Delivering Scalable UAS BVLOS in the Specific Category

The UK CAA Technical Strategy Delivery Model

The UK Civil Aviation Authority presents the individual components, delivery model and roadmap we are delivering to enable routine UAS BVLOS Operations in the UK

CAP 3038

Foreword

If we are to maximise the economic and social benefits of airborne drones- referred to here as Uncrewed Aircraft Systems or UAS - they need to be able to fly further than the direct eye-line of their pilots, or beyond visual line of sight (BVLOS). As part of our commitment to support growth and innovation, the CAA's ambition is for UAS to be able to fly routine BVLOS operations across the UK.

But BVLOS operations are not straightforward, and there are many issues that need resolving. We need to be assured that BVLOS operations can be safely integrated into the UK's airspace. This requires us to be satisfied that the operation itself is safe, that the technology has the appropriate safety features, that pilots are trained, and the rules for integrating these technologies into our airspace that is already widely used by other operators is finalised.

The CAA is pushing forward on all these aspects, promoting an inclusive and pro-innovation culture within the organisation and within our overall framework, however, not forgetting that our mission is protecting people and enabling aerospace. This means that we are seeking to understand and enable new innovations to operate in the UK aviation system within our overall commitment to the safety of the public and passengers.

To provide a clear forward view to industry, this document sets out our strategy for moving from where we are today, with limited BVLOS operations in highly controlled airspace, to regular and routine BVLOS flights within integrated airspace.

As we progress towards full airspace integration, this document sets out how we will achieve two key milestones on that journey: demonstration of BVLOS activities by the end of 2024, and evolving towards routine BVLOS operations in 2027.

As always, we are indebted to industry for their input and we encourage feedback on this document to help us evolve this strategy and deliver BVLOS as soon as practicable.

All of the policies referenced in this document will be appropriately engaged and consulted on as part of the regulatory policy development process following the CAA's regulatory approach.

Rob Bishton, Chief Executive Officer, Civil Aviation Authority

Sophie O'Sullivan, Head, Future Safety & Innovation and The CAA FOF Programme Director, Civil Aviation Authority

Executive Summary

This publication provides the Future of Flight ecosystem with the details of the CAA's Technical Strategy to realise routine UAS BVLOS operations in the Specific Category in the UK through two key pathways:

1. We are first aiming to demonstrate integrated BVLOS operations within Temporary Reserved Area (TRA) Sandboxes, which will provide a Test & Evaluation capability to inform our understanding of safe operational use and integration with other airspace users. This will evolve into the demonstration phase, creating areas of airspace where UAS are able to operate together and with other airspace users.

2. With the introduction of the Atypical Air Environment Policy, limited operations, supported by Test & Evaluation activities commencing 2024 will inform how the operations can be extended to enable routine operations by 2027.

The goal of this document is to increase the CAA's transparency in our work to help industry unlock BVLOS operations in the UK. This document does not address aspects such as economic and societal benefits in detail as they fall outside its scope and are addressed by all partners as part of the wider Future of Flight ecosystem. Our principles for doing this are laid out in the government's Better Regulation framework and its Code. The document provides one voice for the CAA's work on enabling BVLOS by clearly setting out a high-level overview of the regulatory and technical components we are working on across the CAA to successfully deliver our ambition to enable innovation and growth.

We are aware that existing regulation and authorisations already permit certain operations such as overflight of uninvolved people and management of multiple simultaneous UAS operations when demonstrably safe. However, they do not allow operations at scale. This document specifically looks at the capability and delivery steps needed to move towards unlocking such operations at scale in the UK, starting with the premise of one Remote Pilot to one UAS.

This document is split into two Parts. Part 1- Delivery, describes what needs to be achieved and how the CAA is structured to do so. Here we introduce the challenges, describe the delivery model, discuss the operational capability roadmap and then break down each capability step in the delivery strategy.

We conclude Part 1 by describing the functions that support delivery.

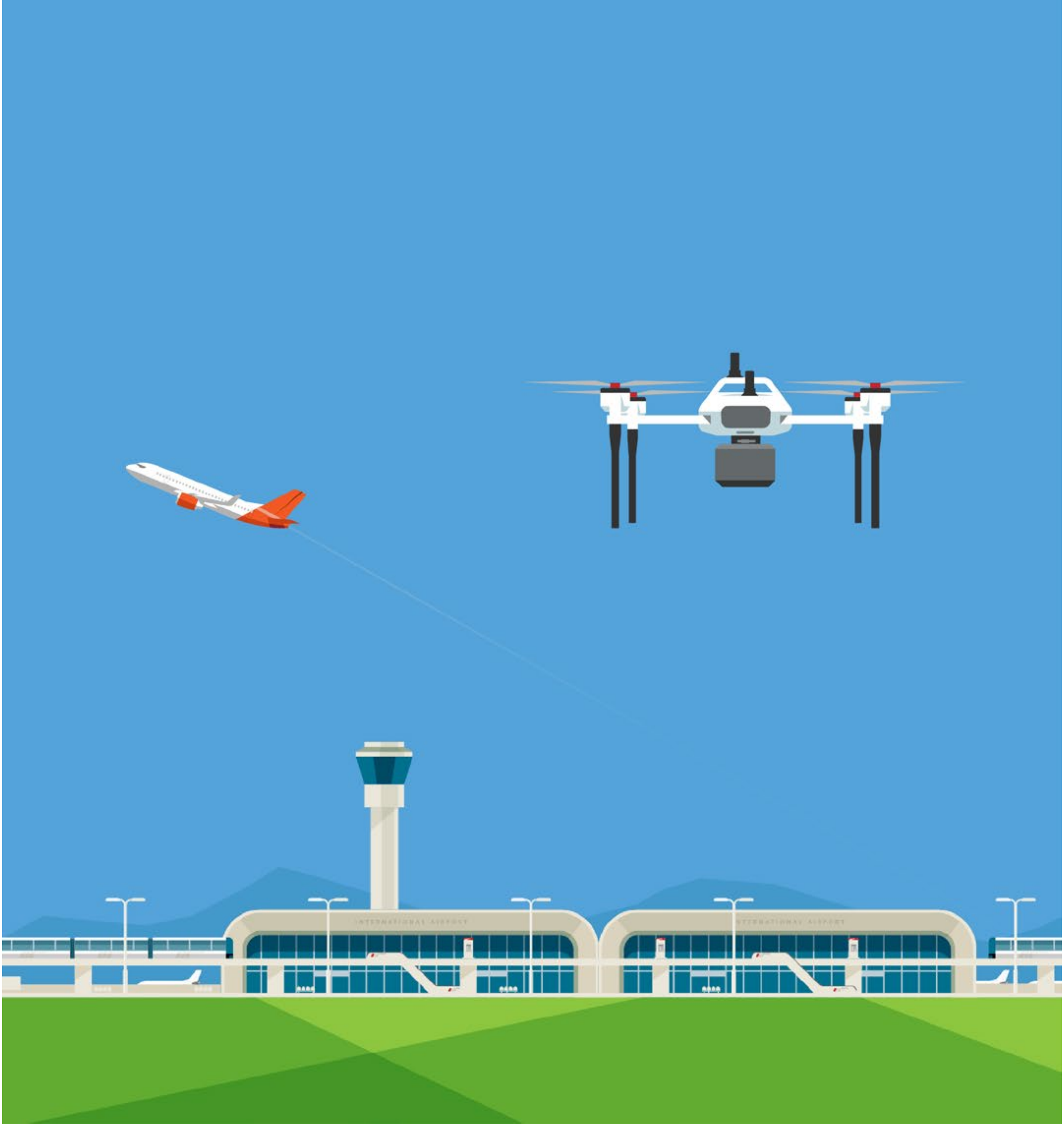
In Part 2- Components, we expand on the key action summaries introduced in the delivery strategy and describe the major components for the Integration of BVLOS in UK Airspace. First by breaking down the UAS Policy and Regulatory Activity and then the Enabling Airspace Activity. The contents on the following page will help you navigate the document.

Ed Clay, Head of FS&I Technical Strategy, Civil Aviation Authority

Navigating this Document

1.

Delivery and introduction



Introduction

Today, UAS BVLOS test operations in the UK are typically conducted in segregated airspace, due to the unmitigated risk of mid-air collision with other aircraft. This is because of the lack of a pilot with the ability to 'see and avoid' in accordance with the Standardise European Rules of the Air (SERA). This airspace is in most cases provided by a Temporary Danger Area (TDA). The TDA is not a practical long-term solution for a sustainable BVLOS business model (recognised in the Airspace Modernisation Strategy (AMS) consultation) due to:

- its 90-day validity,
- its placement of restrictions on other airspace users,
- its inability to re-establish without significant changes once expired
- high demands on resource from all stakeholders.

More permanent airspace design alternatives to TDA's can be costly, requiring significant supporting evidence and investment of resources, without necessarily being truly suitable for the intended operation.

The long-term aspiration of industry is for BVLOS operations to be a routine part of aviation "business as usual" across the UK. To achieve this will require a significant volume of learning, experience, technical development from industry and evidence from all involved. Because of the complexity of the task, it cannot safely be accomplished in one big step. The CAA has a responsibility to work with innovators to build, test, learn and repeat in smaller, verifiable steps to evidence safety cases.

Safety is everyone's priority. To achieve our goals, we must make sure all airspace users are sufficiently protected, and the risk to people and property on the ground is reduced to acceptable levels. A key challenge is to design and demonstrate a technical and operational solution that provides equivalent or superior see-and-avoid, or robust technology solutions able to provide 'Detect And Avoid' capabilities without the need for the current mechanism of temporary airspace changes for BVLOS operations. This will enable UAS operations within airspace that is safely shared with other aircraft – i.e. in non-segregated airspace.

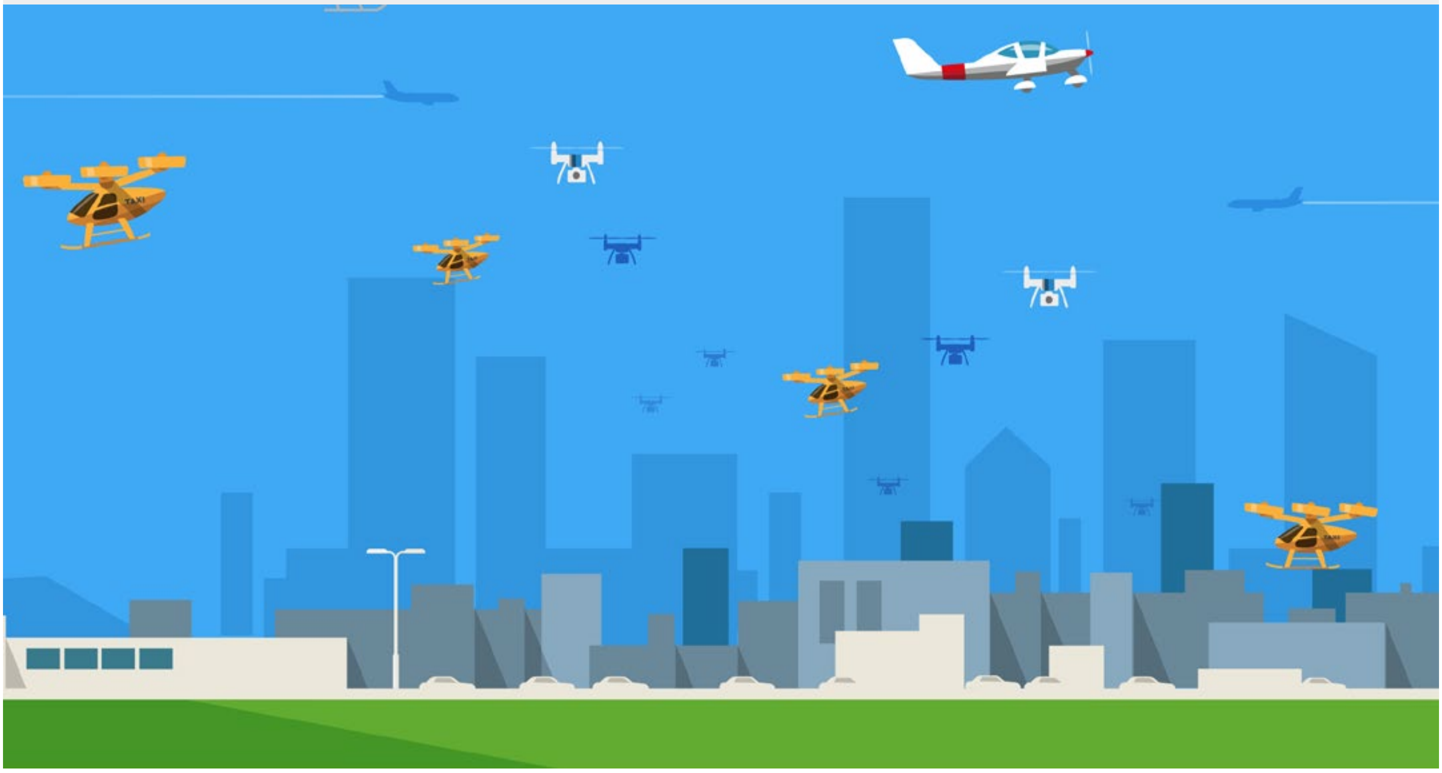
With a technology agnostic approach, we see such a solution being made up from a combination of several components that are interoperable. In most cases we would expect to see a collaborative surveillance environment with at least: some form of aircraft identification or Electronic Conspicuity (EC), an assured Remote Pilot Station (RPS), a robust Command and Control Link (C2 Link), Detect And Avoid (DAA) capabilities, and an Air Traffic Management (ATM) system in low level airspace including specific services for UAS as well as other value added services for existing airspace users and other new vehicles such as electric vertical take-off and landing (eVTOL) aircraft.

Another key challenge is managing the technical capability of the aircraft to ensure it is robust to operate in urban environments where ground risk must be recognised and mitigated, therefore minimising the risk of injury to those uninvolved persons and property on the ground. New Flightworthiness requirements including industry involvement in a Recognised Assessment Entities (RAE) style scheme is being explored. Ground risk is affected by population, density, type of operation and size of the aircraft. Other factors that also contribute to either air or ground risk are the competency of the remote pilots, the competency of operating organisation and the flightworthiness technical requirements for the aircraft operating environment.

The CAA is already working with operators, aerospace industry, training organisations and service providers to enable them to develop multiple ways of solving each one of these technical challenges, and we welcome their innovation. Our task is solely to assess the robustness and effectiveness of any proposed solution against a set of clear criteria to ensure its safety, reliability, and ability to integrate into any wider airspace management system. The CAA communicates recognised standards by our Guidance Material and Acceptable Means of Compliance. The suitability of existing standards and development of new ones by standards bodies is a fundamental part of this process to ensure interoperability and scalability.

The CAA welcomes input on the strategy laid out in this document. We expect to receive feedback via mechanisms that include existing stakeholder working groups, working with academic experts and local government, as well as regular dialogue with industry and central government stakeholders.

The CAA describes many of the terms that are used by the current regulatory framework, and in particular, the term 'Unmanned Aircraft System' or 'UAS', which is used in current legislation. We have chosen to use 'uncrewed' rather than 'unmanned' in this publication, on the basis that it is gender neutral. Where we use the term 'uncrewed aircraft' it means 'unmanned aircraft' in regulatory documentation.



2.

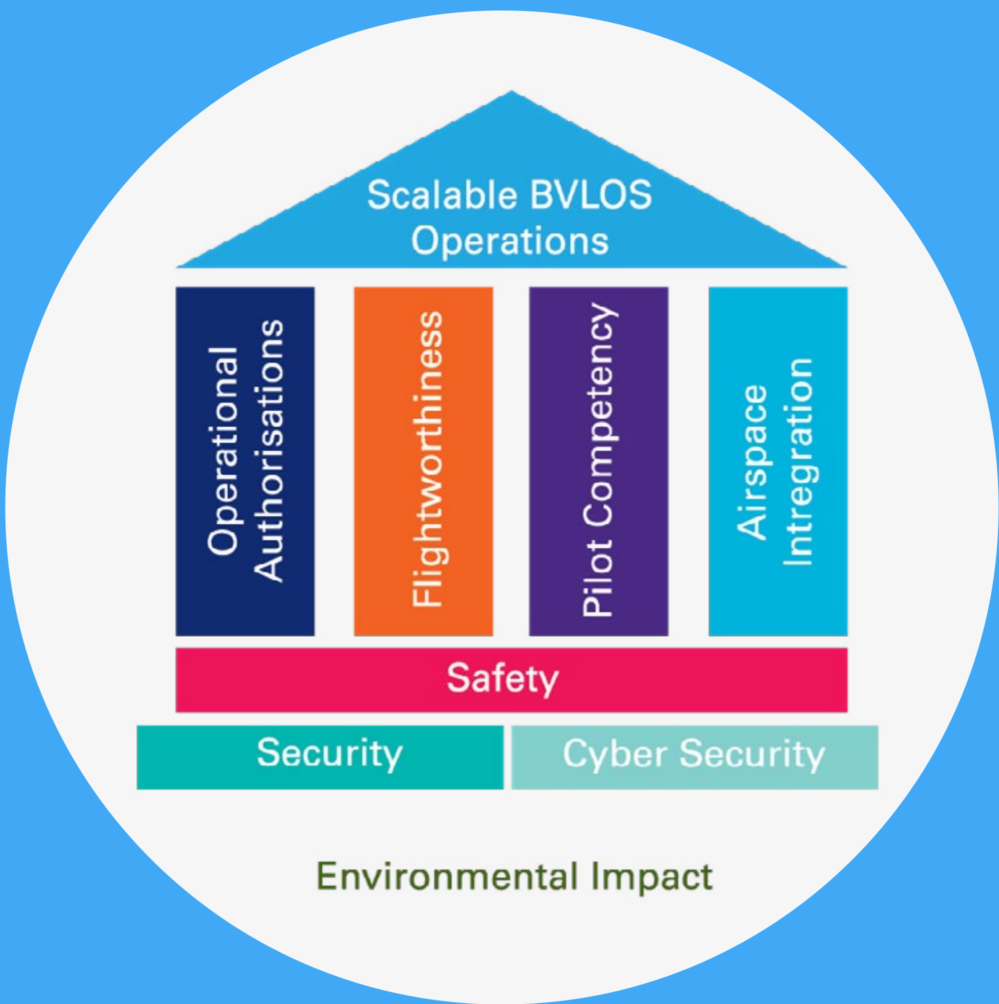
CAA Technical Strategy Delivery Model

This section lays out the CAA's Technical Strategy Delivery Model for scalable UAS BVLOS in the Specific category, introducing the structural approach that our organisation is implementing to build and develop the capabilities and safety oversight needed.

Integration of diverse users is one of the strategic objectives of the AMS and how we safely integrate BVLOS operations into the UK's compact, complex airspace is one of the key challenges. One of the first mitigations to sufficiently address the mid-air-collision risk when operating in non-segregated airspace, will be explored with the use of an Atypical Air Environment (AAE); UAS will be operating in an environment where we can reasonably anticipate there to be almost no conventionally piloted aircraft, for example due to proximity of ground infrastructure.

Our focus is on developing a regulatory landscape which encompasses the adoption of new technologies which include, DAA, EC and new air traffic management services in low level airspace. We are using regulatory sandboxes (e.g. TRA Sandbox) and other focussed test & evaluation activities to inform regulatory policy-making as well as learning from international best practice. This regulatory landscape also needs to identify and rectify any gaps in existing safety systems and processes such as safety reporting, infringements or managing breaches of legislation. We will continuously monitor this scope and assess our ongoing programmes for any gaps.

The four primary areas of work for BVLOS Operations in the Specific Category are: Operational Authorisations, Flightworthiness, Pilot Competency, and Airspace integration which are built on foundation elements of environmental impact, safety, physical security and cybersecurity. This work is not exclusively being carried out by the CAA, instead it relies on a consortia of industry, academia and government alike to inform the capabilities needed.



