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Automated Vehicles: Policy and Principles Discussion Document

Submitted by Germany, Japan, Spain, the Netherlands and United Kingdom

The information contained in this document is intended to highlight possible policies and principles that could be used to populate a non-binding advisory instrument dedicated to highly automated and fully automated vehicles. The instrument would serve the Contracting Parties to 1949 and/or 1968 Conventions on Road Traffic

Automated Vehicles: Policy and Principles Discussion Document

This document was prepared by the experts from Germany, Japan, Spain, the Netherlands and the United Kingdom of Great Britain and Northern Ireland as a Discussion Paper for WP.1.

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1. INTRODUCTION

1.1 In the 74th session, WP1 agreed to commence a process to create a non-binding advisory instrument dedicated to highly automated (SAE level 4), and fully automated (SAE level 5)[1] vehicles which would serve the Contracting Parties to 1949 and/or 1968 Conventions on Road Traffic. This instrument might form the basis of a legal instrument in the medium term.

1.2 The information contained within this document, is intended to highlight possible policies and principles that could be used to populate that non-binding advisory instrument. This instrument, in the form of guidance issued by WP1, will be created/designed to support the development, deployment and use of highly (SAE level 4) and fully automated (SAE level 5) vehicles, to help increase road safety and facilitate international road traffic. The terms “fully automated” is used instead of “driverless”[2].

1.3 The paper covers and proposes a potential set of draft principles for discussion:

- The potential benefits of automated vehicles;
- The study of alternative mechanisms for the conventions to support the use of self-driving systems and the decision adopted by WP1;
- Proposals for principles in relation to the use of automated vehicles.

[1] See the Society of Automotive Engineers document J3016 [http://standards.sae.org/j3016_201609/], and Annex 1.
[2] See Annex 2, Definitions.

2. The potential benefits of automated vehicles

2.1 Both the 1949 Geneva and the subsequent 1968 Vienna Conventions on Road Traffic relate to the improvement of road safety and facilitation of international road traffic. On-going improvements in road design and construction, vehicle technology (such as collision mitigation), and road use (including safe speeds) have done and will do much to deliver the goals of the conventions. Automation of the driving task is complimentary to, rather than a replacement for, existing activities to improve road safety.

2.2 Increasing the automation of the driving task is not new. Advanced Driver Assistance Systems (ADAS) are becoming increasingly commonplace. Several of the functions already available in the market, such as Autonomous Emergency Braking, have demonstrated a measurable beneficial impact on road safety, reducing both the number and the severity of collisions[3]. The work of the World Forum for the Harmonisation of Vehicle Regulations (WP29) has done much to help bring these technologies to the global market.

2.3 ADAS functionalities are starting to change traditional perceptions of what it means to drive a vehicle. For example, Remote Control Parking expands the concept of the 'driving position' by allowing the driver to be a remote driver[4] and exercise control from outside the vehicle (but in close proximity), rather than having to be sitting behind the steering wheel to exercise control. Newer systems can overtake on high speed roads. These systems nevertheless still require the driver to remain attentive and engaged in the driving task.

2.4 Technological advances are expected to change these traditional perceptions further. The introduction of *conditionally automated vehicles* (i.e. SAE level 3) is imminent. These vehicles' Self-Driving Systems (SDS)[5] undertake more of the Dynamic Driving Task (DDT)[6] than those with ADAS, but rely on the human driver to be a fall back ready user when the vehicle reaches the end of its Operational Design Domain[7] (ODD), or if the vehicle encounters an event that exceeds its capabilities.

2.5 The commercial delivery of vehicles with even more advanced SDS is expected as soon as 2020 or 2021. In less than five years, vehicles could be able to effectively 'drive themselves' for periods of time within a journey without the need for a human

[3] Sources: http://etsc.eu/new-study-confirms-real-world-safety-benefits-of-autonomous-emergency-braking/ and https://publications.europa.eu/es/publication-detail/-/publication/47beb77e-b33e-44c8-b5ed-505acd6e76c0

[4] See Annex 2. Definitions

[5] A self-driving system (SDS) is the combination of hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis, regardless of whether it is limited to a specific operational design domain.

[6] The dynamic driving task (DDT) is all of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, (See Annex 2 for more detail)

[7] An operational design domain (ODD) is the specific conditions under which a given self-driving system or feature thereof is designed to function, including, but not limited to, driving modes.

as the fall-back ready user[8] while the SDS is engaged. The SDS of such *highly automated vehicles* (i.e. SAE Level 4) could manage all the situations it encounters in a specific ODD within a longer journey, e.g. the highway elements of a door to door journey.

