CAA Response to 2021 Government Consultation on the Future of Transport Regulatory Review: Future of Flight

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Introduction

1. The Civil Aviation Authority (CAA) welcomes the Department for Transport (DfT)'s 2021 consultation on the future of transport regulatory review: future of flight. The CAA appreciates the opportunity to respond to this consultation and looks forward to working with the DfT and other stakeholders to evolve and adapt the regulatory framework for aviation to allow new technologies and services to be safely integrated into the UK aviation system.

2. Overall, the existing aviation regulation framework established in primary legislation already contains many powers to allow new and novel aircraft into the UK aviation system, where it is safe to do so. Nevertheless, some specific changes may be required, and much detail and reform in secondary legislation and associated guidance will be needed. Further, whilst aviation regulation is one necessary component, there are other potential regulatory and policy frameworks that may demand consideration to allow both the infrastructure requirement to support these services to operate, and for the potential externalities arising from such new services to be examined. These will be necessary to demonstrate societal benefits from these technologies, and to be able to garner public support.

3. Innovation in aviation has been relentless in the last few years. In common with all parts of the economy and society, the aviation and aerospace sector are undergoing significant technological transformation. Many of these changes are not based upon the linear progression of existing aviation technologies. As such, they present a unique challenge and potentially represent a fundamental shift in the underlying operational and economic models of the aviation market. This is an exciting moment for the sector, with the potential for significant economic and social benefits for the UK public if implemented successfully and if safety standards are maintained.

4. The CAA is conscious that the pace of innovation in aviation has significantly advanced. This advancement has been contributed to by a number of key trends including:

    - Growing interest in the application of a range of general-purpose technologies (such as electric motors, higher density batteries, digital connectivity) to aviation and aerospace use cases;
    - Policy determinations and legislative commitments to decarbonisation, which require both incremental and non-incremental technological development to deliver;
    - Significant capital investments in research and development of new aviation technologies from public and private sources (including Her Majesty's Government (HMG)); and

- New entrants joining the aviation and aerospace sectors, some of whom do not have previous operating experience in the field.

5. The CAA has been adapting to meet the new demands created by these innovations and new technologies. We have been doing so by designing mechanisms to better understand the technologies and services that are coming to market, and engaging with those developers to better inform them about the regulatory step they will need to undertake. Based on the learnings from those activities, we have also considered how the regulatory frameworks may need to evolve to allow these new services to be incorporated into the aviation system. This is in response to industry's signal that it needs regulation to advance faster than it has done in the past.

6. Remotely piloted aircraft (RPAS); flights beyond visual line of sight (BVLOS); the transport of dangerous goods (DG) in RPAS; advanced air mobility (AAM) in urban and rural environments; new forms of traffic management; personal flight aircraft; hybrid craft that can be driven or sailed, as well as flown; and the need to effectively engage with the public, are among the many aspects of the future of flight the CAA has been actively working on for the last few years. Frequently, that work involves different levels of engagement with industry and the general public.

7. The CAA sees this consultation as an opportunity for both the DfT and the CAA to learn more about the public's view on the future of aviation. At the same time, the result of the consultation could inform the DfT and the CAA about stakeholder's perceptions about the future of aviation.

8. The CAA has the statutory responsibility to regulate many aspects of these emerging innovations when applied in novel aviation contexts. However, new rulesets and standards that underpin regulatory approvals might take longer to emerge due to the lack of maturity of some of the technologies, as well as the difficulty of integrating new and old technology. Further, many of the proposed use cases for these technologies require regulatory approvals not only from the CAA but also from other regulators, both within the UK and internationally. As such, the CAA does not own all of the regulatory frameworks which may pertain to a particular proposal. This consultation presents an opportunity to highlight some of these concurrent responsibilities.

9. It is possible that further clarity might be needed regarding whether the DfT or the CAA have power to regulate certain new technologies and uses. In those cases, the CAA welcomes proposals to be granted more powers to regulate safety, security and economic aspects of innovation in aviation, aerospace and travel. The ultimate goal should be that the CAA is in a position to regulate relevant aspects of innovation in the sector in the short and long term.

10. We welcome the DfT seeking opinions and evidence on what an innovative and flexible regulatory framework looks like for emerging technologies in the sector. The CAA agrees that it is time to address the challenges faced by new technologies,

based on evidence, through proportionate regulatory powers and, if needed, sanctions.

11. It must be recognised that we are in the foothills of innovation and new technologies in the sector. Many of these technologies are at a very early stage in both their development and their implementation within commercial scaled operations. It is therefore difficult to fully forecast what will be the economic, social and political dividends and disbenefits to be derived. We must recognise the imperfect state of our knowledge and the unpredictable transformative potential of these technologies. It must therefore be assumed that any regulatory approach must be iterative, will develop unevenly and will necessarily trail technological development – just as we have seen from other emergent technologies over hundreds of years. This will demand patience from understandably impatient stakeholders. However, we should not be afraid to engage with innovators and the public early and often, so as to enhance our understanding of those innovations, and in so doing build better policy.

12. It is also important to consider the structure of the regulatory framework. It is inevitable that no party can forecast the future. Therefore, creating regulatory frameworks that establish the core principles in law, and allow detailed requirements to be established through secondary legislation or guidance is the most suitable model for passing flexible regulation that can adapt to the evolving market.

13. While existing rules and guidance might be applied to some of these innovations, in the future the regulatory framework might look very different. This, as well as future formal and informal consultations from the DfT and the CAA, together with other forms of engagement with stakeholders, will help the CAA shape that future regulation.

Response

Safety

Question 1. In your view, are there any new or novel forms of flight that use UK airspace that may, as it currently stands, not fall within aviation regulation? If so, what are these new or novel forms of flight and how could we best ensure they are within scope of our current aviation regulation?

