Written evidence submitted by the Society of Motor Manufacturers and Traders (SDV0023)

Executive summary

An automated vehicle is a vehicle equipped with an **automated driving system** and defined under the Automated and Electric Vehicles Act 2018 as *"designed or adapted to be capable, at least in some circumstances or situations, of safely driving themselves"* and *"may be lawfully used on roads or other public places in Great Britain"*.

This definition is compatible with industry convention SAE J3016 and international technical regulation under the auspices of the UNECE. SAE Levels 0, 1 and 2 are driver assistance systems, which are aimed at supporting but not replacing the driver. SAE Levels 3, 4 and 5 are automated driving systems, where both control and monitoring are performed by the system when it is correctly activated within its operational design domain.

Automated vehicles have the potential to deliver on the UK's triple bottom line of **people, prosperity** and the **planet**. A study commissioned by SMMT suggests connected and automated vehicles could deliver approximately £62 billion of economic impact per year by 2030, with up to 420,000 new jobs being created in the UK, 20,000 of which are directly in automotive, and save 3,900 lives and prevent 47,000 serious accidents when deployed in significant numbers. Automated vehicles could also offer people with restricted mobility, or who are unable to drive, the freedom to travel and have the potential to improve traffic efficiency when deployed in substantial numbers, leading to better air quality and lower emissions.

Automated vehicles can be understood in terms of three overarching applications:

- Passenger cars fitted with automated driving systems,
- Automated passenger services, and

- Automated delivery and logistics.

Of these three main applications, the only one that is now commercially available in Europe is passenger cars fitted with Automated Lane Keeping System (ALKS), which is the world's first **internationally approved automated driving system**, established under UN Regulation 157. Commercial deployment of ALKS-fitted passenger cars in Great Britain is now possible thanks to regulatory reforms that were recently completed. The first passenger cars fitted with ALKS could be rolled out on British roads from the end of 2022 or early 2023.

Full commercial rollout of automated passenger services and automated delivery and logistics is unlikely to be possible before 2025, when the completion of the necessary regulatory reforms is expected. Ensuring these reforms are **completed on time** is of paramount importance to the competitiveness and attractiveness of the UK as a location of choice for the rollout of these applications.

Hitherto, government and industry have jointly invested around £440 million in more than 90 collaborative R&D, demonstration and testbed projects involving over 200 organisations. We believe the UK must now move beyond only testing and trialling to pilot deployment, progressing eventually to full commercial deployment, which is critically dependent on four key factors:

- **Maturing the technology** to ensure it is safe and operational across wider operational design domains;
- Developing a fit-for-purpose **regulatory framework** for approval, authorisation, liability and in-use monitoring;
- **Communicating** to and **educating** the public about automated vehicles to build public acceptance and ensure safe and responsible use; and

- Spawning the right **business models** to ensure deployment of automated vehicles is economically viable.

As an immediate step, government should urgently clarify how advanced trials without an onboard or offboard safety driver can be legally conducted within the existing regulatory framework and set out the process for obtaining approvals and exemptions.

We support government's aim to have the complete regulatory framework in place by 2025 for the full commercial deployment of all types of automated vehicles, as set out in the recently published policy paper *"Connected and Automated Mobility 2025: Realising the Benefits of Self-driving Vehicles in the UK"*. We strongly believe government, legislators, industry and stakeholders must work closely to ensure any barriers to regulatory reform are removed and that there is no delay to developing the complete regulatory framework and tabling of legislation in Parliament. As such, we urge the Committee to do its utmost to ensure the outcome of this inquiry results in **enhancing the pace of regulatory reform** rather than making it more onerous to deploy automated vehicles and slowing progress, as Great Britain is already behind key markets in Europe in regulatory reforms that enable full deployment.

Government should also support the UK automotive **industry and supply chain** to develop automated driving technology that can find a route to market and be exported globally. Government support should be focussed on targeted grant funding for advanced R&D, growth funding to de-risk private sector investment, wider measures for the supply chain and skills development, and promoting and "selling" UK testbed capabilities abroad. In addition, as digital connectivity has the potential to enhance an automated vehicle's decision-making, we believe government has a key role to play in ensuring near-ubiquitous LTE (4G) coverage on the 247,500-mile-long British road network.

Introduction

1. The Society of Motor Manufacturers and Traders (SMMT) is one of the largest trade associations in the UK, supporting the interests of the UK automotive industry at home and abroad. SMMT represents more than 850 member companies, including all major vehicle manufacturers, component and system suppliers, the aftermarket, services and engineering firms, technology companies and mobility start-ups.

2. The automotive industry is a vital part of the UK economy and integral to supporting the delivery of the agendas for levelling up, net zero, advancing global Britain, and the plan for growth. Automotive-related manufacturing contributes £67 billion turnover and £14 billion value added to the UK economy, and typically invest around £3 billion each year in research and development. With more than 182,000 people employed in manufacturing and some 780,000 in total across the wider automotive industry, we account for 10% of total UK goods exports with more than 150 countries importing UK produced vehicles, generating £77 billion of trade. More than 25 manufacturers build over 70 models of vehicles in the UK, plus an array of specialist small volume manufacturers, supported by some 5,000 supply chain businesses and some of the world's most skilled engineers. Many of these jobs are outside London and the Southeast, with wages that are around 14% higher than the UK average. The automotive sector also supports jobs in other key sectors including advertising, finance and logistics.

3. A study commissioned by SMMT suggests the overall economic benefits of connected and automated vehicles are expected to be in the region of £62 billion per year by 2030, with up to 420,000 new jobs being created in the UK, 20,000 of which are directly in automotive. Given that 88% of road accidents in 2020 were caused by human error, significant social benefits

are expected to be realised in increased safety that comes with automation, which could see 3,900 lives saved and 47,000 serious accidents prevented in the UK this decade. If the UK is to unlock the full economic and social benefits of automated vehicles it is essential that it becomes one of the best places in the world to develop, test and deploy this new technology. This includes creating the right regulatory framework and market conditions as key enablers towards achieving this ambition.

4. The significant economic and social benefits that could come with the development and deployment of automated vehicles are motivating many countries to try to position themselves as world leaders. While the UK is already one of the leading locations in the world for testing and trialling automated vehicles, government and industry must now work closely and expend every effort to ensure the UK also becomes a leading location for the **deployment** of automated vehicles.

5. With this goal in mind, SMMT works closely with government's Centre for Connected and Autonomous Vehicles, the wider Department for Transport and international regulators at the UNECE to reform and develop new regulations that pave the way for the deployment of automated vehicles on British roads. Our collaborative efforts have come a long way, culminating with the recent completion of regulatory reforms that will now enable the first automated vehicles, in the form of passenger cars fitted with Automated Lane Keeping System, to be rolled out in Britain. This means Britain is now on the precipice of becoming one of the first countries in the world to allow automated driving on public roads under specific conditions.

6. Our next stage of collaboration with government will focus on ensuring the full regulatory framework is in place by 2025 to enable the deployment of all types of automated vehicles, as set out in government's

recently published policy paper Connected and Automated Mobility 2025: Realising the Benefits of Self-driving Vehicles in the UK. The arrival of automated vehicles will enable consumers to experience increased safety benefits, potentially lower insurance premiums in the future and more comfortable and less stressful journeys. Automated vehicles could also offer people with restricted mobility, or who are unable to drive, the freedom to travel and have the potential to improve traffic efficiency when deployed in substantial numbers, leading to better air quality and lower emissions.

7. SMMT welcomes the opportunity to respond to this inquiry on behalf of the UK automotive industry. We set out below the consolidated and harmonised response of our members. We hope the outcome of this inquiry will enhance the pace of regulatory reform and encourage the deployment of automated vehicles to ensure the UK retains its leadership position in developing and deploying the technology. We welcome further engagement with the Committee on this subject.

Section 1: Defining and understanding automated vehicles

8. Automated vehicles are a subject that has often been written about, described and discussed in various outlets and fora with different levels of understanding about its true concept and applications. This has unfortunately led to misconceptions of automated vehicles. Therefore, we shall first set out in this section an authoritative industry explanation about automated vehicles that is aligned to government definition at both the UK and international levels.

Technical and legal definitions and industry convention

9. In technical terms, an automated vehicle is a vehicle equipped with an automated driving system. An automated driving system is the combination of software and hardware capable of performing the entire **dynamic driving task**[1] in one or more **operational design domains**[2].

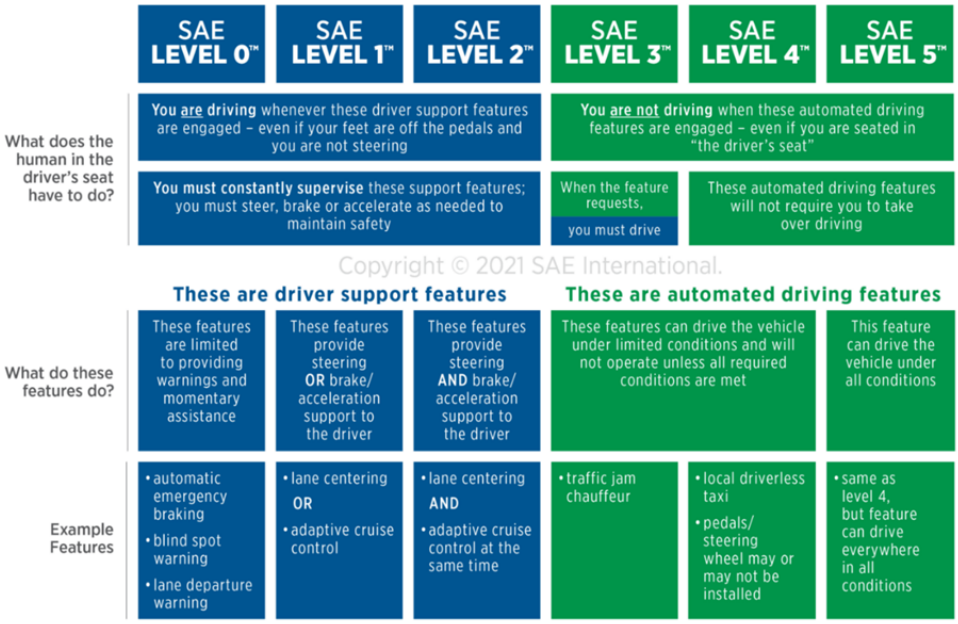
10. In legal terms, automated vehicles are defined under the Automated and Electric Vehicles Act 2018 as *"designed or adapted to be capable, at least in some circumstances or situations, of safely driving themselves"* and *"may be lawfully used on roads or other public places in Great Britain"*. A vehicle that is "driving itself" is then defined as "operating in a mode in which it is not being **controlled**, and does not need to be **monitored**, by an individual".