2.6 Eventually, automation is expected to mature to the point where the SDS could make an entire journey. This journey could be within a specific ODD (i.e. SAE Level 4 Dedicated Vehicle [DV] operating in a dedicated environment[9]), or in *any* ODD (i.e. SAE Level 5), where human input may be limited to summoning these *fully automated vehicles* and setting the destination.

2.7 Over 90% of road traffic collisions involve some form of human error, although other important factors (such as vehicle design, weather etc.) may interplay with human error in causing collisions. Current ADAS can handle elements of the driving task better than humans and are thus already helping improve road safety by supporting drivers in terms of helping reducing collisions, road injuries and fatalities. The advent of increasingly sophisticated ADAS and SDS promises to start making even further **improvements to road safety**. Importantly, the benefits could extend beyond safety[10]:

- Depending on the evolution of the vehicle usage patterns, less congestion may result in fewer collisions, more efficient use of road space, and more reliable journey times which in turn enhances both the derived societal and environmental benefits; and
- The democratisation of mobility through social inclusion, whereby those who are currently excluded due to age or infirmity could start to enjoy the advantages that motoring can bring.

2.8 In addition to this, there are new industrial opportunities in automotive development and manufacture, and in new mobility services. Potentially more importantly, while the SDS active, it might be possible that the driver could safely undertake activities that would currently be deemed as being distracting and/or hazardous, eventually the ability to use time formerly spent driving on work or leisure tasks.

[8] The user of a vehicle equipped with an engaged SAE Level 3 SDS feature who is able to resume the dynamic driving task, and/or achieve a minimal risk condition following SDS-issued requests to intervene and/or DDT performance-relevant system failures

[9] See Annex 2. Definitions

[10] https://www.mercatus.org/system/files/mercatus-winston-karpilow-autonomous-vehicles-v1.pdf , and "New Estimates of Benefits of Crash Avoidance Features on Passenger Vehicles" Status Report, Vol. 45, No. 5, Insurance Institute for Highway Safety, May 20, 2010.

3. THE STUDY OF ALTERNATIVE MECHANISMS FOR THE CONVENTIONS TO SUPPORT THE USE OF SELF-DRIVING SYSTEMS AND THE DECISION ADOPTED BY WP1

3.1 WP29 has already approved technical regulations for some ADAS systems, and its working groups are considering new ones. Once these new regulations are approved, it will be possible for a manufacturer to build a vehicle that meets these new regulations, and once validated (for example, through type approval or self-certification), sell that system in many global markets. With significant financial and intellectual capital invested by both new and existing players in the automotive industry, new assistive and automated systems will come to the market. To ensure that everyone can safely use and therefore benefit from automated vehicle technology, it is necessary to consider how both Conventions can best support their use. Failure to do so could create a situation where the technology can be sold but not safely used, thus forgoing the lifesaving/changing benefits.

3.2 There are many mechanisms available: changing the Conventions through an amendment, or through a separate text, e.g. non-binding guidance. Each mechanism offers some benefits and has some drawbacks. However, simply choosing and using a mechanism will not, in and of itself, enable the safe use of ADAS or SDS in the various contracting parties. National action (and possibly supranational action, e.g. in the case of the EU) will be needed to amend domestic regulatory frameworks too. By first enhancing the common understanding of how the Conventions work in the modern world, national/domestic or supranational laws and requirements can be changed without risking the goals of the Conventions.

3.3 During the 74th session of WP1, there were deep analysis and discussions on how to move forward in relation to the safe use of SDS. Some contracting parties to one or both Conventions were in favour of amending the Conventions, and some others highlighted the need to adopt other legal approaches, such as guidance that could show, as one of its aims, how SDS can be safely used in a way that is not contrary to the principles of the Conventions.

3.4 Convention amendments are useful tools in areas where the scientific or other knowledge in a Convention's subject area is reasonably settled. With respect to amendment, the following aspects should be highlighted:

- firstly, that there are significant difficulties in amending the Geneva Convention which could result in fragmentation of approaches amongst the contracting parties; and
- secondly, amending the Conventions to provide for every single aspect or function of new vehicle technology may result in a "patchwork of successive amendments" which would imply a legally deficient international instrument.

3.5 A binding text specifically dedicated to the use of SDS that sets compulsory provisions at this time, might run the risk of inadvertently creating barriers to deployment and use of automated vehicles, as the technology is still in development and evolving rapidly. Additionally, the time taken to reach a consensus on what a definitive text should say would delay the safety and other socioeconomic benefits of introducing these technologies.