14. There are a number of generic titles grouping technologies such as electric vertical take-off and landing (eVTOL), powered lift RPAS, and hybrid air vehicles (HAV). Notwithstanding these innovative designs, operators and developers have a target purpose or use case. That purpose is the regulatory driver for the rule set. For instance, a light aeroplane could be used for private general aviation purposes, commercial air transport or specialised operations, such as aerial filming or a combination of each. The nature of each operation will necessitate a different regulatory approach, depending upon the quantum of risk to both those involved in the operation and the public.

15. Innovators interested in developing a new technology or in applying existing technologies to new problems or settings, will contact the CAA. That initial contact can take place in the form of an application before the Safety and Airspace Regulation Group (SARG) or, outside the CAA regulatory functions, via the Innovation Hub or other teams. In both cases, the applicant will notify their intended use of the technology to the CAA.

16. The CAA, in turn, will identify the existing applicable frameworks, if any, as well as consider those rules in process of being developed. Based on the preceding analysis, as well as on interactions with stakeholder and other evidence-gathering activities, the CAA might identify regulatory gaps or blockers. Those gaps and blockers might be potentially solved in the short, mid or long terms by producing guidance, interacting with other regulators, engaging in rulemaking or recommending that the DfT consider whether secondary or primary legislation may be required. On occasion, the lack of maturity of the technology, solution or the use case, might mean that an application is rejected or that the non-regulatory teams within the CAA decide to help the innovator by pointing out what specific aspects of their innovation need amendment to fit within the existing regulatory arrangements.

17. The CAA considers that many of the technologies which are being proposed for scaling within the sector such as RPAS, AAM and HAVs are within the

contemplation of the existing regulatory framework (primarily, secondary legislation, acceptable means of compliance and guidance material (AMC & GM), and general guidance, among others). While iteration on these frameworks will undoubtedly be required as both the underlying technologies and regulatory understanding matures, the CAA is already working on facilitating such operations.

18. However, two forms of technology that we have identified as not sitting cleanly within this structure are different types of wing-in-ground effect craft (WIG) and innovative personal flight (IPF). Early discussions and analysis indicate possible routes to operation.

19. Annexes 7 and 8 to the Convention on International Civil Aviation (also known as Chicago Convention) include a definition of aircraft. The UK Regulation (EU) No. 2018/1139 (known as the Basic Regulation), also adopts the Chicago Convention's definition of aircraft. That definition excludes machines that derive support from reactions of the air against the earth's surface. The purpose of the exclusion is to remove ground-effect vehicles (also known as wing-in-ground-effect, ground-effect crafts, wingships, flarecraft or ekranoplans) from the scope of aircraft-specific regulation. The International Maritime Organisation (IMO) issued guidelines for WIG (MSC.1/Circ.1592, dated 18 May 2018), which classify WIG in three types for certification purposes. This classification uses the 150-meter-above-the-surface threshold to determine whether the WIG is operating in ground effect or not.

20. While WIGs are currently being dealt with under maritime regulation, some WIG in the process of being developed by industry, as well as some proposed operations, will stray significantly into aviation. Any future discussions on WIG and similar craft by the DfT with international or domestic agencies or in other context should bear in mind that IMO guidance might not suit new craft and new use cases.

21. Regarding IPF, most of them are jet packs. They rely on air-breathing, jet propulsion; use of kerosene, diesel, paraffine or jet fuel (although tests with batteries are ongoing); have one pilot, who has little to no pilot protection; exclude the possibility of additional passengers; have limited to no access to navigational instruments; and often do not have wings. If an IPF uses air-breathing jet engines, it should normally be considered an aircraft, whereas if it uses rocket propulsion, the IPF is usually a rocket. Classified as aircraft, existing laws and guidance apply to IPF, depending on where, for what purpose and under which conditions the IPF system is flying. However, existing law and guidance was not enacted with IPF or jet packs in mind.

22. In addition to the safety issues, it is important to highlight that in the context of the development of new aircraft, the CAA has decided to no longer use the term *unmanned aircraft,* and replaced it with *RPAS*, which is more accurate. The CAA expects that the DfT moves away from the term *unmanned* or *unpiloted*, as it does not reflect how those aircraft operate, and it might be deemed gendered language.

Question 2. In your view, are the existing legal and regulatory frameworks sufficient to introduce new and novel aircraft in a safe way? If not, what changes are required?

23. The UK's State Safety Programme sets the safety standards for the UK, as defined by the Acceptable Level of Safety performance (ALoSP), with the aim that there are no serious injuries or fatalities to third parties as a result of aviation activities. This should be achieved through our State Safety Objectives, that:

    - Protect people from aviation safety risks, including those in aircraft and on the ground;
    - Reinforce the UK position as a global leader in aviation safety; and
    - Positively influence aviation safety through collaborative working with our international partners.

24. These objectives apply as equally to new and novel aviation as they do to existing aviation.

25. The CAA has mechanisms to allow the safe testing and trialling of novel technology through approvals for experimental aircraft (known as E Conditions) and Permits to Fly (issued under Part 21 or British Civil Airworthiness Requirements). These processes are described at a high level in recently published short guides for innovators who intend to start the certification of their aircraft and want to conduct experimental flights of innovative aircraft. Regarding RPAS, the CAA has the power to issue permissions and exemptions to allow certain operations. New and novel aircraft can benefit from utilising temporary danger areas (TDA) to provide segregated volumes of airspace for test and trials, as well as for temporary operations.

26. As the CAA moves towards operationalising new and novel aircraft, there are well-understood pathways that can be followed. For piloted aviation, airworthiness certification, type certificate and type approval, among others. For RPAS, there are three categories: open, specific and certified (the last one is currently being developed).