11. The control and monitoring tests are key determinants of whether a system can be deemed an automated driving system and, by extension, whether a vehicle can be considered an automated vehicle. Control refers to the sustained lateral (steering) and longitudinal (acceleration and braking) motion control of the vehicle, while monitoring refers to object and event detection and response. The Law Commissions, in their joint report, describe monitoring as the need to pay attention to the driving environment, the vehicle and the way the vehicle drives. For a vehicle to be deemed automated, the automated driving system must be able to perform the entire dynamic driving task (i.e. both control and monitoring) within its operational design domain without human intervention.

12. This British legal definition of automated vehicles is compatible with both industry convention and international technical regulation under the auspices of UNECE. The Society of Automotive Engineers' (SAE) International Standard J3016 (see Figure 1), is widely adopted industry convention. The World Forum for Harmonization of Vehicle Regulations

(WP.29) at the UNECE adopts definitions that closely mirrors industry convention (see Figure 2).

Figure 1: SAE J3016 levels of driving automation.



Source: https://www.sae.org/standards/content/j3016_202104/

Figure 2: UNECE WP.29 definitions of automated driving.

	Object and Event Detection and Response (OEDR) by the driver *The driver may not perform secondary activities*			*Object and Event Detection and Response (OEDR) by the system* *The driver may perform secondary activities*		
	Monitor by Driver	*Monitor by Driver (a)*	*Monitor by Driver (b)*	*Monitor by System (Return to Driver Control on System Request)*	*Monitor by System Full Time under defined use case*	*Monitor by System only*
Ref. SAE Level (J3016)	*1*	*2*		*3*	*4*	*5*
Outline of Classification	System takes care of longitudinal or lateral control. Monitoring by the driver.	The system takes care of both longitudinal and lateral control. Monitoring by driver necessary because the system is not able to detect all the situations in the ODD. The driver shall be able to intervene at any time.		The system is able to cope with all dynamic driving tasks within its Operational Design Domain (ODD) or will otherwise transition to the driver offering sufficient lead time (driver is fallback). The system drives and monitors (specific to the ODD) the environment. The system detects system limits and issues a transition demand if these are reached.	The system is able to cope with any situations in the ODD (fallback included). The driver is not necessarily needed during the specific use-case, e. g. Valet Parking/ Campus Shuttle. The system may however request a takeover if the ODD boundaries are reached (e.g. motorway exit).	The system is able to cope with any situations on all road types, speed ranges and environmental conditions. No driver necessary.

Source: https://unece.org/fileadmin/DAM/trans/main/wp29/wp29resolutions/ECE-TRANS-WP29-1140e.pdf

13. SAE Levels 0, 1 and 2 are not automated driving systems. These are known as driver assistance systems[3], which are aimed at supporting but not replacing the driver, who continues to perform and remains fully responsible for the dynamic driving task. Examples of driver assistance systems include lane departure warning, collision warning, blind spot monitoring, adaptive cruise control, lane keep assist, park assist, advanced emergency braking and remote control parking. These are widely available in new cars today. Eight in ten new cars sold in the UK are available with some form of driver assistance systems, with advanced emergency braking alone available in 71% of new cars.

14. SAE Levels 3, 4 and 5 are automated driving systems, where both control and monitoring are performed by the system when it is safely and correctly activated within its operational design domain. By definition, **vehicles fitted with a Level 3, 4 or 5 automated driving system are considered automated vehicles**. At the time of writing, there is no commercially deployed automated vehicle in the UK.

15. At SAE Level 3, also known as conditional automation, the driver only needs to be receptive to a system-issued transition demand[4], which is a request to retake control within a sufficient lead time. A transition demand is normally issued when the system limits are reached. These are typically vehicles with a **user-in-charge**[5], a term introduced by the Law Commissions. Level 3 use cases include traffic jam pilot and highway pilot. An example of Level 3 automated driving system is the UNECE-approved Automated Lane Keeping System (ALKS), which is currently available only in Germany. We will explain about ALKS in detail in section 4.

16. At SAE Level 4, also known high automation, the driver is no longer needed during the specific use cases, such as advanced highway pilot, automated valet parking, automated passenger shuttles and automated

goods delivery. Some of the vehicles equipped with a Level 4 automated driving system, particularly in the latter two use cases, may not even have a steering wheel and pedals, in which case these are known as no-user-in-charge vehicles. In passenger cars equipped with a Level 4 automated driving system (i.e. user-in-charge vehicles), a transition demand is normally issued only when the operational design domain boundaries are reached, for example, when exiting the motorway in the advanced highway pilot use case.

17. SAE Level 5, or full automation, is arguably the most **misunderstood** level of automation, with popular opinion often erroneously citing automated vehicles without a steering wheel and pedals as necessarily Level 5. While a Level 5 automated driving system may have the same features as a Level 4 automated driving system, the key difference is the ability of the former to operate in all conditions and without any operational design domain restrictions. In other words, it is capable of safely driving itself to deliver full end-to-end journeys anywhere in Britain, at any time of the day and in any weather conditions. This currently remains a theoretical level which is unlikely to be realised in the foreseeable future.

Common parlance

18. The adoption of common terminology is important, as is the choice of words and terms. "**Automated** vehicles", or its derivatives "automated driving systems" and "automation", are the standard industry terms and are also widely used in the regulatory arena, from the UNECE to the European Commission and UK legislation. UK Government's preferred term is "**self-driving** vehicles", as recommended by the Law Commissions in their regulatory review joint report. We consider both terms acceptable, as they accurately represent the technology. We will stress the importance

of clearly distinguishing between automated driving systems and driver assistance systems in consumer marketing in section 8.

19. We no longer use the term “**autonomous** vehicles”, or its derivative “autonomy”, although it was widely used by both industry and government in the early years of the technology’s development. The term does not accurately represent the technology and could create unhelpful connotations in the public’s mind. Learnings from public engagement over the last seven years suggest the word “autonomous”, or “autonomy”, when used in the context of vehicle technology, may give the erroneous perception that these vehicles have a mind completely of their own and could simply decide to do whatever they wished. In practice, although machine learning is the underpinning technique, the development of automated driving technology is predicated on rule-based and explainable artificial intelligence. Therefore, industry and stakeholders are gradually migrating away from using this term.

20. We do not use the term “**driverless** cars” either, as it is non-representative of all automated vehicles. The only exception where we use the term “driverless” is when describing automated vehicles without a user-in-charge, examples of which may include some automated passenger shuttles or delivery vehicles without a steering wheel and pedals.

Section 2: Benefits of automated vehicles

21. We believe automated vehicles have the potential to deliver on the UK’s triple bottom line of **people, prosperity** and the **planet**.

22. Automated vehicles should never be an end but a means to deliver real-world applications that could serve the British **people** in three critical areas:

- **Safety**: Modelling results published in a study we commissioned shows 3,900 lives could be saved and 47,000 serious accidents prevented this decade through the deployment of automated vehicles. Automated vehicles play a critical role in improving overall road safety given that 88% of road accidents in 2020 were caused by human error. A US study suggests, over the course of 15 years, many more lives could be saved by deploying highly automated vehicles early, even when they were just 10% safer than the average human driver.

- **Employment**: 182,000 people are currently employed in automotive manufacturing, while the wider automotive sector employs a total of 780,000 people. Many automotive jobs are outside London and the Southeast, with wages that are around 14% higher than the UK average. Our study also suggests automated vehicles, along with connected vehicles, could create a multiplier effect that accrues to other sectors by delivering 420,000 new jobs by 2030, 20,000 of which will be in automotive.

- **Access to mobility**: Another study that we commissioned shows 56% of people with disability are the most excited about automated vehicles, six in ten people with limited mobility believe automated vehicles will help them obtain higher quality of life, and nearly half of all older people believe automated vehicles will enable them to more easily fulfil day-to-day tasks such as grocery shopping or visiting the doctor.

23. Another central proposition of automated vehicles is to deliver genuine and lasting economic value to the UK, thus contributing to the **prosperity** of the country in a material way. We believe the automated vehicle proposition in relation to this are:

- **Economic impact**: Our study shows the economic impact of connected and automated vehicles to the UK could be as high as £62 billion per annum by 2030, of which £18 billion accrues to wider sectors (e.g. electronics, digital, consumer services, insurance), which underlines the spillover effects connected and automated vehicles can create. It is foreseeable that connected and automated vehicles could create new sectors altogether, for example the operations and servicing of automated passenger shuttles. Our study also discovered that the UK has the most attractive market among major economies for automated vehicle deployment. Another study suggests the connected and automated vehicle market itself could be worth £41.7 billion to the UK by 2035 and would provide approximately £9 billion in direct contributions to economy.

- **Future of automotive**: The automotive industry is a vital part of the UK economy accounting for £67 billion turnover, £14 billion value added per annum and 10% of total UK goods exports to over 150 countries, generating £77 billion of trade. Our study also shows that, besides the spillover effects, connected and automated vehicles could add £2 billion annually to the producers of the underpinning technologies, including both hardware and software.

24. Automated vehicles also have the potential to complement the automotive industry's commitment to electrification, thereby contributing to a cleaner and greener **planet**. While zero emission vehicles will undoubtedly have the greatest impact in the road transport sector's drive to help the country achieve its Net Zero target by 2050, automated vehicles, complemented by connectivity, could expedite the process through:

- **More efficient traffic flows**: When deployed in large numbers, automated vehicles platooning and travelling at optimised speeds and headway gaps could improve traffic flow and efficiency and reduce fuel consumption and emissions. A government-commissioned study suggests a 12% improvement in delays and a 21% improvement in journey time reliability on urban roads in peak traffic periods even with low numbers of automated vehicles.

- **Reducing emissions**: A European study shows that intelligent transport systems could reduce CO_2 emissions by up to 20% by connecting vehicles with each other and with infrastructure. Recent green light optimal speed advisory trials found CO_2 emissions were reduced by up to 27% and NOx emissions by up to 17%.

Section 3: Applications, use cases and deployment of automated vehicles

25. Findings from our extensive engagement with a wide range of stakeholders since the first automated vehicle trialling projects began in late 2014 suggest automated vehicles mean different things to different people. For many people in the UK, the mention of automated vehicles normally conjures up mental images of robotaxis, shuttles or self-driving pods carrying passengers over relatively short distances. This perception is largely influenced by the famous and enduring images of an early-generation automated pod painted with the Union Jack and the adapted Heathrow passenger pods, both of which were part of government-funded trials. For some, automated vehicles are small robotic vehicles delivering groceries to their doorsteps, while for others automated vehicles mean they could one day turn their private cars into a second living room.