3.6 A convention change, either through amendments or binding text, will not support the short to medium term development, deployment, or even use of increasingly sophisticated automated vehicle technologies. This could even hinder international efforts to meet the twin goals of both Conventions, safety and cross border traffic, by slowing down deployment or creating inconsistencies between the two Conventions. However, the need for such a change in the long term cannot be ruled out at this stage.

3.7 As technology advances, those responsible for the Conventions need to be agile and willing to deploy the necessary tools at the right time. At this point, issuing guidance could help contracting parties to change their legal frameworks in a harmonised way without the risk of their citizens being at a disadvantage when traveling in a neighbouring country. Through national traffic rules, motorists would enjoy clear information about how to use these new technologies safely, and thus take advantage of the benefits; other citizens would enjoy the safety and other socioeconomic benefits. Manufacturers would know the requirements under which they can sell the technology, and generate a return on their investment.

3.8 The guidance documents could be updated more rapidly than a convention can be changed, which would allow WP1 to stay abreast of technological changes. The solutions developed for the short and medium term could be used to help develop a longer-term solution, possibly in the form of a binding legal instrument. More importantly, evidence from real world use, enabled by the guidance, would be extremely valuable for creating this instrument.

3.9 Considering these points, WP1 decided to draft a non-binding instrument on highly and fully automated driving[11]. This will clarify possible issues, set harmonized definitions and establish common general, or overarching, principles that enable deployment and use, and possibly act as the basis of a future international legal instrument.

[11] See https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp1/ECE-TRANS-WP1-157e.pdf Report of the Working Party on Road Traffic Safety on its 74. Session, C. Automated Driving, 22. "*WP.1 also agreed to commence a process to create a non-binding advisory instrument dedicated to the highly automated and/or driverless vehicles which would serve the Contracting Parties to 1949 and 1968 Conventions on Road Traffic […]*"

4. PROPOSED KEY PRINCIPLES FOR THE USE OF AUTOMATED VEHICLES

4.1 The overall basis of this document is to promote the development and safety of international road traffic as it relates to the use of SDS by proposing certain uniform principles that countries may promote in accordance with their national laws and processes. The principles cover:

- The role of the driver, and the different levels of driving;
- The nature of control;
- Compliance with traffic rules;
- The nature of the driver; and
- A look ahead.

4.2 These principles could be the foundation upon which a future binding international legal regulation could be set out. They are designed to help contracting parties to create new, or amend existing, national/domestic laws and guidance in a way that encourages harmonisation. In doing so, the guidance would support the safety and cross-border travel goals of the Conventions.

THE ROLE OF THE DRIVER, AND THE DIFFERENT LEVELS OF DRIVING

4.3 The introduction of SDS in vehicles will change the role of human drivers who will, at times, be able to relinquish active physical control of the driving task, or even disengage themselves completely.

4.4 The overall act of driving can be divided into three levels of driver effort in relation to skills and control: Strategic (planning), Tactical (manoeuvring), and Operational (control), (Michon, 1985)[12].

4.5 The strategic level (see Figure 1) defines the general planning stage of a trip, including the determination of trip goals, route, and modal choice, plus an evaluation of the costs and risks involved. Plans derive further from general considerations about transport and mobility, and also from concomitant factors such as aesthetic satisfaction and comfort.

4.6 At the tactical level drivers exercise manoeuvre control, allowing them to negotiate the directly prevailing circumstances. Although largely constrained by the exigencies of the actual situation, manoeuvre such as obstacle avoidance, gap acceptance, turning and overtaking must meet the criteria derived from the general goals set at the strategic level.