27. The challenge is how to scale operations. The CAA is currently considering what the future role of airspace and supporting technologies for airspace integration can be. This task is being delivered through the refresh of the Airspace Modernisation Strategy (AMS). We are streaming the learning from a variety of sources, including the UK Research and Innovation-funded Future Flight Challenge (FFC), Connected Places Catapult (CPC)'s Pathfinder Programme and the CAA's own Innovation Hub sandboxes into the AMS refresh process. All of these activities provide us with significant intelligence with which to evaluate the future needs of regulation.

28. All of these activities rely upon meeting traditional models of safety quantification. The existing legal and regulatory framework is very clear for commercial air transport (CAT). But this framework is likely to be challenged by new or novel aircraft solutions. Any changes would be applicable across all CAT operators and not bespoke to new or novel aircraft operators.

29. Traditional safety certification standards look for empirical reliability data to ensure CAT passengers and cargo remain safe in the event of a system failure. Currently, we do not have that data, as most potential applicants are still in development. System safety assessment will be critical. Similarly, the target level of safety associated with current airworthiness requirements may not necessarily be achieved given the maturity of the technology, and a risk-based approach might be considered when taking into account the end use.

30. In future, this approach might be challenged by novel technologies, such as the move away from deterministic algorithms to true artificial intelligence, and the growth of quantum computing, which present a significant test for that prescriptive approach to safety. Consideration could be given to a form of regulatory architecture which focuses on outcomes and a whole systems approach.

31. An additional factor is that some of the new crafts or vehicles being introduced do not fit squarely within the scope of one regulator. Examples include some WIG, and flying cars being developed abroad. Similarly, some technical solutions require joint work among several regulators. The CAA could benefit from legislation and statutory instruments that allow regulators to jointly regulate new craft or vehicles, where necessary.

Question 3. In your view do new or novel aircraft, or any systems related to new or novel aircraft, require a different approach for managing risk to support the safe introduction of new or novel aircraft? If so, what might risk management for new or novel aircraft and related systems look like?

32. This question assumes integrated airspace, piloted and unpiloted. The CAA agrees that it is paramount that any new or novel aircraft are introduced in a safe way, both for those involved with new or novel aircraft, other airspace users, and third parties on the ground. For that reason, one of the several focuses of the AMS is placed on solutions to improve safety, as well as to enable better integration and less segregation of all airspace users.

33. The public expectation is that, in the future, aviation is at least as safe as today. The level of risk should stay comparable as now, we should not be prepared to accept more risk of loss of life. Currently, aviation is extremely safe and should be able to

stay that way. Certification and airspace management should be maintained at the current, high levels.

34. The integration of new or novel airspace users will place importance on the industry's own and the CAA's risk management and monitoring techniques, which may need to be adapted. An increased focus on risk monitoring and data gathering will inform the overall safety picture. If the volume of movements rises with an increasingly diverse range of platforms, reliability criteria will also need to be enhanced. Otherwise, the absolute number of safety incidents could rise.

35. The CAA's duty in regard to safety is not just about the people involved in the operation, but also to uninvolved bystanders and communities. As the number of different ways that people can fly increases, and the locations over which flights take place expands into urban (i.e., densely populated) areas, the risk exposure could increase. All ways of flying need to recognise the increasing public demands for assurance of safety. Thus, traditional risk mitigation measures will need to be evaluated and applied using new methods.

36. Some new or novel aircraft will need to be addressed through a registration and approval process.

37. Regarding the safety and risk management processes to be applied to new or novel aircraft, the CAA understands that there are two alternatives. The DfT and the CAA could apply existing rules and regulations to new aircraft or may take a new approach. Taking novel approaches will require more policy and development of standards. They, in turn, might limit market access.

38. Risk-based methodologies are also under consideration. Work is underway with academia to elicit options against various scenarios.

Question 4. Do you agree or disagree with the alcohol limits proposed for the different categories of operation of unmanned aircraft? Why? Supply any supporting evidence you have on alcohol limits.

39. The CAA agrees with the alcohol limits proposed.

Question 5. What factors, if any, do you think the Secretary of State for Transport should be required to consider when deciding on the necessity of and the appropriate level of insurance for new or novel aircraft, including unmanned aircraft?

A. Insurance Requirements on Certain Commercial Flights

40. The first consideration for insurance purposes is that any aircraft will be subject to strict liability for any damage or injury on the ground. A second, relevant point is that UK Regulation (EU) No. 785/2004 already imposes an insurance requirement on commercial flights of 250,000 Special Drawing Rights (SDR) per passenger carried, 19 SDR per kg of cargo, and 750,000 SDR for third parties (very roughly, for every 500 kg of minimum take-off mass (MTOM)). At the time of this response, 1 SDR ~= £1. It is worth mentioning that this regulation also applies to eVTOLs.

41. Those values are relatively modest, particularly given the strict liability position. At this point, there is no immediate justification for changing them.

42. An additional point that supports the previous statement is the development of new insurance products. There is a robust RPAS insurance market that quickly developed and responded to those emerging technologies, and will no doubt continue to do so as other technologies progress.

B. Insurance Requirements for RPAS

43. Currently, the aviation insurance legislation (UK Regulation (EU) No. 785/2004) only applies to RPAS with a MTOM of more than 20 kg. The regulation was not written with drones in mind.

44. RPAS policy on aircraft insurance is outlined in CAP 722 ‘Unmanned Aircraft System Operations in UK Airspace – Guidance’ and refers mostly to the requirements set out in: (i) UK Regulation (EU) No. 785/2004; and (ii) Civil Aviation (Insurance) Regulations 2005.

45. CAP 722 guidance (i) indicates that UAS insurance is to be in accordance with UK Regulation (EU) No. 785/2004; (ii) explains that the regulation does not define model aircraft and therefore offers a means to purposively interpret it in a useful manner; and (iii) states that all authorised operations require insurance (see section 1.4).