Safety

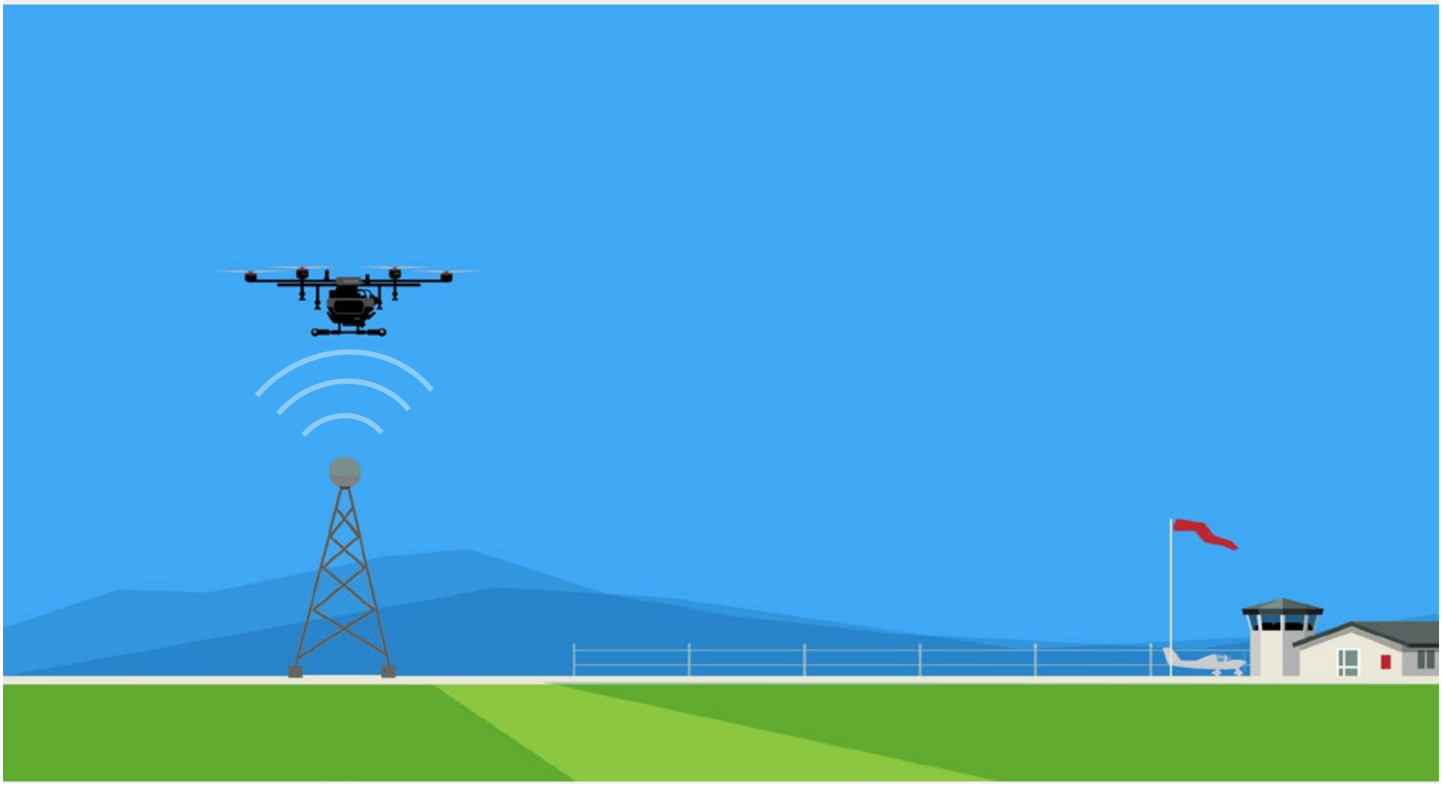
As the UK's aviation regulator, whilst we enable aviation and aerospace to innovate, we are responsible for ensuring the aviation industry maintains a high standard of safety with a common and proportionate approach across all users. The CAA has a duty to ensure safe, fair and equitable airspace access and we do this by constantly seeking proportionate and improved ways of achieving our safety objectives and regulatory aims.

We make safety decisions in accordance with our legal framework to consider certain factors which include the needs of users of airspace, and government policy. We have developed our processes to ensure that they meet best practices for regulatory decision-making and are fair, transparent, consistent, and proportionate. We must be impartial and evidence-based and must take account of the needs and interests of all affected stakeholders.

The CAA has an understanding of the risk picture that exists with the current aviation system and is able to demonstrate that it is taking effective and proportionate action to treat the identified risks. It is important that the CAA has a fully formed and consistent understanding of the emerging risks associated with the integration of new users, technologies and platforms and how they may impact the existing risk picture. Safety systems, processes and procedures drive the treatment of these risks and ensure we have relevant and up-to-date data on existing and emerging risks.

In the context of integrating new users, technologies and platforms, the CAA will be required to demonstrate that it is meeting its statutory obligations inmaintaining high levels of safety. In order to do this and adequately assess the safety impacts associated with the delivery of a programme of change, we will be adapting existing safety assurance processes to improve how the CAA assesses the impact of new users, technologies and platforms on the existing aviation system and considers them against existing risks that the CAA has identified. By conducting this safety assurance work, the CAA will be able to improve how safety arguments are made and presented to demonstrate that the regulatory changes it is introducing meet an acceptable or targeted level of safety.

More broadly, through the Safety at Scale project, the CAA will review its existing safety systems, processes, and procedures to ensure they are fit for purpose in the context of enabling new entrants and drive improvements where required. These improvements will be designed to scale to accommodate for the increase in demand from new entrants and the methods by which they can be incorporated into the wider CAA Safety Risk Management (SRM) process.



Security (Physical and Cyber)

The scaling of UAS and new technologies to support integration have a strong tendency to bring with them new technical challenges and security risks. As the number of UAS operating in UK skies increase, the physical security of the operating environment such as remote pilot stations and operation control centres becomes an important consideration as well as the security of aircraft whilst on the ground at remote locations.

The CAA views cyber security as three key properties; confidentiality, integrity and availability. Any breach of these properties in relation to digital systems is a breach of cyber security. There are 2 categories of breach, business implications and safety implications. Safety implications are caused by breaches that impact safety critical systems and that could result in harm to the general public, these are the implications or cyber risks that the CAA care most about.

Cyber risk can be determined by the vulnerability of a system multiplied by the threat to the system. The threat will inherently come from a source which would be defined as a threat actor. These will come with their own capabilities and motivations to attack your technology. Threats against safety critical systems are considered the biggest cyber risk in aviation.

In the short to medium term, we expect cyber risk in the innovation space categorised into three key areas covered by regulation and published guidance:

- Aerodrome, Air operator or Air Navigation Service Provider
- Artificial Intelligence and Machine Learning
- Electric Chargers

However, this not an exhaustive list and does not cover all our areas of concern. We address this subject in further detail in recently published CAP2973 – A guide to cyber security for innovators.

Environmental Impact

The environmental benefits provided by UAS include many positive use cases which minimalise energy use and emissions in comparison to conventional vehicles. Examples include using UAS powered by renewable energy sources for surveying, or the reduction of emissions when used for last mile delivery.

The Department for Transport (DfT) provides noise and environmental guidance to the CAA in its 2017 Air Navigation Guidance. This paper provides the basis of the CAA's environmental duties in respect of carrying out its air navigation functions, including approving changes to the UK's airspace design and the guidance provides the CAA with key objectives.

The CAA recognises that the new types of aviation and airspace change has the potential to introduce new noise sources and other environmental concerns. These are being addressed in the following ways:

- While generally being cleaner and more environmentally friendly than other services they seek to replace, adding new business models and aircraft types introduces new noise sources and other environmental concerns
- Within the AMS – environmental sustainability is one of its four strategic objectives and examines CO_2, non CO_2, noise, air quality and adaptation/resilience
- Through participation with the Future Flight Community Integration Group with central government, local government and industry to recognise, assess and mitigate any impact from new types of aviation
- Consultation and engagement with other suitable forums
- CAA ongoing internal workstreams in this area.

Operational Authorisations

To deliver an improved customer experience for UAS Operators, the CAA is digitalising the application process for UAS Operational Authorisations. This will allow applicants to manage their application themselves and will guide them through the process to submit it. It will also provide a live view of the progress of the application and updates to the applicant, and deliver an improved back-end for the RPAS Sector team, to assist in the assessment of the application.

Operational Authorisations will be based on JARUS Specific Operations Risk Assessment (SORA), adapted to meet the needs of UK airspace users. The new digital application service went live in early April 2024 to support PDRA based applications. Current Pre Defined Risk Assessment (PDRA) is not based on SORA, however PDRA's will be updated to support the SORA methodology. This will not affect the way operators apply for the PDRA as the risk assessment process is pre-defined.

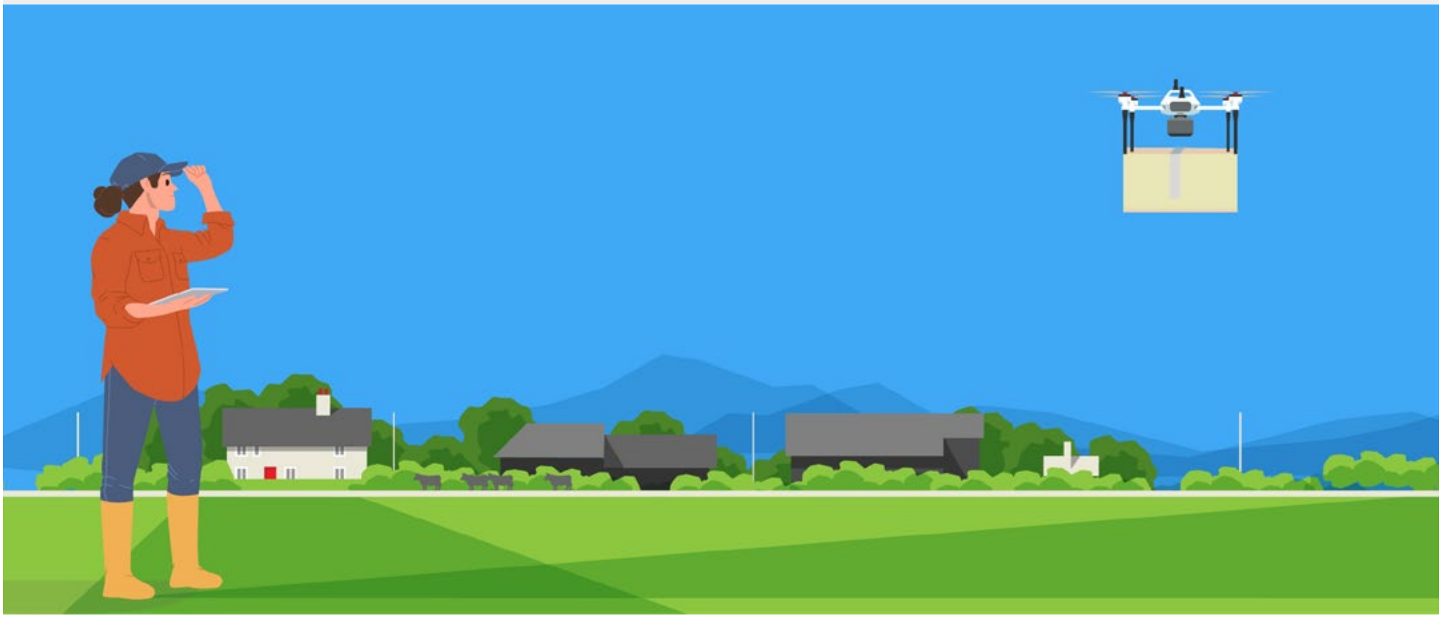
Digitalisation of Specific Category Operations (DiSCO) is scheduled to be updated in 2025 Q2 to support UK SORA based Operational Authorisations, supporting operators applying for increasingly complex operations. This programme of work is managed by the DiSCO project along with developing appropriate policies and guidance to support UK SORA implementation.

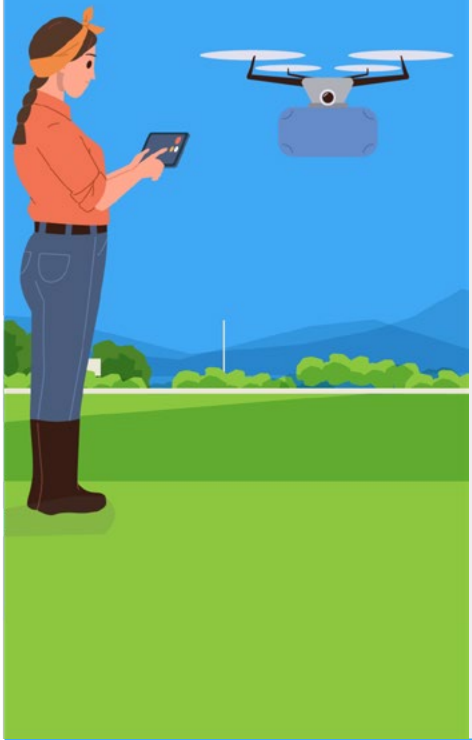
To support a sustainable industry the CAA will continue to explore more flexible ways of authorising UAS operations by developing CAP722G processes such as the technical change definition and associated processes that has been published in June 2024 and considering development of the Light UAS Operator Certificate (LUC).

Flightworthiness

The ground risk assessment within the new SORA approach is integral to informing overall risk assessment of any operation. The flightworthiness of the UAS needs to be assessed and validated to form a part of the mitigation for ground risk. This assessment will review evidence relating to the design, build and testing of the UAS, helping to ensure that it is safe to fly the proposed operation. The flightworthiness component of the UK SORA process contains a number of technical requirements that must be met, including some that could affect the design of the UAS, such as the aircraft avionics equipment, aircraft platform and RPS.

Whilst the UK SORA will set out what these technical requirements are, the CAA would like to replicate the RAE for pilot competency model, but for flightworthiness, delegating authority to assess and assure the UAS against these requirements. The most appropriate option requires engagement with industry to determine possible solutions and the role of the CAA in the short-term.





Remote Pilot Competency

Ensuring remote pilots have the appropriate level of competence is essential for the safety of UAS operations. In non-segregated airspace the competency, capability and airmanship of the remote pilot is expected to be as important to that of an onboard pilot. Competency schemes will also take into account people with disabilities, providing them greater access to the UAS sector.

A new competence scheme will expand on our existing scheme to support a wider range of complex operational scenarios through the introduction of new certification levels

There are currently two defined levels of competence for remote pilots, A2 Certificate of Competency (A2 CofC) and General VLOS Certificate (GVC). The CAA approves RAEs to assess the competence of remote pilots against a specific set of requeirements and to issue the appropriate certificates on the CAA's behalf.

To support a wider range of future operational scenarios, two additional levels of competency have been proposed in addition to the present A2 CofC and GVC certificates. We have engaged with industry on this subject as part of our consultation on remote pilot competencies.

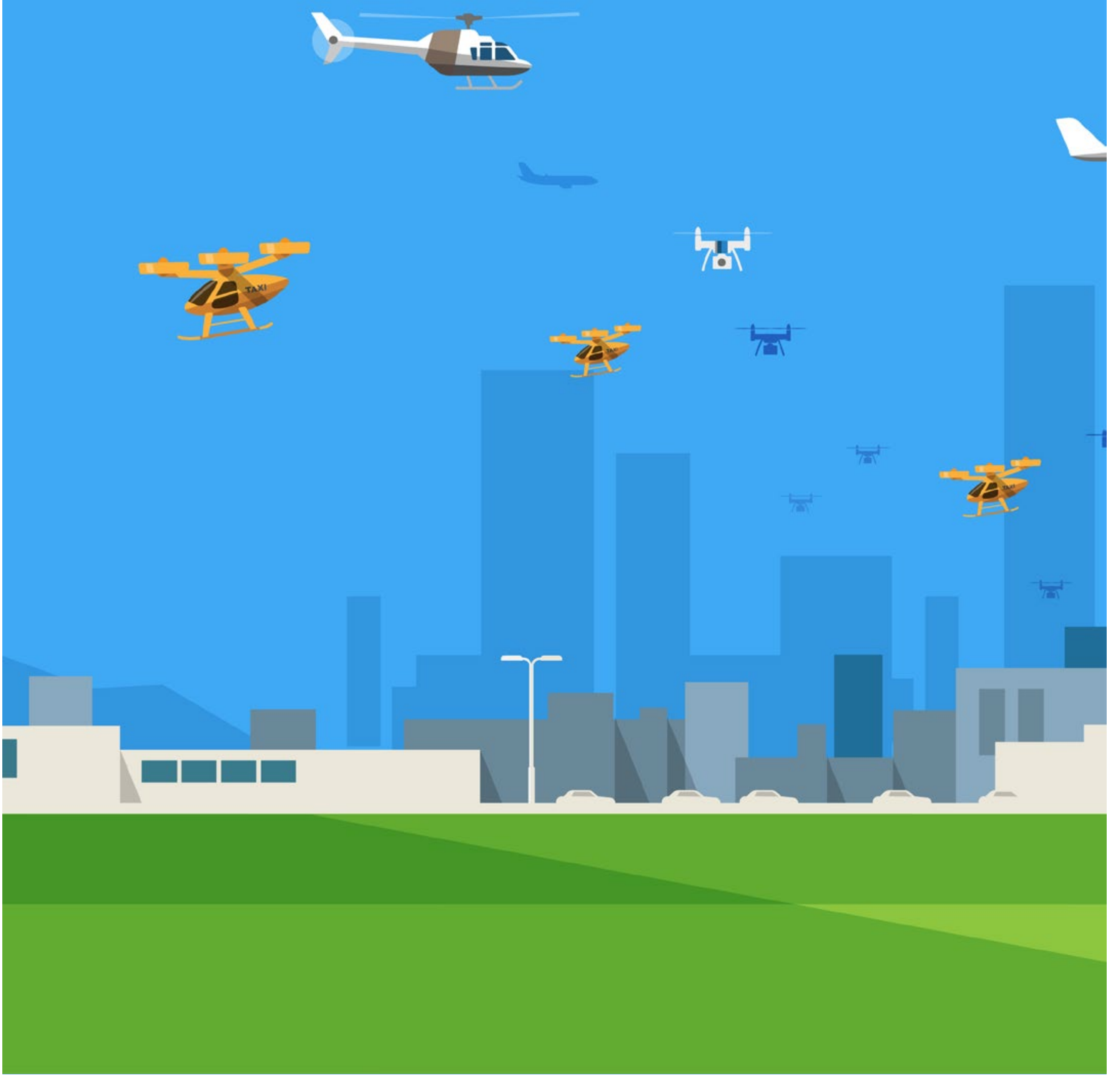
Airspace Integration

There is an expectation that the demand for routine UAS operations will increase rapidly in the coming years, providing cost effective use cases for existing and new types of operation. To do this successfully, there is a need for such aircraft to be able to integrate safely and routinely with the airspace system, without need for 'special provisions' or 'segregated airspace'.

All CAA BVLOS activities are intrinsically interconnected with and dependent on the Airspace Modernisation Strategy (AMS). The CAA's AMS Part 3 Deployment Plan presents the roadmap for the development and modernisation of UK airspace up to 2040. Considered within that strategy is the way that UAS operating BVLOS will be integrated within the UK airspace system. Where appropriate, the CAA will continue to review the activities to meet the needs of industry and government, and develop the evolving scope of the AMS.

3.

Delivery Roadmap for Specific Category BVLOS



Demonstrate (Demonstrable)

- Enabling – Facilitates demonstrations of use cases in support of research & development and small commercial applications
- Regulators – Policy strategy sets direction on key domain areas with specific requirements for industry to explore as part of operational trials
- Industry – Operators and service providers to build business case with consumers for target operations and develop operating procedures and technology to support the corresponding safety case.