26. There is no single definitive “type” of automated vehicles, or indeed how automated vehicles should look. It is important to be clear about the

different types of automated vehicle **applications** and their **use cases**. We set out the differences between three overarching automated vehicle applications, their respective use cases and their state of development in Table 1 below. We also include links to examples of trials, demonstrations and pilot deployments that have taken place or are still continuing.

27. Automated vehicles can be understood in terms of three overarching applications, namely passenger cars fitted with automated driving systems, automated passenger services, and automated delivery and logistics. Of these three main applications, the only one that is now commercially available in Europe is **passenger cars fitted with an automated driving system called the Automated Lane Keeping System (ALKS)**. It is expected that commercial offerings for other automated driving use cases in passenger cars will be available in the coming years once the technology is ready, international technical regulations are adopted and national legislation permits their rollout. As these are passenger cars, the technology is typically developed and brought to market by car manufacturers, although the software development may involve collaboration with a third-party developer in which the car manufacturer has an ownership stake. These are nominally user-in-charge vehicles, although Automated Valet Parking is expected to be carried out without a user-in-charge.

Table 1: Automated vehicle applications, their use cases and state of development.

Applications and description	Likely use cases	State of development
Passenger cars fitted with automated driving systems • With user-in-charge • SAE Level 3 or SAE Level 4	Automated Lane Keeping System (SAE L3, low and/or high speed, motorway only)	• UNECE Reg 157 approved in June 2020 (up to 60kmph) and amended in June 2022 (up to 130kmph). • Now available in passenger car models in Germany. • Recent regulatory reforms permit commercial deployment in GB subject to VCA approval.
	Advanced highway pilot (SAE L4, high speed, motorway only)	• Technology is being further refined. Very complex particularly in urban ODDs. • New international technical regulations to be developed. • National regulatory reforms may be required. • Numerous trials have been conducted, including in the UK and in Europe.
	Highway + urban (SAE L4)	
	Automated Valet Parking (SAE L4)	• Technology is already available and being further refined. • Tests and demonstrations have been conducted, for example in Germany. • Requires infrastructure and participation of parking facility operator. • May require clarification in regulatory framework.

Automated passenger services • Likely to have no user-in-charge, i.e. 'driver-less' • Services and operations overseen by a no-user-in-charge operator • Could have no steering wheels and pedals • Could include some form of remote driving (teleoperation) • SAE Level 4	Urban, sub-urban or rural services for on-demand ride-hailing or scheduled services; sometimes referred to in popular literature as pods, shuttles and robotaxis, but could also be cars	• Technology is being further refined. Very complex particularly in urban ODDs. • Pilot deployment already possible in certain foreign markets, for example in Phoenix and San Francisco. • Trials and demonstrations are still taking place in the UK, for example in Scotland. • Competition for pilot deployment of services under way in the UK. • For rollout on public roads and public spaces (including off-highway), full commercial deployment in the UK subject to regulatory reforms and local authorities' buy-in. • Business case for rural markets may be less clear. • Regulatory barriers are lowest for deployment on private land. Deployment still subject to other considerations, e.g. health and safety regulations, safety case, business case.
	Urban or inter-urban larger shuttles for on-demand ride-hailing or scheduled services; sometimes referred to in popular literature as self-driving buses/minibuses	
	Off-highway services for on-demand ride-hailing or scheduled services; could be in public spaces (e.g. university campus) or on private land (e.g. factories)	
	Urban and/or last	• Technology being further refined.

<table>
<tr>
<td rowspan="3">Automated delivery and logistics
With or without user-in-charge
If no user-in-charge, services and operations overseen by a no-user-in-charge operator
If no user-in-charge, could have no steering wheels and pedals
Could include some form of remote driving (teleoperation)
SAE Level 4</td>
<td>mile goods deliveries (likely without user-in-charge); could be in the form of adapted vans or bespoke light commercial/robotic vehicles</td>
<td rowspan="2">Very complex particularly in urban ODDs.
Pilot deployment of last-mile deliveries already possible in certain foreign markets, for example in Houston.
Commercial deployment of last-mile deliveries, albeit largely on pavements, already available in the UK.
Competition for pilot deployment of services under way in the UK.
Long-haul freight trials already under way, for example in the US.
For rollout on public roads and public spaces (including off-highway), full commercial deployment in the UK subject to regulatory reforms and local authorities’ buy-in.
Business case depends on operator demand and optimisation of operations.</td>
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<tr>
<td>Inter-urban and/or port-to-hub/depot logistics (may require user-in-charge for parts of the journey); could be in the form of trucks, vans or adapted heavy duty vehicles</td>
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<tr>
<td>Specialist off-highway logistics; most likely on private land, e.g. airports, ports, factories, quarries, mines (no user-in-charge)</td>
<td>Technology is already available and has either been deployed or trialled.
Regulatory barriers are lowest for deployment on private land. Deployment still subject to other considerations, e.g. health and safety regulations, safety case, business case.
Business case depends on facility operator demand and optimisation of operations.</td>
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28. Commercial deployment of ALKS-fitted passenger cars in Great Britain is now possible thanks to regulatory reforms that were recently completed. This included the commencement of the Automated and Electric Vehicles Act 2018 in April 2021, and amendments to The Highway Code to introduce a new section on self-driving vehicles and modifications to Construction and Use Regulation 109 which were passed on 1 July 2022. This means, subject to the vehicle obtaining type approval for the ALKS based on UN Regulation 157 and being deemed compliant with GB traffic rules by the Vehicle Certification Agency, passengers cars fitted with ALKS could be listed under the Automated and Electric Vehicles Act 2018 and registered in the Driver and Vehicle Licensing Agency database as self-driving vehicles. Drivers should then be able to obtain the appropriate insurance cover under the Automated and Electric Vehicles Act 2018, which provides the legal framework for liability pertaining to the use of automated vehicles.

29. The first passenger cars fitted with an automated driving system could be rolled out on British roads from the end of 2022 or early 2023. We then expect their numbers to gradually increase until automated driving could be available in a sizeable proportion of new cars in the second half of this decade. A government-commissioned study suggests 40% of new cars in the UK could have automated driving capabilities by 2035.

30. **Automated passenger services** could serve several use cases and be delivered using vehicles with different form factors (e.g. dedicated pods and shuttles, adapted buses and buggies, or adapted cars). When fully commercialised, these are expected to carry fee-paying passengers. While commercialisation has yet to commence in the UK, there have been numerous government-funded trials since December 2014, including the most recent cohort of projects that was supported by £25 million funding. The automated driving technology underpinning automated passenger

services are typically developed by technology developers, many of which were start-ups. Some of these are independent, whereas others are partly owned by vehicle manufacturers. Technology developers integrate their automated driving technology into a host, or shell, vehicle usually through partnership with either a vehicle manufacturer or specialist body builder. They then typically partner with a passenger service (e.g. ride-hailing, bus) operator to offer commercial services to the public.

31. **Automated delivery and logistics** could also serve several use cases and be commercialised using vehicles with different form factors (e.g. vans, trucks, or bespoke light or heavy commercial vehicles). When fully commercialised, these are expected to be used to deliver goods or carry freight. Apart from small robotic vehicles delivering groceries by mainly plying pavements, commercialisation has yet to commence in the UK. Some of the government-funded trials have explored and/or demonstrated goods delivery, logistics operations or transportation of freight. Just like automated passenger services, the automated driving technology underpinning automated delivery and logistics is typically developed by technology developers, many of which were start-ups. Many of these are independent, while some are partly owned by vehicle manufacturers. Technology developers integrate their automated driving technology into a host, or shell, vehicle usually through partnership with either a vehicle manufacturer or specialist body builder, but often working in close collaboration with the end customer, which is likely to be a delivery, logistics or freight operator.

32. Full commercial rollout of automated passenger services and automated delivery and logistics is unlikely to be possible before 2025, when the completion of the necessary regulatory reforms is expected. Ensuring these reforms are **completed on time** is of paramount importance to the competitiveness and attractiveness of the UK as a location of choice for

the rollout of these applications, as we will explain in paragraphs 58 and 59.

33. Hitherto, government and industry have jointly invested around £440 million in more than 90 projects involving over 200 organisations. These projects involved collaborative research and development, trials, demonstrations, feasibility studies and the creation of six testbeds. However, as noted above, the UK has yet to progress towards pilot deployment of the latter two applications despite being blessed with several homegrown vehicle manufacturers and automated driving technology developers as well as attracting the interest of several foreign investors. In the meantime, these applications have already seen pilot deployment in the US, several examples of which are set out in Table 1, while rollout is also targeted for Europe and the Middle East in the next few years[6]. Specialist automated vehicles have already been deployed in enclosed private land such as mines, quarries and factories worldwide.

34. As we stated in our response to government's Future of Connected and Automated Mobility in the UK Call for Evidence in July 2021, we believe the UK must now move beyond only testing and trialling to pilot deployment. To this end, we are pleased government has recently launched a new £40 million funding competition geared towards commercialising automated passenger and delivery services.

35. Pilot deployment, however, does not necessarily mean automated vehicles will be allowed unfettered access to public roads and public spaces from the beginning. Instead, it is likely to come with stringent conditions for deployment that are based on the robustness of the safety case submitted by interested entities and the entities' track record of trialling on public roads or public spaces. For example, in its decision to allow limited pilot deployment of an automated ride-hailing passenger

service in San Francisco, the California Public Utilities Commission set conditions that included deployment only on select streets in San Francisco at a maximum speed of 30mph, between 22:00 and 06:00 when weather conditions do not include heavy rain, heavy fog, heavy smoke, hail, sleet, or snow.

36. However, eventual full commercial deployment of automated vehicles in the UK depends critically on four key factors:

- ***Maturing the technology to ensure it is safe and operational across wider operational design domains***.
  The earliest attempts to develop automated driving technology can be traced back to the 2004 DARPA Grand Challenge. Nearly two decades on, it is now generally accepted that the few remaining technical, or engineering, challenges are mainly to fine-tune the automated driving system to ensure it achieves a "safe enough" performance level, is robust and resilient enough to handle edge cases and is capable of adapting to wider operational design domains. Apart from passenger cars fitted with ALKS that are already deemed safe and capable enough to be deployed within its operational design domain, it is expected that the technology for automated passenger services and automated delivery and logistics should be ready for limited (conditional) pilot deployment in the UK by the middle of this decade. By then, it is likely that the pilot deployments in other markets, as described above, will have progressed further or become full commercial deployments.