46. Regarding point (ii), Article 2(2)(b) of UK Regulation (EU) No. 785/2004 excludes model aircraft with an MTOM of less than 20 kg from its scope. Given that UK Regulation (EU) No. 785/2004 does not define the term ‘model aircraft’, the CAA has defined this term in CAP 722 in order to correctly apply the regulation, as it was intended.

47. Two definitions of ‘model aircraft’ are needed: one for the purpose of UK Regulation (EU) No. 785/2004; and other definition for a generalised use. The latter is set out in CAP 722D. It would be useful to amend Article 2 of UK Regulation (EU) No. 785/2004, to apply it as intended (i.e., to recreational RPAS), without use of the

term ‘model aircraft’, and to align the mass limit with the upper end of the open category.

48. Insurance is mandatory in the open category only for commercial operations or RPAS greater than 20 kg. There is no obligation on the CAA to proactively receive information on insurance for RPAS, however an RPAS operator must be able to produce an insurance certificate upon request by the CAA. If insurance were to become mandatory to all operations in the open category, the CAA might have to amend the Drone and Model Aircraft Registration and Education System (DMARES). This, in turn, would require that the CAA and insurers work together to facilitate the exchange of information about the terms of the relevant policies, such as expiry dates.

Security

Question 6. Are you aware of any technological requirements necessary to introduce new and novel aircraft in a secure way? If so, what are these technological requirements and what factors do you think should be considered when regulating their use?

49. Technological advances are one of the main factors behind the continuing evolution of security threats and risks to and from aviation. We have a very well-developed and effective regulatory framework for managing security risks. In general, as we have seen in recent years with new areas such as drones, cyber security and space, we can build on that existing framework to develop new regimes to address the security threats and risks associated with these new developments.

50. However, the primary legal powers (in the Aviation Security Act 1982 and in retained EU primary legislation) which underpin our regulatory measures are somewhat out-dated, and so inhibit unnecessarily our flexibility to act and to innovate in this area. Any new legislation on the future of flight should therefore incorporate updates to the Secretary of State’s aviation security powers that will enable the CAA to optimise the development, implementation and oversight of the security arrangements likely needed to be put in place around many types of future flight.

51. Regarding the position that security might be needed to protect the technology market, the CAA understands that it is better to frame this statement differently. Cyber and physical security are essential to safety. The concern in aviation should be to target security threats to protect the UK against unlawful interference. The

protection should include not only the protection of individuals, communities and businesses but also assets and infrastructure, more generally.

52. Any new, appropriate powers to address the misuse of new technology and aviation capabilities should not only be given to the Police but also to law enforcement more generally, including appropriate regulatory powers to the CAA. The CAA should have the powers to oversee and enforce from the prospective of safety.

53. The role of the CAA is not focused on regulating technology in itself but on regulating technology's application and capabilities. This should be considered when enacting new legislation and given powers to the Secretary of State and the CAA.

54. The CAA agrees that measures to ensure the security of related systems that enable new technology, such as so-called Unmanned Traffic Management (UTM), are needed. There would be significant safety risks if UTM and other associated infrastructure and technologies were not to be regulated.

55. Regarding the introduction of new and novel aircraft in a secure way, in principle, the CAA does not want to be prescriptive and impose technological requirements. We need to focus on the outcomes that relate to introducing new and novel aircraft, allowing organisations to decide how best to meet those outcomes, for their own specific technology. However, on occasions, the CAA will have to set some boundaries, e.g., establishing some technical standards for electronic conspicuity (EC).

56. Interconnectivity is one of the factors that should be considered when regulating new and novel aircraft. Interconnectivity is increasing exponentially. Regulation needs to take this into account, define how these interconnections between aircraft and systems will be considered, and where risk ownership belongs.

UTM and its Integration with ATM Systems

Question 7. Do you agree that the CAA should be provided with the necessary powers to regulate UTM systems in the UK? If so, what if any, powers do the CAA need and what factors should the CAA have to or be able to take into account when discharging these powers?

57. Yes, the CAA agrees that the CAA should be provided with the necessary powers to regulate UTM systems in the UK, subject to the comments we make in the following paragraphs.

58. There still is not an accepted definition of UTM for the UK. Existing rules do not explicitly mention the term UTM or some of the services currently being described by part of industry as UTM. Based on foreign legal systems, some uses appeared to refer to the provision of traffic management services for unpiloted aircraft, whether remotely piloted or autonomous. However, we understand that some of the industry's proposals labelled UTM refer to new, potentially autonomous systems to provide navigation, traffic management and other services (sometimes wider than that), whether for piloted, remotely piloted or autonomous aircraft.

59. The name 'UTM' might not correctly reflect either the services to be provided to new (and current) aircraft or the type of aircraft that will use those services. This is in addition to the name being gendered and referring to terminology already abandoned by the CAA (i.e., *unmanned aircraft systems* or *UAS* are now referred to as *RPAS*).

60. While there is generally agreement internationally on the full scope of potential UTM capabilities (services), there is currently an opportunity for the DfT, with support from the CAA, to define the meaning and scope of UTM in the context of the UK. For example, it may be preferable to select a subset of UTM services that would fall within the regulatory definition of 'UK UTM', such as those which directly support safe non-segregated BVLOS flights of RPAS. This will subsequently provide clarity for the development of regulation and the market. However, any prescribed definition may also unintentionally restrict potential market opportunities, and so care should be taken.

61. The question addressed here does not specify whether it is referring to economic regulation or safety regulation. We have considered both, to the extent that is possible at this time.

62. Regarding economic regulation, the CAA should have the necessary powers to ensure that the interests of consumers are protected in respect of the provision of UTM. There is an economic regime for air traffic services (ATS) in the UK, which is set out in the Transport Act 2000 (TA00). The CAA also has concurrent competition powers with the Competition and Markets Authority (CMA) in relation to the supply of ATS. Hence, the existing legal framework may provide the necessary approach for some of the services currently being described as UTM. Where this may not be the case, it is in the interests of consumers that the CAA has powers to undertake economic regulation as a reaction to evidence of possible consumer harm.

