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PARLIAMENT, THE COUNCIL, THE EUROPEAN
ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS**

On the road to automated mobility: An EU strategy for mobility of the future

1. CONNECTED AND AUTOMATED MOBILITY IS A NEW OPPORTUNITY FOR EUROPE

Mobility is at a cross-roads. There have been many significant steps forward over the last century in road transport. But mobility is now crossing a new – digital – frontier with increasing automation and connectivity allowing vehicles to "talk" to each other, to the road infrastructure, and to other road users. These developments, that benefit from the progress in the field of Artificial Intelligence¹, open up an entirely new level of cooperation between road users which could potentially bring enormous benefits for them and for the mobility system as a whole, including making transport safer, more accessible and sustainable.

Driverless vehicles will change our lives, just as steam trains and motor cars did before them. They will shape the future of road transport and could lead to significantly reduced transport costs. They could pave the way for new services and offer new ways to respond to the ever-increasing demand for mobility of people and goods. Once the current teething problems have been properly addressed – and they must be, driverless vehicles could significantly improve road safety since human error is estimated to play a role in 94 per cent of accidents². Driverless vehicles could bring mobility to those who cannot drive themselves (e.g. elderly or disabled people) or are under-served by public transport. They could encourage car-sharing schemes and 'mobility as a service'³ (i.e. selling rides, not cars). They could also accelerate vehicle electrification and electro-mobility⁴. Ultimately, driverless vehicles could free up the space wasted in parking and revolutionise urban planning.

The EU is one of the largest exporters of vehicle technologies. Its businesses stand to benefit from the dynamic growth⁵ of the sector. High levels of investment will be needed and new jobs will be created to develop new technologies and services. The EU automotive industry, with its expertise in developing vehicle technologies, is well-positioned to seize this opportunity⁶. Moreover, automated vehicles will also have spill-over effects on many other sectors in the value chain (e.g. semiconductors, processing technologies, digital maps) and the new business models enabled or facilitated by driverless mobility (e.g. electronic commerce, 'mobility as a service').

However, we cannot expect such technological changes alone to solve the challenges of congestion, transport emissions and road fatalities. We need to manage properly the long transition phase and make sure future vehicles are embedded in a transport system that favours social inclusion, low emissions and overall efficiency. We need to strengthen the links between vehicles and traffic management, between public and privately owned data, between collective and individual transport and between all transport service providers and modes.

Initial studies show that a majority of Europeans citizens have a good acceptance of driverless cars with 58 per cent willing to take a ride in a driverless vehicle⁷. However, as the latest accidents in the United States have shown, in order for automated mobility to gain societal acceptance only the highest safety and security standards will suffice. New risks such as

¹ Communication from the Commission "Artificial intelligence for Europe" of 25 April, COM(2018) 237.

² Commission's report on Saving Lives: Boosting Car Safety in the EU, COM(2016) 787.

³ Labour cost represents 60% of the costs of ride-hailing services.

⁴ UBS bank forecasts that automation, competition and electrification will cut the cost of ride-hailing by 70%.

⁵ According to Boston Consulting Group, automated vehicles should represent 20% of global vehicle sales in 2025.

⁶ <https://connectedautomateddriving.eu/mediaroom/europe-leading-patent-race-autonomous-driving/>

⁷ World Economic Forum, Self-driving vehicles in an urban context, January 2016.

overreliance on, and misuse of, technology should be addressed. New questions such as the level of infrastructure support for driverless vehicles and how this infrastructure should interact with the vehicles should be tackled. Ethical issues related to transferring the responsibility of driving to vehicles must also be addressed. This includes our expectations for how a vehicle should react when an accident cannot be avoided and criteria used to determine vehicle's decision. Linked to this we need to ask ourselves who is liable when a driverless vehicle is involved in an accident.

It is also essential to find the right balance between sharing public and private data, enabling fair and effective competition for innovative solutions, and data protection. As we share more data and as the number of players involved increases, it is necessary to ensure that Europe remains competitive in all phases of driverless mobility, up to and including bringing these final services to our citizens and our businesses. Finally, the disruptive effect of driverless mobility on the labour market will have to be addressed, particularly the need for skilling and reskilling (e.g. professional drivers would initially gain freedom to perform additional tasks but could in the long-term no longer be needed in the vehicles).

Provided the regulatory and enabling framework is in place to address all these issues the first vehicles driving themselves under specific driving conditions could be available on a commercial basis by 2020, and they could become commonplace by 2030.

In other words, driverless mobility promises great benefits but also poses serious questions. We are in a global race to reap the benefits and answer the questions raised, as this provides a major opportunity for growth and jobs. The new market for automated and connected vehicles is expected to grow exponentially and large economic benefits are expected, with for instance revenues exceeding EUR 620 billion by 2025 for the EU automotive industry and EUR 180 billion for the EU electronic sector⁸. Automated mobility could therefore support the EU ambition for a stronger and more competitive industry⁹, creating new jobs and boosting economic growth.

With this Communication, the Commission proposes a comprehensive EU approach towards connected and automated mobility setting out a clear, forward looking and ambitious European agenda. This agenda provides a common vision and identifies supporting actions for developing and deploying key technologies, services and infrastructure. It will ensure that EU legal and policy frameworks are ready to support the deployment of safe connected and automated mobility, while simultaneously addressing societal and environmental concerns which will be decisive for public acceptance.