[12] http://jamichon.nl/jam_writings/1985_criticial_view.pdf

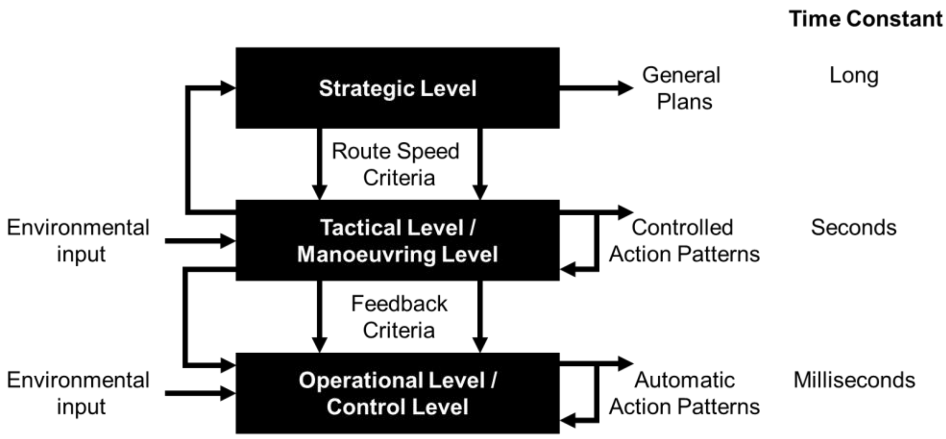

Figure 1: The hierarchical model of the driving task, indicating internal and external outputs. Adapted from the work of Michon, 1985

4.7 Operational effort involves split-second reactions that can be considered pre-cognitive or innate, such as making micro-corrections to steering, braking and accelerating to maintain lane position in traffic or to avoid a sudden obstacle or hazardous event in the vehicle's pathway.

4.8 Together the operational and tactical levels make up the dynamic driving task (DDT). For SDS where the functionality allows the driver to completely disengage from the DDT and hand responsibility for some of the journey, drivers would still be able to control the vehicle when the SDS is inactive, either through choice or because the vehicle is outside of its ODD[13]; therefore, drivers can perform the three levels of driving depending on the environment, operational parameters and/or functions capabilities.

4.9 In the case of an SDS that enables an entire 'door-to-door' journey with no human physical intervention, humans, irrespective of being present in the vehicle or not, will only exercise control at a strategic level issuing commands (such as routing options or intermediate or final destinations).

4.10 In summary, <u>with respect to highly and fully automated vehicles and the role of the driver</u>, the following principles are proposed:

a. The three levels of driving are strategic, tactical, and operational.

b. The dynamic driving task (DDT) is made up of the operational and tactical levels.

c. The user of the vehicle, who may not be inside the vehicle, will normally exercise strategic level control, while the self-driving system will perform the DDT when it is active. .

[13] This would also apply to systems that map to SAE level 4, and so-called 'dual use' level 5 vehicles which retain manual or assisted control interfaces.

THE NATURE OF CONTROL

4.11 In current road traffic rules, the concept of control has been important because the person in control of a vehicle is responsible for the actions of that vehicle.

4.12 The SDS will perform the DDT, raising the question of whether the human driver/user/operator or the SDS is in control of the actions of the vehicle.

4.13 The principle that the driver shall be able to control the vehicle at all times has been set in legal instruments, both at international and national level.

4.14 Neither Convention, nor supplementary text, defines the word control. Though 'control' has not been stated in any traffic regulation, in relation to road traffic, control is linked to two different objectives. Firstly, it facilitates compliance with the traffic rules; and secondly, it enables reasonable judgment in situations not expressly addressed by those rules. Therefore, control in this sense can be considered as a capability or a function. In case of conditionally automated vehicles (i.e. SAE Level 3), where human drivers are the fall back ready user (i.e. able resume control of the DDT when needed), the driver will have strategic, operational, and tactical control of the vehicle, at all times.

4.15 Hence, with respect to highly, and fully automated vehicles and the nature of control, the following principles are proposed:

a. With regard to highly and fully automated vehicles (i.e. SAE Level 4 & 5), the SDS will exercise operational and tactical control of the vehicle while operating in its ODD. If the user of a highly or fully automated vehicle overrides [disengages] the SDS, then they will have strategic, operational, and tactical control.

b. In relation to highly and fully automated vehicles there will always be a person who exercise strategic control of such vehicle.

c. It is important to understand who or what is in control of the vehicle at any moment in time, especially in case of an unexpected event that could impact road traffic safety: The UNECE should establish what relevant data (including who or what undertaking the DDT) is needed to help in this understanding.

COMPLIANCE WITH TRAFFIC RULES

4.16 While the is SDS engaged, and performing the DDT [without the need for the fall back ready user], it may be considered to be the driver in case of both highly and fully automated vehicles, or only in case of fully automated driving vehicles. On this issue further discussion has to needed. However, the SDS must obey and comply with all applicable traffic rules set by international or national/domestic road traffic regulations.

4.17 Those traffic rules that prescribe human driver behaviour (e.g. impaired driving, use of mobile phones, etc.) may not apply to users while the SDS is engaged, or may apply differently. Art 8.6 of the Vienna Convention (minimising non-driving tasks), and Art 10 of the Geneva Convention (drive in a reasonable and prudent manner) effectively impose a requirement on the driver to exercise discretion in adapting their behaviour as appropriate to the level of automation in use in their vehicle at any moment in time.