63. The services which constitute ATS in the TA00 are set out in section 98(1) TA00, which is drafted quite broadly. The CAA considers that the provision of ATS services to RPAS or autonomous aircraft fall under the TA00 regime. When defining UTM, it will therefore be necessary to consider whether the definition of ATS in the TA00 may need to be amended to include any UTM services not currently covered.

64. We recognise and are comfortable that powers for some form of regulation may be appropriate in the future. We consider that our approach should be determined by a

clear identification of any problem, or theory of consumer harm, which will in turn inform the regulation needed, if any. It is not currently clear that a particular form of economic regulation, such as a price control in a licence, would be necessary, justified or proportionate. Thus, we consider it is not yet evident what approach to regulation would be in the interests of consumers.

65. The regulation of services described as UTM should include the regulation of safety, where necessary. The safety risks that a UTM system could pose, without effective cyber risk mitigation, when integrated with air traffic management (ATM) could be significant.

66. Some of the services that are part of existing proposals labelled as UTM may come under the current definitions of ATM and/or air navigation services (ANS), and so be covered by the regime in UK Regulation (EU) 2017/373. If that is the case, the CAA would have the power to regulate safety aspects of those providers of UTM services in the UK. In that scenario, the providers of UTM-related services (assumed to be air navigation service providers (ANSPs)) would require certification from the CAA before they can provide any services, and the CAA would also be responsible for ongoing oversight and enforcement.

Question 8. Do you support a centralised approach to UTM, or a federated approach with multiple providers of UTM services competing for UAS operator customers, or another approach to UTM? What do you see as the advantages and disadvantages of your preferred approach?

67. Regarding the alternative between a centralised and a decentralised model, the CAA strongly considers at this point there is not sufficient evidence to support a particular approach. The CAA is a pro competition regulator and believes that healthy competition can drive innovation and choice for customers. Economic regulation is appropriate only where an operator has significant market power.

68. More generally, the CAA views that a diverse market of UTM service providers would more likely suit the anticipated needs of the sector. The CPC Open Access UTM Framework concluded that a largely federated architecture can be supported by a set of centralised, or core, services — themselves not necessarily being provided by a single entity. This creates new markets for various roles throughout the UTM architecture, founded on open standards that would assure levels of accuracy, reliability and interoperability. Relying on a purely centralised model would provide a clear single source for all services, but in itself this has disadvantages of resulting in another UK monopoly for air traffic services. At this point, both alternatives are possible.

69. Currently, there is not a centralised approach to air traffic service provision in the UK. On the contrary, there are more than 60 ANSPs. Only the provision of en-route services is a monopoly. A question that could be asked, then, is whether multiple, competing UTM providers should be regulated in the same manner as the multiple ATM providers in the UK are presently regulated (that is, as ANSPs). Allowing several ANSPs to provide ATS in the same airspace might require amendment to primary legislation.

70. The CAA is currently working to answer these questions. Forthcoming external activities to gather evidence include a series of informal consultations (calls for insights) asking questions to our stakeholders to learn more about their views on several aspects of UTM. These include: how UTM could be deployed in the UK; our draft vision; a new approach to the name; airspace use and charging for the provision of certain services; economic and safety considerations. The first of these calls for insights will open in a few weeks. Additional informal consultations will take place within the coming months.

Airspace

Question 9. In your view, are there any specific challenges around the integration of new and novel aircraft into UK airspace that are not already reflected in the Strategy?

71. Currently, the CAA is in the process of engaging with a broad cross section of airspace stakeholders, reviewing the air modernisation strategy (AMS), identifying gaps in the existing content, and introducing new areas of focus. Within this engagement activity, the CAA has obtained input from a multitude of new-entrant operators. These include operators of RPAS flying BVLOS, High-Altitude Aeronautical Platforms (HAAPS) or High-Altitude Pseudo-Satellites (HAPS), space launch vehicles, and AAM. This work has enabled the CAA to begin defining what the airspace integration of these new and novel operators will look like, ready for a public consultation on a refreshed AMS launching in January 2022.

Question 10. What are the challenges that are not being addressed through the Airspace Modernisation Strategy? How should we address these issues?

72. The first issue not being addressed though the AMS is low and zero-emission aviation. The AMS's role in the sustainability of aviation will be difficult to define until HMG sets out its ambition for emissions reduction (e.g., Jet Zero Consultation's outcome) and how this informs the ongoing conversations about the appropriate balance between greenhouse gas emissions, noise and capacity.

73. There are other challenges that are not fully addressed by the current AMS, though some of these issues will be considered as part of the forthcoming consultation on a new AMS, due to be published in early 2022. The countrywide provision of Flight Information Service (FIS), outside of current controlled airspace is one of them. Another is the integration of UTM and ATM, since there does not yet exist an agreed standard model, and the UK expects the development of innovative aviation which might partially depend on integration being in place. The CAA, through the Innovation Team, is working on future informal consultations to gain more information on the UTM proposals industry would like to develop, and how they would interact with ATM as it exists today.

74. Capacity at airports is another point that needs further consideration. Airport capacity is based on available ground space. Whilst the AMS can increase capacity in the air, the increase this promises will only work for smaller regional airports.

75. A separate issue is that the current AMS delivery and funding model, with a masterplan coordinated by the Airspace Change Organisation Group (ACOG), is not presently constituted as a means to deploy airspace modernisation elements outside of a controlled airspace and CAT remit. The delivery and funding model is more focused on modernising areas of controlled airspace. There are ongoing activities within the CAA to evaluate changes in the uses of large blocks of controlled airspace (reclassification review).

