Written evidence submitted by Waymo (AVB06)

Introduction

Waymo respectfully submits these views in response to the House of Commons Public Bill Committee's call for evidence. Please note that we do so solely on behalf of Waymo and not on behalf of Google or any other entity that is also part of Alphabet Inc.

In addition to addressing the Bill and expressing our support for its timely passage, our submission outlines Waymo's approach to two key topics that have featured prominently in parliamentary debates on the Bill thus far: safety and accessibility. We hope this will serve as a useful reference point for members during their deliberations.

We thank the Bill Committee for the opportunity to submit written evidence and would be happy to answer any questions members may have.

Executive Summary

- Waymo supports the Automated Vehicles Bill ("AV Bill" or "the Bill") and the amendments that were made in the House of Lords for the following key reasons:
    - The U.K. needs a legislative framework in order for any automated vehicles to operate commercially. This Bill provides the foundation for such a framework.
    - The Bill builds on the four-year review from the Law Commission of England and Wales and the Scottish Law Commission ("the Law Commissions"), which carefully studied corresponding legislation and regulation already in place in other jurisdictions. We believe their study to be amongst the most comprehensive in the world.
- The Automated Vehicles Bill offers considerable future societal benefits for the U.K.:
    - Improved safety and access to mobility - as outlined in the Government's Connected and Automated Mobility 2025 paper,[1]:

        > *"the potential benefits of connected and self-driving technologies are considerable: from better integrating rural communities and reducing isolation for people with disabilities or older people, to helping deliver essential goods and improving access to education, work and leisure…These technologies could also make our roads safer, reducing the number of collisions involving human error – which is currently a factor in over 80% of collisions that result in personal injury."*
    - Economic opportunities:

[1] See p.6: https://assets.publishing.service.gov.uk/media/62ff438c8fa8f504cdec92df/cam-2025-realising-benefits-self-driving-vehicles.pdf

        - Research from the insurer, AXA U.K., shows that automated vehicles could save the NHS £2.3bn every year in medical and ambulance costs associated with crashes on our roads.[2]
        - According to the KPMG study commissioned by the Society of Motor Manufacturers and Traders, connected and automated vehicles could add £51 billion a year to the U.K. economy by 2030. This is in addition to creating 320,000 new jobs, 25,000 specifically in automotive manufacturing.[3]
- With several different authorities likely to be involved in the process for securing an operating permit, **Waymo proposes one amendment for consideration to the Bill Committee that we believe will ensure consistent safety determinations**.
- Secondary legislation is the key next step:
    - We believe timely production of national safety principles issued in the form of secondary legislation can provide substantial details on many of the questions raised during the parliamentary debates thus far.
    - This approach is entirely consistent with other jurisdictions like EU[4], France[5] and Germany[6] - governments that have all set the detailed technical requirements for No-User-In-Charge automated vehicles via detailed secondary legislation. The U.K. Department for Transport has also been an active participant at the United Nations Economic Commission for Europe, which is working on global harmonised requirements for automated vehicles.
    - We strongly encourage members of the Bill Committee to refer to those jurisdictions' legislative and regulatory materials as well as the Bill's Policy Scoping Notes[7] in order to understand how secondary legislation will likely be used to create similar requirements for automated vehicle operation in the U.K.

I. About Waymo

1. Waymo's mission is to make it safe and easy for people and things to get where they are going. The Waymo Driver can improve the world's access to mobility while saving thousands of lives now lost to traffic crashes.

---

[2] https://www.axa.co.uk/newsroom/media-releases/2023/self-driving-vehicles-have-potential-to-save-nhs-up-to-2-point-3bn-every-year/

[3] https://www.smmt.co.uk/industry-topics/technology-innovation/connected-automated-vehicles/#:~:text=According%20to%20the%20KPMG%20study,25%2C000%20specifically%20in%20automotive%20manufacturing.