Scale (Scalable)

- Enabling – Facilitates significant scaling of use cases in support of commercial applications
- Regulators – 2nd iteration of policy is published within the Rulemaking Framework. Underpinning capability (new processes, technology and skills) to support new capabilities. Tailored oversight to monitor industry progress in place
- Industry- Operators and service providers begin early initial operations to build an initial customer base, based on operating procedures and safety case developed in the Demonstrate stream.

Sustain (Sustainable)

- Enabling – Facilitates sustainable development of use cases led primarily by industry
- Regulators – 3rd iteration of policy in place and all stakeholders are managed as 'business as usual'. A sustainable, robust funding model is in place for the regulator
- Industry – Operators and service providers continuing operations/ developing further operations as business as usual.

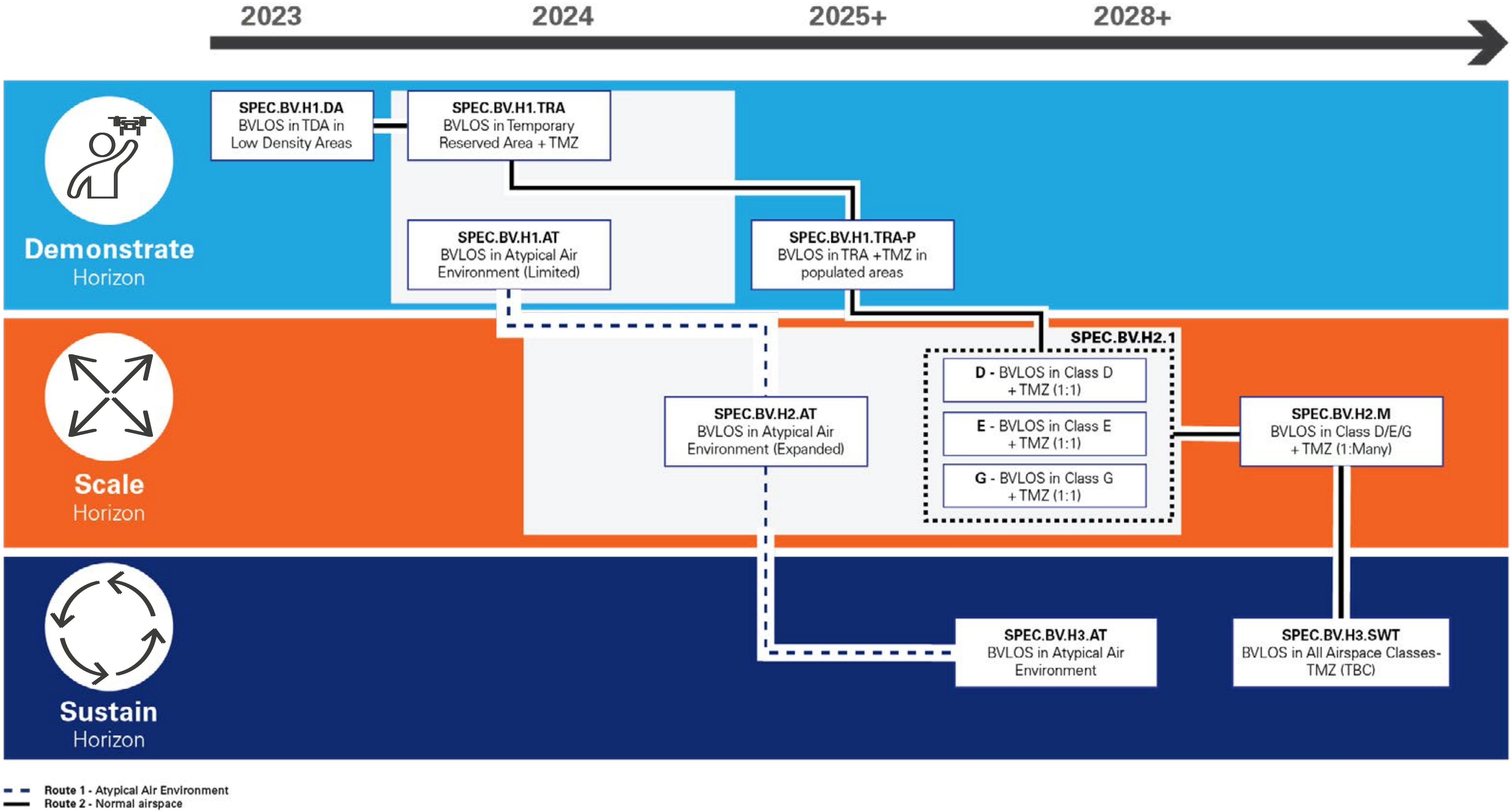
To facilitate the delivery of a hugely complex combination of new infrastructure and regulatory frameworks, the CAA has implemented a programmatic approach to delivering the on the ambition. The programmatic approach is established based on three delivery horizons; Demonstrate, Scale, Sustain. This is explained below. This provides structure for the definition of the Specific Category BVLOS roadmap (Operational Capability Roadmap – p16). The roadmap enables the CAA to work with government, industry and academia to ensure the capabilities exist for industry to develop, test and evaluate innovative aviation technologies in a safe, supported environment, clearly identifying and addressing any challenges to the programme, whilst providing a clear pathway to future commercial operations.

The roadmap was developed between CAA SMEs, DfT and the UKRI Future Flight Challenge with industry engagement. This document considers discrete groups of the agreed roadmap steps, intersecting as technology capabilities and regulatory capacity come online to support the wider objectives of the roadmap.

There are two pathways that form the basis of the roadmap. The first path is BVLOS operations in controlled and uncontrolled airspace. The second and enabling path is operations in Atypical Air Environments. Both pathways form part of the CAA delivery strategy for demonstrable and scalable activity.

Operational Capability Roadmap

Key Implementation Steps for Specific Category BVLOS based on current levels of funding



A key enabler for BVLOS operations is the introduction of UK SORA and the digital technical platform that enables SORA based operational authorisations. This is explicitly noted on the roadmap. The delivery timeline for this is Q2 2025. This will unlock demonstration activities for operations over populated areas and scaling of Atypical Air Environment operations.

Demonstrate

Demonstrated BVLOS UAS operations in non-segregated airspace

Target Date: 2024.

Scope: This covers initial demonstration of BVLOS operations in Atypical Air Environments as well as the first steps to operations within a collaborative surveillance environment (Transponder Mandatory Zone) where the position of all aircraft is known and shared. The specific operating procedures of the ANSP and the chosen air and ground technology deployed within the TRA shall provide the Mid-Air Collision (MAC) mitigation. Access to operations within this step are controlled by CAA to a limited number of operators.

Success Criteria: BVLOS operations in TRA airspace in 2024 with plans agreed by end of 2024 for further demonstrations in 2025. Multiple operations of Atypical Air Environment operations in 2024

Scale

Routine scaled BVLOS UAS operations in integrated airspace

Target Date: 2027

Scope: This covers "phase 1" of routine BVLOS operations. The first step is the formal introduction of Atypical Air Environment policy into the UK SORA Digital Platform. In the second step covering controlled and uncontrolled airspace, 'routine' is considered to be operating in a series of regions i.e., there is no statewide accessibility for BVLOS.

Success Criteria: Long range BVLOS operations in Atypical Air Environments by end of 2025. Multiple BVLOS operators conducting scalable operations in one or more airspace segments by 2027.
The operational environment is to be further considered in updates to this document. Multiple operations in uncontrolled airspace by 2027.

The Operational Capability Steps covering 1 remote pilot to 1 UAS operation within scalable Delivery Horizon are included within the scope of this technical strategy. The steps associated with 1 remote pilot to many UAS operations will be managed in a future update to this document or a separate document.

The delivery strategy for 'scale' is based on enabling routine BVLOS operations in suitable airspace at small scale i.e., enabling operations using a solution that would be scalable by all operators. We would expect elements of this solution to include the SORA Air Risk model and DAA capability within a collaborative surveillance environment. We see the pathway towards routine BVLOS operations as an evolving one: from the use of a TMZ alongside a TRA initially, towards only requiring a TMZ once safety has been demonstrated.

The ambition is for the setup of any airspace (including any change activity) to be independent from the operations being performed. The operating requirements will be clearly and concisely defined, and operators will need to demonstrate through their operational applications that they meet a minimum set of requirements before operating in that airspace. Additional approvals may be required from Local Authorities and Community groups to ensure operations can be performed and this is outside scope of CAA responsibility, however, CAA will contribute to any wider stakeholder engagement.

The outcome is that BVLOS operators have an agreed pathway to large scale routine operations within the UK.

This is a key enabler to sustainable BVLOS operations. This final step of the Specific Category BVLOS Roadmap relies on appropriate solutions to setup of appropriate airspace regions or alternative air risk mitigation solutions. The delivery of this step will be managed separately.

4.

Outline Delivery Plan for Specific Category BVLOS Operations

The following section provides further details on the individual deliverables for each capability step in the roadmap, where appropriate we will include relevant consultation or consideration of all airspace users. Each capability step has an outline plan, together with the key actions required for successful completion. The key actions are further expanded in subsequent sections of this publication. Readers can view the capability steps for AAE and then those for TRA/TMZ as it aids understanding of what they are about to see, however, it should not be assumed that they are mutually exclusive or developed in the chronological order listed. Any further capability steps are not detailed due to the time horizons of this document.

Operations in Atypical Air Environments (AAE)

SPEC.BV.H1.AT- BVLOS in AAE (Limited)Target Delivery
Timeline: Q3 2024
Demonstrate

In the Demonstrate horizon; the first step on the path towards sustainable BVLOS operations are AAE. AAE is a key mitigation for airspace risk. This step will allow the exemption from the rules of the air that AAE provides to be trialled and tested.

Outline Plan

An initial AAE policy has been published to aviation stakeholders for consultation. Consultation responses will be implemented where appropriate and a policy published for use by industry in test and evaluation activities. Applications will be sought to perform operations across the UK over land and sea. The initial operations will be used to explore and define the criteria of operations e.g. distance aircraft can fly from obstacles. The guidance on criteria of operations is based on an operational review of airspace within the UK.

Other AAE operations performed under current UAS policy will also be reviewed as part of our constant learning and evaluation process.

The CAA will publish test and evaluation guidelines for the industry to consider as part of operations. The lessons from these guidelines will be used in the on-going development of CAA policy.

Key Action Summary

1. Publishing the AAE Policy for initial operations
2. Development of tailored safety reporting and learning & evaluation data collection processes to support trials.
3. Delivery of industry led operational trials in AAE
4. Repeatable Operational Authorisation process defined for Atypical early ops (trial) applications including continuous monitoring
5. Review AAE Policy from initial operations, consult and update policy as required

SPEC.BV.H2.AT -

SPEC.BV.H2.AT - BVLOS in AAE (Expanded)

Target Delivery Timeline: Q2 2025

Scale

In the Scale horizon; this is the second step on the path towards sustainable operations in AAE with an broader set of operating criteria. The delivery of this step aligns with the go-live of the UK SORA Digital Platform which will include applicable updates to the AAE Policy.

Outline Plan

A second iteration AAE Policy would be published based on lessons learnt from SPEC.BV.H1.AT. This is intended to be adopted within the UK SORA Digital Platform to support oversight processes and assessment processes when using AAE as an air-risk mitigation.

Note: The policy and related technical and operational elements that support this step will be based on the outcomes from the roadmap steps in the Demonstrate horizon.

Key Action Summary

1. Publish Atypical Air Environment Policy within UAS Rulemaking i.e. SORA Acceptable Means of Compliance (AMC)/Guidance Material (GM) Mitigations
2. Consider systems and process for AAE airspace usage
3. Publish guidance on technical containment of UAS operations and flightworthiness
4. Review incorporation of the AAE Policy within the UK SORA Digital Platform
5. Implementation of the UK Operational Authorisation Application Platform
6. Implementation of the Remote Pilot Competence Scheme
7. Implementation of the Flightworthiness Scheme
8. Ongoing development of Policy Strategy for Command and Control (C2) System including C2 Link, Remote Pilot Station, Aircraft avionics (sensors and flight control system). Development of the appropriate C2 Communication Service Provider CSP oversight arrangements and commercial framework.
9. Implementation of updates to DMARES to enable UK SORA developments Drone and Model Aircraft Registration and Education Service (DMARES)
10. Introduction of new Safety Reporting and Investigation Systems
11. Development of tailored safety reporting and general lesson learning data collection process
12. Delivery of industry led large Scale AAE Operations
13. Review AAE Policy from scaled operations, consult and update policy as required
14. Development of new methods to assess impact of airspace activity on communities within AAE.

Integrated BVLOS operations within a collaborative surveillance environment (Transponder Mandatory Zone)

SPEC.BV.H1.TRA - BVLOS operations integrated with other airspace users within a Transponder Mandatory Zone (TMZ) and an associated Temporary Reserved Area (TRA)
Target Delivery Timeline: Q4 2024
Demonstrate

This is the first step on the path towards the integration of BVLOS operations with other aircraft, both inside and outside controlled airspace. A key requirement to enable integration is the establishment of a 'known traffic environment' within which an accurate position and intentions of all aircraft is established and shared by an ANSP to all integrated users. It is anticipated that this will be achieved by the establishment of a collaborative surveillance environment supporting the volume of integrated airspace and an associated equipage mandate in the form of a TMZ. Here we use TMZ to describe an environment that has a cooperative surveillance mandate and not necessarily a requirement for a transponder. The cooperative surveillance mandate is likely to be for Automatic Dependent Surveillance-Broadcast (ADS-B), however, the CAA would consider any other emerging technologies if they can demonstrate sufficient mitigations.

In order to manage the demand to integrate with other airspace users with BVLOS operations within the TMZ, and to trial a Concept of Operations, a TRA associated with the TMZ will be provided to allow a safe managed environment and stepped approach towards full integration.

Outline Plan

An Airspace Policy Concept – CAP 2533 detailing the airspace requirements for integration of BVLOS UAS been developed and published to the FOF community. However, we recognise that CAP 2533 is not a long-term solution for integration of BVLOS UAS. It is Special Use Airspace and is a short to medium-term enabler which provides for an airspace structure where accommodation of such operations can occur, and which facilitates development of technical and procedural solutions to the challenge of safe airspace integration.

Airspace Change Proposal (ACP)s will be submitted by industry to introduce TRA with a co-incident TMZ. This provides an environment with appropriate minimum level ATM/Communications, Navigation, Surveillance (CNS) services for all airspace users and that can be used by BVLOS operators to build specific safety arguments (e.g. for DAA) for management of air-risk.

The CAA will publish test and evaluation guidelines for the industry to consider as part of operations. The lessons from these guidelines will be used in the on-going development of CAA policy.

Key Action Summary

1. Publish CAP 2533- 'Airspace Policy Concept: Airspace Requirements for the Integration of BVLOS Unmanned Aircraft'-including reference to the existing guidance of use of TMZ

2. Publish CAP2555 Guidance on the Carriage of Dangerous Goods as Cargo for UAS Operators in the Specific Category – and update as per internal approval process for sling and parachute delivery

3. Publish 'Delivering Scalable UAS BVLOS in the Specific Category' (this document)

4. Identify all the learning points the CAA/Industry/Other are looking to resolve e.g. Tech capability of ADS-B at low level or use of ground-based detect and avoid capabilities supporting Flight Information Service (FIS).

5. Electronic Conspicuity critical learning examples defined and EC Study Commenced

6. Publish the Detect And Avoid Policy Concept

7. Development of tailored safety reporting and general lesson learning data collection process to support trials

8. Consider available flight data to understand UAS movement in space and time, to monitor, estimate and predict impact on communities

9. Consider new methods for the provision of FIS within integrated airspace as well as additional methods of promulgation of activity including Traffic Information Service Broadcast (TIS-B) and Flight Information Service Broadcast (FIS-B)

10. Assess the impact to other airspace users in an environment where multiple small UAS are operating that are difficult to visually acquire and consider further mitigations.

SPEC.BV.H1.TRA-P - BVLOS in TRA with TMZ in populated areas
Target Delivery Timeline: Q2 2025
Demonstrate

Outline Plan

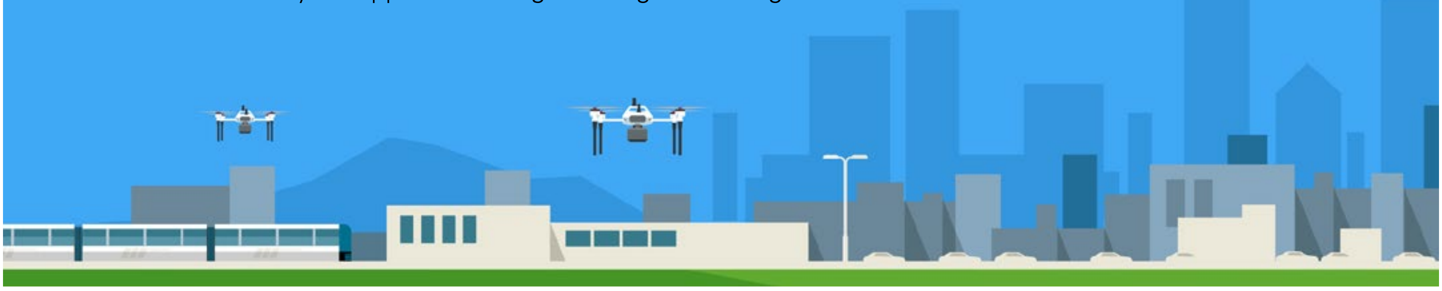
Based on the lessons learnt from ongoing TRA trials, guidance will be periodically updated as required and incorporated into the UK SORA and Operational Authorisation process within the Digital Platform. Ground-risk mitigations associated with flightworthiness of the aircraft platform are confirmed as part of UK SORA requirements in order to fly over populated areas.

An ACP application remains key to setting up TRA Airspace. This provides an environment with appropriate ATM/CNS services that can be used by Operators to build specific safety arguments for management of air-risk.

Implementation of UK SORA supports applications for SAIL scores that don't exclusively rely on implementation of safety mitigations such as DAA and ATM/ANS to enable safe integration to take place within airspace.

Key Action Summary

1. Publish the Airspace Policy: Airspace Requirements for the Integration of BVLOS UAS, and Policy within UAS Rulemaking i.e. SORA AMC/GM: Technical Mitigations
2. Development of the Air-Risk Policy
3. Implementation of the UK Operational Authorisation Application Platform
4. Implementation of the Remote Pilot Competence Scheme including setup of enabling training organisations and courses
5. Implementation of the Flightworthiness Scheme including industry setup of enabling RAE-F or alternative option.
6. Development of Strategy for update to Commercial Air Transport Policy and Dangerous Good Policy in support of carriage of Cargo and Dangerous Goods



SPEC.BV.H2.1 - BVLOS TMZ (1RP:1UAS)
Target Delivery Timeline: Q2 2027
Scale

In the Scale horizon this is the primary step of providing routine BVLOS operations in controlled and uncontrolled airspace with appropriate mitigations. This step is limited by 1 Remote Pilot to 1 UAS as the default means of operation.

Outline Plan

The general approach is to evolve from a requirement for a concurrent TRA and TMZ, to only requiring a TMZ to be set up with the supporting infrastructure and services to enable scalable BVLOS operations. The assumption is that these would be established in controlled airspace, however, there is nothing preventing them being established in other appropriate classes of uncontrolled airspace, providing the appropriate mitigations are in place. This follows the airspace integration principles within the UK AMS.

As part of SPEC.BV.H2.1 we will have tested and understood the minimum level of air traffic management service provision (including FIS and specific UAS traffic management services in low level airspace) to be able to support integrated operations. This level of integrated airspace could be established separately from a BVLOS operator being granted an operational authorisation to operate within such airspace allowing multiple BVLOS operators to take advantage of the integrated airspace. There will be a need for a UAS to have a minimum level of capability to operate in such airspace.