76. The CAA, through its horizon scanning, has also been working to capture a myriad of use cases that look to exploit the upper most levels (and above) of current regulated airspace (FL660) in the coming years. There is a gap regarding what applies above the existing limits of regulated airspace, as there is little framework for the CAA to work with. There have been preliminary discussions with the DfT on the subject so far. The progress of these considerations by HMG could also have an effect on HAPS or HAAPS.

77. The issues not being considered through the AMS need to be addressed in national, regional and international settings. The CAA has started to do this with inputs and support to the European Concept for Higher Airspace Operation (ECHO) project, initiating discussions at the European Civil Aviation Conference (ECAC), and plans to take the issue to the International Civil Aviation Organisation (ICAO) assembly. Clear direction from HMG and the DfT would be welcome. There is also building momentum from industry (HAPS or HAAPS is the strongest contender in the short term but commercial space is also a factor). Perhaps more importantly, the CAA is planning a public consultation, starting January 2022, on a refreshed version of the AMS, where it will be looking for input on these airspace topics.

78. The broadening of the AMS, with new areas of focus (e.g., new Lower Airspace Service (LAS)), is likely to further highlight the need for a conversation about the delivery and funding, both initially and ongoing, of any new initiatives associated with the AMS.

Noise

Question 11. Is your preferred approach to regulating new and novel aircraft noise setting locally enforced aircraft noise limits, standards attached to the aircraft themselves, or another approach?

79. The CAA recognises that the noise footprint of new and novel aircraft will be one of the factors that will determine the level of public support for these new operations, along with other considerations, such as carbon footprint, privacy and visual pollution.

80. Due to the wide and expanding range of potential applications for new or novel aircraft, the CAA believes that setting locally enforced aircraft noise limits would not be the sole means of regulating noise from such aircraft. Equally, noise from new or novel aircraft should not be considered in isolation from other existing aviation sources. Having said this, the different noise characteristics associated with new or novel aircraft may give rise to different human responses that may need to be treated differently to the other aviation noise sources.

81. In future, success in the sector could mean many different operators engaged in a wide variety of types of operations over a range of different communities living in different environments. Although this might be considered justification for setting limits specifically to accommodate these different circumstances, setting such limits would present a significant challenge for a regulatory framework and, in particular, those charged with validating and then enforcing all the different local limits, even if that was considered appropriate. Similarly, it would be difficult for individuals or communities experiencing noise disturbance to know which operators are responsible for the associated activity, presenting a challenge in how operators are held to account for meeting any agreed standards. This differs from current aviation noise activity, where it is largely clear that the noise originates from aircraft using a specific airfield.

82. Our preferred approach would be to draw from the ICAO Balanced Approach to Aircraft Noise Management, which was adopted by the ICAO Assembly in its 33rd Session (2001) and reaffirmed in all the subsequent Assembly Sessions (reference:

ICAO Resolution A39-1 Appendix C). Detailed guidance on the application of the Balanced Approach is provided in the ICAO Doc 9829, Guidance on the Balanced Approach to Aircraft Noise Management.

83. The Balanced Approach consists of identifying the noise problem at a specific airport and analysing various measures available to mitigate noise. This is done through the exploration of these various measures, which can be classified into four principal elements, specifically:

    A. Reduction of Noise at Source (Technology Standards)
    B. Land-use Planning and Management
    C. Noise Abatement Operational Procedures
    D. Operating Restrictions

84. The Balanced Approach addresses noise problems on an individual airport basis and aims to identify the noise-related measures that achieve maximum environmental benefit most cost-effectively, using objective and measurable criteria.

85. The Balanced Approach is currently applied on an airport-by-airport basis, making it relevant, as it stands, for new and novel aircraft launch/landing sites. However, there is greater potential for en-route noise disturbance to occur relating to new and novel aircraft if they are to operate at lower altitudes than civil aircraft, in greater volumes, and over-populated areas. In these cases, elements of the approach may require adaptation.

86. Taking each of the elements of the balanced approach in turn:

A. Reduction of Noise at Source (Technology Standards)

87. This concerns noise certification of new and novel aircraft types. A certification system should be based on the principles set out for civil aircraft in the ICAO Annex 16 Volume 1. It will, however, need to be adapted to apply to new and novel aircraft, specifying: a robust measurement procedure (see response to the question below regarding noise measurement); appropriate standards set for new aircraft designs; and reliable administrative processes for issuing certificates and setting and ensuring compliance.

88. As new aircraft designs enter service and technology evolves, the certification system will need to be evolved accordingly.

B. Land-use Planning and Management

89. This will be concerned with the appropriate location of new and novel aircraft launch/landing sites with respect to noise sensitive receptors, namely residential land-use, schools, hospitals and places of worship. Following developments of such sites, land-use planning will assist in limiting or preventing encroachment of noise sensitive land-uses near to sites.

C. Noise Abatement Operational Procedures

90. The emerging aircraft designs, particularly new and novel aircraft, by definition, will be capable of vertical take-off and landing operations, and more generally be able to operate in more versatile ways than current fixed wing civil aircraft. Noise abatement operational procedures will need to accommodate and make best use of these capabilities in order to protect those who may be disturbed by noise from these aircraft. Indeed, much can be drawn from principles used to manage civil aircraft noise. For instance, noise preferential routes for aircraft departing from and arriving at a launch/landing site may be used to avoid overflying more densely populated areas. Specific noise preferential routes/corridors or some form of static or dynamic geo-fencing may be appropriate for aircraft in cruise, depending on how the airspace is structured.

91. Aircraft operational altitude limits could be used to maintain noise propagation distances between the aircraft noise source and people on the ground.

92. Quiet flying procedures should also be developed and used. These should make the best use of the various operating modes that new and novel aircraft are capable of, to strike an appropriate balance between noise emission and energy consumption.