2. THE EU VISION OF CONNECTED AND AUTOMATED MOBILITY

The ambition is to make Europe a world leader in the deployment of connected and automated mobility, making a step-change in Europe in bringing down the number of road fatalities, reducing harmful emissions from transport and reducing congestion. The deployment of driverless mobility – when fully integrated in the whole transport system and accompanied by the right support measures and synergies between driverless mobility and decarbonisation measures – is expected to contribute significantly to achieving these key societal objectives. Ultimately this is expected to lead to achieving the so-called Vision Zero, i.e. no road

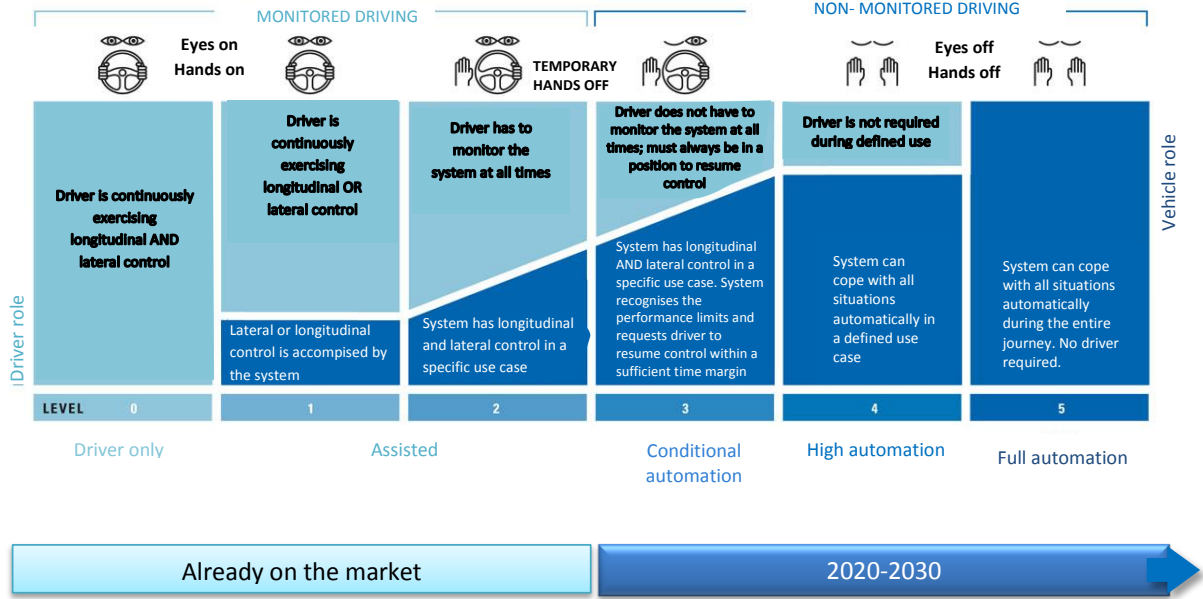
⁸ Commission study(2018): <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/analysis-possible-socio-economic-effects-connected-cooperative-and-automated-mobility-ccam-europe>

⁹ Communication from the Commission "A renewed EU Industrial Policy Strategy", COM(2017) 479.

fatalities on European roads by 2050¹⁰. Turning this ambition for Europe into reality will require the EU, private players, Member States, regional and local authorities, to work together on a common vision of connected and automated mobility.

Automated vehicles are not yet ready to operate without human supervision. There are still many technical challenges to be solved to ensure that the vehicle is fully able to sense its environment, understand it and take the right action as a human driver does. The different levels of automation are described in the figure below.

Figure: Different levels of automation (source: Society of Automotive Engineers-SAE¹¹)



Vehicles assisting the driver are already available on the EU market (levels 1 and 2) and automated vehicles that can drive themselves in a limited number of driving situations (levels 3 and 4) are being tested and some of them should be available by 2020¹².

In its policy-making capacity, the Commission favours a progressive approach based on experience gained during testing that will validate the safety of the technologies. This will be done through identified automation use cases, i.e. driving situations where the vehicle is able to drive autonomously.

¹⁰ White Paper: Roadmap to a Single European Transport Area, COM(2011) 144.
¹¹ For the full definition of Society of Automotive Engineers levels see: <http://articles.sae.org/13573/>. Level 4 includes vehicles either with a driver (e.g. motorway autopilot) or without a driver (e.g. shuttles on dedicated trips).
¹² See European Road Transport Research Advisory Council's Automated Driving Roadmap: <http://www.ertrac.org/uploads/images/ERTRAC Automated Driving 2017.pdf>

The Commission has identified the automation use cases which are relevant from a public policy perspective for the next decade (see text box below) but will remain open to considering other possible new use cases being developed in the next years.

- **Passenger cars and trucks** able to autonomously handle specific situations on the motorway (automation levels 3 and 4) are expected to be available by 2020 (in particular highway chauffeur for cars and trucks¹³, truck platooning convoys). Cars and trucks **able to handle some low speed situations** could be in cities by 2020, such as rubbish trucks (working together with human employees) or valet parking (cars self-driving to a parking space). The capabilities of vehicles will then be further developed to satisfy increasingly complex situations (e.g. longer operating time or longer range with no driver input).
- **Public transport**, vehicles able to cope with a limited number of driving situations at low speed (automation level 4) are expected to be available by 2020 (in particular urban shuttles for dedicated trips, small delivery or mobility vehicles). These will most likely still require human supervision and/or operate on a very short range. The number of situations that these vehicles will be able to handle will then increase with time (e.g. a longer operating time or longer range with no human supervision, higher speed).

Even though automated vehicles do not necessarily need to be connected and connected vehicles do not require automation, it is expected that in the medium term connectivity will be a major enabler for driverless vehicles. Therefore, the Commission will follow an integrated approach between automation and connectivity in vehicles. When vehicles become increasingly connected and automated, they will be able to coordinate their manoeuvres, using active infrastructure support and enabling truly smart traffic management for the smoothest and safest traffic flows¹⁴.

Many vehicles are already connected with cellular technologies and all new cars are expected to be connected to the internet by 2022¹⁵. This connectivity enables access to information on traffic conditions ahead (e.g. accidents, roadworks, environmental conditions), but will also allow large scale fleet data to be gathered by public authorities, such as anonymised real-life average fuel/energy consumption or real-time traffic conditions. As of 2019, some new vehicles series will also be equipped with short-range Wi-Fi-based communication devices. These technologies enable safety-related services requiring very low latency. They will also allow automated vehicles to coordinate their manoeuvres in complex traffic situations. As of 2020, emerging 5G technology will considerably broaden the communication mix, providing more complex and improved services.