4.18 Contracting parties may need to consider if traffic rules aimed at vehicle passengers and/or vehicle operators will apply differently when SDS, especially in highly and fully automated vehicles, are in use.

4.19 However, a human driver who has adapted their behaviour should still be able to safely resume the DDT should they need to, or wish to. This is especially relevant for:

- conditionally automated vehicles, where the driver is the fall back ready user and may be required to resume the DDT at any time;
- highly automated vehicles, which might require the driver to resume the DDT at the end of the ODD in order to continue the trip outside that ODD; and
- 'dual-use' fully automated vehicles that have functionality for the user to directly perform the DDT should they so wish to.

4.20 The use of SDS may not impact on traffic rules relating to the passengers of a highly or fully automated vehicle. It is possible that such traffic rules may apply to a user in a highly or fully automated vehicle while the SDS is engaged.

4.21 <u>With regard to highly and fully automated vehicles and compliance with traffic rules</u>, the following principles are proposed:

a. Contracting Parties should ensure, in accordance with their own domestic circumstances and internal divisions of roles and responsibilities, that all applicable traffic rules (including laws and guidance) pertaining to the usage automated vehicle are made readily available to the public, allowing all road users the ability to inform themselves of these rules in the jurisdiction where they intend to use a vehicle with SDS.

b. The SDS, when engaged, should obey all applicable traffic rules.

c. A human driver using a conditionally, highly, or fully automated vehicle should adapt their behaviour based on the functionality of the SDS, according to its designed and given capabilities and limitations. If a human driver undertakes non-driving activities while the SDS is engaged, such activities should

   i. Not prevent a human driver from safely resuming proper control of the vehicle, by diminishing their situational awareness to an unacceptable level; and

   ii. Be in line with the prescribed use of the vehicle systems and their defined functions

d. SDS shall be in conformity with any applicable law, especially those related to registration, homologation and manufacture.

e. Any UNECE Vehicle Regulation for SDS should include elements to [help] verify that these systems comply with national road traffic rules at the time of their release, and following any updates.

THE NATURE OF THE DRIVER

4.22 Since the SDS, when activated, will control the vehicle actions and shall comply with traffic rules, as stated above, there is a need to determine the nature of the driver. Both Conventions define a ‘driver’ as ‘a person who drives’; they leave open the definition of ‘person’. This flexibility, combined with the advent of new technologies, opens the possibility of some parts of the driving task being performed by something other than a human being. It is important to remember that the driving task can be split in to the dynamic driving task (i.e. the operational and tactical tasks, as defined by Michon, 19865), and the strategic driving task.

4.23 To facilitate road safety, one of the objectives of the existing Conventions on Road Traffic is to establish how road users shall behave and act to minimise any danger or risk to other road users, as set out in art. 7.1 Vienna Convention and art. 7 Geneva Convention. This objective should be preserved with regards to the use of automated vehicles. Therefore, while the introduction of SDS may appear to change the superficial meaning of these principles, it actually enhances and furthers the underlying goal of improving road safety.

4.24 Depending on the level of automation and the specific ODD, there might be different “drivers” for different parts of the journey or for the different aspects and roles of the driving task. Therefore, in some moments of a journey, the driver could be a human being, or the system. Each would perform different tasks at different times to ensure that the vehicle is under proper control at all times. In other words, the driver could be a human being (exclusively performing the strategic driving task, or both the strategic and dynamic driving task) inside or outside the vehicle (i.e. a remote driver or dispatcher[14]), or the system (performing some or all elements of the dynamic driving task, and potentially elements of strategic task[15]), or both[16]. However, it is clear that the strategic task must be done by a person.

4.25 In summary, <u>with respect to highly and fully automated vehicles and the nature of the driver</u>, the following principles are proposed:

a. SDS shall comply with relevant national laws and avoid any behaviour likely to

i. endanger other road users;

ii. obstruct traffic; and/or

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[14] See Annex 2 Definitions
[15] For example, routing, but not destination planning.
[16] The driver might, at the start of the journey, be a human who turns on the SDS, which will then perform the entire DDT. For example:

a. In a vehicle with highway chauffeur, the driver may initially be the human who controls the vehicle until the highway is reached and then activates the SDS. Then the driving task is divided between the human, who retains the strategic task, and the SDS, which performs the DDT. The SDS becomes the dynamic driver, until the human (who has remained the ‘strategic driver’ all along) resumes the DDT.
b. In a fully automated taxi delivering an on-demand mobility service, the driver could be a remote driver (i.e. a human dispatcher) who instructs (i.e. performs the strategic driving task) the vehicle to move around a city. The SDS acts as the dynamic driver until a person chooses to use it; the user of the fully automated taxi may or may not then become the strategic driver, while the SDS continues to perform the DDT.