D. Operating Restrictions

93. Restrictions are considered a last resort to be used only if the preceding elements do not go far enough to protect those who may be disturbed by noise from these aircraft. Typical restrictions include: limits on operating hours to avoid noise sensitive periods; limits on total movement numbers, total noise factored movements or some other type of noise envelope (see CAP 1129 for further information).

Question 12. At which points should we measure the noise impact of new and novel aircraft when gathering data on noise? Why?

94. It is expected that data will be gathered on noise at the certification stage (for regulation) and during operation (for management). Measurement would also be required to build computer models for predicting new and novel aircraft noise as could be necessary for noise management.

A. Certification

95. The noise impact of new and novel aircraft should be measured during the phases of flight that have the greatest potential to adversely impact the public. Noise should be measured using flight test procedures that simulate the noise effects of typical operations during take-off, flyover, landing and hover phases, where relevant.

96. Setting maximum noise levels for different phases of flight encourages the design of quieter aircraft and prevents noisier designs from being approved. For this process to function, test procedures must be robust and reliable. In this respect, hover noise presents some test and measurement challenges and is consequently not part of ICAO helicopter or tiltrotor noise certification, despite hover noise being recognised as one of the phases of operation that can cause disturbance. Research will be needed to help inform to what extent all phases of flight associated with new and novel aircraft can be robustly and reliably measured in order to establish meaningful noise limits. As for existing aeroplane, helicopters and tiltrotors, establishment of noise certification test procedures and associated limits is best done under the auspices of ICAO, through the establishment of new requirements in ICAO Annex 16 Volume I.

97. Due to their uniquely different propulsion systems compared to conventional fixed-wing aeroplanes and rotorcraft, any new noise measurement methods and resulting standards for new and novel aircraft will also need to account for their substantially different noise characteristics.

B. Operation

98. It is expected that measuring noise from new and novel aircraft in operation could form part of an approach to noise management. Operational noise measurement may be required if there is a policy decision to enforce operational noise limits, as is done at some airports for civil aeroplane noise. Operational noise measurement would also help inform the development of relevant noise certification test procedures and ensure that operational noise levels correlate with noise certification levels.

C. Modelling

99. It is anticipated that the management of noise from new and novel aircraft will need to be supported by calculation models/methods in order that potential noise problems may be avoided or mitigated to the extent practicable.

100. This may require new noise modelling methodologies that fully reflect the operational and noise characteristics of such aircraft. Although, new and novel aircraft are similar to helicopters or tiltrotors, there are no internationally agreed methods or data for the calculation of helicopter or tiltrotor noise. There are, however, methods in development for the calculation of rotorcraft noise, that are anticipated to be suitable for new and novel aircraft noise calculation. This work needs international consensus and the collection of supporting noise characteristic data.

Infrastructure and Digital Infrastructure

Question 13. Are you aware of any digital infrastructure or other infrastructure needs for new or novel aircraft? If so, what needs? Is existing regulation sufficient to meet these needs?

101. Cyber security (and wider security) will need to play a key part in ensuring that the infrastructure requirements for new and novel aircraft are properly considered. We will need to consider how we regulate interfaces between infrastructure owned and operated by different organisations.

102. There are huge differences and variations with new and novel aircraft concepts. This makes it challenging to give a comprehensive response at this stage. For aviation safety, it is important that infrastructure decisions reflect the performance and needs of the specific aircraft, and the operational requirements of the environment where they are being used. Some novel aircraft will be able to use existing infrastructure, provided the right procedures and other aspects –such as operational and environmental risk assessments– support this.

103. The existing regulation enables new infrastructure to be developed in accordance with the above principles and safety considerations. However, as novel aircraft emerge, we must continue to monitor their performance. This will allow us to assess whether different approaches and additional infrastructure are required; as well as to ensure this approach remains consistent and compatible with the existing regulatory frameworks.

Future Plans

Question 14. What do you think are the main 'use cases' for new and novel aircraft?

104. The CAA is also interested in hearing industry's view on the main use cases for new and novel aircraft, as primarily it is for the sector rather than the regulator to define or second-guess such benefits. Further research into specific areas of technology, the gathering of data to inform regulation, and developing regulations around the safe and secure use of new technology are critical for the CAA to remain agile, act and regulate in technology-relevant time scales.

105. At this point, the CAA has had the opportunity to deal with several different types of use cases for RPAS which want to fly BVLOS, and for AAM. Those cases are sometimes analysed by our regulatory team (SARG) in the context of an application for authorisations or permits. Frequently, it is the CAA's Innovation Team who reviews innovators' proposals before they are submitted to SARG (although they might not need to), to help innovators achieve maturity.

106. As regards RPAS flying BLVOS, the CAA has had opportunity to consider these use cases: response survey in case of oil spill offshore; inspection of assets offshore; delivery of mail and parcels to small islands; small drones to help in mountain rescue; powerline inspection in urban and rural areas; police surveillance and law enforcement; aerial mapping of rural and urban areas; and HAPS or HAAPS; among others.

107. Some of the AAM use cases that the CAA has seen so far include: air taxi operations over London; regional transport of passengers within cities in large eVTOLs; remotely piloted eVTOL aircraft (BVLOS or autonomous) to transport cargo; pop-up airports for vertical take-off and landing aircraft (VTOL); and zero-emission regional airline operations; among others. Most projects are aimed at both cargo and passenger transport, while a few focus exclusively on passenger services.

108. We have also seen strong use cases developing for novel aircraft designed towards zero emissions – e.g., using electric or hydrogen propulsion. These novel, zero or low emission aircraft will replace existing regional routes or establish a new direct transport link where there lacks one. The solutions to achieve low or zero emission range from replacing existing propulsion systems within certified airframes to newly designed VTOL.

Question 15. In your opinion, what are the milestones for achieving these 'use cases' in the next 5 years?