- ***Developing a fit-for-purpose regulatory framework for approval, authorisation, liability and in-use monitoring***.
  The current regulatory framework, as described in paragraph 28 above, caters for the deployment of passenger cars fitted with automated driving systems, beginning with ALKS. Industry would like to work

closely with government on regulatory reforms and development of new legislation with the aim of ensuring the complete suite of regulation is in place by 2025 to enable the deployment of all automated vehicle applications across all use cases. This is important as Great Britain is already behind key markets in Europe in regulatory reforms. We will return to this topic in sections 5 and 6.

- ***Communicating to and educating the public about automated vehicles to build public acceptance and ensure safe and responsible use***.
  Manually driven motor vehicles have been in existence and have shaped our understanding of mobility for over a century. Vehicles that are capable of driving themselves represent a step-change in our concept of mobility. As such, it is necessary to ensure the public are aware of this new technology, understand how it can be used safely and responsibly, and are comfortable with embracing change while retaining the choice of status quo. Towards this end, we are working with government and other stakeholders to deliver a communications programme to inform and educate the public. We will explain more about this in section 8.

- ***Spawning the right business models to ensure deployment of automated vehicles is economically viable***.
  While automated driving features in passenger cars are likely to be made available to customers as optional fitment in the foreseeable future, finding the right business model for the latter two applications, i.e. passenger services and delivery and logistics, may be slightly more challenging. To a large extent, the customers of the automated driving technology developers are likely to be, although not limited to, operators of ride-hailing services, public transit, goods delivery services, logistics and freight. In private settings, such as mines, factories and airports, these could be landowners and facility

operators. Key to ensuring successful deployment is an attractive business case on the part of these customers vis-à-vis the next best alternatives.

Section 4: Automated Lane Keeping System

37. Automated Lane Keeping System (ALKS) is the world's first **internationally approved automated driving system** and is currently available in several passenger car models in Germany. ALKS was approved by the World Forum for Harmonization of Vehicle Regulations (WP.29) at the UNECE, of which the UK is a contracting party and active participant, and established under UN Regulation 157. It was the culmination of years of detailed discussion and debate during which every aspect of the technology was carefully scrutinised. International regulators, including officials from the UK Department for Transport, collectively approved ALKS to be an automated driving system in June 2020 after being satisfied that the technology and its regulated design requirements were safe. Above all, safety is the number one priority for vehicle manufacturers, who thoroughly test the technology to ensure it is robust and safe before it is rolled out.

The operational design domain for ALKS

38. ALKS is conditional automation (SAE Level 3) and operates only in a **limited** environment, specifically on roads where pedestrians and cyclists are prohibited and with a central reservation. In the UK, this means it can only be used on the **motorway**. The original text of the Regulation, approved in June 2020 and came into force in January 2021, limited the operational speed of ALKS to a maximum of 60kmph (37mph). An amendment to the Regulation approved in June 2022, which will come into force in January

2023, extends the operational speed limit to 130kmph (81mph). On British roads, this will of course be capped at the national speed limit of 70mph.

Activating ALKS

39. Contrary to popular but erroneous perception, ALKS cannot simply be activated anywhere at the driver's choice. The system, through the aid of state-of-the-art sensors and positioning technology, constantly monitors the environment to detect if the conditions for ALKS to operate are present. If the vehicle is found to be travelling in ALKS's regulated operational design domain, **the vehicle indicates** to the driver that automated driving is now available. This will be clearly communicated to the driver via the driver display, infotainment screen and/or other intuitive human-machine interfaces. The driver may then activate ALKS, or choose to continue driving manually. It is not possible for ALKS to be activated on narrow and unmarked country lanes or on roads where pedestrians and cyclists are legally allowed to travel.

40. Once ALKS is safely and correctly activated within its prescribed operational design domain, it performs the driving task and the external environment monitoring directly related to the driving task, i.e. both control and monitoring, as described in paragraphs 10-11 above. The system itself detects, responds to and mitigates the risks posed by any oncoming hazards. The driver becomes a user-in-charge who only needs to remain receptive to a transition demand and retains the option to override the system and resume manual driving at any time.

41. The activated system normally keeps the vehicle in its lane of travel and within a safe distance to the vehicle in front, steering, braking and pulling away as necessary. The system may from time to time assess that it is necessary to intentionally cross lane markings in order to perform a lane-

change procedure, carry out an emergency manoeuvre, form a corridor to allow emergency or enforcement vehicles to pass, or to drive around an obstacle partly blocking the lane. The activated system is intelligent and designed to detect any risks of collision, for example due to a decelerating lead vehicle or a cutting-in vehicle. It automatically performs appropriate manoeuvres to avoid a collision and/or minimise risks to the safety of vehicle occupants and other road users.

Performing activities other than driving

42. While the vehicle is driving itself, the driver who has become a user-in-charge can now perform some limited activities other than driving. These activities, which are subject to national traffic rules, are those that generally will not prevent the user-in-charge from retaking control of the vehicle when prompted by the system[7]. This means sleeping and vacating the driver's seat are prohibited. In Great Britain, as set out in the new section on self-driving vehicles in The Highway Code and modification to Construction and Use Regulation 109, these activities may be performed via the onboard infotainment display, but using a hand-held mobile phone, or similar hand-held devices, remains prohibited.

43. In practice, this means personal devices such as mobile phones and tablets must be tethered so that the content is mirrored on and controlled via the infotainment display. In the event of a transition demand requesting the user-in-charge to retake control, the activities on the infotainment display will be automatically suspended and visual and audible warnings to resume control of the vehicle are issued. The user-in-charge will also be notified via the infotainment display of any system warnings.

44. ALKS is designed to include risk mitigation measures to prevent misuse. A driver availability recognition system continuously detects if the user-in-

charge remains in a driving position and if the seatbelt remains fastened, while an in-vehicle driver monitoring system detects if the driver is attentive by way of monitoring gaze direction and head movement. Any detected attempt to misuse the technology will result in the user-in-charge being requested to retake control and resume manual driving.

Transition demand and fail-safe measures

45. When the conditions for ALKS to operate are no longer present, or when the vehicle is soon approaching the motorway exit, the system will prompt the driver to retake control by way of a transition demand. The initiation of the transition demand will provide sufficient time for a safe transition to manual driving. There will be an escalation of warnings – first visual, then audible and finally haptic. The system remains in safe control of the vehicle until the user-in-charge resumes the driving task.

46. In the event the user-in-charge does not respond to a transition demand by resuming manual control of the vehicle, such as in medical emergencies, a minimum risk manoeuvre will be initiated no sooner than 10 seconds from the start of the transition demand. The minimum risk manoeuvre is designed to bring the vehicle to a standstill unless the user-in-charge resumes driving during the manoeuvre. This is an incremental safety benefit compared to a conventional vehicle with a driver who has passed out or has a medical emergency, where the vehicle may just crash into other vehicles or the central reservation.

47. For ALKS with a manufacturer-specified maximum operating speed of 37mph, which most likely caters to a traffic jam use case, the minimum risk manoeuvre will bring the vehicle to a safe stop in the lane of travel and automatically turns on the hazard warning lights; whereas ALKS with a manufacturer-specified maximum operating speed above 37mph will have

the option of changing lanes when performing a minimum risk manoeuvre. Lane changes during a minimum risk manoeuvre, including with the possibility of coming to a safe stop on the hard shoulder, will be made only if they are considered the best option to minimise the risk to safety of the vehicle occupants and other road users under real-time circumstances (e.g. traffic situation/congestion, environmental conditions, potential system failures).

Common misconceptions

48. Some commentators incorrectly label ALKS as just a glorified form of driver assistance system. ALKS is neither simply adding a lane keeping system to adaptive cruise control nor a sum of disparate driver assistance technologies. ALKS uses a more sophisticated sensor suite than driver assistance systems and is designed as a self-contained system that enables automated driving when the conditions for its safe operation are met. The testing that some third parties may claim to have carried out has been performed using vehicles with only multiple driver assistance technologies acting as a proxy for ALKS. The outcome, unsurprisingly, does not reflect the true performance or capability of ALKS. As explained in section 1, the driver is still responsible for monitoring the road ahead, the vehicle and the way the vehicle drives when driver assistance features are used. The driver does not have to do so when ALKS is safely and correctly activated.

49. There have also been misleading claims that ALKS will not be able to react to the red X signal on a motorway gantry indicating lane closure, obey traffic rules or perform evasive manoeuvres to avoid pedestrians or an obstacle. ALKS is designed to read and respond to road signage and speed limits. UN Regulation 157 also mandates that ALKS must comply with traffic rules in the country of operation (specifically 5.1.2 in UN Reg 157) and manufacturers need to declare in which countries their vehicles will

operate. The authority granting the approval will assess compliance with these requirements. In Britain, the Vehicle Certification Agency will assess if passenger cars fitted with ALKS are compliant with GB traffic rules before approving them to be listed under Automated and Electric Vehicles Act 2018 as self-driving vehicles. In the unlikely event of pedestrians on the motorway, ALKS is designed to avoid a collision, or at higher speeds to implement strategies to reduce the potential for a collision, where there is an unobstructed pedestrian crossing in front of the vehicle (specifically 5.2.5.3 in UN Reg 157).

50. There may also be concerns among some consumers that they may not be able to obtain the appropriate insurance for ALKS-fitted vehicles. In July 2018, the UK became the first country in the world to pass legislation to ensure automated vehicles can be appropriately insured. The Automated and Electric Vehicles Act 2018, which commenced in April 2021, states that in the event of an accident involving an automated vehicle, the insurer will compensate the victim(s) or injured party(ies). The insurer may then recover costs from the at-fault party through the aid of a data recorder. ALKS-fitted vehicles are equipped with a Data Storage System for Automated Driving (DSSAD) in compliance with UN Regulation 157. The DSSAD records who was driving the vehicle (i.e. the system or the human driver) at the time of an accident, thus assisting insurers in determining liability. As the insurance industry has pledged its "100% commitment" to supporting the development of automated vehicles, it is hoped that British insurers will offer the appropriate insurance products for ALKS-fitted vehicles. Given ALKS is a technology that will deliver safety benefits, it is also hoped that drivers will eventually benefit from lower insurance premiums, as they did with other safety technologies such as advanced emergency braking.

Section 5: The regulatory framework for automated vehicles

Regulating trials

51. Trialling of automated vehicles on British roads has taken place since late 2014 and remains possible under existing regulations. We commend government for its light-touch approach to regulation on trialling automated vehicles with a safety driver. Government's Code of Practice: Automated Vehicle Trialling was a seminal guidance when it was published in 2015, supporting industry and stakeholders to conduct safe and responsible trials on public roads and spaces in Britain.

