UK Civil Aviation Authority

Regulatory Sandbox for the development of capabilities to integrate Unmanned Aerial Systems (UAS) in unsegregated airspace

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Introduction

The Civil Aviation Authority are inviting organisations to join its Regulatory Sandbox to trial systems to enable the integration of Unmanned Aerial Systems (UAS) into unsegregated airspace utilising the policy concept for temporary reserved areas (TRA). Our intention is that the integrated Concepts of Operation (ConOps) be trialled by appropriate industry stakeholders to support the ongoing development of CAA policy and understanding for UAS flights integrated with other airspace users. The call is open to individual organisations or consortia working on the development of UA systems (UAS) operating beyond visual line of sight (BVLOS).

1. Context

The Airspace Modernisation Strategy (AMS) presents the roadmap for the development and modernisation of UK airspace until 2040. One element considered within that strategy is the way that Unmanned Aerial Systems (UAS) operating beyond visual line of sight (BVLOS) will be integrated within the airspace system.

There is an expectation that this mode of aviation will expand rapidly in the coming years. To do so successfully, there is a need for such aircraft to be able to enter the airspace system routinely, without the need for special provisions, and to integrate safely in unsegregated airspace.

To enable the development of technologies and procedures to support the integration of UAS with crewed aviation, the CAA issued an Airspace Policy Concept: Airspace Requirements for the Integration of Beyond Visual Line of Sight (BVLOS) Unmanned Aircraft (CAP2533). It is strongly recommended that any potential applicant ensures they are familiar with CAP2533 before applying to this sandbox. It is also recommended that any applicant is familiar with the Airspace Modernisation Strategy (AMS).

The policy concept proposes the utilisation of a special use airspace (SUA) structure called a temporary reserved area (TRA) to enable the trialling of systems and approaches to safely enable the transition of UAS from segregated to unsegregated airspace in the UK. This process is referred to as ‘accommodation’, which is defined by ICAO as “the condition when a UAS can operate along with some level of adaptation or support that compensates for its inability to comply within existing operational constructs”.

A TRA is defined as an airspace that is temporarily reserved and allocated for the specific use of a particular user during a determined period of time, and 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.

The TRA adopts the background classification of the airspace it is in and may have additional requirements applied to enable the safe trialling or operation of aircraft within the TRA. The TRA is managed by an air navigation service provider (ANSP) in accordance with an agreed ruleset when the TRA is active, this ruleset could include for example:

- Entry only permitted if Electronically Conspicuous via a known system (e.g. ADS-B)
- Entry only via prior agreement with the controlling ANSP
- No access to airspace during the trials

It is this “accommodation” phase that will be utilised in this sandbox to enable UAS operators to test and trial their approaches to operations in integrated airspace within a safe and controlled environment. This may be achieved through technical and/or

procedural means, with various phases of testing with increasing levels of complexity as the assurance of the systems and approaches envisaged are tested and proved.

2. Objectives of the sandbox

Our intention is for appropriate industry stakeholders to test and trial concepts which develop methods of integrating UAS with crewed aircraft within defined volumes of airspace to support potential future operations in unsegregated airspace. This will enable the ongoing advancement of the use of UAS and as a result, inform the CAA in the development of the corresponding policies and regulations.

The objectives of the sandbox are to:

- Demonstrate technologies, airspace management procedures and Air Traffic Service (ATS) provisions, and flight operation procedures that may enable the safe and managed integration of BVLOS UAS and crewed aircraft.
- Enable participants to progress beyond segregation towards integration of BVLOS UAS flights with crewed aircraft and deliver integrated use of airspace.
- Enable the CAA to validate the use of the airspace policy concept with real world use cases to evidence how it supports and enables the accommodation phase.

To support the CAA in delivering future capability of the safe integration of BVLOS UAS flights in unsegregated airspace, sandbox participants are asked to identify how their trials will support one or more of the following key CAA enabling policy areas:

- Build specific safety arguments for management of air and ground risk
- Electronic conspicuity
- Detect and Avoid (Cooperative & Non-Cooperative)
- Unmanned Traffic Management
- Airspace requirements for integration of BVLOS unmanned aircraft
- Remote pilot competency
- Command and Control (C2) link
- FIS-B
- Service Provision needs and requirements for UAS in TMZ

Annex 1 of this document provides example questions that could be considered when building a narrative on how the proposed tests and trials will support development of the above policy areas by providing meaningful and specific data outputs.

The trial of the integrated ConOps will be delivered using the Regulatory Sandbox methodology.

The Regulatory Sandbox allows the CAA to develop policies that better meet the needs of the industry, and to shorten the lifecycle for developing these policies. This is achieved by following cycles of hypothesis-driven experimentation in a controlled and safe environment to accelerate learnings, eliminate unknowns and uncertainties, and rapidly converge towards the design of a policy. These cycles are called Build-Test-Learn cycles, Figure 1.