109. There are no legal blockers for most BVLOS use cases, as two paths would lead to authorisation: to fly it in segregated airspace (e.g., a TDA); or to develop appropriate detect and avoid (DAA) systems. Regarding the BVLOS use cases identified above, there are some minimum, at this point, theoretical requirements to enable BVLOS without a TDA. An effective DAA system which can handle uncooperative aircraft (i.e., with no transponder or EC), other aircraft and objects (e.g., birds) would in principle allow BVLOS to be approved, under existing regulation. At the moment, there is not a proven system in place. We do not know whether such a system will effectively be in place in five years.

110. Enabling BVLOS will require a combination of EC-based, cooperative DAA, uncooperative DAA systems, and deconfliction services possibly delivered via UTM systems. To allow BVLOS in unsegregated, class G airspace, the minimum enabler would be an effective uncooperative DAA system. In certain circumstances, a low risk of airspace argument could potentially be used to allow BVLOS. This refers to areas where an air encounter would only occur if other airspace users were breaching the rules of the air.

111. Given the importance of DAA, the CAA's Innovation Hub recently launched a DAA sandbox. This consists of three separate technology demonstrators as part of the DAA challenge, each of which will investigate a key technology enabler for DAA. More information is available in CAP 2238.

112. As for AAM, five years is a very short horizon. The CAA does not expect a wholesale distributed, on-demand model of AAM to be operating at a large scale within this timeframe. More limited scheduled and fixed route commercial services are though highly probably within that timeframe. These have the potential to still add significant numbers of additional movements to the UK's aviation system.

113. However, to enable the initiation of operations within the next five years, certain developments may need to be in place. Ongoing research into the technologies and operational concepts under this topic will confirm specific milestones. Similarly, HMG decision making on the role of AAM within the UK transport and aviation network will support understanding in this area.

114. From collaborative discussions, possible key milestones may include:

1. A defined airworthiness certification process for eVTOL vehicles;
2. Advancements regarding vertiports and ground infrastructure, including:
    - design and licensing requirements;

- coordination with local planning authorities and developments; and
- safety case approval for eVTOL operations within new and existing operating environments;

3. Review of the current airspace change process (CAP 1616) to ensure it is capable of supporting new AAM airspace users and full consideration of airspace integration, including integration of traffic management services;
4. Consideration of social license issues (planning and operational stages); and
5. A UK framework that allows for investment and associated recovery of charges from eVTOL operations (at low traffic levels, this might not be a priority issue).

115. This summary of potential milestones assumes that AAM operations will initially be low density. In that context, improvements in traffic management are a slightly lower priority for the first wave of AAM operations. Growth may depend on a range of economic, social and political factors. This can be seen, for example, under the current CAA Sandbox project which is seeing Eve Air Mobility developing a Concept of Operations against a specific AAM case study.

116. It is worth noting that a number of other states have identified entities to champion the introduction of new AAM services within their jurisdictions. These delivery bodies coordinate a range of regulatory, public policy, planning and commercial interests to facilitate the rapid introduction of such services. For example, in France this role is played by the Choose Paris Region Economic Development Agency, which is working in partnership with airports group ADP and ground transportation network RATP to meet the goal of launching air taxi operations on a trial basis in 2024. If HMG had significant ambition to introduce such a service in the UK, then the establishment of a similar delivery agency could facilitate attainment. This would not properly be the role for a regulator such as the CAA, however, we would be a key stakeholder.

117. From the perspective of low or zero-emission air travel, in the next five years, it is expected that the aircraft used to develop regional transport of passengers on novel, low or zero emission aircraft will be relatively small. However, industry has signalled a desire to develop this over the longer period to include larger aircraft (i.e., more than 100 passengers).

118. Achieving these use cases requires a holistic effort, including technological milestones, such as development of efficient and demonstrably safe aviation-sector batteries for electric propulsion. Industry also needs to develop standards for these technologies, with the CAA and HMG's collaboration and support. For operations, use of airspace is critical. Milestones under the AMS will be relevant to these operations as with all other in UK airspace.

Equalities Duty

Question 16. Do you have data or evidence about whether any of the proposals discussed in this consultation would positively or negatively impact on individuals with protected characteristics (as defined in section 4 of the Equality Act 2010)?

119. The future of transport regulatory review rightly focuses on modernisation, innovation and the potential for new technologies and business models to emerge. In this context, the CAA welcomes the emphasis that HMG has placed on safety and security in the consultation and, as the UK's specialist aviation regulator, much of the CAA's response to the consultation focuses on these two issues. The CAA does not enforce the Equality Act 2010 (EA2010), but is subject to the Public Sector Equality Duty (PSED) set out in the EA2010 and, as such, welcomes the opportunity to provide feedback on this issue also.

120. The EA2010 places certain obligations on service providers, including businesses, in relation to prohibiting discrimination against people with protected characteristics and the duty to make reasonable adjustments for disabled people. As such, in designing, developing, and implementing new technologies and business models, businesses will need to ensure that they are complying with the requirements of the EA2010. These requirements, especially the requirement to make reasonable adjustments for disabled people, will be particularly relevant for businesses when they offer services to consumers and the public, more generally. This could arise, for example, in cases where the business is looking to provide services on new aircraft technologies or, more broadly, wherever consumers or the public have to access physical and digital infrastructure. The CAA would also like to note that there is sector specific regulation covering the rights of disabled people when accessing air travel.

121. Although the CAA does not enforce the EA2010, the PSED places a duty on the CAA to have due regard to furthering certain societal objectives relating to equality whenever carrying out any of its functions. In light of this, as new and innovative technologies and business models emerge, the CAA, in its role as regulator, will play its part in raising awareness of the requirements of the EA2010 amongst the businesses concerned, and will encourage them to take steps to comply. However, the CAA would like to request HMG to ensure that the needs and interests of people with protected characteristics, and the requirement for businesses to comply with the EA2010, have a prominent place in its ongoing thinking on the future of transport.