3. THE STATE OF PLAY

Existing EU legislation is to a large extent already suitable for the placing on the market of automated and connected vehicles. EU vehicle approval framework legislation, modernised in

¹³ Detailed system classifications: <https://www.adaptive-ip.eu/files/adaptive/content/downloads/Deliverables%20&%20papers/AdaptIVe-SP2-v12-DL-D2.1-System%20Classification.pdf>

¹⁴ Studies have quantitatively showed that automation without connectivity could lead to a potential deterioration of traffic conditions: <https://ec.europa.eu/jrc/en/publication/connected-and-automated-vehicles-freeway-scenario-effect-traffic-congestion-and-network-capacity>

¹⁵ PwC, The 2017 Strategy & Digital report.

2018¹⁶, ensures a real internal market for vehicles - Member States cannot adopt national rules that contradict EU vehicle legislation - and a special procedure is foreseen for new technologies. The EU vehicle approval framework serves as a model for international harmonisation with our international partners (e.g. Japan, Russia and China)¹⁷. The United States is also planning to implement similar principles (see text box). In addition, EU data protection rules are increasingly recognised at international level as setting out some of the highest standards of data protection in the world and are shaping the digital revolution in line with European values. But new regulatory changes will have to follow in order to build a harmonised, complete and future-proof framework for automation.

Other regions are not standing still (e.g. United States, Japan and China) and are already adopting strategies for automated vehicles and attracting investment in this field. **For Europe to remain competitive and foster employment, it will be essential that the key technologies, services and infrastructure are developed and produced in Europe and that the necessary regulatory framework is in place.**

Strategies in the United States and Asia

Testing of automated vehicles has been taking place for years in some parts of the United States led by Silicon Valley companies. However, some of the states have already banned the use of automated vehicles on the road. As a result, the United States Congress is discussing a bill for a Self-Drive Act¹⁸ which will introduce principles similar to the EU vehicle approval framework to avoid individual states of the United States adopting laws contradicting federal vehicle rules.

Testing is also taking place in China, Japan and Singapore. China has already adopted a plan to set up a preliminary standard system by 2020 to support low-level automated driving. Japan has identified autonomous driving as a key innovation to drive its economic growth and aims to demonstrate driverless cars in the run-up to the 2020 Tokyo Olympics.

Many initiatives are already underway in the Member States (e.g. Germany, France, United Kingdom, Sweden and Netherlands), especially for large scale testing, which is also supported by the Commission.¹⁹ There is however a need to better coordinate these initiatives. In the Declaration of Amsterdam²⁰, Member States called upon the Commission to develop a shared European strategy on automated and connected driving, to review, and where necessary, adapt the EU regulatory framework, to develop a coordinated approach towards research and innovation and to deploy interoperable Cooperative Intelligent Transport Systems.

The Commission has already taken actions to promote the deployment of connectivity infrastructure and services in the support of automated vehicles with the adoption of strategies for the 5th generation of communication networks ("5G")²¹, Cooperative Intelligent Transport

¹⁶ Directive 2007/46/EC on vehicle approval repealed by a new Regulation on type-approval (to be published: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2018-0179+0+DOC+PDF+V0//EN>).

¹⁷ The EU is a contracting party to the United Nation 1958 international agreement on vehicle approval.

¹⁸ <https://www.govtrack.us/congress/bills/115/hr3388>

¹⁹ See section 4.

²⁰ <https://www.regjeringen.no/contentassets/ba7ab6e2a0e14e39baa77f5b76f59d14/2016-04-08-declaration-of-amsterdam---final1400661.pdf>

²¹ Communication from the European Commission "5G for Europe: An Action Plan", COM(2016) 588.

Systems²², and the space strategy²³. The Commission has also recently proposed an initiative on artificial intelligence²⁴ that will support driverless vehicles.

The Commission has prepared the ground for a shared strategy on driverless mobility with an extensive stakeholder and Member State consultation process, in particular through the GEAR 2030 high level group which adopted recommendations on automated and connected vehicles on 18 October 2017²⁵. Those recommendations built on earlier work to deploy Cooperative Intelligent Transport Systems²⁶ and to bring together the telecom industry and the automotive industry²⁷.

4. MAKING THE EU STRONGER ON TECHNOLOGIES AND INFRASTRUCTURE FOR AUTOMATED MOBILITY

Significant investments will be needed to develop the relevant technologies, to create the necessary infrastructure support and to ensure social acceptance for automated mobility. While most of the investment will come from the private sector, the EU provides significant stimulus for research and innovation and for deployment of targeted infrastructure.

To maximise the benefit of public investment, the Commission will link supportive measures with key policy and regulatory initiatives around the use cases identified above.

Demonstrations and large-scale testing are already taking place in the EU Member States. The Commission supports these through research funding programme and deployment projects, and will help to better coordinate cross-border testing²⁸. For 2014-2020, a total budget of around EUR 300 million from the EU's framework programme for research and innovation "Horizon 2020" has been allocated to support research and innovation on automated vehicles, half of which was provided through calls launched in 2016-2017.

Calls for proposals to support research and innovation for automated road transport are planned for 2018-2020 with a total budget of EUR 103 million. The emphasis of these calls is on large scale demonstration pilot projects to test highly automated driving systems for passenger cars, efficient freight transport operations and shared mobility services in urban areas. Other research priorities include user acceptance, design of a safe human-machine interface, road infrastructure to support automation and testing and validation procedures of automated driving functions. In addition, the Commission will offer support in 2018 for testing the use of 5G connectivity to enable highly automated driving functions and new mobility services with a budget totalling around EUR 50 million.

Similarly, support from the Connecting Europe Facility (a total of EUR 443 million triggering EUR 1,173 million of total investments) helped to digitise road transport infrastructure across the EU, in support of automation. Large-scale deployment initiatives on the trans-European transport network were enabled in 16 Member States²⁹ and 2 associated countries for

²² Communication from the European Commission on Cooperative Intelligent Transport Systems, COM(2016) 766.