The Regulatory Sandbox is managed by the CAA Innovation Advisory Services team working in collaboration with the Remotely Piloted Aircraft Systems (RPAS) Unit and Airspace, Air Traffic Management & Aerodromes (AAA) Department.

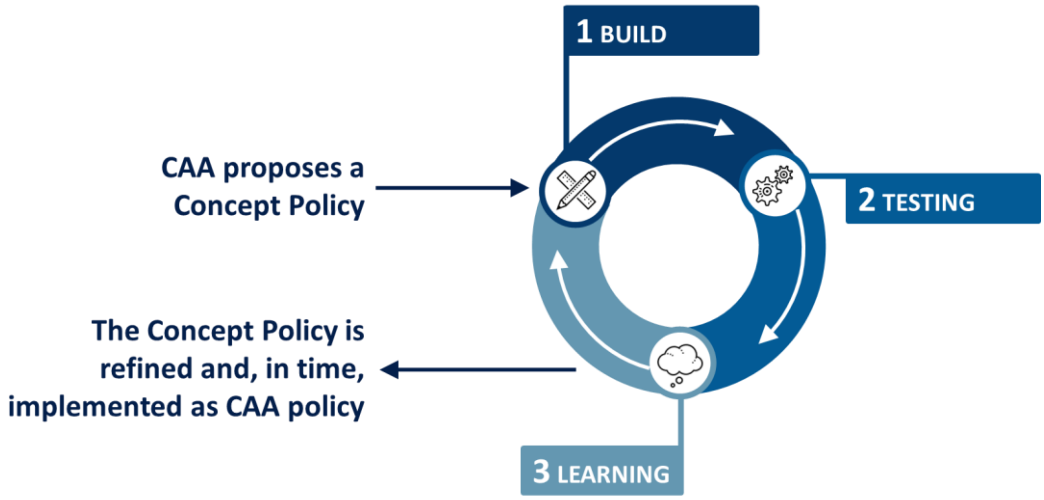

Figure 1. Functional aspects of the sandbox

Sandbox services do not predispose regulatory decision making:

Sandbox services do not, in any way, predispose regulatory decision-making. Regulatory decision making is made by the CAA's core regulatory teams that sit in another part of the CAA. Such outcomes remain the sole discretion of the relevant regulatory teams with reference to our statutory duties.

The Innovation Advisory Services team will continue to engage throughout the duration of trialling within the integration sandbox by the applicant to support the collection of data and evidence in support of CAA activities in the development of policies and guidance material to enable the delivery of integrated flight operations of UAS.

3. What we are looking for?

We are looking for organisations planning to conduct or manage BVLOS flights in unsegregated airspace. This includes all airspace classes – controlled airspace (Class A, C, D and E) and uncontrolled airspace (Class G).

The call is open to individual organisations or consortia working on the development of BVLOS operations of UAS.

We are seeking a range of end use applications for this sandbox to ensure we capture a range of data and knowledge. This includes, but not limited to, use cases such as:

- Delivery operations (medical, commercial, etc.)
- Development of test and trial capabilities utilising the flexibility of the TRA policy concept
- Surveying
- Search and rescue
- Security applications
- Academic development of UAS integration capabilities
- Validation testing of equipment and procedures against technical standards

The following are explicitly **excluded** from this Sandbox:

- Operations which are purely commercial and, in the view of the CAA, have no or minimal development of integrated ConOps
- Operations which can be conducted without the requirement for a TRA
- Operations outside of the jurisdiction of the CAA
- Capabilities with only military applications
- Applicants that are already participants in a TRA sandbox and the proposal is demonstrating similar operational capabilities and complexities

Sandbox applicants must be able to demonstrate the following conditions:

- There is agreement with an ANSP to manage and operate the TRA, which includes but is not limited to the provision of the required air traffic service within the TRA.
- That alongside the airspace management function and the provision of air traffic services in accordance with the background airspace classification, the ANSP is capable of providing flight information service to all airspace users to support the testing and trialling.
- The airspace change sponsor must be familiar with the process to submit an airspace change proposal in accordance with CAP1616.
    - Note: the CAA **will** provide appropriate support to the applicant through this process as the Airspace Requirements for the Integration of Beyond Visual Line of Sight (BVLOS) Unmanned Aircraft is a policy concept.
- The applicant must be able to explain how their participation in the sandbox will support the transition from segregation to integration.
- The UAS operator must be competent and experienced in applying for Specific category authorisations to conduct BVLOS flights.

  - Note: applicants must be able to create the operating safety case (OSC) without help from the CAA as that support is not part of the sandbox.
- The UAS operator is ready to conduct BVLOS flights in the TRA and can support the full duration of the test trial plan developed.