The strategic mitigations that are already available in controlled airspace allow for the first stage of scalable operations. Such operations are reliant on mitigations that could include the use of a TMZ. The specific actions for each Airspace Type will be reviewed and further detailed in subsequent updates to this delivery strategy. Operations are reliant on mitigations such as the use of a mandatory zone for surveillance or communications.

This approach requires government, regulator and industry to work in partnership to identify appropriate location(s), deployment activities and operational system requirements.

Note: The policy and related technical and operational elements that support this step will be based on the outcomes from the roadmap steps in the Demonstrate horizon.

Key Action Summary

1. Following results from TRA Trials input to all relevant policy updates – eg Acceptable Means of Compliance (AMC) to SERA, UAS (SORA) and ATM/ANS (for UAS and other airspace users)

2. Develop new Safety Policy for air traffic management services in low level airspace for the industry implementation of new ATM services. New ATM services include as examples, network flight information co-ordination, flight information services or specific services for UAS.

3. Develop a cost recovery model for an ANSP providing additional Air Traffic Services (ATS) to certain cadres of operations in support of integration and data sharing

4. Understand market conditions and develop the most appropriate Economic Policy

5. Introduction of new Airspace Air Risk Model related to use of TMZ included in UK SORA Digital Platform

6. Industry deployment of DAA solution based on electronic conspicuity requirements

7. Electronic Conspicuity Concept of Operations to enable the development of EC Standard for EC Transition and proposal for policy decision on use of 978MZ as part of Dual Frequency Strategy that resolves interoperability issues

8. Develop policy for certification and funding of new FIS infrastructure and the deployment of that FIS infrastructure to support FIS-B and TIS-B within TMZ

9. Implementation of Policy Strategy for Command and Control (C2) System including C2 Link, Remote Pilot Station, Aircraft avionics (sensors and flight control system). Oversight provided across Flight Operations, Flightworthiness, CNS, Physical Cyber Security, C2 Link and Spectrum Policy (Protected and Unprotected) and standards. Implementation of the appropriate C2CSP oversight arrangements and commercial framework.

10. Test & Evaluation Programme defined for all enabling technologies, procedures and mitigations to inform policy development considering all airspace users

11. Rules of the Air developments including review of existing derivations

12. Conduct ACP to create TMZ

13. Implementation of Strategy and Policy for Commercial Air Transport in support of carriage of Dangerous Goods with necessary rulemaking activity

14. Policy development/engagement on community integration and noise policy to protect overflown communities from the noise impact of operations at scale

15. Understand the development of legal and insurance frameworks to support routine BVLOS

16. Understand the implications of Geozones and Geofencing capabilities

17. Standards development e.g. DAA, SORA, Noise Certification, etc.

18. Guidance on the Noise Certification of platforms

19. Oversight in place for all the elements listed

The CAA expect there to be a series of actions that are specific to controlled airspace – assuming operations will occur in Class D and uncontrolled airspace. Operations could also be technically possible in Class E, however, this airspace is both rare and at an altitude not commonly used by UAS in the UK. At this stage the delivery strategy and this action summary is generic to both controlled and uncontrolled.

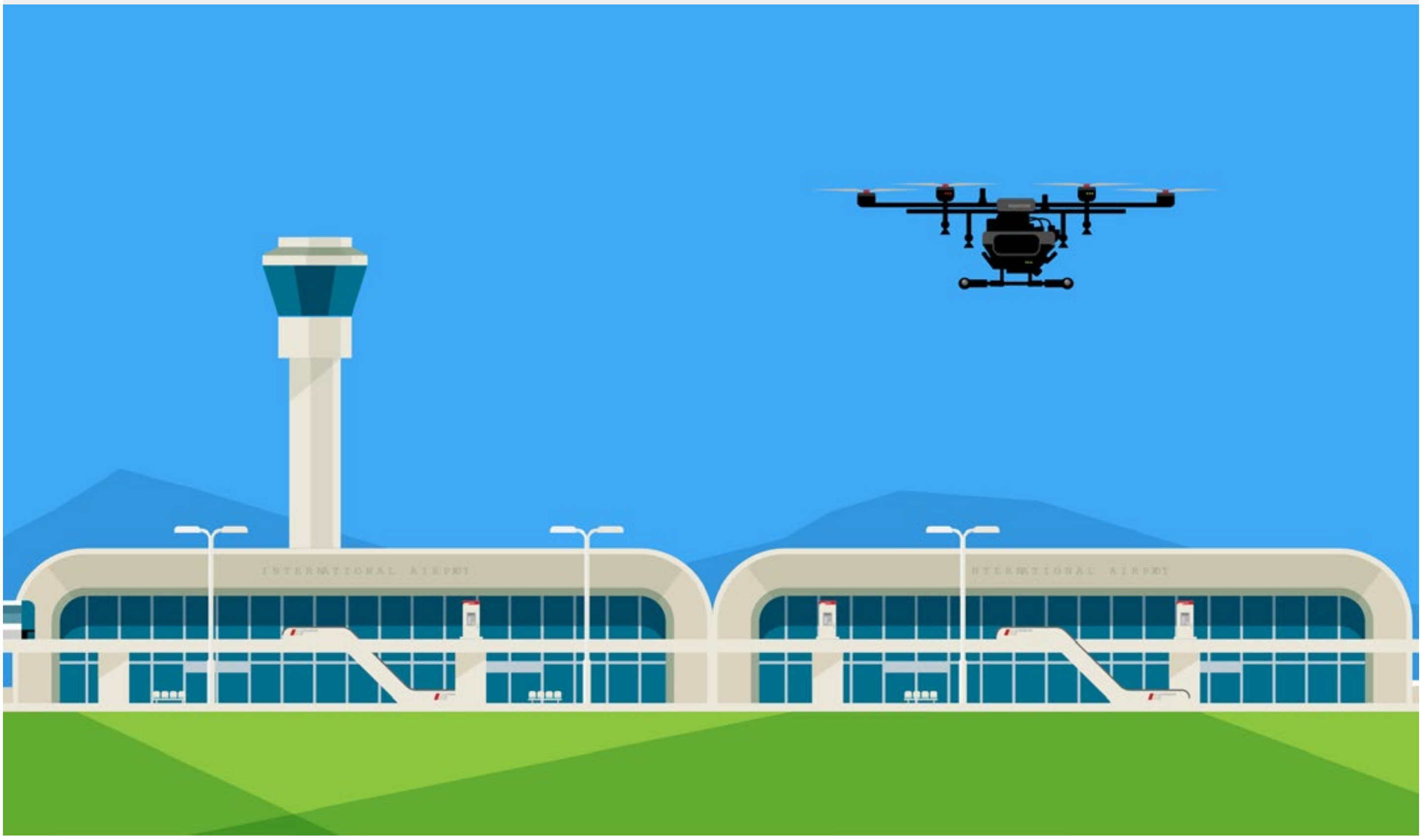
Controlled and uncontrolled airspace

In the UK there are currently five classes of airspace; A,C,D,E and G. The classification of the airspace determines whether an aircraft can operate under Instrument Flight Rules (IFR), Visual Flight Rules (VFR) or Special Visual Flight Rules (SVFR), and the minimum air traffic services which are to be provided. Classes A, C, D and E are areas of controlled airspace and G is uncontrolled airspace.

Controlled airspace is provided to protect its users. Aircraft which fly in controlled airspace must be equipped to a certain standard and the users must hold certain qualifications. Users must obtain clearance from Air Traffic Control (ATC) to enter controlled airspace and, except in an emergency situation, they must follow ATC instructions implicitly. In most scenarios ATC provide separation between aircraft inside controlled airspace, which aircraft this is applied between and against is dependent on the airspace classification, the operations being carried out and the flight rules that are being adhered to by a specific aircraft. It should be noted that some aircraft (UAS operations being conducted visual line of sight (VLOS)) do not need to obtain ATC clearance to enter controlled airspace when operating below 400 ft AGL outside a flight restriction zones as per AMC1 UAS.SPEC.040(1)(b).

Uncontrolled airspace allows airspace users to operate when and where they like, subject to the flight rules appropriate for the conditions. While airspace users are not required to obtain specific ATC services, they are responsible for the safe operation of their aircraft by observing all relevant regulations and being vigilant about the presence of other aircraft.

Notified airspace, such as TMZ, adopt the background classification and associated provisions of the airspace that it is contained within and therefore can exist in controlled and uncontrolled airspace. The following table describes the airspace classes in the UK, envisaged operations for Specific Category UAS and some of the associated challenges of integration in those airspace classes.



The operational requirements for UAS operations in different airspace classes will be determined by extant rules and the outputs of the Air Risk Model within UK SORA, however, there is an expectation that the minimum requirements will require some form of EC and/or cooperative surveillance. The utility of this model is underpinned by several policies which are currently in progress and outlined in Part 2, section A and B of this document. It is expected that these policies will be initially published as policy concepts which will allow test and evaluation of activities of formal adoption and wider roll out. As these supporting policies are published and subsequently updated this air risk model will be updated as required.

Class A

Context - IFR Flights Only. Compliance to ATC instructions mandatory.
Envisaged Operations - Certified Category UAS operations only. Not applicable to Specific Category UAS operations.
Challenges - Not applicable.

Class C

Context - IFR Flights and VFR flights allowed. Permission to access required and must comply with ATC instructions. Flight levels 195 and above(e.g. 19,500 feet).
Envisaged Operations - Certified Category UAS Operations. No Specific Category operations envisaged at scale due to vertical extent of airspace boundaries.
Challenges - Scaling of Certified or Specific Category UAS operations in this environment will require impact assessment on current ATM/ANS capabilities provided by ANSPs.

Class D

Context - IFR and VFR flights allowed. An ATC clearance is needed and compliance with ATC instructions is mandatory. Control areas around aerodromes are typically Class D.
Envisaged Operations - Specific Category UAS operations.
Challenges - Increased intensity of operations leading to new demands on ANSPs – new or enhancement of existing traffic management services required e.g. Ensuring FIS service including ADS-B. Integration with Commercial Air Transport and other General Aviation Users. ANSPs and Airports understanding of UAS operation and integration needs

Class E

Context - IFR and VFR Flights allowed. VFR do not require permission to access. Setup to support low intensity and complexity operations. Limited Class E airspace in the UK.
Envisaged Operations - Specific Category UAS operations.
Challenges - IFR flights require large volumes of airspace for manoeuvring. Any additional complexity or increase in traffic density could invalidate the classification of that airspace volume (requiring assessment on case by case basis).

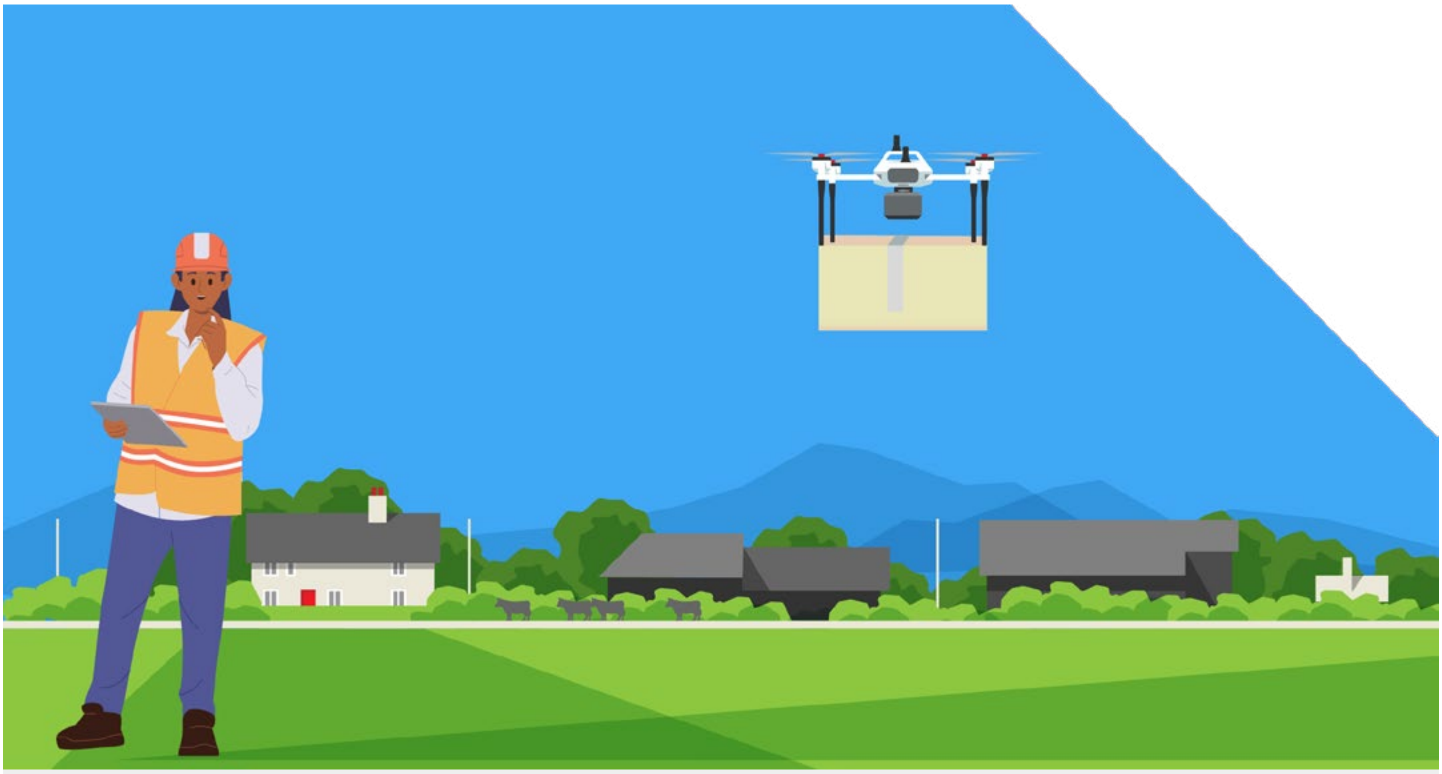
Class G

Context - Uncontrolled airspace. Any aircraft can fly in Class G subject to rule set. Notification to ATC is voluntary and basic Flight Information services are available.
Envisaged Operations - Specific Category UAS operations.
Challenges - Integration of all airspace users will require a coordinated surveillance environment. ANSPs required to provide additional / enhanced air traffic management services e.g. FIS with specific traffic information services. New ground based infrastructure technology required to support service provision and / or detect and avoid capability. Cost recovery model required for new traffic management services.

5.

Delivery Functions

The complexity of the challenge as described in the previous section requires a programmatic workstream with managed interdependencies and clear functions. A significant part of delivery involves programme management, technical strategy, regulatory policy development and stakeholder engagement.



CAA FOF Programme

The CAA FOF Programme takes the enabling structure and milestones from government and industry and sets them down in a programmatic workstream with managed interdependencies. A part of the programme involves identifying the individual capabilities and workstreams (both technical and regulatory) that need to be developed and delivered to enable the next technology revolution in aviation. The scope of the CAA FOF programme also extends to cover all BVLOS operations in the open and certified categories, including for example certified fixed-wing BVLOS UAS.

Based on operational capability roadmaps endorsed by industry, the CAA programme continually evolves by identifying and understanding essential delivery activities to align with government and industry, resulting in detailed planning for each roadmap step. In turn, this planning informs the level of resource investment needed for on-time delivery.

The CAA FOF Programme Control Board (CAA FOF PCB) is constructed of cross-departmental CAA leaders and provides direction and oversight to the CAA FOF Delivery Programme, reviewing overall programme progress and supporting or escalating the resolution of risks and issues. It is sponsored by the Director of Future, Safety & Innovation who provides leadership and Direction the overall programme, with accountability for the delivery of all programme objectives, outputs and expected benefits. For most effective alignment with the CAA's Executive Committee, this board is held nine times per year.

Technical Strategy

The CAA FOF Programme is being delivered alongside the FOF-enabling Airspace Modernisation Programme, a mandated requirement for the UK and itself a complex workstream, with multiple areas being worked on and delivered over a far longer timeframe. Ensuring that individual delivery modules are aligned across both these programmes is a complex task. For successful delivery, the CAA FOF Programme is entirely reliant on many co-dependencies and capability steps which will be delivered by the AMS Programme.

1. **Technical projects.** We work with colleagues from across the CAA and industry to complete specific projects that develop the CAA's understanding and knowledge and improve regulation. These projects typically come before policy writing in the lifecycle and include research, for example, work investigating the safety risks and regulatory options for C2 links and Remote Pilot Stations.

2. **Test and Evaluation.** To support the delivery of the AMS, UKRI Future Flight Challenge, the DfT's and Future Flight Industry- there is a requirement for the CAA to facilitate test and evaluation activity that will enable innovators to safely conduct test flights in integrated airspace. The ambition of the Test & Evaluation Function is to support the CAA's Innovation Advisory Service (IAS) in their work to enable innovators to safely conduct test and evaluation activities in a manner that satisfies the safety of all other airspace users, industry needs, acquires valuable information to inform policy and regulation, and improves internal efficiencies.

    The Test & Evaluation team will focus on three priority areas:

    a. **CAA driven data and intelligence gathering:** The CAA needs to test new policy concepts such as the DAA policy and Atypical Air Environment policy. The team will undertake test and evaluation activity to acquire data and information from operator's flights and use these insights to test CAA hypotheses and policy concepts.

    b. **Facilitation and support of T&E operations:** To undertake T&E activity such as Regulatory Sandboxes, operators require authorisations and in some instances an ACP. As the data that will be gathered within these operations benefits the CAA, it is valuable to support this process, so that the CAA objectives can be met.

    c. **Enabling industry testing:** Beyond trials that are directly valuable to the CAA, industry need to safely and effectively conduct trials of new technology, without taking up disproportionate CAA resource. The Test & Evaluation team is putting in place best practices to enable operators to conduct this testing activity without direct CAA supervision, in an efficient and safe manner. This could include alternative means of compliance in policy areas such as EC and DAA.

3. **Technical roadmap:** We work with industry to understand the likely development path of new industries and applications and then put in place a roadmap to ensure the CAA is prepared to safely regulate the industry and support its growth.

4. **Future safety:** By considering, determining and managing risks as part of our test & evaluation work, we are able to conduct further research and testing to understand future risk in detail, hence, put in place regulation, policies and guidance so that operational risks are better understood before operations begin with appropriate mitigations in place from the start

Regulatory Policy Development

The purpose of the Future Safety & Innovation (FS&I) Policy function is to provide the regulatory link between future of flight activity, and collaborating with wider CAA policy areas. As the Technical Strategy identifies the longer term roadmap required for industry, the FS&I Policy function will deliver alongside existing policy areas what is required from a legislative, safety and policy perspective to enable it.

The policy and regulatory function will work as described below, with a number of touch points with forward looking teams, and business as usual capability areas, and will operate the rulemaking process on behalf of FS&I in co-ordination with the established rule-making process in concert with colleagues across the business. The purpose of this is to ensure effective, efficient policy making, which can be iterated in real-time with industry, through close liaison with industry partners, as part of the development process.

The policy function will assess the safety impact of any policy/regulatory change as part of the overall assurance, throughout its development, constantly learning from the future safety function and implementing policy changes as a result.

A key aspect of the policy function's role is to ensure that, where possible, our policies are compatible and aligned with international organisations such as JARUS and International Civil Aviation Organisation (ICAO). We also work closely with other NAA's to ensure that aircraft developed and initially operated in the UK will be able to operate across borders and internationally. This ensures that developing an aircraft in the UK remains an attractive proposition and beneficial to the UK aerospace industry. This will include working closely with the DfT and its international counterparts in understanding and developing market access requirements and air service agreements.