²³ Communication from the European Commission "Space Strategy for Europe", COM(2016) 705.

²⁴ COM(2018) 237.

²⁵ https://ec.europa.eu/growth/content/high-level-group-gear-2030-report-on-automotive-competitiveness-and-sustainability_en

²⁶ <https://www.c-roads.eu/platform.html>. The C-ROADS platform brings together all ongoing Cooperative Intelligent Transport Systems deployment activities across the EU to ensure interoperability of services.

²⁷ <https://ec.europa.eu/digital-single-market/en/cooperative-connected-and-automated-mobility-europe>

²⁸ https://www.bmvi.de/SharedDocs/EN/Documents/DG/action-plan-automated-and-connected-driving.pdf?__blob=publicationFile

²⁹ <https://www.c-roads.eu/platform.html>

interoperable vehicle-to-vehicle and vehicle-to-infrastructure communications based on Wi-Fi and 3G/4G cellular technologies. To allow synergies between the transport, telecom and digital part of Connecting Europe Facility, the Commission intends to include a coordinated call for projects in its 2018 work programme for Connecting Europe Facility.

Automated cars

L3PILOT is a large scale test started in September 2017. It is unique due to its size (EUR 36 million EU-funding) and is the first in the world to test such a comprehensive array of different automated driving functions for passenger cars.

The connected vehicle eco-system

AUTOPILOT is a large-scale pilot project started in January 2017 and focusing to the autonomous vehicle in a connected environment, enabling the emergence of connected ecosystems supported by open technologies and platforms. The 5GCar started in June 2017 as a large research and innovation project developing the 5G connectivity technologies for automated cars and will evaluate the existing and future spectrum usage for that purpose and contribute to the standardisation efforts in the field.

Truck platooning

Truck platooning is the term used to describe trucks using connectivity and automation to follow each other at a very short distance to save fuel and reduce CO₂ emissions. The ENSEMBLE project (EUR 20 million EU-funding) will start in summer 2018 and will support the standardisation of communication protocols for multi-brand platooning.

Member States and stakeholders called for better cross-border cooperation on testing³⁰ as well as an increased coordination and exchange on lessons learnt during testing on subjects of public interest³¹. Discussions have begun³² with Member States and industry experts to prioritise use cases for testing, exploit possible synergies between connectivity and automation use cases, and define common methods for testing, evaluation and exchange of knowledge. Work will continue to develop a network of pan-European 5G cross-border corridors³³ for the large scale testing and early deployment of advanced connectivity infrastructure supporting connected and automated mobility.

The Commission intends to further develop the Galileo services and related vehicle navigation technologies for driverless mobility. Galileo is a major asset for precise and secured positioning and for the integrity and reliability of digital maps. A study will be launched in 2018 to investigate the question of integrity and reliability of digital maps. Galileo offers already today accuracy levels beyond those of other constellations and will, through its future authentication features, provide signals of an unparalleled trust level.

Current EU support will need to be sustained in the long term as the EU is still some way from deploying fully automated and connected vehicles and the related infrastructure. The Commission therefore intends to propose that the research on cooperative, connected and automated mobility remains a priority in the next framework programme for research and innovation.

³⁰ https://www.bmvi.de/SharedDocs/EN/Documents/DG/action-plan-automated-and-connected-driving.pdf?__blob=publicationFile

³¹ GEAR 2030 final report.

³² Within the Intelligent Transport Systems Committee.

³³ A set of digital cross-border corridors was identified by Member States to foster large scale testing and the deployment of 5G for connected and automated mobility along these corridors following the letter of intent of 23 March 2017 signed by 27 Member States, Switzerland and Norway.

There is a need to update the research and innovation roadmap for driverless mobility including a concrete action plan for short, medium and long-term research and innovation actions. This roadmap will be developed with the help of representatives from Member States with the input from experts and stakeholders³⁴. It will serve as a basis for setting priorities for research and innovation investment in some key technologies (e.g. digital maps, big data, the internet of things, artificial intelligence, etc.) and infrastructure (mainly Galileo, telecom and road) with significant potential for mobility solutions for the future.

Although a lot of research and innovation and testing is happening in Europe, the Commission is considering ways to ensure further synergies between EU and national funding programmes, between supports for connectivity cooperative systems and automation, as well as between the research and innovation phase and the pre-deployment phase.

The Commission is making available today up to EUR 450 million under the Connecting Europe Facility to support digitisation in transport in support to automation and:

- encourages Member States and regions to make use of the opportunities offered by EU regional policy and the European Structural and Investment Funds for co-financing investments in research, innovation and deployment.
- will work with Member States in 2018 to draw up a priority list of transport use cases for large scale testing and take advantage of possible synergies between connectivity and automation use cases.
- will put in place in 2018 one single EU wide platform grouping all relevant public and private stakeholders to coordinate open road testing and making the link with pre-deployment activities.
- will build on work already carried out by establishing a partnership under the next European multiannual financial framework to give a clear long-term framework to the strategic planning of research and pre-deployment programmes on driverless mobility at EU and national levels.
- will by 2019 offer Galileo's initial high-accuracy services for free, being the first to be able to offer such a navigation service on a worldwide basis.
- will by 2019 prepare guidelines for the optimised use of advanced services (i.e. high-accuracy, robustness, authentication of positions) offered by the EU satellite navigation systems, EGNOS/Galileo, and their inclusion in vehicle navigation systems, to address liability and safety issues.

5. ENSURING AN INTERNAL MARKET FOR THE SAFE TAKE-UP OF AUTOMATED MOBILITY

Guaranteeing a real internal market will be key to ensure legal certainty, foster investment in the relevant technologies and protect citizens against new risks brought by driverless vehicles.