iii. cause damage to, or endanger, public or private property.

b. Depending on who or what performs the DDT, the driver may be a person or the system when engaged.

c. The strategic driver shall always be a person who is able to specify the parameters of operation for an automated vehicle or several automated vehicles, even when the SDS is active.

A LOOK AHEAD

4.26 Although liability and responsibility is beyond the remit of UNECE and WP1, it might be important to highlight the future and likely necessity of Contracting Parties to tackle this issue.

4.27 International road traffic instruments have set general principles – some of them *ius cogens* provisions (i.e. fundamental provisions which must be complied with) – with respect to compliance with traffic rules and the behaviour of drivers. Contracting parties have used their national traffic rules to provide additional detail on the general provisions in the Conventions, and, importantly, set out the consequences of not acting in conformity with those rules.

4.28 When the SDS is not engaged, then the human driver is effectively no different from a driver of a conventional vehicle, even if they are using non-traditional control interfaces (e.g. a remote-control device). Therefore, they should be a licensed driver, and comply with all relevant traffic rules, just as if they were driving a conventional vehicle.

4.29 When the SDS is engaged, it should avoid any behaviour likely to endanger any road user, obstruct traffic and/or cause property damage. Ensuring this may create new responsibilities or alter existing different responsibilities domestically. And, contracting parties will need to be able to deal with the possibility that the SDS may, for one reason or another, may fail to comply with traffic rules and create a negative impact.

4.30 Some recent studies and declarations[17,18] have pointed out the difficulties of allocating responsibility to an autonomous system such as an SDS. The Conventions' require that there be a person who drives the vehicle: this person could be the person that has ultimate responsibility for the strategic driving task. It is possible, but may not be appropriate, for that person to be held liable for any failure on the part of the SDS. The actual causality of events and behaviour/proper functioning from human and/or system may be a strong determining factor for defining and allocating the actual responsibility in any case. These issues have to be resolved at the domestic level.

4.31 Assigning criminal and civil liability in the event of a traffic violation or a collision involving an automated vehicle goes beyond the scope of the International Road

[17] Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)) Committee on Legal Affairs, European Parliament, http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2017-0005+0+DOC+XML+V0//EN#
[18] http://www.europarl.europa.eu/RegData/etudes/STUD/2016/571379/IPOL_STU(2016)571379_EN.pdf