52. The Code of Practice provides guidance on developing safety cases, engagement strategies, ways of working with relevant bodies and the public, as well as vehicle and operator requirements. It also includes some technical guidance, such as collecting and accessing vehicle data. By setting out the relevant existing regulations within the Road Traffic Act 1988, the Road Vehicles (Construction and Use) Regulations 1986 and The Highway Code that govern trials, no additional or onerous regulations are imposed on trialling organisations, as long as trials are conducted with a safety driver. This has contributed to the UK becoming an attractive location for industry and stakeholders to conduct trials, as evidenced by the more than 90 projects involving over 200 organisations supported by government funding since late 2014.

53. To complement the Code of Practice, government has commissioned the British Standards Institution to develop a series of Publicly Available Specifications that set out common standards and best practices for trialling. Since 2019, government has also been developing a comprehensive safety and security assurance process that is aimed at ultimately enabling the widescale deployment of automated vehicles. Known as the Connected and Automated Vehicles Process for Assuring

Safety and Security (CAV PASS), the programme seeks to develop technical standards and regulations necessary to ensure safe and secure trialling, commercial deployment and ongoing roadworthiness of automated vehicles. An important component of CAV PASS is the development of an approval scheme for highly automated vehicles, including those operating at low speeds, that do not fall within international technical regulations harmonised at the UNECE.

54. The Code of Practice was updated in early 2022 to provide greater clarity on vehicle authorisations and exemptions for more complex trials, particularly for vehicles with an offboard safety driver. The Code of Practice has thus far been used only for trials with a safety driver, whether onboard or offboard. However, as an intermediate step between trialling with an offboard safety driver and pilot deployment, it would be necessary for automated vehicles that are ultimately intended to be used without a user-in-charge (i.e. most likely for passenger services, delivery and logistics) to be trialled **without** an onboard or offboard safety driver. The lack of legal clarity governing such trials is a potential barrier for developers intending to trial no-user-in-charge automated vehicles in the UK.

55. Therefore, it is important that government urgently clarifies how such trials can be legally conducted within the existing regulatory framework, sets out the process for obtaining approvals and exemptions, and provides updated guidance within the Code of Practice to support industry and stakeholders carrying out these trials. For example, we think clarification on the exemptions that apply are particularly crucial. This is because a prototype automated driving system may mature considerably during the trial, thus enhancing its performance compared to its original state which was assessed for the granting of an exemption. In order to afford the trialling organisation the required flexibility to improve the automated

driving system, appropriate exemptions should be given to the trialling organisation for the entire duration of the trial.

Progress of regulatory reforms for deployment

56. A fit-for-purpose regulatory framework is a key enabler for the full commercial deployment of automated vehicles. For the past eight years, industry has been working closely with UK Government and international regulators at UNECE to ensure fit-for-purpose regulatory frameworks are in place for the deployment of the first automated vehicles, i.e. passenger cars fitted with Automated Lane Keeping System (ALKS). This close collaboration, which should continue into the future, has resulted in the following current regulations:

- Automated and Electric Vehicles Act 2018, which sets out the legal framework for insuring automated vehicles. Received Royal Assent in July 2018 and commenced in April 2021.
- UN Regulation 157, concerning the approval of vehicles with regard to ALKS. Approved by WP.29 at UNECE in June 2020 and came into force January 2021. Amended and approved at WP.29 at UNECE in June 2022 and will come into force January 2023.
- The Highway Code, amended to create a new section on self-driving vehicles. Laid in the houses of Parliament in April 2022 and passed in July 2022.
- Road Vehicles (Construction and Use) Regulations 1986, with modifications to Regulation 109 concerning television receiving or other cinematographic apparatus to enable the legal use of the automated vehicle's built-in infotainment display to view content. Laid in the houses of Parliament in April 2022 and passed in July 2022.

- UN Regulation 155, concerning the approval of vehicles with regards to cyber security and cyber security management system. Approved by WP.29 at UNECE in June 2020 and came into force January 2021.
- UN Regulation 156, concerning the approval of vehicles with regards to software updates and software updates management system. Approved by WP.29 at UNECE in June 2020 and came into force January 2021.

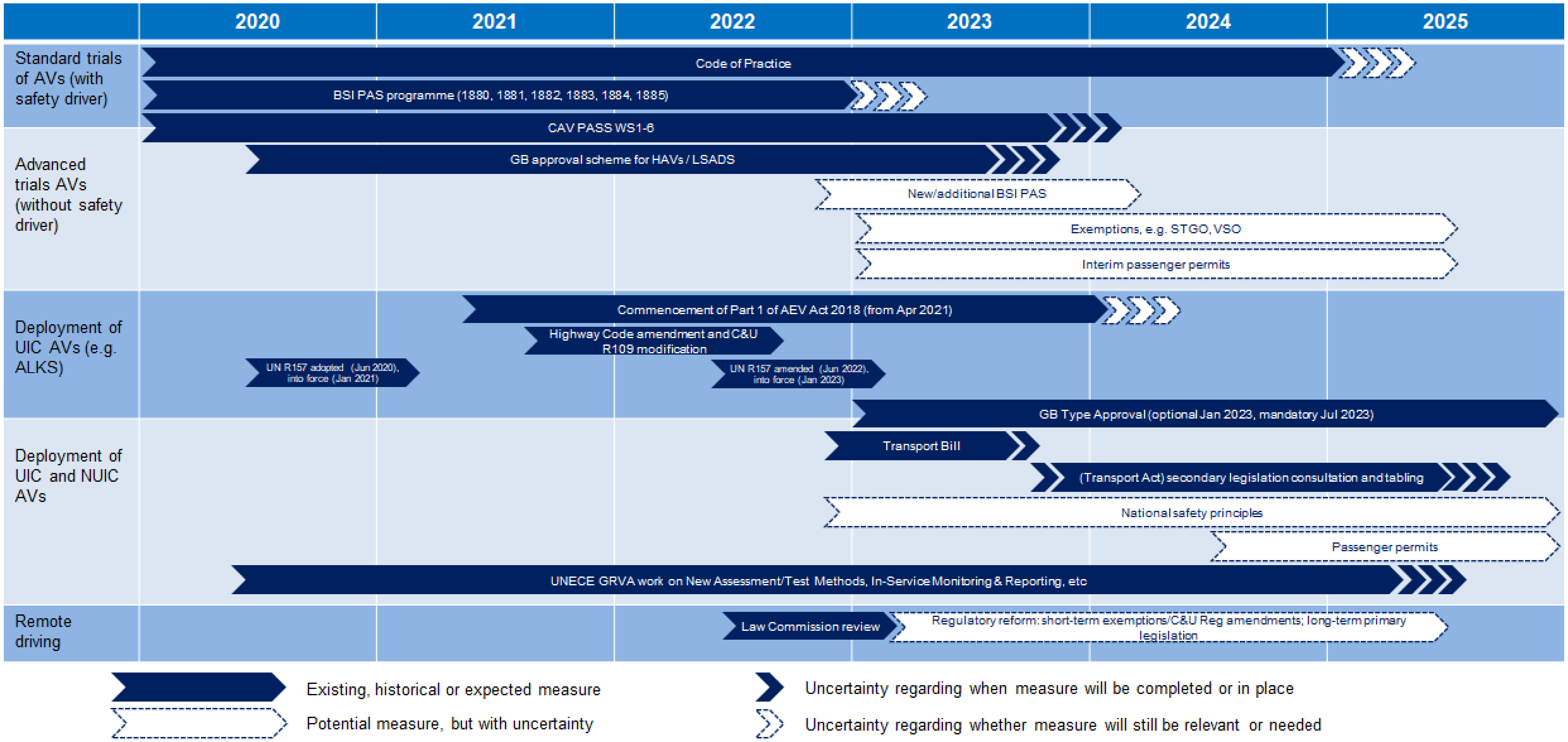
57. The existing regulatory frameworks will form the bedrock on which future regulation will be developed to pave the way for the deployment of all types of automated vehicle applications in Great Britain. This follows a comprehensive four-year regulatory review carried out by the Law Commission of England and Wales and the Scottish Law Commission. Government has recently announced that it will take forward the core recommendations from the Law Commissions' final report into developing primary legislation that will be set out in a Transport Bill, followed by secondary legislation with details for implementation. We support government's aim to have the complete suite of regulation in place by 2025, as set out in the recently published policy paper Connected and Automated Mobility 2025: Realising the Benefits of Self-driving Vehicles in the UK. Ensuring the regulatory reforms are **completed on time** is of paramount importance to the competitiveness and attractiveness of the UK as a location of choice for the rollout of automated vehicles. Figure 3 depicts our understanding of the regulatory roadmap towards 2025 and interpretation of Figure 2 in government's policy paper.

58. We strongly believe government, legislators, industry and stakeholders must work closely to ensure any barriers to regulatory reform are removed and that there is no delay to developing the complete regulatory framework and tabling of legislation in Parliament. As such, we urge the Committee to do its utmost to ensure the outcome of this inquiry results

in **enhancing the pace of regulatory reform** rather than making it more onerous to deploy automated vehicles and slowing progress. Leaving aside the US, which is the current global leader in pilot deployment of automated vehicles but where there is a markedly different regulatory framework, Great Britain is already behind key markets in Europe in regulatory reforms that enable full deployment. Those key European markets already have type approval regulations in place and have amended their road traffic laws to pave the way for automated vehicle rollout. A clear regulatory framework is important for providing legal certainty for manufacturers and developers intending to deploy automated vehicles.

59. For example, amendments to the German Road Traffic Act in 2017 meant conditional and highly automated driving were, by law, already possible long before regulatory reforms were completed to allow for the deployment of ALKS-fitted passenger cars on British roads. Germany has further consolidated its position as the leading market for deployment by passing legislation to allow the deployment of SAE Level 4 automated vehicles without a user-in-charge, which paves the way for the rollout of automated passenger shuttles and automated delivery/logistics vehicles. While it may not apply to Great Britain, the European Union has recently adopted an implementing regulation for the type approval of automated driving systems for passenger services, goods delivery and/or freight, and Automated Valet Parking. The regulation comes into force in summer 2022 for small series and in 2024 for unlimited series, a year ahead of the expected completion of our own regulatory reforms. As regulatory harmonisation reduces cost, enhances speed to market and promotes cross-border trade, we hope the eventual regulatory framework for Great Britain will align as much as possible with the European regulation.

Figure 3: Industry interpretation of the regulatory roadmap towards 2025.



Section 6: Key aspects of future regulatory reforms

Approval and authorisation of automated vehicles

60. Following the Law Commissions' recommendations, we understand government will develop new legislation to authorise vehicles as "self-driving" if they meet certain regulatory requirements. We agree with the Law Commissions that only vehicles **authorised** by the Vehicle Certification Agency as self-driving can be put on the market, used and insured as automated vehicles. We also agree with the Law Commissions that it should be an offence to market or advertise unauthorised vehicles as automated vehicles or having self-driving capabilities, or to mislead consumers into believing so.