Allowing innovation

The EU vehicle approval framework was overhauled in 2018³⁵. The EU is the first region in the world to combine vehicle approval rules with market surveillance rules. Building on this new framework, the Commission will start working on the development of a new approach for certifying the safety of automated vehicles which will be less design specific and more adapted to the evolutionary nature of these vehicles.

³⁴ A dedicated subgroup of the Strategic Transport Research and Innovation Agenda.

³⁵ To be published: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2018-0179+0+DOC+PDF+V0//EN>

New and ground-breaking vehicle automation technologies can already be validated today under the EU vehicle approval framework.³⁶ Technologies not foreseen by EU rules can be approved through an EU exemption granted on the basis of a national ad-hoc safety assessment. The vehicle can then be placed on the EU market like any other EU approved vehicle. Several technologies have already been approved this way. However, to ensure mutual recognition of national ad-hoc safety assessments, it is important that Member States follow a common approach.

The Commission will:

- work with Member States in 2018 on guidelines to ensure a harmonised approach for national ad-hoc vehicle safety assessments of automated vehicles.
- initiate work with Member States and stakeholders on a new approach for vehicle safety certification for automated vehicles.

Making automated mobility safe

The deployment of automated vehicles has significant potential to improve road safety, given that the human factor – error, distraction, violation of the traffic rules – is at the cause of most accidents. But it also creates new challenges. Driverless vehicles will have to share the roads or streets with non-automated cars and also with pedestrians, cyclist and motorcyclists. For this reason their deployment can only take place once overall road safety is guaranteed and not just the safety of automated vehicle users.

The complete revision of the General Safety Regulation for motor vehicles, presented together with this Communication, will provide the opportunity to cover missing aspects in the present vehicle safety legislation for the expected automation use cases. The revision will also allow the Commission to adopt the relevant implementing rules. In adopting new safety rules, the Commission will follow the guiding principles for human-machine interface proposed by GEAR 2030³⁷ and ensure that road safety considerations (mixed traffic, interaction with other road users) are fully taken into account. The Commission will support the international technical harmonisation of automated vehicles within the framework of the United Nations in coherence with EU rules.

It is also important to ensure consistency between national traffic rules and avoid contradiction with EU vehicle rules. To support this, the Commission proposes to use the identification of the expected tasks of the driver and the vehicles for the different levels of automation developed in the framework of the United Nations³⁸. As there is currently no EU legislation on traffic rules, Member States are invited to support convergence on national traffic rules in particular at international level with instruments such as the 1949 Geneva Convention and the 1968 Vienna Convention on Road Traffic³⁹. At European level, the Commission will support this convergence by encouraging the coordination of Member States' authorities in the appropriate fora, e.g. high level group on road safety.

Safe and high quality road infrastructure will play a key role in supporting automated vehicles. For example, the quality of markings and signs may influence the performance of

³⁶ Article 20 of Directive 2007/46/EC. The new regulation contains an equivalent provision in Article 39 and becomes applicable on 1 September 2020.

³⁷ https://ec.europa.eu/growth/content/high-level-group-gear-2030-report-on-automotive-competitiveness-and-sustainability_en . See Annex 3 of the report.

³⁸ <http://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29resolutions/ECE-TRANS-WP29-1140e.pdf>

³⁹ The 1968 Convention on road traffic is applied by most of EU Member States. The 1949 Geneva (predecessor of the Vienna Convention) is applied by some EU Member States.

automated vehicles. It is equally vital that when road traffic information (e.g. dynamic speed limits, traffic rules, the location of stationary vehicles, etc.) is communicated digitally, it is understood by the different road users. This implies that all systems providing such information are interoperable. The Commission will support the availability and accessibility of such information.

Finally, the Commission will assess the consequences of automation for some existing EU legislation concerning drivers, such as Directive 2006/126/EC on driving licence, the Directive 2003/59/EC on professional drivers training or Directive 2002/15/EC on driving time.

The Commission is now proposing new safety features for automated vehicles as part of the revision of the General Safety Regulation for motor vehicles as well as requirements in the Road Infrastructure Safety Management Directive, and will also:

- present in 2018 the work priorities in the EU and in the United Nations to implement the new vehicle safety legislation for automated and connected vehicles in particular for vehicles with the highest levels of automation.
- intensify coordination with Member States on traffic rules (e.g. the Geneva and Vienna Conventions) so that they can be adapted to automated mobility in a harmonised way.
- adopt by the end of 2018 a delegated regulation under the Intelligent Transport Systems Directive⁴⁰ to ensure secured and trustful communications between vehicles and infrastructure, sound data protection level in compliance with the General Data Protection Regulation⁴¹ and interoperability of messages for safety-related and traffic management services.

Addressing liability issues

Liability for motor vehicles is addressed through various instruments at EU level such as Motor Insurance⁴² Directive or Product Liability Directive⁴³ as well as the different liability regimes in the Member States (e.g. traffic law, civil law, specific strict liability regimes, and national implementation of the EU Product Liability Directive).

The actual cause of events that lead to damage or incident is decisive for the attribution of liability. Therefore the Commission is proposing that automated vehicles are fitted with data recorders to clarify who was driving (the vehicle's autonomous system or the driver) during an accident.

On the compensation of victims, the Motor Insurance Directive already provides for a quick compensation of victims including where an automated vehicle is involved. The insurer can then take legal action against a vehicle manufacturer under the Product Liability Directive if there is a malfunction/defect of the automated driving system. The European Commission just evaluated the Product Liability Directive and as a follow-up, it will issue an interpretative guidance clarifying important concepts in the Directive including in the light of technological developments⁴⁴. The Motor Insurance Directive has recently undergone an evaluation, which

⁴⁰ Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems.

⁴¹ Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

⁴² Directive 2009/103/EC relating to insurance against civil liability in respect of the use of motor vehicles.

⁴³ Council Directive 85/374/EEC concerning liability for defective products.

