European Commission

Autonomous Vehicles & Traffic Safety

Summary

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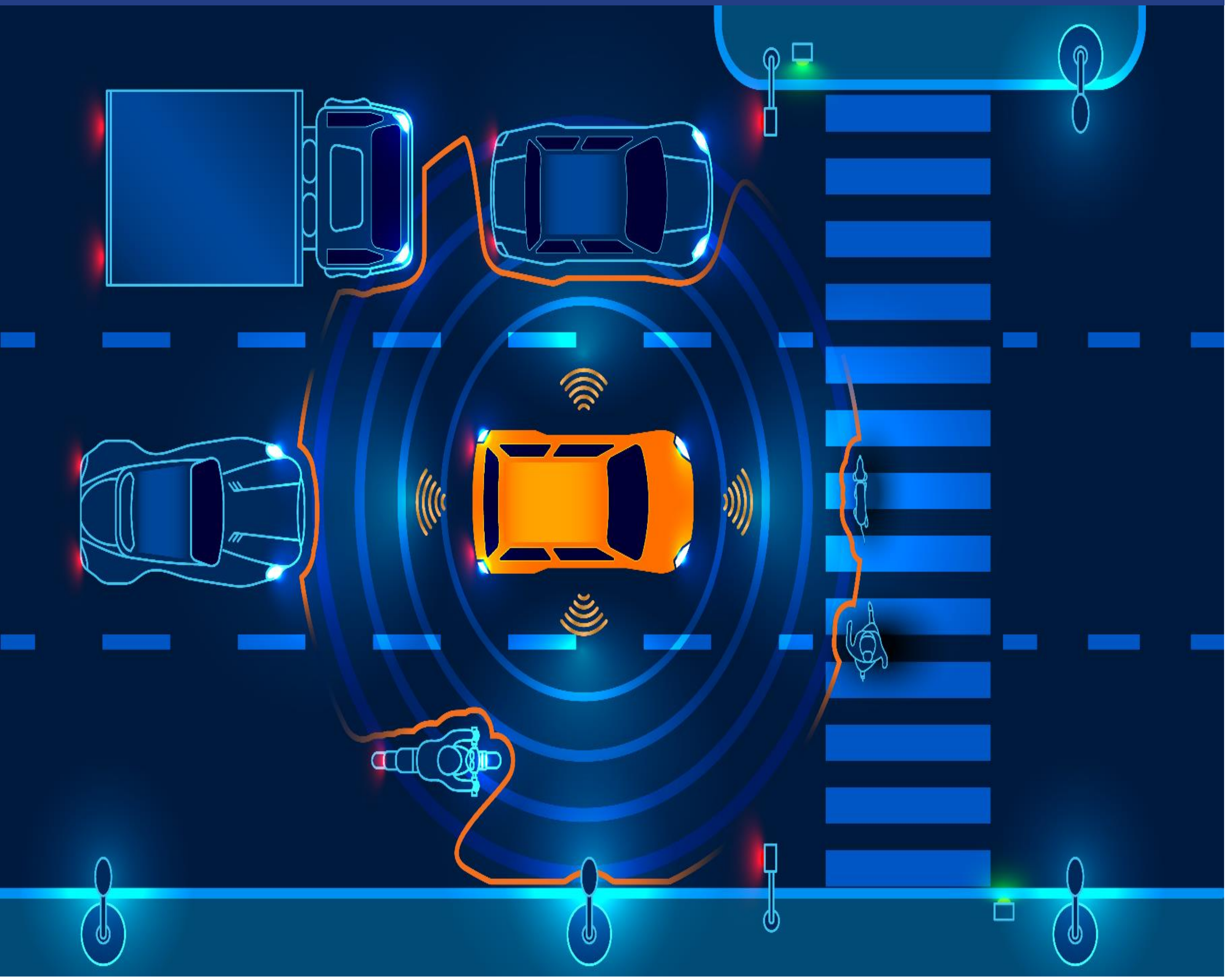

Transport

What are autonomous and connected vehicles?

Autonomous or Automated Vehicles (AVs) are vehicles that are operated by an artificial intelligence in place of a human driver. AVs use arrays of sensors and auxiliary devices to collect information of the surroundings of the vehicle, and/ or devices for intercommunication with other vehicles or infrastructure elements, namely vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication (collectively known as V2X schemes). These systems provide input to the algorithms that are used to provide all driving related controls and decision making that substitutes traditional drivers.

Connected Vehicles (CVs) are conventional vehicles that are still operated by a human driver, which are also enhanced via various technological and electronic devices and upgrades. These devices allow intercommunication of vehicles through V2X schemes as well. Thus drivers receive more enriched information about the entirety of the driving environment than they normally would.

What are automation Levels?

Within the transport community, five descriptive Levels of automation, additional to baseline unautomated driving (Level 0) are widely recognized, ranging from Level 1 (Driver Assistance) to Level 5 (Full Automation). In Levels 0 to 2 the human driver monitors the driving enviroment, whereas in Levels 3 to 5 the automated driving system.

What is the current technological state?