61. Authorisation will be a statutory decision on whether the vehicle can drive itself safely enough in at least some circumstances or situations such that the driver no longer needs to be responsible for its behaviour and that it operates in compliance with the law. We believe authorisation must be based on an assessment of the following four key requirements:

- ***The vehicle must have obtained the appropriate type approval.***
  Type approval must be based on technical regulations, either those harmonised and adopted internationally at the World Forum for Harmonization of Vehicle Regulations (WP.29) of the UNECE or, where there is a current lack of international technical regulations, the GB approval scheme for highly automated vehicles, including those operating at low speeds, that is currently being developed by the International Vehicle Standards at the Department for Transport.

- ***The vehicle must be deemed to meet the threshold of self-driving***.

The threshold of self-driving is determined by applying the control and monitoring tests, as explained in paragraphs 10-11 above.

- ***The vehicle must meet the requirements to record and store data*** related to automated driving that can be used to establish liability. The rationale for this is to determine whether the vehicle was driving itself at the time in question. The data is expected to be made available to authorised parties such as the police, accident investigators, the regulator and insurers upon request, for specific purposes and in accordance with data protection laws.

- ***The vehicle must be supported by a suitable Authorised Self-Driving Entity (ASDE).***
  As proposed by the Law Commissions, an ASDE is the manufacturer or developer that puts the vehicle forward for authorisation and takes responsibility for its actions. The ASDE must be of good repute, have sufficient financial standing, have been substantially involved in the safety development of the vehicle and be able to comply with in-use duties specified by the regulator.

62. We believe the second and the third requirements above could be met at the type approval stage, which should make the assessment by the Vehicle Certification Agency for the purposes of authorisation superfluous and help avoid duplication.

Setting safety principles

63. The Law Commissions recommend that the Secretary of State for Transport should publish a safety standard against which the safety of automated vehicles can be measured. The safety standard will set the performance expectations before deployment and enable a comparison

with human driving while they are in use. We do not think this is practical in an environment where there is not yet any automated vehicles on the road. In the absence of meaningful real-world deployment data, like-for-like comparisons are impossible and how high the safety bar ought to be set will be, at best, arbitrary. Furthermore, any fixed safety standard will be obsolete when traffic rules change, societal behaviours evolve and technology improves.

64. As we set out in paragraph 22, one of the key aims of automated vehicles is improving road safety. As such, we support the view set out in an industry-wide standard, ISO/TR 4804:2020, which suggests a meaningful threshold should be a **positive risk balance while avoiding unreasonable risks**, which means automated vehicles should, on the whole, cause fewer deaths and injuries than human drivers. The acceptance criteria in determining a positive risk balance should be based on traffic accident statistics that are representative of relevant traffic types and scenarios. In the first instance, instead of a safety standard, we believe the concept of positive risk balance should be accompanied by a set of **national safety principles**. Automated vehicles should be developed, validated, authorised and deployed based on these principles, which government should set based on British traffic rules, road use traditions and motoring culture.

65. As the history of automotive has shown, continuous improvement and innovation in safety is a hallmark of the industry. Aided by data from in-use monitoring, it is expected that continuous improvement and innovation will result in automated vehicles that are even safer in the future. As such, we think achieving a positive risk balance while avoiding unreasonable risks should be the starting point. When progress is evident, a major review in the future may set specific thresholds. Setting thresholds from the beginning is unrealistic and may result in automated vehicles that could bring even marginal road safety improvements excluded from

deployment. This is akin to “letting the perfect become the enemy of the good” and deprives society of the overall safety benefits for many years, potentially resulting in avoidable casualties.

Automated vehicles with no user-in-charge

66. Many of the automated passenger services and automated delivery and logistics use cases are likely to involve automated vehicles without a user-in-charge. Some of these vehicles may not even have a steering wheel and pedals. New regulation should put in place a no-user-in-charge automated vehicle **operator licensing scheme** for vehicles that will be used on public roads or other public places. For automated vehicles operating as a passenger service, we urge government to also expedite the development of a scheme to issue **passenger permits**, which will be needed for both advanced trials, pilot deployment and full commercial deployment.

67. We support the notion that no-user-in-charge automated vehicle operators should be required to demonstrate professional competence through a safety management system as a prerequisite for obtaining a licence. Professional competence ought to be demonstrated at a system level, where outcome-based requirements should be set. The licensed operator should be duty-bound to supervise, maintain and insure the automated vehicles it runs as a service, as well as report accidents. That said, the responsibility to maintain the automated vehicles, install safety-critical updates and maintain cybersecurity may be shared between the licensed operator, the ASDE and/or the vehicle manufacturer based on contractual agreement.

68. Our understanding of the Automated and Electric Vehicles Act 2018 is that it extends conventional motor insurance to cover automated driving, thereby providing a single insurance framework for vehicles that are

capable of safely driving themselves in at least some circumstances or situations. As no-user-in-charge automated vehicles essentially do not have human drivers, we think the Automated and Electric Vehicles Act 2018 may need to be reviewed for its suitability to be applied to these automated vehicles, particularly if they are running as a service.

69. As automated vehicles that operate as a passenger service have the potential to improve mobility for people with accessibility needs, setting common accessibility standards for automated passenger services is important. However, we believe regulation should not impose inappropriate technical and operational requirements that could hinder the introduction of automated passenger services. For example, instead of setting a blanket requirement for all automated passenger services to have staff on board with non-driving responsibilities to focus on providing customer care, regulation should be flexible enough to account for the deployment of a mixed fleet where some vehicles will have staff on board to cater for special customer access needs. Automated passenger services could be personalised – for example, a special disability access option could be available on the vehicle configurator app at the ordering stage. Furthermore, not unlike the Motability Operations model, some emerging automated passenger services propositions may exclusively serve the special access needs segment of the market.

70. Regulation, where necessary, could focus on improving accessibility for the most relevant automated passenger services use cases (e.g. access to healthcare, workplace, transport hubs) and making these operationally attractive for licensed operators to address. For example, not unlike taxi regulation in London, some automated passenger services in a mixed fleet could be specially designed for ease of getting in and out of the vehicle and seating comfort for people with wheelchairs.

Deployment conditions

71. We understand pilot deployment of automated vehicles, mainly of the no-user-in-charge variety, may be limited to certain conditions imposed by the regulator, as in the example in San Francisco described in paragraph 35. However, we do not agree with any suggestion that **full commercial deployment** should be limited to certain numbers so as to gather further data on safety in real-world conditions. Regardless of their applications, automated vehicles, once authorised for full deployment, should not be subjected to what is effectively a probation. Probation, if necessary, should take place at the pilot stage, which is pending authorisation. If the Vehicle Certification Agency is not convinced of the safety of a particular automated driving system, authorisation should not be granted in the first place. Artificial conditions, such as a limit in deployment numbers, are likely to disincentivise ASDEs from becoming first-movers. Quantity restrictions distort the market and work against the interest of consumers, as they will result in reduced availability, increased waiting times, reduced scope for downward competitive pressure on fares and reduced choice.

72. As with any vehicle technology, the benefits of automated vehicles will only be fully realised when there is a sizeable number of them on the road. For example, although advanced emergency braking system (AEBS) was already available from around 2003, its cumulative safety benefits only became clear when the technology was introduced more widely from 2010 onwards. Since then, low-speed AEBS has led to a 38% reduction in real-world rear-end crashes.

Assuring safety in use

73. Once on the road, we believe there should be an in-use monitoring scheme to assure the continuing safety of automated vehicles. Data from

a large number of deployed automated vehicles will be the most realistic way to assess the safety performance of an automated driving system over a wide range of real-world conditions, which is why we would disagree with any proposal to allow their deployment only in limited numbers in the first instance. A feedback loop through in-use monitoring is a useful mechanism to confirm the safety by design concept and the validation carried out by the ASDE before market introduction.

74. However, we urge alignment and harmonisation with similar proposals under the multi-pillar approach to New Assessment/Test Methods currently discussed at the Informal Working Group on Validation Method for Automated Driving at the UNECE. Divergence, for example in terms of the data elements that should be collected through in-use monitoring, is highly undesirable and makes compliance very costly. The purpose and implementation of an in-use monitoring scheme must be to foster continuous improvement of both the technology and legislation. To that end, data collected from in-use monitoring should be for the use of the regulator and law enforcement agencies only and should be handled and processed in compliance with data protection laws. It should not be used for commercial purposes, for example as a basis for insurers to increase insurance premiums.

75. Where there are serious accidents involving automated vehicles, the recently launched Road Safety Investigation Branch (RSIB) should act as the specialist incident investigation unit that investigates only the most serious, complex or high-profile collisions. The RSIB should focus on learning the lessons from incidents to make recommendations for safety improvements rather than determining where liability should lie. This will ensure there is no overlap with the police, who will continue to investigate day-to-day incidents, and with the in-use regulator that will monitor how automated vehicles perform in real-world traffic. There should also be

greater clarity on how the RSIB will work with local authorities, particularly in the context of serious accidents involving automated passenger services.

Retaking control following a transition demand

76. In the context of automated vehicles with a user-in-charge, for example passenger cars fitted with an automated driving system, we believe government should clarify the Motorway Traffic Regulations to ensure the user-in-charge is suitably incentivised to retake control of the vehicle when requested. The user-in-charge must be warned against **deliberately ignoring** a transition demand.

77. If the automated driving system operates according to its design intent, meets all the requirements and standards, and there is no mechanical, software or system failure, the user-in-charge should nominally be responsible for failing to respond to a transition demand and allowing the vehicle to stop in a manner which constitutes a criminal offence under Regulation 7 of the Motorway Traffic (England & Wales) Regulations 1982 and Regulation 6 of the Motorway Traffic (Scotland) Regulations 1995.

78. The law must explicitly and unequivocally require the user-in-charge to respond to a transition demand to retake control of the vehicle and clearly state the only conditions under which the user-in-charge could avoid prosecution if the vehicle comes to a stop in a manner which otherwise constitutes a criminal offence are genuine illness, an emergency or vehicle breakdown. Clarity in legislation is important not least to warn the user-in-charge against the misuse or abuse of automated driving and to provide legal certainty on the user-in-charge's liability in such circumstances.

Penalising wrongful interference

79. We believe government should make more explicit that tampering with automated vehicles or external infrastructure that could affect the operations of automated vehicles is a criminal offence. This is to create awareness of the severity of the potential consequences of such mischief and to discourage people from committing them. Wrongful interference, or tampering, with safety-critical physical parts (e.g. sensors) or software of an automated vehicle could lead to serious accidents, injuries or even death. Therefore, we think it would be helpful if there was a legislative amendment to clarify that the tampering offence in Section 25 of the Road Traffic Act 1988 applies to anything that is physically part of an automated vehicle and any software installed within it. This would help ensure dangerous behaviour is appropriately criminalised and public awareness of the consequences of such offences is raised.