We will triage all the applications against the criteria above. We will onboard a limited number of candidates to match our capacity. Our decision on sandbox applicants will be final.

4. What you will get from us

The organisation(s) which enter the CAA Regulatory Sandbox will receive the support from a dedicated innovation advisor and from regulatory subject matter experts, who will:

- collaborate on the development of specific airspace management arrangements and flight operation procedures to enable safe operation of a UA within a TRA;
- provide feedback on the safety argument for BVLOS operations in unsegregated airspace;
- provide advice on the relevant policy concepts that are under development e.g. EC, DAA, UTM etc. to support appropriate testing;
- collaborate on the development of the trial plan for testing in the TRA to ensure both the CAA and participant objectives are realised via appropriate test data;
- provide a critical review of the test data obtained through operations in the TRA; and,
- ensure lessons learnt are presented in support of the development of UAS integrated operations.

All CAA support and access to subject matter experts for the sandbox activity will be free of charge to the selected participant(s). All other costs (e.g. regulatory applications, test and trialling, etc.) must be met by the sandbox participants.

5. Application process

A formal briefing session will be conducted on 10 January 2024 at 2pm to provide an overview of the Sandbox and provide an opportunity to ask questions of the Sandbox delivery team. Please register for this event here.

To apply, you will need to:

- Send an email to innovation@caa.co.uk to request an application form.
- Once received, complete the application form, ensuring you provide details of your proposed solutions for operating BVLOS in unsegregated airspace.
- Confirm that an Airspace Change Proposal will be submitted within six months of notification of acceptance in the sandbox.

Once the application form is completed it should be sent to innovation@caa.co.uk.

The sandbox will be delivered as a rolling programme, with several review dates. Applications received by the closing date for a particular tranche will be included in the review. Any application received after the closing date will be held until the next review date. After the final tranche, any application received will not be reviewed.

- Tranche 1
  - Closing date 23:59 on Thursday 1 February 2024
- Tranche 2
  - Closing date 23:59 on Thursday 29 February 2024
- Tranche 3
  - Closing Date 23:59 on Thursday 4 April 2024

The intention is that the outcome of the application sift will be notified to the applicant within four weeks of the closing date. Each tranche will onboard two applicants, with the total number of applicants onboarded for this sandbox being six.

All applications received will be reviewed as follows:

- Initial sift
  - Applications will be checked if they meet the minimum criteria specified in section 3.
  - All sections of the application have been completed.
  - Any application failing this phase will be **rejected** and the applicant informed.
- Second sift
  - All applications that have passed the initial sift will be assessed and scored by three people independently.
  - Any application not been passed to the next stage will be **rejected** and the applicant informed.
- Elevator pitch
  - Up to six applicants from the second sift will pass through to deliver an ‘elevator pitch’ to the panel in support of their application.

    - Details of the pitch process will be provided prior to this phase to successful applicants.
    - The elevator pitch sessions are targeted to occur for each tranche as follows:
        - Tranche 1 – week commencing 26 February 2024
        - Tranche 2 – week commencing 25 March 2024
        - Tranche 3 – week commencing 29 April 2024
- Decision conference
    - All applications that have reached the elevator pitch phase will be moderated by a panel that agree a moderated scoring for each section.
    - Applications will then be ranked by the total moderated score.

Upon completion of the review process, the outcome will be notified to the applicants with one of the following:

- Accepted onto sandbox
    - On confirmation from the applicant that they still wish to proceed and timelines in the initial application are still valid, the onboarding process will be started.
- Reserve listed
    - Applicants who have not made the initial selection will be reserve listed and provided feedback. The application will be reconsidered in the next tranche of applicants. Applicants may submit additional information in response to feedback to support their application.
- Rejected
    - Applicants who have failed to reach the minimum required standard to be included in the sandbox will be rejected and may, depending on feedback, be eligible to reapply for a future tranche.

NOTE: Successful applicants/consortia will be required to enter into a memorandum of understanding (MoU) and non-disclosure agreement (NDA) with the CAA. Please review the provisions of these documents as there will be no scope to negotiate them.

If you have any questions about the application process, please contact us through our email address: innovation@caa.co.uk.

Annex 1 – Critical learning examples for the proposed Trial Plan, Specification & Data Outputs

The policy concept and sandbox are intended to give industry stakeholders an environment where they can develop methodologies, procedures, and technology to further the ambition of integrated BVLOS UAS flight.

To demonstrate how the proposed integration can safely take place, the applicant should be considering technical questions that will be answered within the sandbox and what type of meaningful data, format and amount of data is required for each output being considered to add value to the statistical picture.

Examples of critical questions include:

ATS (ATM/UTM) service provision considerations

What is the proposed concept for lower airspace traffic management?

What procedures might ANSPs/UTM ANSPs need to apply and how do other airspace users interact with systems being trialled?

