated driving and their essential features

29. There is a need to create clarity to the human roles in the context of automated driving. In order to create clarity, the number of (new) roles should be as few as possible. Following to the views of the majority in IGEAD, the distinction below is only made between ADAS and ADS, without an attempt to further subcategorize ADS.

30. There seems to be a general understanding that the full range of driver responsibilities described by the Geneva and Vienna Conventions remain with the driver when using ADAS (or DCAS). It is possible to define further roles (e.g. assisted driver, fall-back ready driver) on the top of the simple “traditional driver”, but they do not change the fundamentals. Driver using ADAS will need to constantly monitor the traffic environment as well as functioning of the systems. It is not possible to perform other activities.

31. There seems to be also an emerging understanding that the dividing point between the human role using ADAS or ADS is that human using ADS should not be required to constantly monitor either the traffic environment or the functioning of the systems. The role of the driver when the ADS is engaged remains still in nominated and would benefit from a clear definition. One possibility could be “user-in-charge”, but there is no common view on this, even though IGEAD agreed to use the term in the table below in its 22nd meeting in September. There is a need for an individual human being inside the vehicle, who will be in charge of non-driving related responsibilities in the Conventions, even while the ADS takes care of the dynamic driving tasks¹. If the ADS issues transition demands, they must be given with sufficient lead time and the human must be receptive to such demands. The human should be able to perform some other activities than driving while the ADS has dynamic control. It should be considered, whether the driver should be held liable for dynamic driving offences carried out by the ADS or not, but this is a decision to be taken on national level.

32. It is possible that also the role and responsibilities of the owner of private vehicle needs to be addressed, since there are for example responsibilities related to requirements vehicles maintenance, but these need to be addressed later on, as well as possible product liability issues.

33. It is also possible that later on in fully automated private vehicles there will still be a need for an individual human being who is in charge of non-driving related responsibilities in the Conventions while the ADS takes care of the dynamic driving tasks (passenger-in-charge?). This role is not further dealt with in this paper.

¹ Note that this paper does not address automated vehicles used for public passenger transport.

Distinction between the human roles when using ADAS or ADS

Distinction between the human roles when using ADAS or ADS	Driver/ADAS	User in charge/ADS
General description of the human role	<p>Human individual with full control/assisted control/supervisory control at the tactical and/or operational level of the driving task.</p> <p>Full control =>"traditional" driver Assisted control =>Assisted driver Continuous supervisory control =>Fall-back ready driver(?).</p>	<p>Human individual in the vehicle with access to the controls of the vehicle, as he/she may become "the driver" along the journey.</p> <p>Has obligations to be qualified and fit to drive, but has no control of the dynamic driving tasks while the ADS is engaged.</p>
Description of driving automation technologies role (while engaged)	<p>"I am assisted in driving or my vehicle is performing longitudinal and/or lateral control for me, but I am responsible to monitor continuously and ensure the safety of the driving task at all times."</p>	<p>"My vehicle is driving for me, and while the ADS is engaged I don't need to monitor either the traffic environment or the functioning of the systems (and so I can engage in NDRA)."</p>
Driving automation technologies used	ADAS	ADS
Responsibilities of the human	<p>Full driver responsibilities ranging from full control of all the dynamic driving tasks to the need to monitor the traffic environment and functioning of the systems.</p> <p>- Also many non-driving related responsibilities.</p>	<ul style="list-style-type: none"> - Need to be receptive to a transition demand for systems that issue them. - Need to take care of duties of drivers that do not arise from dynamic control (such as duty to carry details of the vehicle's registration and behavior in the case of accidents).
Allowed NDRA	Restricted by law, basically same as thus far.	Restricted by law, but may/should be wider than for the driver.
Liabilities	- Full driver responsibility.	<p>To be decided on national level:</p> <ul style="list-style-type: none"> - Immunity for the UIC from dynamic driving offences when the ADS is engaged. - Liability may follow if does not respond to the transition demand + non-driving related duties.