The policy function is a wider component of the legislative mechanism within the CAA and DfT that reviews the need for legislation, then follows that task through to laying a Statutory Instrument (SI) before Parliament. Rulemaking is a complex task, typically taking 18-20 months from the first draft of an initial policy to an SI being laid. The CAA works collaboratively with the policy and legal teams at the DfT to ensure efficient and effective rulemaking, however, the legislative timetable is subject to the Government and Parliamentary process.

To ensure that legislation and the regulatory framework are fit for the future we are conducting a legislative review together with the Law Commission on autonomy in aviation. It will examine the existing legal framework to identify the challenges and opportunities linked to the introduction of highly automated systems into the aviation sector.

The project will review existing legislation to identify any legislative blocks, gaps or uncertainties. The Commission will consult with key stakeholders in the aviation and innovation sectors, before proposing a series of law reforms that will ensure the UK is ready to take advantage of oncoming advances in autonomy.

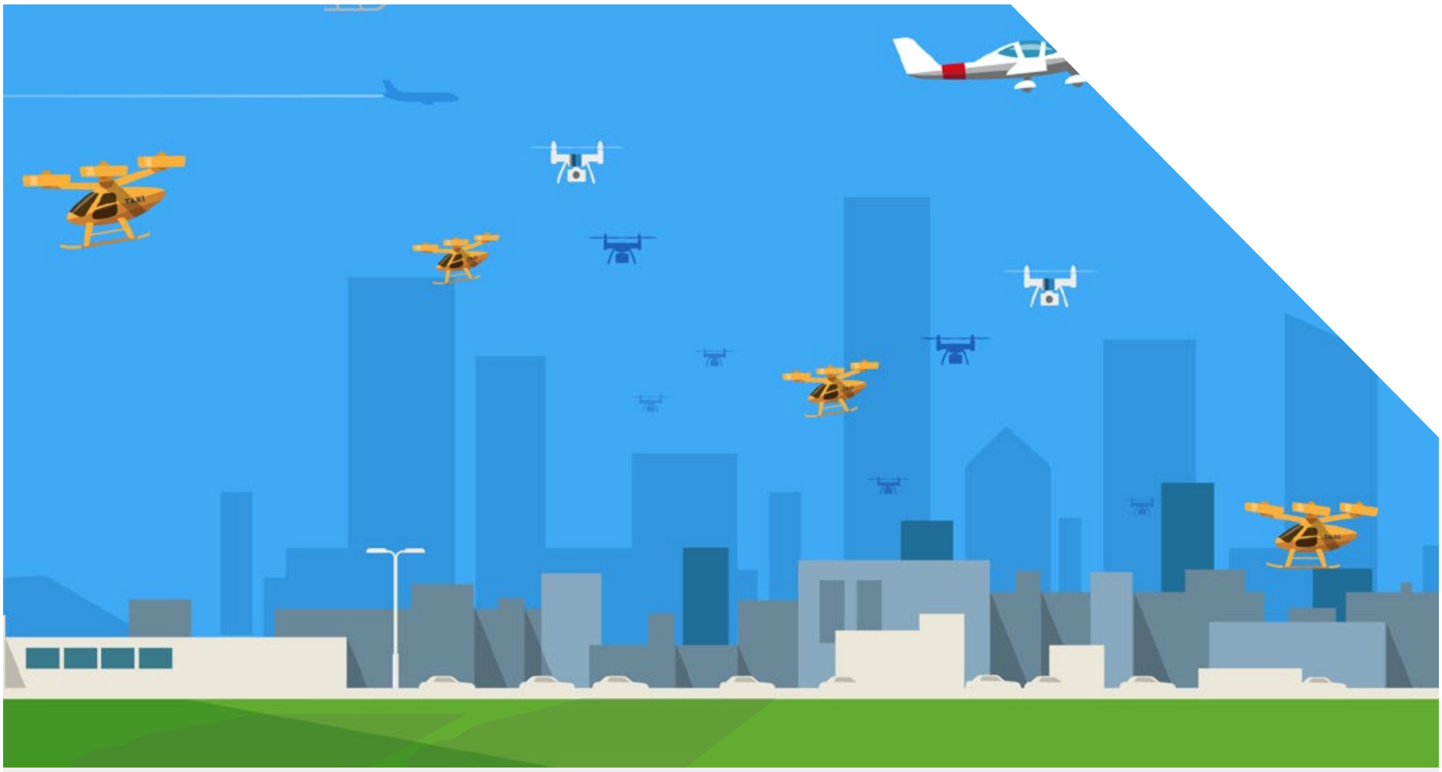
Stakeholder Engagement

A key component in the delivery of Specific Category BVLOS operations at scale in the UK relies on the regulator, government and industry having a high degree of awareness, respect and trust of combined progress in regulatory and technology capabilities. The fast-moving nature of this sector brings a greater challenge to test, evaluate and approve the use of technologies at pace, many of which have seen little or no use in an aviation context. Doing this in a traditional way can only create delays for the development of this sector, hence, the need for regulator and stakeholders to work together in a more dynamic, data-sharing and collaborative way, ensuring that regulatory oversight can keep pace with technology development, without compromising the CAA's standards of safety to both air users and those on the ground.

Some of the different ways that the CAA is working with external stakeholders include:

- more transparent stakeholder working groups
- test & evaluation activities
- earlier engagement through the development and use of Aviation Review Committees
- working with academic experts and local government through Community Engagement Groups to better understand societal and environmental impacts
- improved dialogue and communications with industry and government stakeholders.
- engaging with innovators at the appropriate stage via our IAS team's gateway
- supporting innovators find the most appropriate regulatory pathway via our IAS team

We are constantly evaluating these new methods of working, adapting them as necessary to continuously improve how the CAA is engaging with external stakeholders.



Innovation Advisory Services

The Innovation Advisory Services (IAS) team is the advisory function of the CAA. The IAS team can assist industry in identifying the regulatory pathways for testing, trialling, and scaling up BVLOS operations in the UK. The IAS team works together with the Test & Evaluation function and has access to a diverse range of Subject Matter Experts (SMEs) across the CAA. The team sits as an advisory function separate from the regulatory approval functions of the CAA. This separation allows to engage in open dialogues and explore various solutions and approaches for BVLOS operations without causing conflict of interest or regulatory capture.

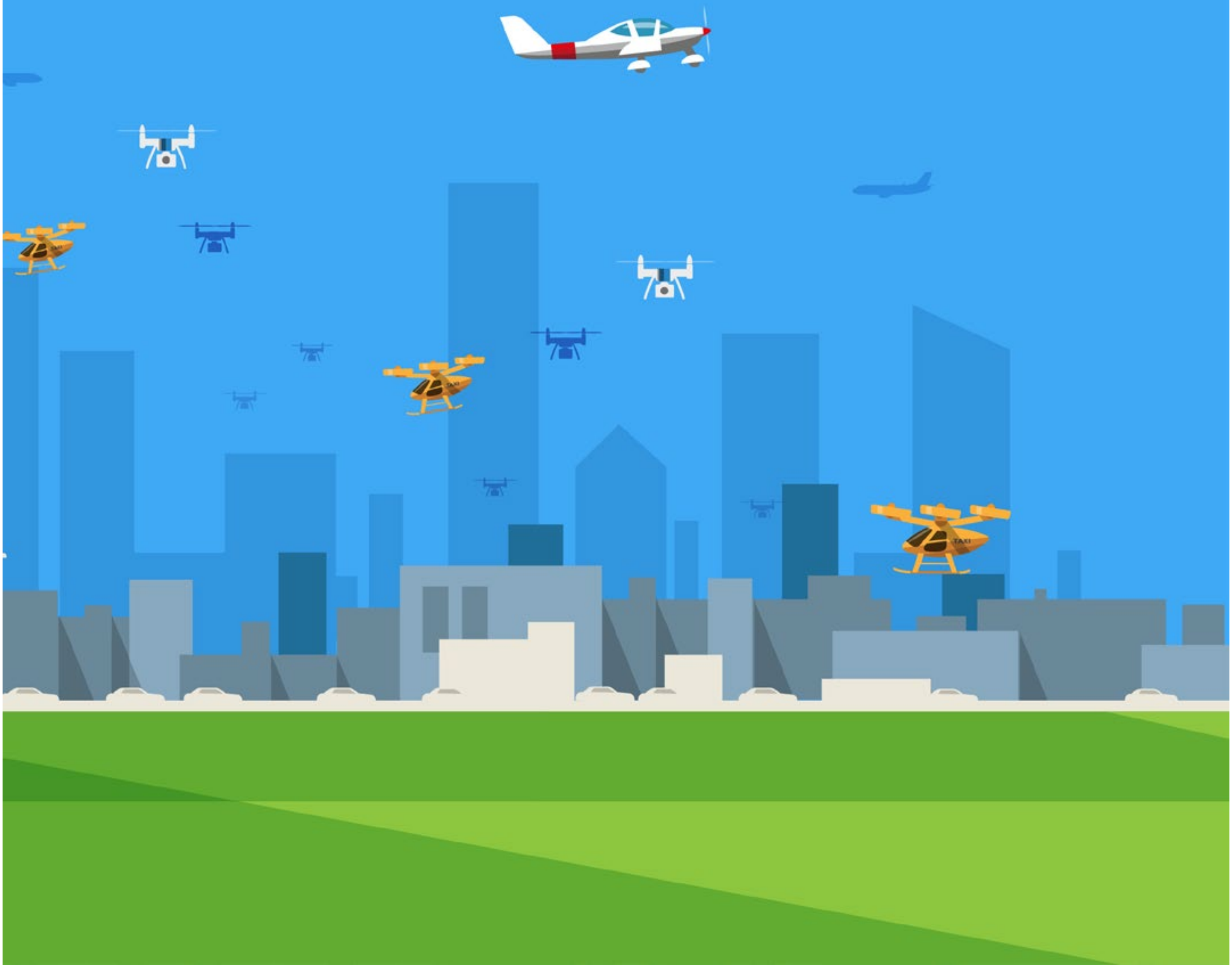
The IAS team offers guidance on a broad range of topics, ensuring comprehensive support throughout the innovation process. The guidance includes:

- Clarifying UK regulations and CAA policies for BVLOS operations.
- Explaining CAA's position and ongoing work on developing new policies.
- Identifying regulatory pathways for testing, trialling, and scaling up BVLOS operations.
- Discussing hazards and safety risks associated with the BVLOS operations.
- Providing early feedback from the CAA on the design considerations and performance specifications proposed to operate BVLOS.
- Reviewing evidence obtained from tests and simulations.

For any information, contact innovation@caa.co.uk

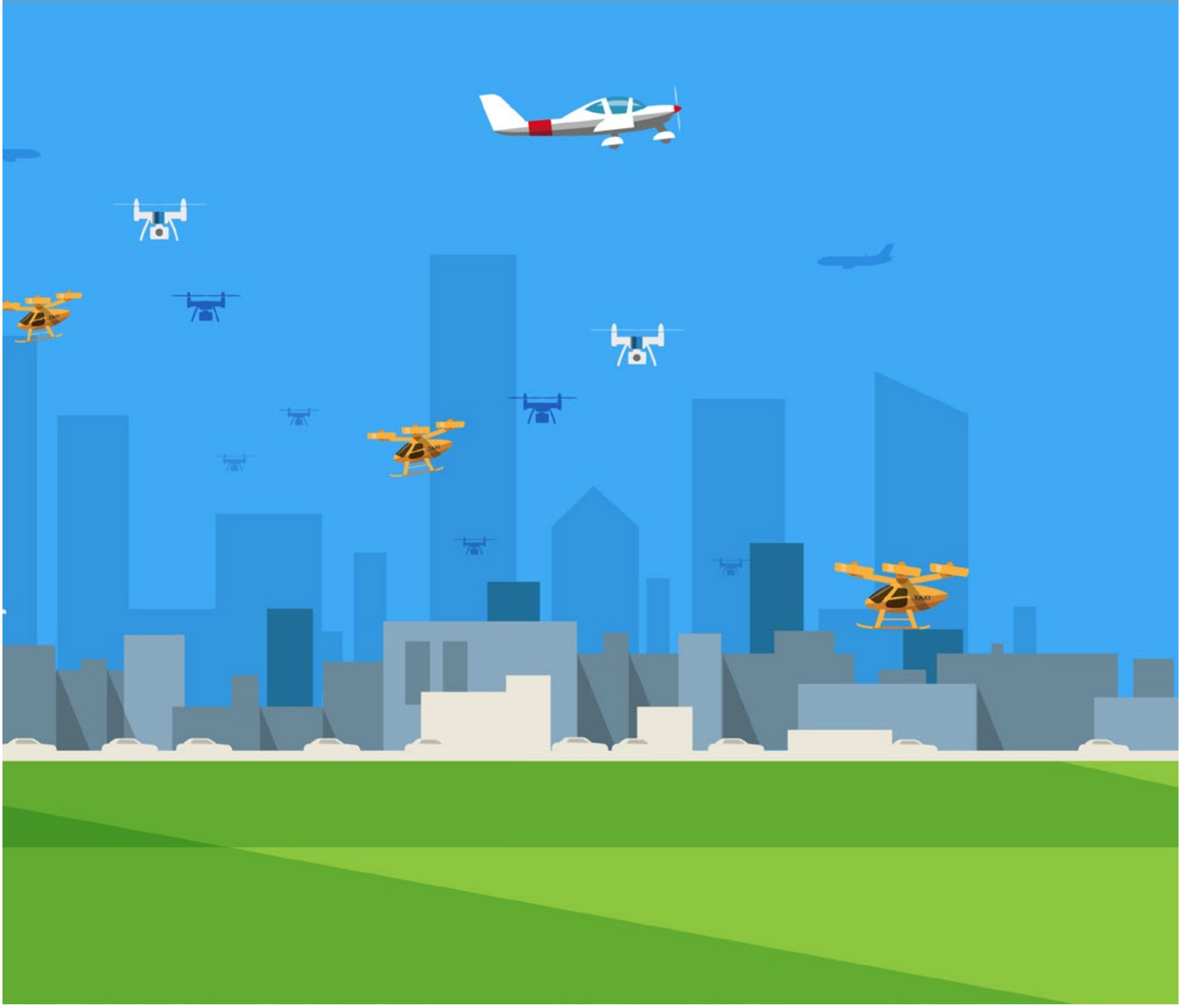
Part Two: Components

This part of the publication looks at the individual components or capability steps needed to enable integrated BVLOS in the UK. Section A contains the functional regulatory components around safely operating UAS, including risk assessment, flightworthiness and remote pilot competency. Section B contextualises components that relate to current and future airspace requirements, technical solutions, air traffic management and rules of the air.



A.

UAS Policy and Regulatory Activity for the Integration of BVLOS in UK Airspace



Specific Operations Risk Assessment

As part of the CAA's strategy for enabling routine scalable BVLOS operations the SORA methodology will be introduced in the UK across 2024, adapting to local specificities as required. It is referred to as UK SORA to recognise adaptions made for UK.

SORA is a way to classify the risk posed by an UAS operation and then identify mitigations and safety objectives to counter those risks. It allows the UAS operator to identify operational limitations and training objectives for the personnel involved in the flights, technical requirements for the aircraft and develop the appropriate operational procedures. The detailed SORA methodology is provided by JARUS , with the high-level 10-step process as follows:

1. **CONOPS** – The applicant provides a high-level description of the proposed operation.

2. **Intrinsic Ground Risk** – An initial Ground Risk Class (GRC) is calculated based on the UAS characteristic dimensions and the overflown population density.

3. **Final Ground Risk** – Mitigations to the ground risk may allow a reduction factor to be applied, resulting in the Final GRC.

4. **Initial ARC** – An initial Air Risk Class (ARC) is calculated based on a generalised model of airspace encounter characteristics.

5. **Residual ARC** – Strategic mitigations may allow the initial ARC to be reduced to a residual ARC.

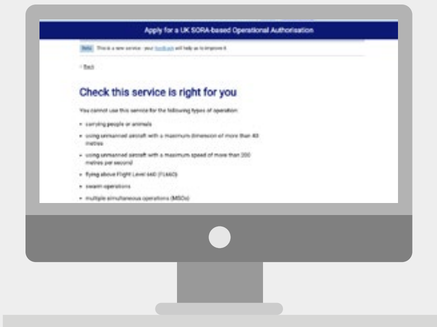
6. **Tactical Mitigations** – The final ARC determines whether tactical mitigations (e.g., Detect and Avoid) are required to reduce the residual air risk down to the agreed Target Level of Safety (TLoS), and the required level of tactical mitigation performance.

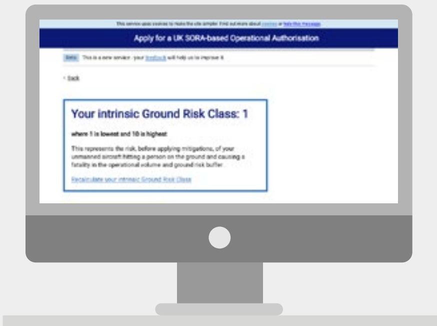
7. **Specific Assurance Integrity level (SAIL) Determination** – A Specific Assurance and Integrity Level (SAIL) is calculated based on the GRC and ARC.

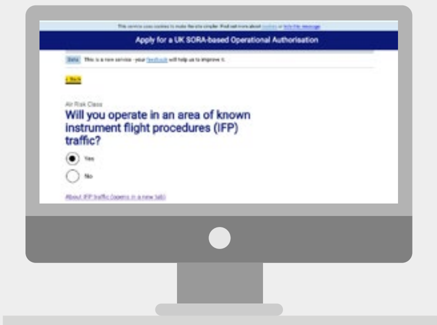
8. **Operational Safety Objectives (OSOs)** – For each SAIL, Operational Safety Objectives (OSOs) are defined, covering all elements including design, manufacture, maintenance, training, operating procedures, human factors, environmental conditions, etc.

9. **Adjacent Area / Airspace** – Design features should ensure that the UAS remains contained within the intended operational volume.

10. **Safety Case** – Output from the previous steps is documented in a safety case document.







The SORA provides structure and guidance to both the competent authority and the UAS operator to support an application to operate a specific UAS in a given operational environment. The benefit of this process is that both the operator and competent authority can allocate their available resources and time in proportion to the risk of the operation.

Recognised Assessment Entities - Flightworthiness (RAE-F) and SAIL Mark

The initial assurance of the design and manufacture of the UAS will be against technical requirements commensurate with the risk level that the UAS may be flown within (the SAIL level) and will result in a SAIL Mark being issued for that type and configuratuon of UAS. This will mean Operators can select a UAS for their operation, knowing that a number of the UK SORA technical requirements have already been met.

The Remote Pilot Station forms a part of the UAS and will be all assessed for compliance with UK SORA technical requirements by the RAE(F).