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R1426

[5] https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000043729532

[6] https://www.gesetze-im-internet.de/afgbv/BJNR098610022.html

[7] https://www.gov.uk/government/publications/automated-vehicles-bill-2023/automated-vehicles-bill-policy-scoping-notes

2. Globally, 1.19 million people are killed in road traffic crashes (1,633 in the U.K. in 2023) and an estimated 20-50 million injured (133,443 in the U.K. in 2023) annually.[8] [9] A large proportion of these crashes are linked to drowsy, distracted, and impaired driving. This is why our No-User-In-Charge ("NUIC") / Society of Automotive Engineers (SAE) Level 4 automated driving system[10] [11] ("ADS") - called the *Waymo Driver* - includes the software, hardware, and compute that, when integrated into the vehicle, performs all driving functions.
3. From our start as the Google Self-Driving Car Project in 2009 and since becoming a standalone company under Alphabet Inc. in January 2017, Waymo has been focused on improving transportation for all people by building the world's most experienced driver. Our system has travelled more than 10 million miles without a human driver and completed more than 40 million miles of testing with an autonomous specialist behind the wheel, across thirteen U.S. states. In simulation, we virtually drive around 20 million miles a day, which is the equivalent of 100 years of driving in the real world, and have driven tens of billion total miles in simulation.
4. Since 2019, Waymo has employed an engineering team in the U.K, which helps develop machine learning functionality for the Waymo Driver in the U.S.
5. Today, Waymo operates a paid, round-the-clock NUIC ride-hail service, called Waymo One[12] in the U.S. cities of Phoenix, San Francisco, and Los Angeles. We deliver more than 30,000 NUIC rides to members of the public every week and served more than 700,000 rides in 2023 in our fleet of fully electric Jaguar I-PACE vehicles. This is the only service of its kind in the world today.

II. Waymo's approach to safety

6. Safety is the core of Waymo's mission. In 2017, we became the first company to submit a detailed ADS safety report to the US Government. In 2020, Waymo published an overview of the safety methodologies[13] that govern the testing and commercial deployment of our NUIC automated vehicles – the first time a company publicly released such a framework.
7. Waymo's safety methodologies,[14] which draw on well-established engineering processes and address new safety challenges specific to Automated Vehicle technology, provide a firm foundation for safe deployment of Waymo's ADS, Waymo's determination of its readiness to deploy its automated vehicles safely in different

[8] https://www.who.int/health-topics/road-safety#tab=tab_1
[9] https://www.gov.uk/government/statistics/reported-road-casualties-in-great-britain-provisional-estimates-year-ending-june-2023
[10] A vehicle operated by the Waymo ADS is equivalent to a "No-User-In-Charge" vehicle" under the AV Bill and as described in Law Commissions' Joint Report on Automated Vehicles: https://s3-eu-west-2.amazonaws.com/cloud-platform-e218f50a4812967ba1215eaecede923f/uploads/sites/30/2022/01/Automated-vehicles-joint-report-cvr-03-02-22.pdf
[11] https://www.sae.org/standards/content/j3016_202104/
[12] https://waymo.com/waymo-one/
[13] https://waymo.com/blog/2020/10/sharing-our-safety-framework/
[14] https://arxiv.org/abs/2011.00054

settings rests on that firm foundation and on a thorough analysis of risks specific to a particular Operational Design Domain. Waymo's process for making these readiness determinations entails an ordered examination of the relevant outputs from all of its safety methodologies combined with careful safety and engineering judgement focused on the specific facts relevant for a particular determination. This paper explains Waymo's methodologies as applied to the three layers of its technology: hardware, NUIC ADS behaviour, and operations, and also explains Waymo's safety governance. Waymo will continue to apply and adapt those methodologies, and to learn from the important contributions of others in the automated vehicle industry, as Waymo continues to build an ever safer and more able NUIC ADS.