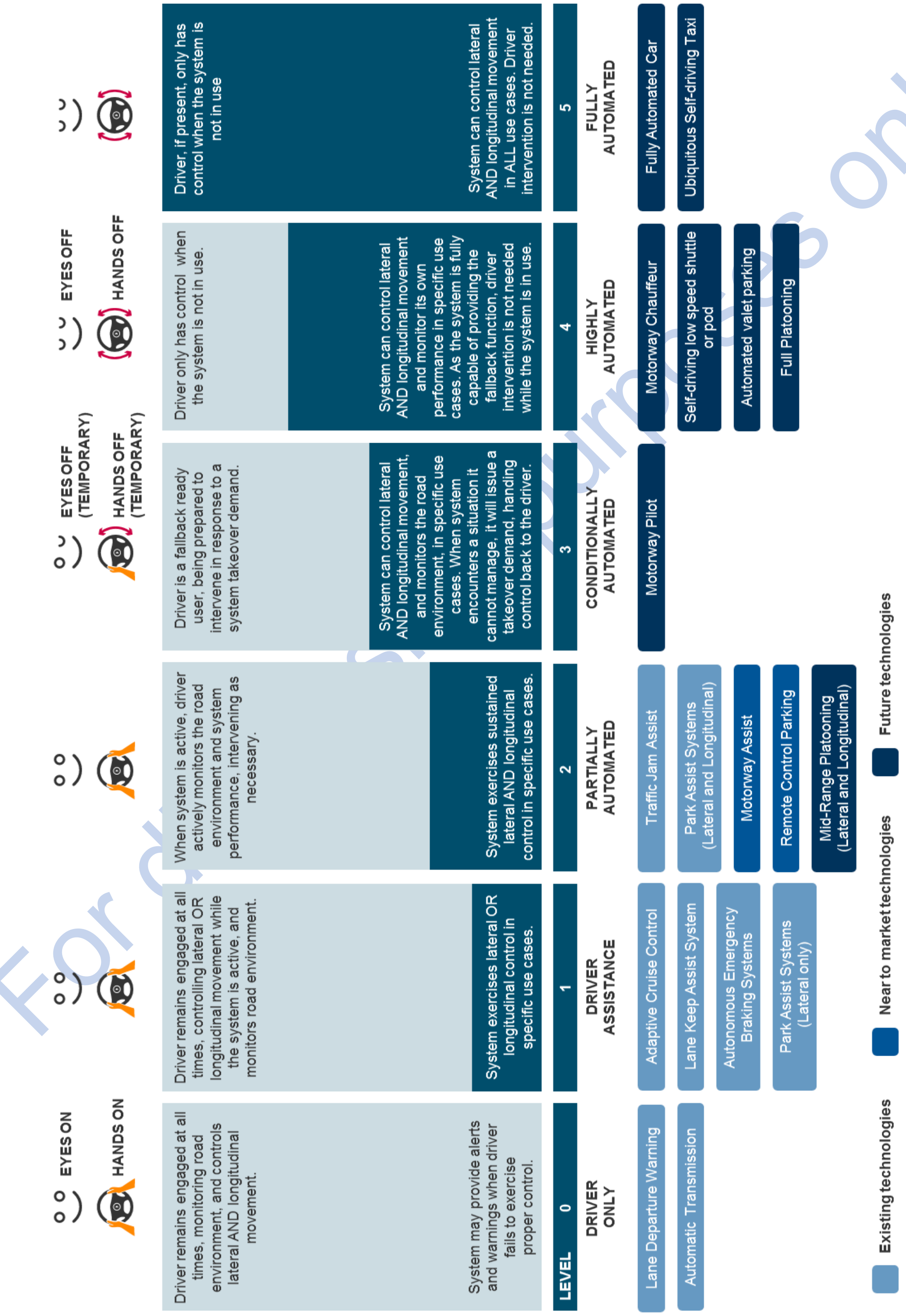
Traffic Conventions. Therefore, contracting parties might need to establish domestic regimes to do this (either by providing guidance, allowing a body of case law to develop, or creating their own legislative frameworks, etc.). These domestic regimes could define the liability as, for example, resting with a human (e.g. the user or owner of the vehicle), legal person (e.g. the manufacturer, or operator of the vehicle) or even a nominated human who works within a legal entity (e.g. a dispatcher or supervisor). To facilitate international travel, contracting parties should make sure that their domestic regimes are easily understood by drivers from other contracting parties; they may also wish to try to harmonise such regimes if this is practical or possible.

4.32 In summary, with respect to highly and fully automated vehicles, the following proposals would need to be considered at a domestic level:

a. Contracting Parties should, in accordance with their domestic circumstances, ensure that legal regimes are adapted or created to address civil and criminal liability issues in relation to incidents that involve the use of SDS.

b. Contracting parties should ensure that all applicable laws and guidance on these new, or adapted, legal regimes are made readily available to the public, allowing all road users the ability to inform themselves of relevant laws and procedures in the jurisdiction where they intend to use an SDS.

ANNEX A: THE SAE LEVELS OF VEHICLE AUTOMATION



This infographic is adapted from the Society of Automotive Engineers J3016 Standard "Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems" (http://standards.sae.org/j3016_201609/). While these are not formally recognised by the UK Government, or the United Nations World Forum for Harmonisation of Vehicle Standards, they are seen as a helpful guide to automated vehicle technology, describing what the system and driver can do at each level. In level 4 and 5 systems, the driver effectively becomes a passenger if they are inside the vehicle when the system is active. The driver may be outside the vehicle, in which case they are a remote driver (levels 0 to 3), or a dispatcher (level 5, and some level 4 systems) when the system is active. The graphic some shows example systems (a vehicle may have multiple systems of different levels.