Dependencies

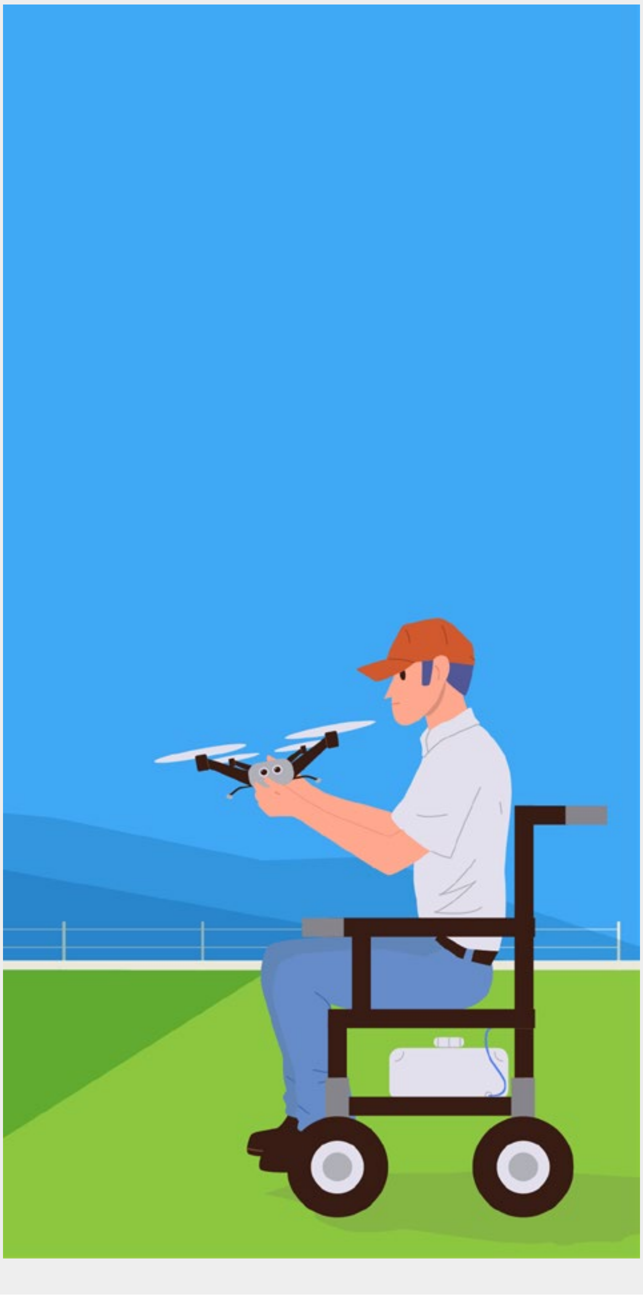
These policies are dependent on the development of suitable technical standards, to support the policy requirements. The AMC and GM will set out what requirements need to be met, in order to meet the regulatory requirements, and will refer to technical standards. Some of these already exist, however some do not.

The policies are also dependent on industry uptake - the concept of the RAE-F relies on organisations within industry recognising this opportunity and taking a business decision to enter the Flightworthiness market. If there is insufficient uptake from industry, then the CAA will consider its own Design & Certification team taking on the responsibility in the interim.

Outputs

This work comprises two key outputs, both of which will result in updates to the AMC and GM to the regulation:

1. The SAIL Mark Policy
2. The RAE-F Policy
3. Organisational capability changes to manage the implementation of the RAE-F Policy.



Recognised Assessment Entities - Pilot Competency (RAE-PC)

The CAA has enabled RAEs to deliver remote pilot competence training and issue competency certificates on behalf of the CAA since 2020, they currently deliver two levels of Remote Pilot Certificate (RPC). The first is the A2 Certificate of Competence (for the Open Category) and the second is the General VLOS Certificate (for the Specific Category).As Specific Category UAS operations grow in complexity, the CAA established that additional levels of standardised RPC would be needed to assure Remote Pilots possess the right level of competence.

The current work-programme does not cover the pilot competency requirements for levels of automation where a single remote pilot is responsible for multiple UAS or the system monitoring capabilities for autonomous flight.

Components and Dependencies

There are two primary policy components:

1. Requirements for RAE-PCs to deliver complex training on behalf of the CAA
2. Requirements for remote pilots to demonstrate competence

In addition, the CAA has developed two supporting policies:

1. Remote pilot medical requirements for operations where this is applicable
2. Guidance to RAEs on the qualification and use of simulators for training remote pilots

The primary policies will contain new requirements for an organisation wishing to become an RAE-PC and will set out how the CAA will regulate them. Remote pilots will benefit from comprehensive AMC and GM describing the new RPC framework and how to demonstrate competence.

The additional policies support the primary policies and industry by providing means of compliance and guidance relevant to specific new requirements.

The new RPC requirements have been developed based on ICAO Standards and Recommended Practices (SARPS) on Pilot Licencing SARP requirements, adapted for UAS and adjusted for proportionality, and SORA requirements for Remote Pilots.

The CAA has conducted comprehensive engagement with industry throughout the policy development including two public consultations totalling 20 weeks, a stakeholder working group, and numerous direct stakeholder interviews. The supporting policies have been developed collaboratively across the CAA.

Outputs

The output of this work will be:

1. Updates to the regulatory basis for RAE-PCs
2. Updated Policy material for RAE-PCs to follow, within CAP 722B including flight simulator qualification requirements
3. Updated AMC and GM, that will set out the requirements to demonstrate competence
4. Two new CAPs providing guidance on medical requirements for remote pilots and guidance to general practitioners (GPs) to make an assessment

The UK Air Risk Model

Perhaps the most significant barrier to the growth of this sector is the mid-air collision risk associated with BVLOS operations. The Air Risk Model forms steps 4, 5 and 6 of the SORA process, and considers a range of factors, including the class of airspace, aircraft encounter types, encounter rates, equipment carriage standards, strategic and tactical mitigations.

The objective of this work task is to define the SORA Air Risk Model as adapted for UK specificities. This model will be embedded within the wider UK SORA framework that will be externally consulted ahead of implementation across 2024.

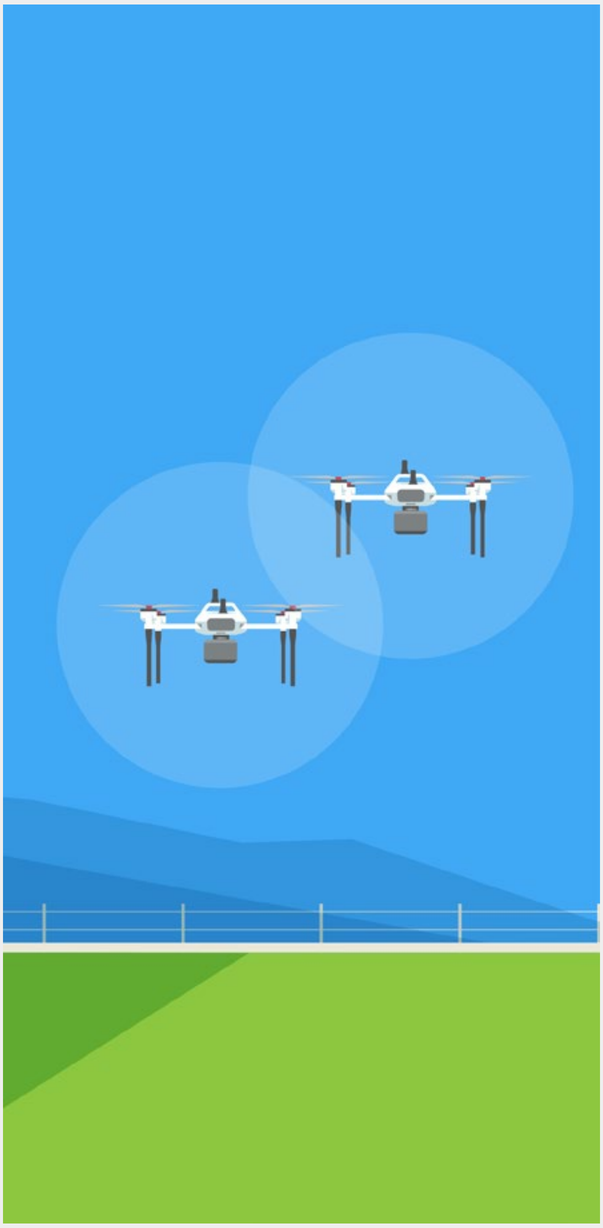
The initial version of the Air Risk Model does not in itself enable new UAS BVLOS operations within the UK. Rather, it embeds current CAA policies for approval of UAS operations within the SORA structure and terminology, creating a framework within which new policies that are currently in progress will sit as shown in the enabling components & dependencies below, including:

Enabling Components & Dependencies

- Atypical air environment
- Electronic conspicuity (EC)
- Detect and Avoid (DAA)
- Air Traffic Management services including Flight Information Services and Future Air Traffic Management services including UAS Traffic Management
- Ground Infrastructure
- Airspace requirements for integration of BVLOS in UAS in UK airspace
- Examine the use of 2-way Very High Frequency (VHF) radio by Remote Pilots to add greater situational awareness for all airspace users

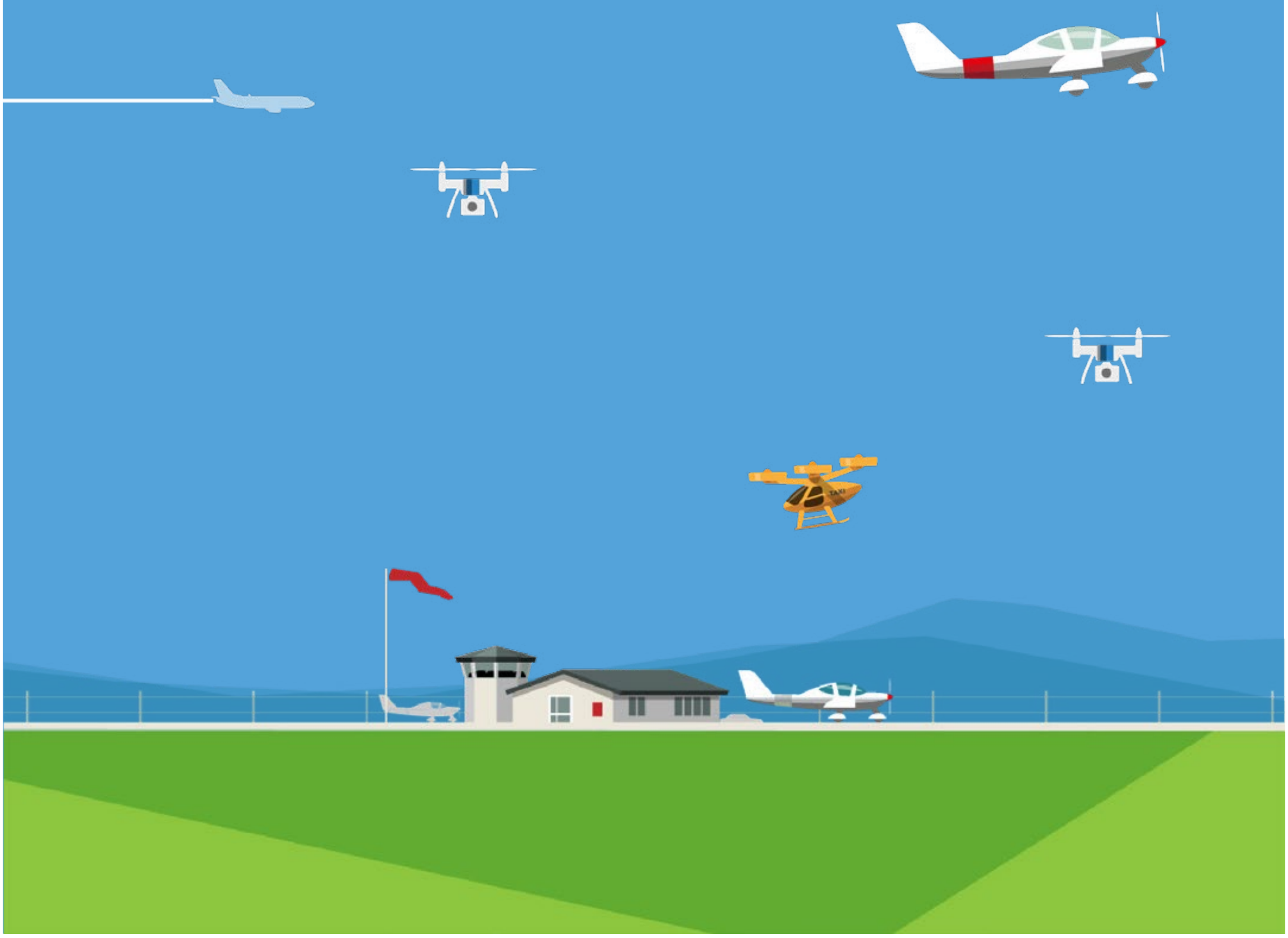
Outputs

The air risk model provides a single source of BVLOS requirements for industry, highlighting the requirement for, and expected use of, the above policies. The operational utility of the model to UK UAS operators is therefore highly dependent on completion of the above policies.



B.

Enabling Airspace Activity for the Integration of BVLOS in UK Airspace



Airspace Modernisation

Routine BVLOS operations conducted in UK airspace should be integrated with other air system(s) wherever possible. Practical aspects have to be suitable for all airspace users and not just the BVLOS industry. Airspace segregation to accommodate BVLOS operations should be the exception:

- Air Traffic Services (ATS) will be provided by an Air Navigation Service Provider (ANSP) in the UK.

- The only additional ATS service requirement currently specified to support BVLOS integrated airspace in the UK, is the provision of an ICAO Flight Information Service (FIS) with the enhancement that specific, accurate and timely Traffic Information on ALL aircraft will be used to generate a recognised traffic environment.

- It is anticipated that the manual provision of Flight Information Services (FIS) with specific traffic information (via voice comms/VHF receive and transmit) will be supplemented by the deployment of digital Traffic Information Service – Broadcast (TIS-B) in many circumstances.

- All BVLOS operations should use the significant safety net enabler of Electronic Conspicuity (EC). CAA and DfT policy established (December 2022) that EC for UAS will be achieved via ADS-B utilising 978 MHz/ Universal Access Transceiver (UAT).

- An Airspace Policy Concept – CAP2533: Airspace Requirements for the Integration of Beyond Visual Line of Sight (BVLOS) Unmanned Aircraft has been published by the CAA Airspace, Air Traffic Management and Aerodromes Policy Team in April 2023 and outlines the potential use of Temporary Reserved Area (TRA) in support of the trial and evaluation of the goals and objectives outlined above.

The key requirements are achieved by some of the goals and objectives of the AMS Part 2, to establish a safe operating environment (airspace) with minimum additional ATS service requirements defined. They do not relate to the Operating Safety Case (OSC) or specific operating conditions for any individual BVLOS operation proposing to utilise this integrated environment. The BVLOS operator needs to demonstrate how they can deploy DAA or other mitigations to safely integrate with other aircraft within the integrated airspace. It is anticipated that the availability of a Flight Information Service (FIS) with specific traffic information, for example, in the form of a data feed supplied by the ANSP will, in many cases, form a fundamental part of the OSC for the BVLOS operator. Additional considerations for UAS traffic management services are discussed below.

The ability of an ANSP (either existing today, or new in the future) to charge for additional services such as a surveillance feed or an enhanced FIS to specific users requiring these services needs to be fully examined and developed.

In the medium term (e.g. by 2027) we expect UAS to fly in integrated airspace with other aircraft using ATM services supported by an ANSP, DAA and EC capabilities. These UAS will be able to operate with freedom within their specified airspace structure and remain clear of other participating air traffic based on the associated system criteria for both air to air and ground to air DAA.

Where appropriate, the CAA will continue to review the activities required to meet the needs of industry, defined by FS&I and develop the evolving scope of the AMS. Mechanisms will be established for understanding these continuous evolution of requirements to integrate new users that programmatically develop enabling regulatory policy.

Airspace Change to Enable Integration

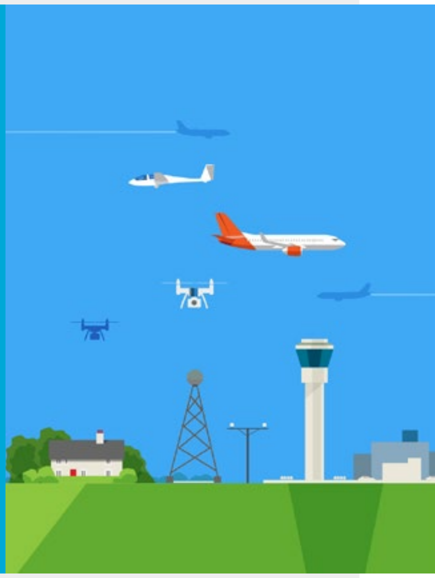
The CAA will work closely with airspace change sponsors to support the deployment of airspace with supporting infrastructure and services to enable routine BVLOS operations alongside existing airspace users. The CAA will work with all relevant stakeholders and ensure appropriate regulatory action to deliver the outcome. The assumption is that appropriate sponsors would not be individual UAS operators to ensure the outcome that multiple operators can perform operations that are scalable within this airspace.

Enabling Components

- Identify airspace and associated airspace characteristics
- Determine appropriate type of airspace structure
- Facilitate the airspace change process
- Implement new airspace structure
- Mitigating environmental impacts

Outputs

Airspace in place to support routine BLVOS operations



Future Airspace Architecture ATM/ANS

The changes required to ATM/ANS components required to deliver integrated BVLOS operations have been grouped together as a sub-programme. This programme is made up of the following projects:

1. EC
2. Ground Infrastructure
3. C2 Link & C2CSP
4. DAA
5. Future ATM

These projects have been grouped together due to the significant number of interdependencies, each cannot be considered in isolation, many of these interdependencies will involve working closely with other regulators and standards bodies to facilitate the licencing, operating conditions or adoption of existing standards for the technical elements outlined above. Some projects that have multiple workstreams in common include Spectrum and Rules of the Air. In addition, this programme will work very closely with Airspace Change to Enable Integration and System Wide Information Management (SWIM).

Longer term, the requirement for enhanced service provision and air traffic management in the lower airspace will increase with the need to integrate more aircraft, particularly larger uncrewed aircraft (UA)UAS and piloted eVTOLs (as two specific examples covered by the Future of Flight Action Plan). Currently, most small UAS BVLOS operations and new piloted passenger operations are expected to operate in compliance with the extant international and national VFR ruleset.

The ability of any new airspace user to operate in low level airspace under IFR will clearly place considerable demand on ATS provision within airspace classifications where separation is required to be delivered between IFR flights. Any change to those separation agreements or to the core requirements of the flight rules (such as Digital Flight Rules) should be progressed internationally but contributed to and anticipated nationally.

Electronic Conspicuity (EC)

Electronic Conspicuity (EC) is an umbrella term for the technology that can help pilots, UAS operators and air traffic services be more aware of what is operating in the surrounding airspace. EC includes the devices fitted/carried on to aircraft or UAS that send out the information, and the supporting infrastructure to help them work together. Airborne transponders, air traffic data displays, ground-based antennas and satellite surveillance services are all components of EC.

The information generated by these can be presented to pilots and air traffic services staff to provide them with information on other traffic nearby. This strengthens the fundamental safety principle of 'see and avoid' by adding the ability to 'detect and be detected'. To be most effective it needs 100% of users operating in a designated block of airspace using compatible EC devices and be able to be detected by others.

EC plays a vital role in key areas to support both the UK's Airspace Modernisation Strategy (AMS) and the CAA FOF Programme:

1. Enabling the on-going modernisation of the UK's airspace structure and route network.

2. Helping to mitigate the risk of mid-air collisions in Class G, and infringements into controlled airspace.

3. Enabling the safe and efficient integration of UAS

4. Providing the ability to share accurate navigation position data between airborne devices and ground (or indeed space-based) systems.

The UK AMS envisions greater connectivity between and amongst airspace users and ground-based actors enabling advanced Aircraft Based Navigation and Airspace Management capabilities to be realised. Development of EC enables many aspects of the AMS and will form the foundational basis for enabling Data services and achieving Integration requirements ensuring fair and equitable use of airspace.