III. Waymo's safety performance

8. Our comprehensive research[15] — across 25 papers that we have published to enhance transparency and understanding of our operations — shows that the Waymo Driver performs safely across a range of evaluations.
9. **The data to date indicates the Waymo Driver is already reducing traffic injuries and fatalities in the places where we currently operate**. At Waymo, we aim to reduce traffic injuries and fatalities by driving safely and responsibly, and will carefully manage risk as we scale our operations.
10. In December 2023, we published two new research papers,[16] demonstrating that the Waymo Driver significantly outperformed human driver crash benchmarks over 7.1+ million miles in Phoenix, San Francisco, and Los Angeles. The Waymo Driver demonstrated an:
    - 85% reduction in injury-causing crashes (0.41 vs. 2.27 incidents per million miles)
    - 57% reduction in police-reported crashes (2.1 vs. 4.85 incidents per million miles)
        - This means that over the 7.1 million miles Waymo drove, there were an estimated 17 fewer injuries and 20 fewer police-reported crashes compared to if human drivers with the benchmark crash rate would have driven the same distance in the areas we operate.
11. In September 2023, Waymo and Swiss Re, one of the world's leading reinsurers, published a first-of-its-kind study[17] finding that Waymo's NUIC automated vehicles are significantly safer than human-driven ones. Bodily injury claim frequency was reduced to zero and property damage claim frequency reduced by 76% during our first 3.8 million miles of Waymo rider-only operations in San Francisco and Phoenix, when compared against the relevant human driver baselines in those geographies.

---

[15] https://waymo.com/safety/
[16] https://waymo.com/blog/2023/12/waymo-significantly-outperforms-comparable-human-benchmarks-over-7-million/
[17] https://www.swissre.com/reinsurance/property-and-casualty/solutions/automotive-solutions/study-autonomous-vehicles-safety-collaboration-with-waymo.html

12. In March 2021, we published a cutting-edge paper[18] where we conducted reconstruction simulations of actual fatal crashes involving human drivers that had occurred in Chandler, Arizona (part of the Waymo Driver's ODD) that showed the Waymo Driver would have completely avoided or mitigated 100% of those crashes, except for a few where it would have unavoidably been rear-ended.
13. In September 2022, we published a study[19] indicating our technology avoids collisions better than always-attentive human drivers.
    - We compared the Waymo Driver's simulated collision avoidance for the Chandler fatal crashes to a non-impaired human with their eyes on the conflict ("NIEON") - a synthetic model of a consistently performing, always attentive driver that does not exist in the human population.
    - The Waymo Driver prevented 75% of the crashes and reduced 93% of serious injury risk.
    - The NIEON model (i.e., the model of an attentive human driver) prevented 62.5% of the crashes and reduced 84% of serious injury risk.

IV. Waymo's approach to accessibility

14. Improving mobility access is core to Waymo's mission as a company, and we are dedicated to improving personal independence and access to transportation through the broad deployment of our technology. To better understand rider needs, including riders with disabilities, we conduct targeted research studies and collect feedback on an ongoing basis, including from the trips we provide to members of the public.
15. Waymo actively engages individuals and organisations spanning a breadth of access issues to better understand ways to improve accessibility for our riders, including through the Waymo Accessibility Network.[20]
16. Our work on accessibility is ongoing but already has generated features and service improvements to assist and accommodate riders of all abilities. These include the following:
    - When the car is stopped at a pickup, riders looking for the car intended for them can press a button on their phone and use the sound of the horn or chime to locate the car.
    - Using the Waymo app, riders can hail a wheelchair accessible vehicle provided by a Waymo partner in a conventional (not autonomous) Americans With Disabilities Act-compliant wheelchair accessible van.
    - Riders can select an app setting to minimise walking, even if a shorter walk means the car may need to take a longer route and add to their overall trip time.

[18] https://waymo.com/blog/2021/03/replaying-real-life/
[19] https://waymo.com/blog/2022/09/benchmarking-av-safety/
[20] https://waymo.com/waymo-accessibility-network/

- Our Android and Apple iOS apps are regularly tested with talkback and voiceover screen readers to ensure blind and low-vision riders can navigate them.
- Riders can enable a setting that provides more audio cues and information throughout the ride (e.g. why the car is yielding) which is particularly helpful for those living with vision disabilities.
- Before requesting a ride, riders are informed if a long walk will be required at pickup or drop-off.
- App navigation wayfinding features can provide riders with turn-by-turn directions to their Waymo vehicle using visual, audio, and haptic cues.
- Our rider support agents can help riders navigate to the vehicle, including by looking through the car's cameras to understand the rider's environment.

V. Waymo supports the Automated Vehicles Bill

17. Waymo supports the timely passage of the Bill and the amendments made in the House of Lords and supports the comprehensive study published by the Law Commissions, to enable secondary legislation for commercial NUIC use-cases in the U.K.