What are the Service Provision needs and requirements for UAS in TMZ?

What is the proposed ATS service provision concept i.e. FIS with surveillance based traffic information?

How is FID being deployed and for what mitigations i.e. what is its role and suitability for RPAS?

In the volume of airspace that is being proposed for the sandbox, what safety analysis is being undertaken to determine applicable requirements for this operation to be agreed between the ANSP and the UAS operator?

How will the operational risk assessment conducted by the UAS operator and the safety assessment of the change to the functional systems undertaken by the ANSP inform the design and establishment of the TRA?

In the design of the TRA, including the operating requirements and procedures what are the considerations with respect to the:

- safety risk(s) posed by the UA leaving the defined volume of airspace;
- operating characteristics and technical capabilities of the UAS;
- airspace operating environment in which the segregated airspace and/or TRA is proposed to be established (i.e. existing traffic mix and density);
- types of flights that may be permitted to transit a TRA;
- effect of the segregated airspace/TRA on instrument flight procedures (IFPs) contained within the volume of airspace;

- effects of wake turbulence on the UA that is generated by manned aircraft operating within a volume of airspace that adjoins the segregated airspace/TRA laterally and/or vertically;
- effects of meteorological conditions on the UA and;
- need to establish a 'recognised air traffic environment' and/or a 'known traffic' environment in order to mitigate the risk of mid air collision?

Electronic Conspicuity (EC)

EC is likely to form part of a BVLOS safety case to mitigate the mid-air collision risk. The EC team is currently conducting studies around airspace risk relating and the mitigations of EC, along with probability of detection, ADS-B capacity, and Human Factors. The following would aid identification of use cases that could support these studies:

What Electronic Conspicuity devices are you planning to deploy?

How does the Electronic Conspicuity solution that you propose reduce the risk within the specific airspace you intend to operate?

What is the potential for integration between existing and new EC systems (based on the technical details of the solutions deployed)?

How could the data from EC devices be integrated by ground infrastructure (what information is available from the ground?)

How will that ground infrastructure integrate with other operational systems including C2?

What is the effectiveness of systems being utilised for EC with regard to:

- successful message rate;
- range;
- data capability;
- latency and;
- mitigating vulnerability to spoofing/jamming of GNSS and the EC system itself?

What happens if there is a loss of GNSS signal?

Does your platform and/or ground network include a backup source of position e.g. onboard INS / triangulation of signal using a ground network / RADAR / Beacon systems etc.?

How is traffic displayed to the pilot / operator?

How does the position accuracy compare to published standards and previous studies?

Detect & Avoid

What detection technologies are being explored?

The CAA's DAA Policy Concept is under development and due to be published in the near future. Following that publication, the sandbox participants should consider:

- How does your proposed DAA system align with the CAA's DAA Policy Concept?
- How does the proposed requirements of the CAA DAA Policy Concept impact on the commercial model?

TIS-B

Should a participant propose to discharge their obligations in the provision of surveillance-based traffic information using TIS-B? What data does the participant propose to transmit? For what purpose?

Consideration needs to be given to the reliability of the data being transmitted and the use of such data. Will it be used simply for traffic awareness or will the data be relied upon for collision avoidance?

Are there any novel concepts being proposed?

Will the transmission be co-located with ground infrastructure that might be part of the wider communications system?

Communications, Navigation, Surveillance & Spectrum

What type and level of surveillance will be required (reference the EC section above)?

How will surveillance be used?

What are the installation complexities and challenges for all radio systems utilised?

How does communication with other airspace users work if applicable?

Are there any licencing challenges for elements of CNS&S?

Command and Control (C2)

What technologies are being deployed as part of the C2 links system?

What are the antenna types, operating frequencies and bandwidths being utilised?

What are the arrangements are in place with third party communication providers?

What are spectrum allocation and licensing arrangements for the C2 links?

What is the C2 link performance and characteristics for BVLOS with regard to:

- range;
- stability;
- availability;
- continuity;
- latency;
- transaction expiration time;
- radiated signal strengths;
- coverage volume;
- link budget;
- the maximum range under normal conditions and;
- the effect of RPA altitude on range?

What are the minimum acceptable data rates (uplink and downlink) of the C2 Links?

What is the link independence for multi-link systems?

What link integrity in terms of Safety Integrity Level and Development Assurance Level?

For the C2 links, what failure modes exist and what causes analysis understood?

In the event of C2 lost link what measures are being deployed for:

- error correction protocols;
- declaration time;
- protocols;
- recovery protocols;
- RPA automation capabilities, behaviour and flightpath and;
- link-handover protocols?

What are the cyber security threats and how will they be mitigated?

Remote Pilot Competency

What remote pilot training is being proposed for the operations?

What combined training is being provided between the ANSP and Operator?

What is the communication strategy with regard to technologies and radio integration with existing systems?