⁴⁴ The broader case of liability linked to the Internet of Things and artificial intelligence is covered by the Commission Communication on Artificial intelligence (COM(2018) 237) and the accompanying Commission Staff Working Document on liability for emerging digital technologies (SWD(2018) 137).

concluded that no changes are necessary as regards autonomous vehicles: They will be required to have third party liability insurance in line with the Directive⁴⁵.

The Commission will continue to monitor the need for additional EU instruments as the technology further develops.

The Commission is proposing to regulate data recorders for automated vehicles as part of the revision of the General Safety Regulation for motor vehicles to clarify who was driving (the vehicle or the driver) during an accident.

Fostering vehicle connectivity for automation

The ability of vehicles to communicate will be key to integrate automated vehicles in the overall transport system. The different types of communication technologies are complementary and evolving over time with improvements (for example in coverage, speed, latency, security). This enables more and more advanced use cases of automated vehicles. Although most of the investment for connectivity should come from the private sector, the EU can help in providing regulatory approaches that foster the investments needed in vehicles and communication infrastructure (road and telecoms).

To enable safety-related services that require very low latency several manufacturers have committed to fit in addition short range communication devices (Wi-Fi based) on vehicles from 2019 and Road operators have also started to pre-deploy roadside communication infrastructure, allowing direct interaction between vehicles or between vehicles and the road infrastructure. As of 2020, 5G connectivity infrastructure is equally expected to be an important enabler of connected and automated mobility as well as empower innovative digital ecosystems around cars.

On vehicle-to-vehicle communications, the Commission follows a technology-neutral approach in line with the EU Strategy on Cooperative Intelligent Transport Systems⁴⁶ and has not proposed mandatory deployment of specific technologies at this stage. However, for certain applications such as platooning (see also box p. 7) there is an expressed need for regulation to ensure data standardisation of vehicle communication protocols across different brands and ensure proper response from the vehicles⁴⁷. Platooning is a clear automation use case where vehicle-to-vehicle communication is essential. Multi-brand platooning will be supported by a call under the Horizon 2020 research and innovation framework programme.

The increasing use of radio equipment (short-range radar, direct connectivity between vehicles, network connectivity) will require more radio spectrum bands. Existing spectrum access opportunities are being reviewed in particular to ensure adequate spectrum in the 5.9 GHz band for safety-related functions and catering for a wide range of applications. The Commission will support the coexistence of different radio technologies using the 5.9 GHz spectrum band while taking into account the principles of uncompromised safety, technology neutrality and efficient spectrum use. Ongoing technical studies involving both the European Conference of Postal and Telecommunications Administrations and the European Telecommunications Standards Institute could lead in 2019 to an update of the relevant Commission Implementing Decision.

⁴⁵ https://ec.europa.eu/info/consultations/finance-2017-motor-insurance_en. The full conclusions of the evaluation are forthcoming.

⁴⁶ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2016%3A766%3AFIN>

⁴⁷ http://www.acea.be/uploads/publications/Platooning_roadmap.pdf

Furthermore, there is a potential gap in guidance on the use of 5G pioneer spectrum bands used for large scale testing. Where appropriate, regulatory, operational adjustments will be discussed in the Radio Spectrum Committee and/or the Telecommunication Conformity Assessment and Market Surveillance Committee to ensure an efficient use of spectrum.

The Commission is proposing to regulate platooning under the revision of the General Safety Regulation for motor vehicles to ensure standardisation of data exchange across different brands. The implementing legislation will build on the results of the call on platooning (2018-2020) in the Horizon 2020 research and innovation framework programme and complement the delegated Regulation on Cooperative Intelligent Transport Systems.

Ensuring cybersecurity, data protection and data access

Vehicle connectivity and system integration of thousands of components originating from different sources bring new threats of cyber-attacks such as remote taking control of the vehicle. At present there is no sector specific approach on the protection of the vehicle against cyberattacks. For data protection on the other hand, the EU rules on the protection of personal data apply to any processing of personal data, including those collected from vehicles⁴⁸.

Considerable work has been done on cybersecurity in the recent months. On 13 September 2017 the Commission adopted a cybersecurity package including a proposal for a voluntary certification framework of information and communication technology (ICT) products and services⁴⁹. In addition, guidelines have been developed in the framework of the United Nations for the protection of vehicles against cyberattacks and it is the intention of the Commission to implement these guidelines in the EU vehicle rules. Finally, as announced in the European Strategy on Cooperative Intelligent Transport Systems, the Commission has published guidance⁵⁰ on the certificate and security policy needed for secure and trustful communication between vehicles and infrastructure for road safety and traffic management related messages.

Automated and connected vehicles will generate a large amount of data that could be shared through communication devices. These data have an enormous potential to create new and personalised services and products, revolutionise existing business models (e.g. roadside assistance, vehicle insurance, vehicle repair, car rental, etc.) or lead to the development of new ones. Different economic actors are competing for such data. Vehicle manufacturers or digital platforms have a privileged access to car data and to vehicle resources, such as the possibility to propose services directly to the driver by using the vehicle dashboard. In its non-legislative resolution of 13 March 2018⁵¹ on "A European strategy on Cooperative Intelligent Transport Systems", the European Parliament called upon the Commission to publish a legislative proposal that ensures a level playing field on access to in-vehicle data and resources, protecting consumer rights and promoting innovation and fair competition.