VI. Waymo supports the AV Bill's safety ambition

18. Waymo supports the amendment made to the Bill in the House of Lords, which ensures that an ADS will be equivalent to or better than a "competent and careful" human driver as that measure is understood in the UK. This articulation provides a baseline safety expectation across UIC and NUIC use cases alike and aligns with both current U.K. law and the comprehensive recommendations of the Law Commissions.
19. We believe that secondary legislation will be the most appropriate stage to set out the technical requirements for approval of NUIC systems and clearly defined safety principles, safety cases, and considerations for approvals, as described by the Law Commissions. This approach is consistent with other jurisdictions like the EU[21], France[22] and Germany[23], all of which have used primary legislation to set out broad legal principles and used secondary legislation/regulation to set out detailed technical requirements.
20. When it comes to making a specific safety determination, the relevant expert national regulator should be empowered to make a safety determination to approve or reject deployment, based on the ADS' demonstrated capability in its ODD.[24] Apportioning responsibility to multiple regulators at different levels of government that may not

[21] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R2144
[22] https://www.legifrance.gouv.fr/loda/id/JORFTEXT000039666574
[23] https://dip.bundestag.de/vorgang/gesetz-zur-%C3%A4nderung-des-stra%C3%9Fenverkehrsgesetzes-und-des-pflichtversicherungsgesetzes-gesetz/273887?f.deskriptor=Autonomes%20Fahrzeug&rows=25&pos=17
[24] British Standards Institute PAS 1881 - Assuring the operational safety of automated vehicles: https://www.bsigroup.com/en-GB/insights-and-media/insights/brochures/pas-1881-assuring-the-operational-safety-of-automated-vehicles/#:~:text=PAS%201881%20enables%20a%20consistent,safety%20in%20automated%20vehicle%20trials

have the relevant in-house expertise to adjudicate safety risks significant confusion and inconsistent safety determinations, creating commercial and public acceptance challenges. We believe the Law Commissions' recommendations as accepted by the Government already take this into account.

VII. Waymo supports the Bill's automated vehicle approval and licensing regime but proposes one amendment to ensure clarity on consistent safety determinations

21. The proposal to establish a clear national approval regime for commercial automated vehicle operation by an Authorised Self-Driving Entity ("ASDE"), both with and without a user-in-charge is a necessary prerequisite for the commercialisation of automated vehicle technology. It must be carried out by a specialist national regulator, to ensure a harmonised level of safety for automated vehicle passenger services in the U.K., and build on the safety determination made relating to the NUIC system, as well as the long-established testing criteria under the existing Code of Practice[25].
22. **Waymo recommends the following amendment to Part 5, Clause 82 (Power to Grant Permits) (5) - recommended amendment text is underlined:**

> *Permit conditions may take the form of—*
>
> *(a) further limitations on the services that may be provided under the permit, <u>provided they are consistent with any conditions that the Secretary of State attaches to an individual authorisation ("authorisation conditions") under section 5</u>, or*
>
> (b) obligations that the permit holder has to fulfil as a condition of holding the permit.

23. This amendment is designed to ensure that the permitting procedure is consistent with the Secretary of State's authorisation process.

VIII. The completion of secondary legislation by 2025 is the key next step

24. Waymo supports the ambition put forward by the government's strategy articulated in the "CAM 2025" paper[26] to complete secondary legislation for NUIC ADS operation by the end of 2025.
25. We believe the combined expertise of the government entities which have specialised in automated vehicle evaluation, such as the Centre for Connected and Autonomous Vehicles, the Vehicle Certification Agency, the Driver and Vehicles Standard Agency,

[25] Code of Practice: Automated vehicle trialling: https://www.gov.uk/government/publications/trialling-automated-vehicle-technologies-in-public/code-of-practice-automated-vehicle-trialling
[26] https://assets.publishing.service.gov.uk/media/62ff438c8fa8f504cdec92df/cam-2025-realising-benefits-self-driving-vehicles.pdf

can facilitate the timely completion of both secondary legislation and corresponding permits by the end of 2025.

19 March 2024