ANNEX B: DEFINITIONS

Term	Meaning
Advanced Driver Assistant System (ADAS):	A vehicle automation system that does not perform the entire DDT, nor does it recognise its limitations with lead time. The driver is assisted with the DDT and needs to monitor and be able to intervene immediately (e.g. SAE Level 1 functions such as Lane Keep Assist, and Level 2 functions like Traffic Jam Assist)
Dynamic Driving Task (DDT):	All of the real-time operational and tactical functions (a defined by Michon, 1985) required to operate a vehicle in on-road traffic, (monitoring and responding to the driving environment, ordering and supervising manoeuvres and maintaining constant control of all driving tasks), excluding the strategic elements (see Strategic Driving Task) and including without limitation: • Lateral vehicle motion control via steering (operational); • Longitudinal vehicle motion control via acceleration and deceleration (operational); • Monitoring the driving environment via object and event detection, recognition, classification, and response preparation (operational and tactical); • Object and event response execution (operational and tactical); • Manoeuvre planning (tactical); and • Enhancing clear visibility via lighting, signalling and gesturing, etc. (tactical).
(DDT) Fall back	The response by the user or by a SDS to either perform the DDT or achieve a minimal risk condition after occurrence of a DDT performance-relevant system failure(s) or upon ODD exit.
(DDT) Fall back ready user	The user of a vehicle equipped with an engaged SAE Level 3 SDS feature who is able to operate the vehicle following a system-issued requests to intervene and/or DDT performance-relevant system failures in the vehicle compelling them to perform the DDT fall back.
Self-Driving System (SDS):	A self-driving system is the combination of hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis, regardless of

	whether it is limited to a specific operational design domain. The SDS may be found in a conditionally automated vehicle, a highly automated vehicle, or a fully automated vehicle • Conditionally Automated Vehicle: A vehicle equipped with SDS equivalent to SAE Level 3. The SDS recognises its limitations/end of the ODD with lead time and issues a transition demand to the driver. While the driver does not need to permanently monitor the driving environment, they are the fall back ready user, and are expected to be receptive and able to resume the DDT in response to a system request or system failure. For example: – SAE Level 3, which requires the driver to intervene upon a transition demand, e.g. a Highway-Pilot that keeps to the lane and is able to perform lane changes without confirmation by the driver • Highly Automated Vehicle: A vehicle equipped with SDS equivalent to SAE Level 4. The SDS recognises its limitations/end of the ODD with lead time and issues a transition demand to the driver. The driver does not need to permanently monitor the driving environment, and the system can perform the entire DDT fall back in case the driver fails to respond to the transition demand. The driver would be expected to resume the DDT to continue the trip outside of the ODD. Some Contracting Parties consider all occupants to be passengers while the SDS is engaged though they may still be performing the strategic driving task. Other Contracting Parties consider the user still as driver while the SDS is engaged. Thus, further discussion is needed on this point. – SAE Level 4, which requires a human driver to reach a specific ODD and then activate the SDS for travel within that ODD (e.g. Motorway Chauffeur). • Fully automated vehicle: A vehicle equipped with SDS equivalent to SAE Level 4 or 5. The system performs the entire DDT and DDT fall back within a specific ODD (SAE Level 4) or all ODDs (SAE Level 5). No occupant is expected to perform any part of the DDT, though if the vehicle is suitably equipped (a ‘dual’ use fully automated vehicle) and the occupant has the necessary skills and qualifications [licenses] they may choose to perform the DDT. All occupants may be considered as passengers when the SDS is engaged. – SAE Level 4 Dedicated Vehicle, which operates

	without a human driver within a specified ODD, (e.g. dedicated autonomous shuttle) – SAE Level 5, as SAE level 4 Dedicated Vehicle but in all ODDs (e.g. ubiquitous autonomous taxi)
Strategic Driving Task:	The strategic functions of driving, such as trip scheduling and selection of destinations and waypoints.
(Human) User	A general term referencing the human role in driving automation. Under this definition the following three terms (1 – *driver/remote driver*, 2 – *passenger*, 3 – *dispatcher*) can describe categories of (human*) users*. These human categories define roles that do not overlap and may be performed in varying sequences during a given trip. • Driver A person who drives; undertaking the strategic driving task, and may perform (in real-time) part or all of the DDT and/or DDT fall back for a particular vehicle. In a vehicle equipped with a driving automation function, a driver may assume or resume performance of part or all of the DDT from the system during a given trip. • Remote Driver A driver who is not within the vehicle, and thus unable to manually exercise in-vehicle braking, accelerating, steering, and transmission gear selection input devices (if any) but is able to control the vehicle by way of a remote-control device. • Passenger A user in a vehicle who, generally, has no role in the operation of that vehicle (but where SDS is in use, may still be the strategic driver). • Dispatcher A remote driver(s) who verifies the operational readiness of the vehicle and SDS (even in an SAE Level 4-DV as defined in paragraph 4.24 and 4.32) and engages or disengages the SDS.