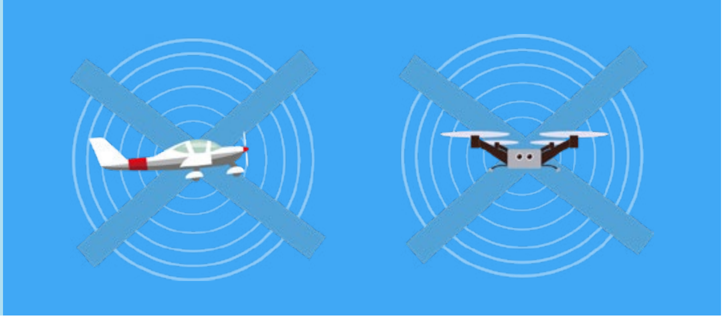
Enabling Components

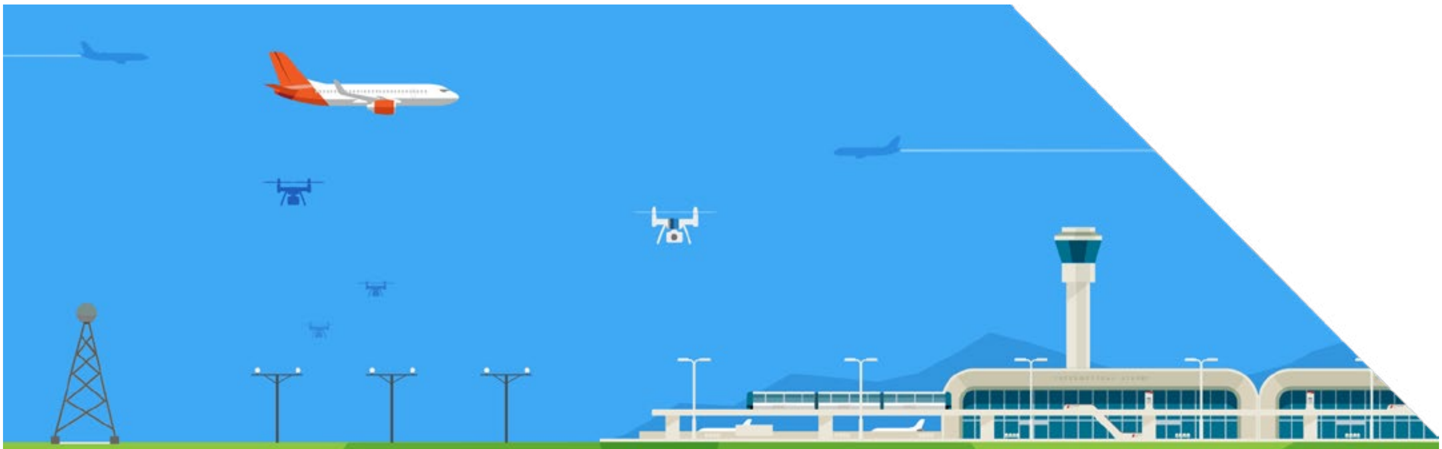
- Develop EC Con Ops which will cover: frequency management, probability of detection, airspace risk study, ground infrastructure and human factors
- Adopt EC Standards, AMC and GM
- Implement; rule changes and Civil Aviation Publication (CAP)s
- Develop airspace safety case in relation to EC Standards and carriage
- Examine options to compel adoption of EC

Outputs

Completion of CAA developmental, policy and any necessary rule making activity will provide stakeholders with guidance on EC carriage requirement.

Generates a cooperative traffic environment in specified airspace structures.





Ground Infrastructure

Due to capacity limitation, crewed aircraft and UAS will occupy different frequencies and airborne platforms may not be equipped to receive both EC transmissions. Therefore, a ground infrastructure may be required to enable the interoperability between the two systems. The purpose of the ground infrastructure would be to provide the following benefits:

- Reception and onwards relay of EC data in the airspace volume within which a BVLOS UAS is operating (this may co-exist with UAS Command and Control (C2) infrastructure etc). Onwards relay of this data might be for the purpose of the collision avoidance between UAS and crewed aircraft (in any combination) and for an air traffic management resource.
- The standards of the communication system used to relay EC and potentially other operational data to the operator and potentially traffic management providers.
- Verification of the position of airborne targets using multi-lateration of 978MHz UAT to confirm the position of UAS transmitting to that standard and 1090MHz ADS-B to authenticate positions of crewed aircraft. This data and / or alerts would then be transmitted to a UAS operator who may receive an alert if the Global Navigation Satellite System (GNSS) derived positions differ from the multilateral positions calculated by the ground network.
- The provision of FIS-B data on UAT including meteorological data such as Meteorological Aerodrome Reports (METARs), Terminal Aerodrome Forecasts (TAFs), wind, precipitation maps and temporary airspace restrictions. This may also replace or enhance the current VOLMET3 system.
- The opportunity to re-transmit traffic data on other EC technologies using TIS-B.

Enabling Components

- Develop airspace architecture assumptions
- Develop ground infrastructure strategy
- Adopt appropriate standards/policies
- Lower airspace service provision

Outputs

Ground Infrastructure standards/policies in place to enable: Traffic Information Service Broadcast (TIS-B), Flight Information Service Broadcast (FIS-B) and GNSS Signal Assurance in different constructs of airspace.

Command and Control (C2) Link

Fundamental to enabling BVLOS UAS of all categories, including the Specific Category, are reliable and secure Command and Control (C2) Links. The C2 Link is the means by which the remote pilot, via the Remote Pilot Station (RPS) or Control Unit (CU), exerts control of the UAS flightpath and systems, and by which the UAS returns data including location, trajectory, systems status, and sensor data. Depending on the UAS size, capabilities and its airspace integration approach, the C2 Link will most likely carry information to enable the DAA function; this could include data from sensors on the UAS (such as EC receivers and active DAA sensors), data from the ground such as a local recognised air picture from the ATM or UTM provider, and commands from the remote pilot to enable safe separation to be maintained, with collision avoidance manoeuvres should they become necessary. It is vital to understand that the smaller the UAS is, the more likely it is that the C2 Link will be critical to the DAA function.

The objective of this complex task is define the risk-based and performance-based requirements for C2 Links, including: target levels of safety and reliability, acceptable balances of C2 Link performance vs UAS automation capabilities, approved methods / technologies / providers, required functionality, spectrum and licensing requirements, required link performance, technical standards, equipment standards, safety requirements (including redundancy requirements), cyber security, and Lost C2 Link protocols. A proportional and risk-based approach to all these elements will need to be adopted that aligns with the SORA approach, and integrates the outcomes of the EC, DAA and ATM strategies.

Enabling Components

- ICAO RPAS C2 Link SARPs and guidance – although the ICAO work focuses on Certified Category UAS, the airspace integration challenges are very similar hence there will inevitably be a flow-down of requirements and approach to the Specific Category, depending on the SORA SAIL Level (We are not dependant on ICAO timelines in order to progress this capability for domestic operations.)
- UK SORA (including the UK Air Risk Model)
- Spectrum / Ofcom – including whether to permit use of unlicenced spectrum for low SAIL UAS and whether to permit use of SATCOM services other than AMSIS for Specific Category UAS Control Non-Payload Communications (CNPC).
- C2CSP policy, particularly for third party providers such as SATCOM and 4G/5G Mobile Network Operators (MNOs)
- RPS

Outputs

- List of technical standards that the CAA supports for use with C2 Links for Specific Category UAS
- CAA C2 Link roadmap
- CAA C2 Link team organisational strategy and resourcing plan (including SME and management roles), including a team growth roadmap and associated budget forecast
- C2 Link policy for Specific Category UAS, integrated with UK SORA. Hopefully most of this can be done at AMC/GM level, but as the work progresses it is entirely possible that some requirements necessitating SI-level changes will be identified.
- There will be a need to co-ordinate with Ofcom, likely resulting in new consultations and regulations from them, and matching implementation regulations from the CAA.
- It is expected there will need to be significant changes to assimilated regulations 2019/945 and 2019/947, as a minimum.
- There may be a need to amend regulations pertaining to ANSPs, ATM and DAA as well, depending on the eventual C2 Link dependencies that other FOF workstreams reveal or create.

C2 Communications Service Provider (C2CSP)

C2CSP is a concept that emanated from the ICAO RPAS Panel, to cover provision of C2 Link services to UAS. We are not dependent on ICAO timelines in order to progress this capability for domestic operations. Although ICAO focuses on Certified Category UAS, the airspace integration challenges are very similar hence there will inevitably be a flow-down of requirements and approach to the Specific Category, depending on the SORA SAIL Level.

A C2CSP can be a function within an UAS operator, whereby all elements of the C2 Link are provided by that operator, but as the industry scales there will be increasing third-party provider involvement. Obvious examples are SATCOM service providers, MNOs, and other providers of Radio Line of Sight links, such as mesh radio networks or other networks using 4G technology but operating in a different spectrum band. C2CSPs will relieve UAS operators of the complexity of providing their own C2 Links: they will simply need to connect their RPS or to third-party C2CSPs via suitably robust communications methods, which could include VPN, land-line, 4G/5G or SATCOM. Bearing in mind that the C2 Link performance and reliability is determined by its weakest link, there will be a need to assure the entire communications chain from the RPS to the UAS, in a manner proportionate to the safety risk of the planned operation (i.e. aligned with the UK SORA methodology). For UAS operations at or above a certain SAIL (exact threshold TBD), UAS Operators will be required to use CAA approved C2CSPs, and the C2CSPs are likely to require some level of CAA approval before they can provide C2 Link services to UAS.

Expected areas of interest for CAA approval will include: spectrum licensing, service coverage, personnel competencies, management structure, processes, equipment installations, physical security, network security, cyber security, resilience and redundancy, recovery plans, management interfaces with UAS operators, data sharing with UAS operators, interference monitoring, performance monitoring, occurrence reporting, and safety management. C2CSPs will have an important role to play in assuring resilience, redundancy, cyber security and, as far as practicable, protection against jamming and spoofing.

Enabling Components

- The C2CSP Link Strategy is interdependent with the C2 Link Strategy – the two policies have some areas of cross-over and will evolve together.
- Spectrum and Ofcom input
- CAA engagement with the comms industry (SATCOM providers, MNOs, telecoms infrastructure providers/ operators)
- Cyber strategy and standards for C2 Links and C2CSPs

Outputs

- ICAO RPAS C2SP SARPs and guidance
- CAA C2CSP roadmap
- CAA C2CSP policy, which is likely to need SI-level implementation and significant accompanying AMC and GM. This could be incorporated within 2019/945 and 2019/947, or within a new regulation.
- CAA C2CSP organisational strategy and resourcing plan, including a growth roadmap and associated budget forecast

There may be a need to co-ordinate with Ofcom, likely resulting in new consultations and regulations from them, and matching implementation regulations from the CAA.

Detect and Avoid (DAA)

An air system's conflict management, i.e. the capability to detect and take action to avoid collisions where there is not a human operator on board to apply the 'see and avoid' principle. DAA systems are essential for ensuring safe airspace integration and play a crucial role in BVLOS activity. In time DAA may also become part of assisting crewed flights as part of a suite of Airborne Collision Avoidance Systems (ACAS) that already exist.

The premise of DAA is that it should be a capability that is at least equivalent to the 'see and avoid' principle used in manned aviation to avoid collision with other aircraft and obstacles. When operating VLOS, the rules apply to UAS in the same way that VFR apply to manned aircraft. However, BVLOS operations in a non-segregated airspace will not normally be permitted without an acceptable DAA capability. To maintain the appropriate levels of safety, a suitable method of aerial collision avoidance is required for all UAS operations. In essence, to gain access to all classes of airspace without segregation, UAS will have to be able to display a capability that is equivalent to the existing safety standards applicable to manned aircraft types. These capabilities will need to be appropriate to the class (or classes) of airspace within which they are intended to be operated.

Conflict management within the existing global aviation system is premised on cockpit-based see-and-avoid supporting both Remain Well Clear and Collision Avoidance functions within the following three-layer system:

Layer 1: Strategic conflict management – Airspace design / demand & capacity balancing / traffic synchronisation

Layer 2: Separation provision – ATC unit or Pilot 'see & avoid' (Remain Well Clear)

Layer 3: avoid responsibilities and is defined within the ICAO RPAS Manual as providing "the capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action".

The CAA is adapting the JARUS SORA methodology for UK specificities. Within this work an air risk group has reviewed the JARUS air risk model and will update it as required for the UK. The existing JARUS work includes a stated TLoS, an air risk collision model, a framework for definition of Airspace Encounter Category (AEC) and the resulting Air Risk Class. A DAA system is then used as a tactical mitigation with performance requirements provided for different air risk classes. It is initially expected that the JARUS SORA Air Risk group will provide the required TLoS and supporting data for a set of UK AECs. The DAA workstream will then focus on appropriate performance assurance of the DAA system for different AECs. It should also be noted that the SORA air risk model focusses only on conflicting aircraft and does not consider certified UAS.

EC developments will enable the deployment of localised TIS-B in those airspace environments identified as requiring additional detect and avoid capabilities to manage integration of all airspace users. TIS-B is envisaged to rebroadcast a unified surveillance picture based on co-operative and non-co-operative means (e.g. Mode-S, ADS-B (1090HZ and 978MHZ), and where appropriate other EC devices. Other means of data including new innovative technology not yet proven will be assessed for its viability to support surveillance provision and other secondary functions such as detect and avoid. The use of TIS-B is envisaged to benefit all airspace users.

Detect and Avoid (DAA) -continued

Enabling Components

- **DAA Intended function**.
- **Target level of safety** (TLOS).
- **Required DAA system performance**, e.g., DAA risk reduction targets required for different levels of operational risk. This can be developed based on a collision risk model, encounter rate data and the TLOS.
- **DAA system performance assessment framework**, including encounter terminology & thresholds (encounter, well-clear, Near Mid-Air Collission (NMAC), MAC), test methodologies (Fast-Time-Sim / Real-Time-Sim / Live-flight), encounter models, interoperability, human factors (e.g., nuisances), etc.
- **Required DAA system technical integrity & assurance,** including position report data quality indicators (cooperative and uncooperative) for both ownship and threats, validation of passive data, design, development / production & installation, etc.
- Interaction with **Rules of the Air**
- Linkages to both the governing regulatory framework and published technical standards.
- Conformance with radio regulatory requirements.

Outputs

Policy setting out rules of the air and associated system criteria for both air to air and ground to air DAA, tailored to different classes of airspace.

Future Air Traffic Management Services

The development of additional ATM requirements and policy will set the framework for future ATM service provision. Any ATM solution must ensure that the principle of fair and equitable use of the air is upheld.

The development of the concept of operations, system architecture and ultimately the tools and processes to support new airspace users is not yet standardised on the global stage. While not standardised, ICAO has published material for UAS Traffic Management (UTM). The definition ICAO uses can be applied to both segregated and non-segregated airspace operations. The ICAO Advanced Air Mobility (AAM) Study Group is tasked with developing the vision and framework for AAM. This work includes developing positions on ATM for new airspace users. The UK CAA holds the chairperson role for the AAM Study Group.

In a UK context, UAS Traffic Management and the needs of other vehicles such as eVTOLs are considered part of the overall ATM service provision. The AMS recognises that UAS and eVTOLs will have different traffic management service needs in the short term when demonstrating the capability and in the medium term when operations are scaling. The AMS recognises the need for a coherent approach to managing services which will require development. Where appropriate the UK may choose to align with other regions' approach to ATM.

The strategic vision for airspace modernisation to 2040 aims to safely facilitate access by diverse airspace users, with a transition towards greater integration of air traffic. Incorporating this ever more complex and growing mix of traffic requires advanced technological tools and ATM solutions. Developments in ATM is one of the key enablers to integrating UAS BVLOS operations at scale, the introduction of piloted eVTOL aircraft (including day 1 operations with low flight numbers) and supporting future large-scale autonomous flight. Through ATM, it is envisaged that ANSPs will be able to provide real-time information regarding airspace constraints and the intentions of other aircraft to all airspace users where appropriate.

UTM is accepted as supporting the real-time or near-real-time organisation, coordination, and management of UAS operations, including the potential for multiple BVLOS operations, using consensus based standards to ensure interoperability and a means of compliance. Specific services for UAS will include, among other things, flight planning and flight notification. The CAA, with input from stakeholders, is developing traffic management to support new airspace users.

The introduction and management of UAS as well as the development of associated ATM infrastructure should not negatively affect the safety or efficiency of the existing ATM system. Modernisation of ATM and airspace will use technology to manage airspace in a flexible, near real-time operation, from high-altitude airspace to very low-level urban airspace environments. Whilst UTM, in the near term, is addressing the needs of the UAS industry elements of the service provision will be applicable to assist traditional aviation and piloted eVTOL through increased situational awareness, avoidance of Controlled Flight into Terrain (CFIT) and flight planning generally.

Enabling Components

- Concept of operations / service provision concept for Low level Airspace
- Development of notional system architecture
- Technical requirements for ATM services
- Policy concepts to support demonstration operations
- Authority Requirements and Organisational Requirements
- Policy concepts to support scaling operations
- Policy development to support scaling and sustainable operations
- Mitigating environmental impacts

Outputs

Concept of operations for ATM in low level airspace and aligned notional system architecture- The key regulatory policy components will be developed to support this concept and focus on traffic management needs of BVLOS Specific category in demonstrate, scale and sustainable horizons.

Enable integration of suitably equipped air systems, critical to BVLOS operations

System Wide Information Management

SWIM provides for a data exchange framework that enables interoperability and exchange of digital information between various stakeholders. SWIM aims to improve the efficiency and safety of airspace usage with the real-time exchange of pertinent aviation related data.

The present-day model for information exchange is very limited and acts as a constraint on the forward-looking implementation of future, performance-enhancing operational improvements. Chief limitations are:

a. systems have not been designed and implemented to be globally interoperable within globally-agreed parameters;

b. many interfaces, which were designed to support point-to-point or application-to-application exchanges, have limited flexibility to accommodate new users, additional systems, new content or changed formats;

c. message-size limitations and a non-scalable approach to information exchange with the present infrastructure;

d. the current infrastructure can make it difficult and costly for one stakeholder to access, on a timely basis, information originated by another stakeholder;

e. the current variety of systems and exchange models makes it challenging to devise security frameworks across systems and stakeholders to support the increasing need for open and timely data exchange whilst at the same time respecting the legitimate security concerns of all stakeholders;

f. currently, most organisations manage their ATM information in partial isolation leading to duplication and inconsistencies.