80. We believe "wrongful interference" in Section 22A of the Road Traffic Act 1988 should be clarified to specifically include tampering, and "traffic equipment" in 1(c) of Section 22A should be clarified to include external infrastructure that may affect the operation of automated vehicles. Unlawful interference with external infrastructure such as networks and beacons that support vehicular communications, particularly with the intention to deliberately transmit spoof messages, can be potentially detrimental to the performance of the automated driving system, increasing the risk of death or serious injury.

Civil liability and data disclosure

81. The UK was the first country in the world to pass legislation that created an insurance regulatory framework for automated vehicles. Part 1 of the Automated and Electric Vehicles Act 2018, which commenced in April 2021, extends conventional motor insurance to cover automated driving,

thereby providing a single insurance framework for vehicles that are listed by the Secretary of State for Transport as self-driving. In the event of an accident involving an automated vehicle, the insurer will compensate the victim(s) or injured party(ies). The insurer may then recover costs from the at-fault party through the aid of a data recorder. We believe the Automated and Electric Vehicles Act 2018 is still fit for purpose in the context of passenger cars fitted with automated driving systems. As we suggested in paragraph 68 above, the legislation may need to be reviewed for its application to no-user-in-charge automated vehicles. However, we believe government must now develop clear measures to compensate victims of accidents caused by uninsured automated vehicles. We firmly believe the existing Motor Insurers' Bureau provisions should be extended for this purpose.

82. There have been calls for legislation to impose a duty on vehicle manufacturers or ASDEs to disclose data to insurers for the purpose of claims processing in the event of an accident. We cannot agree to caveats that challenge consumer trust, and therefore any obligations to share data must only occur on the basis of **the user of the vehicle providing consent** to sharing the data. Because the data belongs to the vehicle user, only he/she should have access to the data and should decide whether or not to transmit the data to the insurer. This will naturally depend on whether the user wishes to challenge the ascribing of fault in an insurance claim. Insurers should follow a formal process of **request and consent**, as is the practice today where data from the vehicle manufacturer is sought. Post this, disclosure should be in line with requirements of the Data Protection Act 2018 and the UK General Data Protection Regulation.

83. We also strongly disagree with any proposals that are imprecise as regards the scope of data that is necessary to process insurance claims in the event of an accident involving an automated vehicle. Open-ended

provisions risks giving a carte blanche for insurers to demand a disproportionate and unreasonable amount of data under the pretext of “necessity”. Legislation must therefore provide **legal certainty** by **clearly specifying the data fields** that must be disclosed to insurers for the fair and accurate processing of claims. For example, under Article 32 “Access to vehicle data” of the French Mobility Orientation Law, clause 5 of Article L1514-6 clearly stipulates that *“only the data strictly necessary to determine whether driving delegation of the vehicle is activated or not, or the conditions of take-back, for the purposes of compensating the victims …… shall be transmitted”*. Legislation must also spell out the data protection obligations of insurers under the Data Protection Act 2018 and the UK General Data Protection Regulation once the data has been disclosed to them.

84. We believe data from the Data Storage System for Automated Driving (DSSAD) should be disclosed to insurers upon request for the sole purpose of processing insurance claims and establishing civil liability in the event of an accident involving automated vehicles. As such, recorded occurrences and data elements in the DSSAD regulated under Section 8 of UN Regulation 157 that should be disclosed to insurers, or their authorised agents, solely for this purpose are those that are relevant for establishing whether the vehicle is driving itself at the time of an accident. All other information is more relevant for accident investigation. The method by which the information is disclosed to insurers should be a matter for ASDEs, as long as the relevant data is disclosed.

Section 7: Potential implications for infrastructure and urban traffic

Digital infrastructure

85. Discussions on digital infrastructure are usually more relevant in the context of connected vehicles, as the use cases are far more varied and diverse. However, due to the scope of this inquiry, we shall limit our views to the interplay between connectivity and automated vehicles.

86. There is a common misconception that cellular connectivity is a prerequisite for automated driving. An automated driving system is engineered in its basic form without the need to rely on connectivity. For example, the Automated Lane Keeping System (ALKS), as described in section 4, does not rely on connectivity but a sophisticated sensor suite. However, connectivity complements automation and can enhance the operations of the automated driving system. For example, the automated driving system may be able to better plan its path in advance if it is informed in real-time that there is lane closure ahead. However, it is designed with adequate redundancy to enable it to carry on functioning despite the lack of, or intermittent, connectivity.

87. How the vehicle drives, which is a function of the performance of an automated driving system, must be distinguished from the wider activities of a no-user-in-charge vehicle licensed operator to keep tabs on its fleet of automated vehicles, usually from a remote operation centre. This is particularly relevant in the context of automated passenger services or delivery vehicles. The remote centre's operations will certainly require connectivity in order for it to track where the vehicles are in real-time and if any of the vehicles encounter unforeseen or unexpected issues. The **connectivity is not a requisite for the vehicle to drive itself**. The only exception to this is teleoperation, which is also known as remote driving, the subject of a current consultation by the Law Commission of England and Wales. Importantly, **teleoperation, or remote driving, is not automated driving**, as it does not pass either of the control or monitoring tests described in paragraphs 10-11.

88. Given connectivity has the potential to enhance the automated driving system’s decision-making, such as path planning, it is reasonable to expect that automated vehicles that are deployed across any of the three applications explained in Table 1 will be equipped with vehicle-to-network (V2N) connectivity. In fact, V2N connectivity via mobile networks is already widely available in passenger cars today. However, mobile signal coverage on the 247,500-mile-long British road network remains unsatisfactory. Independent analysis of Ofcom data reveals only 51% of the entire British road network has full LTE (4G) network coverage, while 2% does not even have a 2G signal (see Table 2). Full network coverage, which means a signal is available from all four mobile network operators (MNOs), is crucial as there is no domestic roaming. On the 2% of the road network where even a 2G signal is not available, the regulated eCall, a feature that will automatically dial the emergency services in the event of an accident, will not function.

89. While we welcome the wider rollout of 5G, the connectivity that complements the operations of most automated vehicles on non-urban roads (e.g. motorway) in the near-to-medium term could be adequately delivered by LTE (4G) alone. As such, we think government should help de-risk MNO investment by co-investing in infrastructure to provide **near-ubiquitous LTE (4G) coverage** on the British road network. While the £1 billion government-MNO Shared Rural Network scheme is laudable as it aims to deliver LTE (4G) coverage to 95% of the UK by 2025, its priority, understandably, is to cover populated areas. The scheme aims to provide coverage for only an additional 10,000 miles of the road network, which are only a fraction of the 121,000 miles (49%) without full LTE (4G) network coverage.

Table 2: Mobile network coverage on the British road network.

	Miles (%) of road in Britain with		
	Full network coverage	Partial network coverage	No network coverage
2G	195,797 (80%)	44,368 (18%)	5,540 (2%)
3G	173,635 (71%)	66,619 (27%)	5,452 (2%)
4G	124,570 (51%)	107,187 (44%)	13,948 (6%)

Note: percentages might not add up to 100% because of rounding. Partial network coverage means that at least one, but no more than three, of the four network providers (Vodafone, O2, EE, Three) offers a signal.

Source: https://www.racfoundation.org/media-centre/picture-of-patchy-mobile-coverage-across-road-network

90. However, 5G is important for the deployment of automated vehicles in urban areas as well as on non-urban roads in the longer-term. 5G's use cases in automated driving are likely to include real-time refresh and layering of high-definition and ultra-high-precision maps and multi-access edge computing that enables certain data analytics and processing to be performed on the network's edge closer to the vehicles (as opposed to in the cloud). 5G's ability to deliver higher-bandwidth connectivity (1000x greater than LTE per unit area) and lower latency (<1ms end-to-end) enables ultra-reliable low latency communications (URLLC). URLLC is particularly crucial in densely populated urban areas where the collective demand for connectivity from consumer electronic devices and other connected machines, including automated vehicles, could be very high. 5G also enables network slicing, which means a segment of the mobile

network could be partitioned for the exclusive use of certain safety critical applications or services. URLLC and network slicing could prove critical for remote operation centres to maintain real-time connectivity with their fleets of no-user-in-charge automated vehicles deployed for passenger or delivery services.

91. Just like V2N connectivity, **short-range** vehicular connectivity that uses the unlicensed 5.9GHz spectrum to communicate with other vehicles (V2V) and infrastructure (V2I) is not a prerequisite for automated driving but can complement and enhance the operations of the automated driving system. V2V use cases include electronic emergency braking warning and emergency vehicle warning, while V2I use cases include green light optimal speed advisory and in-vehicle signage. All short-range connectivity use cases are time critical and could help the automated driving system plan for the right tactical course of action in advance.

92. However, investment into deploying infrastructure that enables V2V and V2I is currently hampered by a lack of consensus on which technology format should prevail. It is non-viable economically for industry to support both ITS-G5 (802.11p) and C-V2X (PC5) technologies. As there is currently an impasse in both Europe and the UK, short-range connectivity is unlikely to be deployed in the near-to-medium term. As such, automated vehicles that will be deployed in this period are unlikely to be fitted with short-range communication technology.

Physical infrastructure

93. We do not believe automated vehicles should require dedicated physical infrastructure for its operations. The only slight exception to this is the need for parking operators to equip their facility with sensors and communication infrastructure should they wish to offer Automated Valet

Parking services (see Table 1). Apart from that, automated vehicles are designed to operate within the allowances and constraints of existing physical infrastructure. Therefore, no alterations are needed to existing physical infrastructure.

94. Popular suggestions that a dedicated lane on the motorway should be reserved for the exclusive use of automated vehicles are misguided. Exclusive lanes for automated vehicles are an inefficient use of finite and precious road space, and will only worsen congestion as automated vehicles are unlikely to comprise the majority of the 40.5 million-strong UK vehicle parc in the foreseeable future.

95. What is far more important is to ensure physical infrastructure is regularly maintained to the highest quality. For example, clear lane markings should be a priority on not just the Strategic Road Network, which falls within National Highways' remit, but also the wider road network, which is primarily the responsibility of local authorities. As visual perception and computing technology that relies on high-definition stereo cameras is a norm in automated vehicles, local authorities should ensure road signs are not obstructed by overgrown trees or shrubs.