Given the emergence of this new economy, the Commission's approach on access to data and resources strikes a balance between fair competition, the possibility for consumer to have access to different services, safety, cybersecurity, in full compliance with the legislation on

⁴⁸ Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

⁴⁹ <https://ec.europa.eu/digital-single-market/en/cyber-security>

⁵⁰ Certificate and security policy documents available at https://ec.europa.eu/transport/themes/its/c-its_en

⁵¹ European Parliament document A8-0036/18/ P8_TA -PROV(2018)0063.

competition and on the protection of personal data such as user consent for data sharing. There is already EU legislation specifically covering the fair access to repair and maintenance information by independent repairers. This legislation was recently modernised to include the repair and maintenance activities supported by wireless networks⁵². For other type of data, the Communication "Towards a common European data space"⁵³ published on 25 April 2018 provides further guidance on the business-to-business and business- to-government exchange of data in addition to the Communication on Building a European Data Economy⁵⁴ on data location and the guiding principles laid down in the Cooperative Intelligent Transport Systems platform report⁵⁵. The proposed Regulation on the free flow of non-personal data⁵⁶ will take away unjustified data localisation restrictions, enhancing the freedom of businesses to store or process their non-personal data anywhere they want within the EU. However, a Commission study gave indications that centralisation of in-vehicle data on so-called 'extended vehicle data platform servers', currently implemented by several vehicle manufacturers, might in itself not be sufficient to ensure fair and undistorted competition between service providers.⁵⁷ The Commission therefore intends to improve access and reuse of mobility and vehicle data for commercial and non-commercial purposes as part of a forthcoming Recommendation (see text box below).

The Commission will continue monitoring the situation on access to in-vehicle data and resources and will consider further options for an enabling framework for vehicle data sharing to enable fair competition in the provision of services in the digital single market, while ensuring compliance with the legislation on the protection of personal data

Finally as some of the data generated by vehicles may be of public interest, the Commission will consider the need to extend the right of public authorities to have access to more data. In particular, it will consider specifications under the Intelligent Transport Systems Directive⁵⁸ regarding the access to data generated by vehicles to be shared with public authority for improved traffic management. It will also consider requirements to collect large-scale real-world fuel/energy consumption information in an anonymised form within the framework of carbon dioxide emission standards for light-duty vehicles (cars and vans)⁵⁹.

The Commission is proposing to regulate the protection of vehicles against cyber-attacks as part of the revision of the General Safety Regulation for motor vehicles and will:

- consider the need for specifications for access to vehicle data for public authorities' needs, in particular traffic management in 2018/2019 (delegated act under the Intelligent Transport Systems Directive) and in 2019/2020 for the collection of anonymised large-scale real-world fuel/energy consumption information.
- implement a pilot on common EU-wide cybersecurity infrastructures and processes needed for secure and trustful communication between vehicles and infrastructure for road safety

⁵²To be published: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+P8-TA-2018-0179+0+DOC+PDF+V0//EN>

⁵³ COM(2018) 232.

⁵⁴ COM(2017) 9.

⁵⁵ Final Report of January 2016: <https://ec.europa.eu/transport/sites/transport/files/themes/its/doc/c-its-platform-final-report-january-2016.pdf>

⁵⁶ Proposal for a Regulation on a framework for the free flow of non-personal data, COM (2017) 495.

⁵⁷ <https://ec.europa.eu/transport/sites/transport/files/2017-05-access-to-in-vehicle-data-and-resources.pdf>

⁵⁸ Directive 2010/40/EC.

⁵⁹ Commission Proposal COM(2017) 676, CO2 targets for new cars and vans up to 2030.

and traffic management related messages according to the published guidance on the certificate and security policy.

- issue in 2018 as a first step a Recommendation on the use of pioneer spectrum for 5G large scale testing, cybersecurity and on a data governance framework that enables data sharing, in line with the initiatives of the 2018 Data Package, and with data protection and privacy legislation.

6. ANTICIPATING EFFECTS OF AUTOMATED MOBILITY ON SOCIETY AND THE ECONOMY

Because automated and driverless vehicles are still under tests, the long term effects of driverless mobility on the transport system, the economy, the environment and on existing jobs are still largely unknown. Although it is difficult at this stage to have a full picture, these long term effects need to be assessed as soon as possible to anticipate any rebound effects and to take mitigating measures. It is also necessary to tackle as soon as possible emerging ethical issues to ensure that technologies are developed in line with European values.

The Council, in its conclusions on the digitalisation of transport adopted on 5 December 2017, emphasised the importance of wide societal dialogue on these issues and called on the Commission to *"...assess the socioeconomic and environmental impact of automation and digitalisation in the field of transport taking into account the new skills needed in that sector, and, if necessary, to propose measures to address those impacts"*.

The Commission intends to assess these issues, discuss them with all interested parties, including the social partners, and possibly consider regulatory activity at EU level⁶⁰. It is essential to carefully consider the concerns of the future users of these systems and other road users.

More research is needed to anticipate the long term effects of automated and connected driving. For instance, it is anticipated that driverless mobility will decrease transport costs, free driver's time, and foster car sharing, thereby improving air quality and urban planning. But lower transport costs and freeing the driver from driving tasks could also lead to more or longer journeys, a bigger increase in total traffic, and subsequently an increase in total emissions and congestion. Another concern is that little is known about the interaction between automated vehicles and other road users in mixed traffic conditions. The Horizon 2020 transport work programme 2018-2020 includes projects to undertake in-depth analyses on behaviour of users and public acceptance and to assess the medium and long term impacts of automated and connected driving.

The Commission has already carried out a comprehensive review of existing studies on the expected socio-economic impacts of automated and connected vehicles on the EU economy and jobs. The results of this review are published together with this Communication⁶¹. With 23 per cent of global motor vehicle production and almost 72 per cent of inland freight transported by road in Europe, automated mobility is expected to substantially benefit the

⁶⁰ For instance the International Transport Forum Organisation for Economic Co-operation and Development study on "managing the transition to driverless road freight transport", proposes the setting up of a temporary permit system. The fee paid by the fleet operators to obtain a permit would make it possible to manage the speed of automation and to generate funds to retrain the workforce and help people made redundant.

⁶¹ Commission study (2018): <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/analysis-possible-socio-economic-effects-connected-cooperative-and-automated-mobility-ccam-europe>

European economy. The revenues for the EU automotive industry could for instance exceed EUR 620 billion by 2025 and EUR 180 billion for the EU electronic sector. The economic impacts from automated and connected mobility will bring benefits far beyond the automotive industry but could possibly affect negatively some sectors like insurance, maintenance and repair. The impact of automated mobility will be strongly dependent on the ability of European industry to keep pace with international competitors (especially from the IT sector). Aspects related to social inclusiveness and ways to address the needs of vulnerable users will also play a role in making sure that the gains benefit the society as a whole, including those who may be cut off from mobility services today, such as the elderly and the disabled. Particular attention shall be paid to increased accessibility of remote areas and wider provision of mobility services.