SWIM contributes to achieving the following benefits:

- improved decision making by all stakeholders during all strategic and tactical phases of flight (pre-flight, in-flight, and post-flight) through:
  - a. improved shared situational awareness; and
  - b. improved availability of quality data and information from authoritative sources;
- increased system performance;
- more flexible and cost-effective communications by the application of common standards for information exchange;
- loose coupling which minimalises the impact of changes between information producers and consumers;
- support of ATM Service Delivery Management

Enabling Components

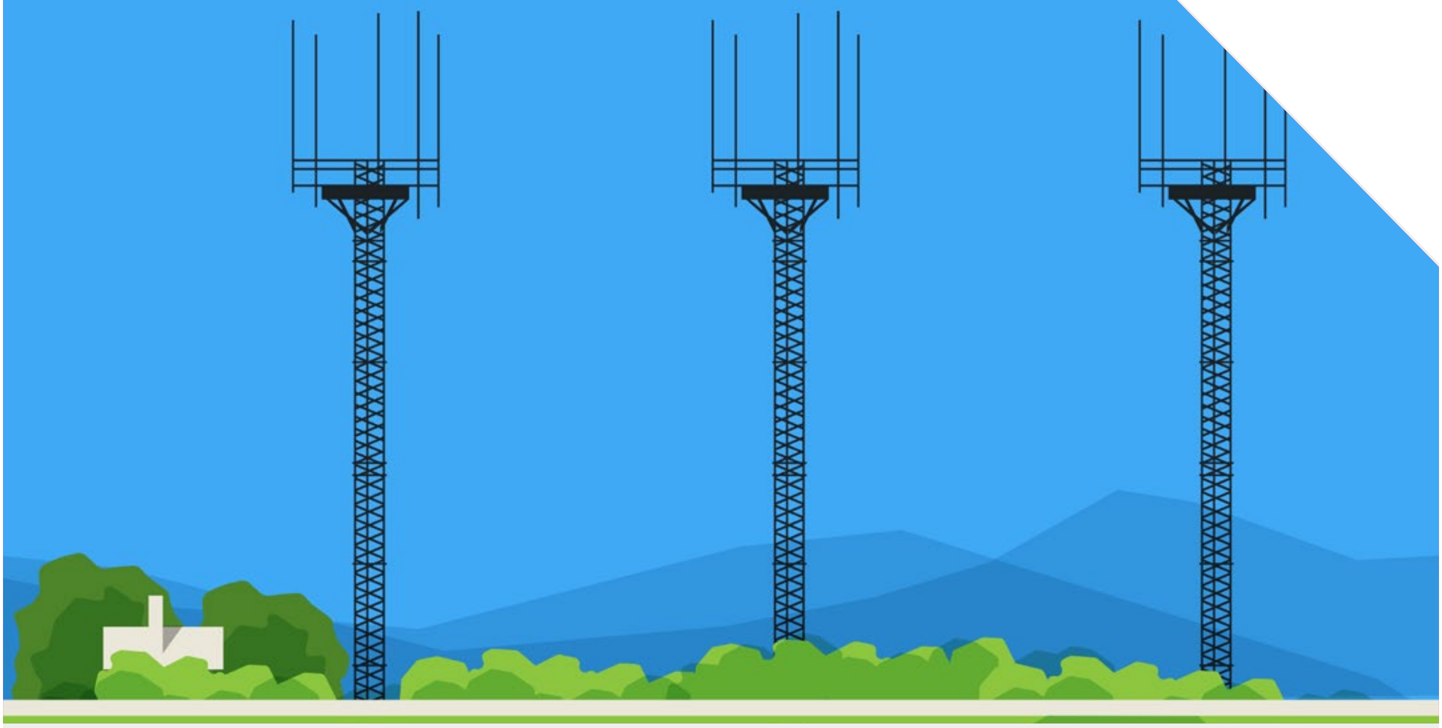
- Develop UK position on service orientated architecture
- Develop AMC/GM for PCP AF#5 SWIM
- Develop policies, processes, and guidance in support of SWIM implementation
- Define roles, responsibilities and accountabilities of SWIM stakeholders
- Identify and document relevant standards for info provision and info service consumption
- Clarify CAA position on UK SWIM Services

Outputs

Completion of CAA activity will provide industry with a framework and the standards to develop and deploy a UK data exchange network

Wider availability of digital aviation data will improve pre-flight and tactical decision making for all aviation stakeholders

Spectrum



Radio spectrum availability will enable new innovations and systems. Aviation is greatly dependent on harmonised radio spectrum availability to enable systems that support safe flight. Without adequate spectrum availability any system that has a dependency on wireless communication is unlikely to be developed. In the traditional aviation domain, the systems are typically broken down into 3 categories. Communication, Navigation and Surveillance. Generally, spectrum allocations are managed through ICAO, International Telecommunications Union(ITU) or regional bodies such as European Conference of Postal and Telecommunications Administrations (CEPT). Alternatively, spectrum availability may be generated through updates to global, regional or national spectrum/frequency management rules. Going forward, once a system is standardised, it's continued availability and integrity is dependent on effective spectrum management to protect it from interference.

Enabling Components and Dependencies

- Spectrum and associated frequency management for detect and avoid systems, UAS Command and Control link suitable for the associated category of flight and electronic conspicuity
- Updates to associated spectrum management documentation to reflect new interface requirements and spectrum management rules
- Advise and technical information to support the appropriate use of non-aeronautical communication infrastructure such as mobile communications networks or short-range devices.
- Technical advice to support spectrum compatibility studies

Outputs

Due to the necessary harmonised nature of spectrum assignments across a region or globally much of the relevant work is conducted within ICAO and typically outputs will include updated to SARPS and indirectly minimum operational performance standards (typically completed by standards bodies), ICAO frequency management handbook and other relevant ICAO documents. Local outputs could include radio regulation policies and documentation including updated interface requirements, licensing procedures and coordination mechanisms.

Rules of the Air (SERA)

An important enabling activity for airspace integration, is a review of the rules of the air: UK Reg (EU) No 923/2012 (the UK Standardised European Rules of the Air (SERA)). SERA lays down the common rules of the air and operational provisions regarding service and procedures in air navigation

SERA does not apply to model and toy aircraft operated as (VLOS) in the open' category. However, SERA requires that Secretary of State for Transport must take appropriate steps, such as establishing national rules to ensure that model and toy aircraft are operated in such a manner as to minimise hazards related to civil aviation safety, to persons, property, or other aircraft. Open category VLOS operations are also not in scope of this group.

Any UAS operating BVLOS will be operating in either the 'Specific' or 'Certified' category, depending upon the type of platform and the operation being undertaken. Not all requirements within SERA are relevant to UAS in the 'specific' category, with UAS operators charged with considering specific requirements and, where relevant, incorporating them within their operations manuals as procedures as necessary, whereby the inclusion of such procedures will make them mandatory for the UAS Operator to follow.

Enabling Components and Dependencies

- UK Reg (EU) No 923/2012 (the UK Standardised European Rules of the Air (SERA)
- AMC to UK Reg (EU) 2019/947 Article 7(2) Rules and Procedures for the Operation of UAS

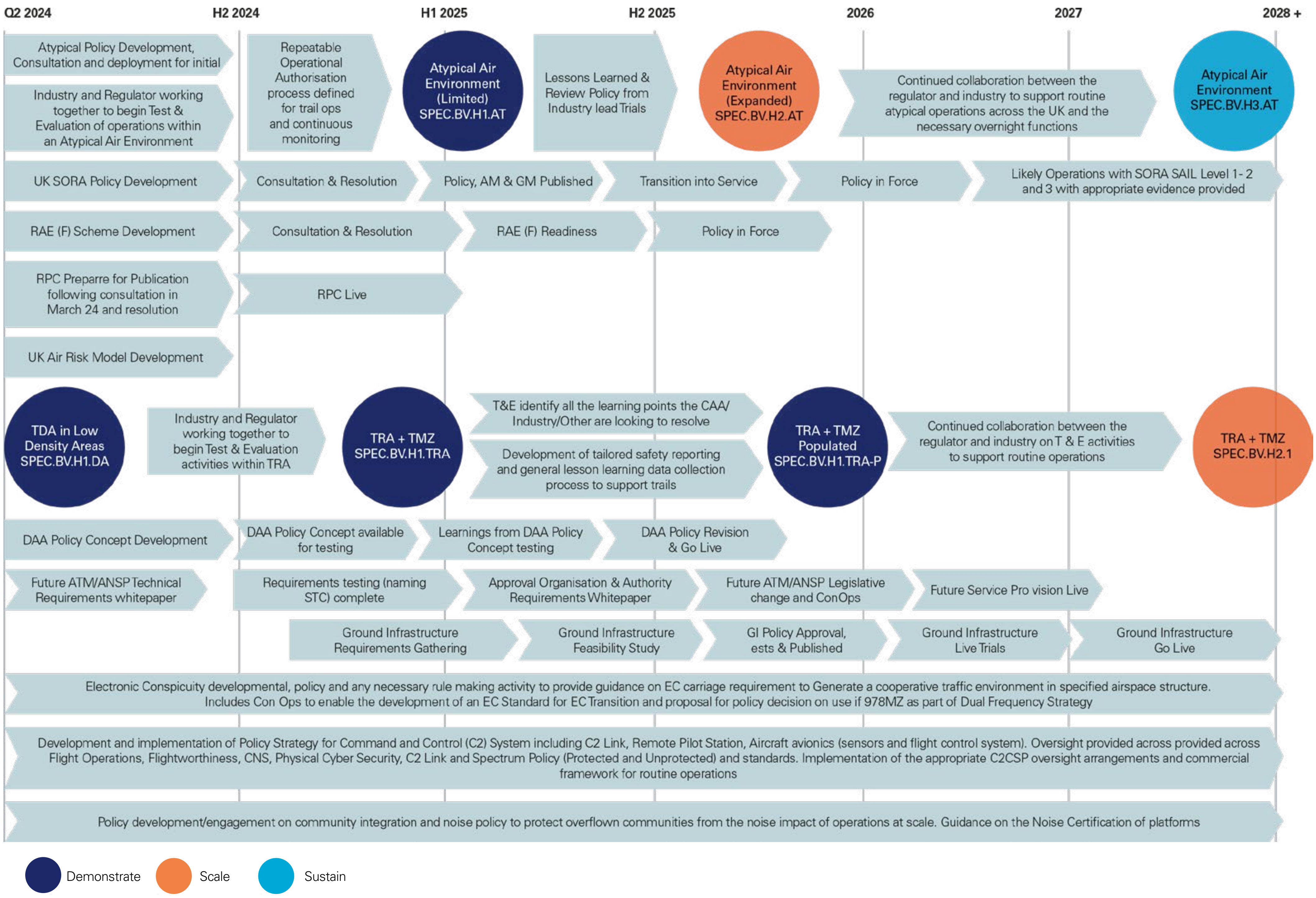
Outputs

- Review the relevant regulatory material including AMC and GM
- Make recommendations to accommodate UAS

Longer term, the requirement for enhanced service provision and air traffic management in the lower airspace will increase with the need to integrate more aircraft and particularly new UAs such as BVLOS UA and AAM. Currently, most BVLOS operations and AAM movements are expected to operate in compliance with the extant international and national VFR ruleset.

The ability of any new airspace user to operate in low level airspace under IFR will clearly place considerable demand on ATS provision within airspace classifications where separation is required to be delivered between IFR flights. Any change to those separation agreements or to the core requirements of the flight rules (such as Digital Flight Rules) should be progressed internationally but contributed to and anticipated nationally.

Enabling Activities



Glossary
Definitions

A2 CofC - The A2 Certificate of Competency is a qualification that allows individuals to operate small unmanned aircraft in the open category within specific limits and conditions.

AAE- Atypical Air Environment, a volume of airspace where you can reasonably anticipate there to be a reduced number of conventionally piloted aircraft due to proximity of ground infrastructure.

AAM- Advanced Air Mobility, a term referring to new and emerging aviation technologies and services, including electric vertical takeoff and landing (eVTOL) aircraft and urban air mobility (UAM) systems.

ACAS- Airborne Collision Avoidance System provide advice to pilots for the purpose of avoiding potential collisions. This is achieved through resolution advisories, which recommend actions (including manoeuvres), and through traffic advisories, which are intended to prompt visual acquisition and to act as a precursor to RAs.

ACP – Airspace Change Proposal, are requests from a 'change sponsor', usually an airport or a provider of air navigation services (including air traffic control), to change the notified airspace design. Airspace change proposals must follow the CAA's airspace change process.

ADS-B- Automatic Dependent Surveillance-Broadcast, a surveillance technology used in aviation to determine an aircraft's position via satellite navigation and broadcast it to other aircraft and ground stations.

AEC- Airspace Encounter Category, a grouping of airspace types that best reflect perceived levels of collision risk.

AMC- Acceptable Means of Compliance, is non-binding policy developed by the CAA that can be used to demonstrate compliance with the Basic Regulation and its Implementing Rules. As it is non-binding an applicant may choose to offer an alternative means of compliance (which must be reviewed and accepted by the CAA)

AMS – Airspace Modernisation Strategy, a co-sponsored legislative requirement aimed at modernising airspace to make it more efficient, improve punctuality, reduce CO2 emissions, reduce noise, and ensure there is capacity to meet future demand.

ANS - Air Navigation Services, services provided to ensure the safe and efficient movement of air traffic, including air traffic control and navigation assistance.

ANSP - Air Navigation Service Provider, an organisation responsible for providing air navigation services within a specific airspace region.

ARC – Air Risk Class

ATM- Air Traffic Management, the system of services and procedures designed to ensure the safe and efficient movement of air traffic.

ATS- Air Traffic Services, services provided to aircraft during flight, including air traffic control, flight information service, and alerting service.

BVLOS - Beyond Visual Line of Sight, referring to operations where the remote pilot cannot maintain direct visual contact with the uncrewed aircraft.

C2 Link- Command and Control Link, the communication link between the remote pilot and the unmanned aircraft, used to control and monitor its flight.

C2CSP- Command and Control Communications Service Provider, an organisation responsible for providing command and control services for unmanned aircraft operations.

CAA- Civil Aviation Authority, the national aviation authority responsible for regulating civil aviation in the United Kingdom.

CAS- Controlled Airspace, airspace where air traffic control has the authority to control the movement of aircraft.

CAP- Civil Aviation Publication, a series of documents published by the CAA providing guidance and information on various aspects of civil aviation.

CEPT - European Conference of Postal and Telecommunications Administrations,

CFIT- Controlled Flight Into Terrain, an accident where an aircraft unintentionally impacts the ground or water while under the control of the pilot.

CNS- Communications, Navigation, and Surveillance, referring to the systems and technologies used for aircraft communication, navigation, and surveillance.

DAA- Detect and Avoid, referring to systems and procedures used by unmanned aircraft to detect and avoid collisions with other aircraft and obstacles.

DfT – The Department for Transport, is the UK government department responsible for transport infrastructure, regulation and policy

DiSCO- Digitalisation of Specific Category Operations, a CAA project transforming the operational authorisation process for Remotely Piloted Aircraft Systems (RPAS) in the Specific Category

DMARES- Drone and Model Aircraft Registration and Education Service

EC – Electronic Conspicuity, an umbrella term for the technology that can help pilots, uncrewed aircraft users and air traffic services be more aware of what is operating in surrounding airspace.

eVTOLs- electric vertical take-off and landing (eVTOL) aircraft

FIS- Flight Information Service, a service provided to pilots to assist them with flight planning and navigation.

FIS-B- Flight Information Service-Broadcast, a service that broadcasts weather and other relevant information to aircraft equipped to receive it.

FOF – Future of Flight, a shared vision for 2030 to support the UK future of flight industry to become a sustainable and thriving ecosystem.

FS&I – Future Safety & Innovation, a technical innovation team within the CAA with the purpose to deliver the large programmes of change that are required to enable aviation innovations in the UK to be realised

GM – Guidance Material, is non-binding and provides explanatory and interpretation material on requirements contained within Basic Regulation the Implementing Rules, and the AMC. It contains information, including examples, to assist the applicant with the interpretation of the legislative provisions.

GNSS- Global Navigation Satellite System, is a network of satellites that provides positioning, navigation, and timing (PNT) services on a global or regional basis.

GVC- General Visual Line of Sight Certificate, a qualification allowing individuals to operate small unmanned aircraft in the specific category within specific limits and conditions.

ICAO – International Civil Aviation Organisation, is a specialized agency of the United Nations that coordinates the principles and techniques of international air navigation, and fosters the planning and development of international air transport to ensure safe and orderly growth

ICAO SARPS – Standard and Recommended Practices, are technical specifications adopted by the Council of ICAO in accordance with Article 38 of the Convention on International Civil Aviation in order to achieve "the highest practicable degree of uniformity in regulations, standards, procedures and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation".

IFR – Instrument Flight Rules as per UK Rules of the Air (SERA), UK Regulation (EU) No. 923/2012

ITU- International Telecommunications Union, is the United Nations specialized agency for information and communication technologies

JARUS- Joint Authorities for Rulemaking on Unmanned Systems, an organisation that develops recommendations for the regulation of unmanned aircraft systems.

LUC – Light UAS Operator Certificate, which, if obtained, guarantees some privileges to its holder.

MAC – Mid Air Collision, is an accident where two aircraft come into contact with each other while both are in flight.

METAR- Meteorological Aerodrome Report, a report providing current weather conditions at an aerodrome.

MCN- Mobile Communication Networks, telecommunications network that provides services via radio signals for mobile devices.

MNO – Mobile Network Operator, is a company that owns the underlying MCN and spectrum assets required to provide mobile communications services

Mode-S - Mode S is a Secondary Surveillance Radar process that allows selective interrogation of aircraft according to the unique 24-bit address assigned to each aircraft.

NMAC- Near Mid-Air Collision, an incident where two aircraft come dangerously close to colliding but do not actually make contact.

OfCom-The Office of Communications, commonly known as Ofcom, is the government-approved regulatory and competition authority for the broadcasting, telecommunications and postal industries of the United Kingdom.

OSC- Operational Safety Case, a document outlining the safety case for a specific aviation operation, such as unmanned aircraft operations.

OSO – Operational Safety Objective, a component in the SORA process in which compliance to a level of robustness is demonstrated

PDRA – Pre-defined risk assessment, is a shortened set of prescriptive conditions that must be complied with by a UAS operator in order to conduct a pre-determined type of operation. In these cases, the CAA conducts a risk assessment for the operation, to generate a list of mitigations. These mitigations are then published as a series of requirements and limitations. The Operator must demonstrate compliance with these mitigations within the operations manual, as part of a 'shortened' application for an operational authorisation

RAE – Recognised Assessment Entity, an entity recognised by the CAA in assuring competency.

RAE-F - Recognised Assessment Entity- Flightworthiness, an entity recognised by the CAA in assuring flightworthiness.

RAE-PC- Recognised Assessment Entity – Pilot Competency, an entity recognised by the CAA in assuring pilot competency.

RPC- Remote Pilot Certificate, a qualification allowing individuals to operate unmanned aircraft.

RPS - Remote Pilot Station, The component of the remote pilot aircraft system containing the equipment used to pilot the remotely piloted aircraft

SAIL- Specific assurance and integrity level, in the SORA process, it consolidates the ground and air risk analyses and drives the required activities. The SAIL represents the level of confidence that the UAS operations will stay under control.

SATCOM- Satellite Communication, communication using satellite technology to transmit data between two points on Earth.

SERA- Standardised European Rules of the Air, is a regulation that lays down common rules and operational provisions for air navigation. It applies to every aircraft operating in UK airspace and covers flight planning requirements, visibility, and other related aspects.

SME – Subject Matter Expert.

SRM – Safety Risk Management, A process within the Safety Management System composed of describing the system, identifying the hazards, and analysing, assessing, and controlling the risk

SVFR – Special Visual Flight Rules as per UK Rules of the Air (SERA), UK Regulation (EU) No. 923/2012

SWIM - System-Wide Information Management, a concept for managing and sharing aviation information across different systems and organisations.

TAF- Terminal Aerodrome Forecast, a forecast providing weather conditions at a specific aerodrome.

TDA - Temporary Danger Area, airspace designated as temporarily hazardous to flight due to specific activities or events.

TIS-B - Traffic Information Service-Broadcast, a service that broadcasts information about nearby aircraft to enhance situational awareness.

TLoS – Target Level of Safety, a threshold value for collision risk

TMZ - Transponder Mandatory Zone, airspace where aircraft are required to have an operating transponder.

TRA- Temporary Reserved Area, is airspace that is temporarily reserved and allocated for the specific use of a particular user during a determined period of time and Policy for the Establishment and Operation of Special Use Airspace through which other traffic may or may not be allowed to transit in accordance with the air traffic management arrangements notified for that volume of airspace.

UAS- Uncrewed Aircraft System, an aircraft operated without a human pilot on board.

UAT- Universal Access Transceiver, is a broadcast data link operating on 978 MHz, with a modulation rate of 1.041667 Mbps

UK SORA- UK Specific Operations Risk Assessment, UK SORA is a methodology for the classification of the risk posed by a drone flight in the specific category of operations and for the identification of mitigations and of the safety objectives

UKRI - UK Research and Innovation, a government agency responsible for funding and promoting research and innovation in the UK.

UTM - UAS Traffic Management, a system for managing the integration of uncrewed aircraft into airspace.

VFR – Visual Flight Rules as per UK Rules of the Air (SERA), UK Regulation (EU) No. 923/2012

VHF – Very High Frequency, is the ITU designation for the range of radio frequency electromagnetic waves (radio waves) from 30 to 300 megahertz (MHz)

VLOS- Visual Line of Sight, referring to operations where the remote pilot maintains direct visual contact with the uncrewed aircraft.

VOLMET3- Meteorological Information for Aircraft in Flight, a service providing weather information to aircraft during flight.

UK Civil Aviation Authority