Disproportionate fears of empty cruising

96. It has been suggested by some stakeholders that automated vehicles, particularly those operating as passenger services, could cruise empty, partly to avoid parking charges, while waiting to be hailed by the next passenger. This could worsen congestion in cities. As such, some commentators have called for an appropriate balance between road pricing and parking charges to discourage empty cruising.

97. The conundrum of empty cruising is actually no different for automated passenger services than for manually driven taxis and private hire vehicles today. Regardless, it is a commercial imperative for operators to match available vehicles to the nearest customer as frequently as possible. As evidence from trials and pilot deployments in other countries suggest automated passenger services are most likely offered using electric vehicles, empty cruising serves only to drain the battery more quickly and reduces the available range for carrying passengers. As such, contrary to alarmist sentiments on empty cruising, it is very likely that the algorithms on the operator's platform will optimise fleet operations to ensure empty cruising is minimised, as empty cruising effectively means increased inefficiency and cost.

98. While local transport management and parking charges are rightly matters for local authorities and should be highly dependent on the unique characteristics of each individual local area, we are opposed to measures that specifically discriminate against automated passenger services, or automated vehicles in general. One of the fundamental benefits of automated passenger services is the anticipated reduction in the use of private cars in congested cities or urban areas at peak hours. In order to persuade people to leave their private cars behind, automated passenger services must be both convenient and affordable. If the combined effect of road pricing and parking charges that are specifically targeted at automated vehicles makes passenger fares unattractive, there could be a risk that some people may eventually resort to using their private cars.

Section 8: Educating motorists and creating public awareness

99. As regards automated vehicles with a user-in-charge, manufacturers often adopt a multi-channel approach to delivering information and education to satisfy individual needs. These are holistic and include online tutorials

and demonstration videos, comprehensive briefing and physical demonstration by well-trained retail/dealership staff on collection of a vehicle or at customers' request, instructions in the user's manual in digital, online and offline formats, tutorials and instructions on the vehicle infotainment display, on-board intelligent personal assistant and experiential driving clinics. Manufacturers also go to great lengths at the design and testing stages to ensure the technology is intuitive to use.

100. Just as vehicle manufacturers, dealerships and retail outlets invest in ensuring staff are well trained to educate customers on automated driving, it is important for rental businesses and car club operators to likewise ensure their customers are well informed and educated through a variety of channels before they hire or use a vehicle with automated driving features.

101. However, educating motorists and creating public awareness of automated driving require the collaborative efforts of government, industry and other key stakeholders such as insurers, the fleet and vehicle rental sector, motoring groups and safety organisations. As such, SMMT supports government's Centre for Connected and Autonomous Vehicles in convening the Automated Vehicle Driver Responsibility in Vehicle Education (AV-DRiVE) Group to develop and implement a comprehensive strategy to educate drivers on safety and their responsibilities when handling an automated vehicle. This initiative brings together government, government executive agencies, industry, insurers, the fleet and rental sector, motoring and safety organisations, the police and the Advertising Standards Authority.

102. Under the auspices of AV-DRiVE, SMMT published new guiding principles in November 2021 to ensure marketing of automated vehicles is clear, consistent and comprehensible. These principles, which are recognised

and supported by industry, government and the Advertising Standards Authority, are as follows:

- An automated driving feature must be described sufficiently clearly so as not to mislead, including setting out the circumstances in which that feature can function.
- An automated driving feature must be described sufficiently clearly so that it is distinguished from an assisted driving feature.
- Where both automated driving and assisted driving features are described, they must be clearly distinguished from each other.
- An assisted driving feature should not be described in a way that could convey the impression that it is an automated driving feature.
- The name of an automated or assisted driving feature must not mislead by conveying that it is the other – ancillary words may be necessary to avoid confusion – for example for an assisted driving feature, by making it clear that the driver must be in control at all times.

103. We are currently working with government to develop a communications toolkit to help stakeholders communicate to the public and educate drivers on automated driving using consistent language and terminology. Upon its completion, we believe government and its agencies should in due course make full use of the toolkit and sponsor a well-timed public communications programme delivered via multiple press and media channels to raise general public awareness on automated driving. This should include communicating to the public the salient aspects on the safe and responsible use of automated vehicles as set out in the recent amendments to The Highway Code.

Section 9: Supporting UK industry to remain a leader in automated driving technology development

104. While we believe government efforts should now be focussed primarily on enabling deployment of automated vehicles across the three types of applications in Table 1, government must not neglect supporting the UK automotive **industry and supply chain** in developing automated driving technology that can find a route to market and be exported globally. We suggest government support should be focussed on the following four areas to maximise value for public money.

Targeted grant funding for advanced research and development

105. In the early stages of the development of automated driving technology and applications, it was understandably necessary to fund a relatively large number of exploratory and demonstration projects. Nearly eight years on, the invaluable learnings from these projects along with other developments around the world have shown that the vast majority of the challenges surrounding automated driving technology development have been overcome. These include, for example, developing software stacks capable of path planning and motion control and sensor fusion to make sense of machine-based imaging and perception.

106. However, it is now generally accepted that the remaining obstacles are proving to be the most challenging. These include, but are not limited to, fine-tuning the automated driving system to ensure it achieves a "safe enough" performance level, dealing with edge cases and developing superior virtual verification and validation methods for certification that are influential enough to be adopted by the UNECE. As such, we believe any future government funding for collaborative research and development projects must be far more **targeted** than before and should focus only on those capable of solving problems that fall within the remaining challenges. The ultimate aim of government intervention

should be to advance the supported technologies to Technology Readiness Level 9 ahead of pilot and full deployment.

Growth funding to de-risk private sector investment

107. There is currently a sizeable number of start-ups, scale-ups and SMEs in the supply chain with technologies that are capable of early commercialisation. However, access to large-scale private investment, such as those regularly seen in the US, has proven to be a recurrent challenge that impedes the rapid growth potential of innovative companies in the UK automated driving technology ecosystem. Each private funding round for US-based automated driving system developers raises typically at least 15-20 times the amount of capital a similar funding round in the UK could deliver for their British competitors.

108. In order to both de-risk private investment and drive the rapid growth of high-potential, albeit relatively risky, ventures in the UK automated driving technology sector, we suggest government should consider setting up a **special purpose vehicle** (SPV) to make calculated **equity investments** in a minority stake in carefully identified companies. Not unlike private equity, such investments will inject much needed funds that will allow high-potential companies to rapidly scale and commercialise their technology. Once they scale, become post-revenue and can demonstrate a realistic pathway to future profitability, they become more attractive to private investors, thus allowing government to exit by selling its stake for a profit. This not only justifies the prudent use of public money to create economic value for the country but also creates a virtuous circle where a decent return on investment allows the SPV to reinvest in supporting more of similar risky but high-potential companies.

Wider support measures for the supply chain and skills development

109. In addition to the above, government should consider long-term support measures for the automated driving technology supply chain, with a particular focus on automotive software and electrical and electronics engineering. These could include a mixture of tax breaks, collaborative research and development grant funding through Innovate UK, and smaller-scale equity investment through the government SPV suggested above.

110. However, the one pivotal area where government support is a key requisite for driving the future growth of the UK automated driving technology sector is skills. We suggest government should develop a comprehensive and adequately funded long-term skills and retraining strategy that supports industry needs across the sector. A long-term vision is required to more holistically develop scarce and critical skills in science, technology, engineering and mathematics through reforms at all levels of education. Government should also pilot greater Apprenticeship Levy flexibility in the sector to better support retraining, as many larger companies are currently unable to effectively spend their Levy contributions to better serve their workforce needs.

111. Another important aspect of industry that should not be overlooked is the role of the aftermarket in the wider supply chain. It is important to better understand the potential impact of automated driving technology on the aftermarket and to ensure resources and investment are adequately targeted to uplift the skills and technical capabilities of technicians within the aftermarket. Government should also ensure the aftermarket can continue to provide services to connected and automated vehicles by safeguarding access to suitable parts, tools and technology that are crucial to enabling the aftermarket to perform safe and high-quality servicing, repair and maintenance.

Promoting and "selling" testbed capabilities abroad

112. Public funding for the development of a testing ecosystem was a necessary step to provide the UK with a strong basis to attract vehicle manufacturers and developers to not just test and trial but also locate their development activities in the UK. In an update given at the SMMT Connected and Automated Vehicles Forum on 25 November 2020, government estimated the £100 million from the public purse invested in the testing ecosystem had then created or safeguarded 442 jobs and attracted £24 million new foreign direct investment during the build phase of the testbed programme.

113. It is unclear if our world-class testbeds have so far attracted sufficient major players in the global automated driving technology sector and generated satisfactory revenues from related activities to deliver a proportionate early return on investment. Now that the UK has an enviable ecosystem of physical and virtual testbeds, future government funding for testbeds should be focussed on aggressively promoting our testing and trialling capabilities abroad in order to ensure there is improvement to the economic returns accruing to our testing ecosystem.

August 2022

Endnotes

[1] Dynamic driving task is the real-time operational and tactical functions required to operate a vehicle in on-road traffic. It includes steering, accelerating and braking together with object and event detection and response.

[2] Operational design domain is the domain within which an automated driving system can drive itself. It may be limited by geography, time, type of road, weather or by some other criteria.

[3] SAE Level 2 is sometimes referred to as Advanced Driver Assistance Systems (ADAS), as features within this level are capable of providing lateral and longitudinal control support to drivers, who must continue to monitor the road ahead.

[4] A transition demand is an alert issued by an automated driving system to the user-in-charge to take over the dynamic driving task, communicated through visual, audio and haptic signals, which gives the user-in-charge a transition period within which to respond. If there is no response, the automated driving system performs a risk mitigation manoeuvre bringing the vehicle to a safe stop.

[5] A user-in-charge is an individual who is in the vehicle and in a position to operate the driving controls while the vehicle is safely driving itself. The user-in-charge is not responsible for the dynamic driving but must be qualified and fit to drive. They might be required to retake control following a transition demand. They would also have obligations relating to non-dynamic driving task requirements including duties to maintain and insure the vehicle, secure loads carried by the vehicle and report accidents. In simple terms, when the driver safely and correctly activates the automated driving system, he/she becomes a user-in-charge until he/she retakes control of the vehicle.

[6] Examples of intended pilot deployment in Europe and the Middle East include https://www.masstransitmag.com/alt-

mobility/autonomous-vehicles/press-release/21212168/mobileye-mobileye-transdev-ats-lohr-group-to-develop-and-deploy-autonomous-shuttles and https://www.arabianbusiness.com/industries/transport/dubais-driverless-taxis-journey-kickstarts-with-digital-mapping-operation respectively.

[7] The Global Forum for Road Traffic Safety (WP.1) at the UNECE has adopted a resolution on safety considerations for activities other than driving when the automated driving system is corrected activated.