On employment, it is anticipated that the development of new technologies and services will require new skills and highly paid jobs (engineers, researchers) together with new medium skilled jobs to maintain these new technologies. While it may well reduce demand for professional drivers, it could also help to make driving jobs more attractive and remedy current driver shortage⁶². It is still difficult for the technology to completely replace drivers in all driving situations. So it is likely that during a transition phase, instead of replacing the driver, the vehicle will allow the driver to perform other tasks, for instance freight planning, during driving in limited conditions (e.g. on the motorway) as it is the case in aircrafts. The more gradual the introduction of these technologies, the higher the probability that the negative implications on employment will be absorbed by the economic system.

In order to manage this transformation, workers whose jobs are changing or may disappear due to automation must have every opportunity to acquire the skills and knowledge they need, to master new technology and to be supported during labour market transitions. National schemes will be essential for providing up-skilling and training with support from the European Social Fund and other dedicated projects.

The Commission, with its digital single market strategy⁶³, and Skills Agenda for Europe⁶⁴ is putting priority on digital skills at all levels, from basic to high-end. In order to deliver sector-specific skills solutions, the Blueprint for Sectoral Cooperation on skills was launched as part of the Skills Agenda⁶⁵. The blueprint is a framework for strategic cooperation between key stakeholders such as businesses, trade unions research, education and training institutions, in order to overcome skills shortage and prepare for digital transition. Five pilot sectors have been selected for the first wave of calls and the automotive is one of them.

In addition a three-year research project called 'Skilful' (running until September 2019) was launched under the Horizon 2020 research and innovation programme. Skilful studies which transport professions are likely to disappear and which are likely to be created in the different modes of transport. It also assesses future skills and training needs.

⁶² The International Transport Forum Organisation for Economic Co-operation and Development study on "managing the transition to driverless road freight transport" estimated the demand for drivers in Europe could decrease down to 1 million by 2030 from 3.2 million drivers existing today.

⁶³ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2017%3A228%3AFIN>. It targets digital skills for all (developing digital skills to enable all citizens to be active in our digital society).

⁶⁴ <http://ec.europa.eu/social/main.jsp?catId=1223>

⁶⁵ <http://ec.europa.eu/social/main.jsp?catId=1415&langId=en>

Moreover, the European Pillar of Social Rights provides a comprehensive policy framework to assist in labour market transitions through access to effective employment and social services, access to training and adequate income support. In this respect, the Commission has adopted a proposal to strengthen access to social protection – in particular for the self-employed and atypical workers.

Ethical issues are an equally important topic for automated mobility. Automated vehicles will have to be safe, respect human dignity and personal freedom of choice. The Commission has recently set up the European Artificial intelligence (AI) Alliance⁶⁶ tasked to develop draft ethical guidelines for artificial intelligence, which will provide a horizontal approach on ethical issues for autonomous systems with relevance also for automated vehicles. However a complementary sectorial approach to driverless mobility will be needed given the specific issues of the transport system (e.g. road safety). Member States have already moved ahead with the establishment of a task force on ethical aspects of automated and connected driving to specify those ethical issues that should be addressed jointly at EU level⁶⁷. As a follow up to the task force the Commission will provide a dedicated Forum, working in collaboration with the European Group on Ethics in Science and New Technologies⁶⁸ and the European AI Alliance, to facilitate discussions at the European level.

Driverless mobility is still at its early stages. The long-term impacts are uncertain and will depend on how fast and how far the technology will develop and the market responds. It will also depend on how public authorities support and steer this development to ensure that all segments of society benefit from the new mobility services. The Commission intends to continue monitoring and assessing these issues and consulting with all interested parties. It may also consider regulatory activity at EU level, where needed.

⁶⁶ The European AI Alliance is a broad multi-stakeholder forum that will be set up by the Commission in 2018 to discuss the future of AI in Europe. The European AI Alliance will work in cooperation with the European Group on Ethics in Science and New Technologies.

⁶⁷ 2nd High Level Structured Dialogue organised in September 2017 as a follow up of the 2016 Amsterdam declaration.

⁶⁸ The European Group on Ethics in Science and New Technologies is an advisory group of the European Commission established by Commission Decision (EU) 2016/835.

The Commission will:

- monitor and assess the medium and long term impacts of automated and connected driving in particular in the Horizon 2020 automated transport Work Programme 2018-2020.
- consult interested parties on the socioeconomic and environmental impacts of driverless mobility.
- support the acquisition of new skills, retain and reskill the workforce in the sector through the new skills agenda for Europe and evaluate the options for facilitating the transition to automation in the road sector.
- support Member States in their effort to provide smooth labour market transitions for the affected workers through quality employment and social services, access to training, and social protection in line with the European Pillar of Social Rights.
- provide an EU Forum to address specific ethical issues raised by driverless mobility.

7. CONCLUSION

Connected and automated mobility is poised to transform the way we move and the way vehicles are used, sold and owned. It will open up new areas for business development and pave the way for new mobility services. The comprehensive EU strategy aims to set the path for the EU, Member States, industry, social partners and civil society to work together and ensure that the EU seizes the opportunities offered by driverless mobility, while anticipating and mitigating new challenges for society. With its strong industrial base and supported by an ambitious research and innovation programme and the legal framework put forward in this strategy, Europe has the strength to compete globally.

The Commission now calls upon all parties concerned, in particular on Member States, industry, social partners and civil society to support the approach presented in this Communication. In a fast-changing world, Europe must seize this opportunity to be a leader in delivering safe, efficient, socially responsible and environmentally friendly driverless mobility for EU citizens.