There are several technological components integral to AVs and CVs that are commercially available currently, including adaptive cruise control (ACC), collision warning, autonomous emergency braking (AEB), lane departure warning (LDW) and lane keeping assistance (LKA) systems, etc. Field tests for more (or completely) independent vehicles are currently underway by the industry.

What are the impacts of vehicle automation on safety?

Direct safety impacts:

AVs are expected to be very beneficial overall, eliminating a large amount of the human element that leads to so many crashes nowadays. However, the exact safety benefits are still unclear and quite difficult to estimate, due to the very large number of unknown parameters. As a numerical indication, it has been estimated that, for AV penetration rates of 10%, 50% and 90%, a corresponding 1.100, 9.600 and 21.700 lives saved per year in the US can be expected.

Indirect safety implications:

Mechanical and physical safety is paramount if AVs start operating widely. AVs could likely generate additional traffic demand and vehicle-kilometers travelled, with more sophisticated and obscure functions. Thus all mechanical systems would have to have resilience and considerable redundancies, in order to not compromise passenger safety, which would be mostly dependent on the automated systems. Cybersecurity concerns should be addressed by manufacturers and governments to avoid any malicious interventions.

Traffic safety in the transition phase:

There are concerns that during the transition phase, where AVs will share the road network with human drivers, safety levels might decline, at least for human drivers. Traffic system will have to cope with 'mixed traffic', i.e. with vehicles of different Levels of automation (or no automation) operating simultaneously. This can potentially impose an increased risk to road users, who will not be able to know to what extent another vehicle is automated, what behavior is therefore to be expected, and how they must anticipate and interact. Also, it is critical that autonomous vehicle systems take properly into account the interaction with vulnerable road users, such as pedestrians, cyclists and powered two wheelers, and that the behavior of automated vehicles - or partially automated vehicles in the transition phase - is understandable and predictable by them.

What are other implications of vehicle automation?

Infrastructure adaptation

In order to make AVs feasible, it is imperative that the driving environment, i.e. road infrastructure, is compatible with their requirements. These requirements may differ significantly, depending on the autonomous technology approach, and could refer to Road Side Equipment (RSE) deployed in several points along the road network, custom reflective road markings and signage that can be read from AVs etc. An additional issue of concern are temporary infrastructure interventions (i.e. workzones).

Legislation issues

The main obstacles consist of vehicles being taken from human control, and given to artificial intelligence; in the event of a crash, it can be unclear to discern whether the liability lies with passengers or manufacturers. The consensus seems to be to charge manufacturers for actions of AVs, and passengers for altering their operational mode. Additionally, the standards with which an AV will be judged as roadworthy are under consideration.

Economic impacts

Crash costs are expected to decrease, both collectively due to fewer crashes occurring but also individually, due to improved pro-and-after crash functions (e.g. e-call). Additional reforms might be introduced in the industry since manufacturers will have to internalize several externality costs, especially when they are being assigned crash liability.

What are the future challenges?

The greatest challenge is to not lose sight of safety amidst enthusiasm. New opportunities for capacity increases and vehicle repurposing will captivate the interests of manufacturers and network administrators, and raffic safety could be very easily disregarded at first, in order to increase market shares of the new technologies.

Both the expertise to exploit existing traffic safety knowledge drawn from current practices and the intuition to navigate a digitally intelligent transport system will be demanded from traffic safety scientists and practitioners, and specialized training may be required. As a positive development, there will be interconnection with conventional road safety at least during the first years of automation, with mutual benefits.

On the road towards automation, significant initiatives have been taken up to now, particularly from the private sector. However there is still a lot of ground to cover for proper and smooth integration and transition. There should be a consensus on how to determine whether an automated system is roadworthy, whether from adhesion to standards or self-policing demonstrations.

Notes

1. Country abbreviations

Belgium	BE	Italy	IT	Romania	RO
Bulgaria	BG	Cyprus	CY	Slovenia	SI
Czech Republic	CZ	Latvia	LV	Slovakia	SK
Denmark	DK	Lithuania	LT	Finland	FI
Germany	DE	Luxembourg	LU	Sweden	SE
Estonia	EE	Hungary	HU	United Kingdom	UK
Ireland	IE	Malta	MT		
Greece	EL	Netherlands	NL	Iceland	IS
Spain	ES	Austria	AT	Liechtenstein	LI
France	FR	Poland	PL	Norway	NO
Croatia	HR	Portugal	PT	Switzerland	CH

2. This 2018 edition of Traffic Safety Synthesis on Autonomous Vehicles & Traffic Safety was written by Apostolos Ziakopoulos and George Yannis, from the National Technical University of Athens (NTUA), Athens, Greece.

3. All Traffic Safety Syntheses of the European Road Safety Observatory have been peer reviewed by the Scientific Editorial Board composed by: George Yannis, NTUA (chair), Robert Bauer, KFV, Christophe Nicodème, ERF, Klaus Machata, KFV, Eleonora Papadimitriou, NTUA, Pete Thomas, Loughborough University, UK.

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5. Please refer to this Report as follows:
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