UK
Civil Aviation
Authority

Innovation Hub

Detect and Avoid for BVLOS Operations

Sandbox Challenge Announcement

Introduction

The CAA Innovation Hub is launching a series of Technology Demonstrators aiming to inform the development of frameworks for approving and certifying Detect and Avoid solutions.

For Remotely Piloted Aircraft Systems (RPAS) to be fully integrated into existing airspace, and for commercial Beyond Visual Line of Sight (BVLOS) operations to scale up, certifiable Detect And Avoid (DAA) solutions need to become a reality.

Even though DAA technologies are rapidly advancing, frameworks and standards for approving and certifying DAA systems are still in early stages of development. Given recent and ongoing technological advancements, we plan to inform the development of the regulatory frameworks by examining the key enabling technologies in more detail.

We are pleased to announce that over the coming months, the CAA Innovation Hub will be launching three separate Technology Demonstrators as part of the DAA Challenge, each of which will investigate a key technology enabler for DAA.

As described in CAP1861A, it is expected that a complete DAA Solution is likely to include some combination of different technologies and sensors. Industry and academia who are developing DAA technologies and solutions are invited to participate in any of the following Technology Demonstrators:

- Non-Cooperative Sensors
- Electronic Conspicuity (EC)
- Traffic Management, including UTM

More information on each of these technologies, as well as some of the challenges around each one, can be found on pages 4-6.

The goal of the Technology Demonstrators is to explore the performance requirements of DAA technologies, investigate the applicability and sufficiency of various technical standards for UK airspace, and explore requirements for UK Technical Standard Orders (TSO) for DAA equipment.

The DAA Challenge, through these Technology Demonstrators, will provide unparalleled benefits to both the CAA and Industry. Certified DAA systems will unlock routine BVLOS operations and enable RPAS operations to be conducted safely at a larger scale. This is one of the key enablers for removing airspace segregation.

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The Challenge

Since the formation of the CAA's Innovation Hub, one of the main areas of interest has been RPAS operations, specifically Beyond Visual Line Of Sight (BVLOS) in non-segregated airspace.

In 2019 the Innovation Hub announced its first sandbox challenge, inviting entities interested in conducting BVLOS operations to submit their proposals (Concept of Operations). Since then, we have worked closely with a number of companies and consortia, investigating the risks of such operations, as well as potential mitigations to those risks. These sandbox projects have helped us to further define our approach to this type of operations and have led to two key publications: CAP1861 and CAP1861A. We are now looking to work with industry and academia once again to expand our understanding around the technologies that have the potential to unlock routine BVLOS operations.

As per CAP722, for BVLOS operations to be approved, at least one (or a combination) of the three conditions below needs to be fulfilled:

1. A technical capability which has been accepted as being at least equivalent to the ability of a pilot of a manned aircraft to 'see and avoid' potential conflictions. This is referred to as a Detect and Avoid (DAA) capability.
2. A block of airspace to operate in which the unmanned aircraft is 'segregated' from other aircraft
3. Clear evidence that the intended operation will pose 'no aviation threat' and that the safety of persons and objects on the ground has been properly addressed. (Includes operations in 'atypical air environment')

So far, operations have been approved mainly based on conditions 2 or 3. However, as these conditions limit the up-scale of BVLOS operations, we must progress towards enabling condition 1 where certifiable DAA solutions are necessary for routine BVLOS operations in non-segregated airspace.

The two main functionalities of a DAA solution are to ensure that the aircraft "Remains Well Clear" (RWC) of other airspace users and obstacles and provides a "Collision Avoidance" (CA) functionality when and as required, as per ICAO Annex 2.

To accomplish the two main functionalities, JARUS also define five main DAA sub-functions which are:

1. Detect
2. Decide
3. Command
4. Execute
5. Feedback Loop

Depending on the operating environment, DAA solutions should be able to detect two types of airspace users: Cooperative and Non-cooperative. Cooperative aircraft are considered airspace users who can provide, either actively or upon interrogation, their position, speed, altitude and heading as a minimum, but may also include their planned route and destination. Non-cooperative aircraft are airspace users who do not provide the above information due to not being electronically conspicuous.

This challenge is aimed primarily towards DAA solutions that are intended to be used to support BVLOS operations in the Specific category. Furthermore, the challenge is more suited to systems supporting operations outside of controlled airspace

Technology Demonstrators

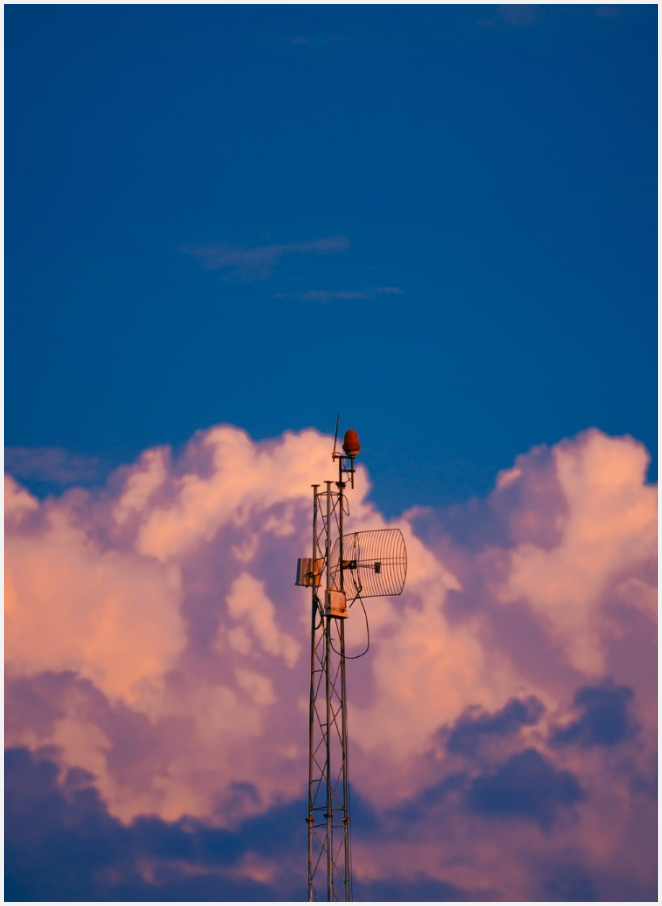
The Technology Demonstrators will look to further investigate the three main DAA technologies and the challenges around each one.

Non-Cooperative Sensors

Non-cooperative sensors, as the name suggests, are sensors that are used to detect aircraft that are not electronically conspicuous. Such sensors could be either ground based or airborne (onboard the platform) and could be anything from Electro-Optical/Infra-Red (EO/IR) and vision-based systems to acoustics and radar-based; each having its own benefits and drawbacks.

It is expected that BVLOS operations in uncontrolled/class G airspace will need to include one or more non-cooperative sensors due to the lack of mandate for EC equipage in this type of airspace.

As non-cooperative sensors are essentially substituting an onboard pilot flying under Visual Flight Rules (VFR) it is expected that the system will be able to perform at least to an equivalent level of performance. Even though there has been research undertaken in assessing the performance of the human eye, it is not always as straightforward to be used as a benchmark or to be directly comparable to.



Non-cooperative sensors pose a series of challenges when it comes to assessing them and certifying them, depending on their type. Sensors utilising different types of technology will require different performance metrics, however, they will eventually have to be assessed against common target levels of safety. The use of non-deterministic and/or probabilistic methods of detection further exacerbates challenges around validating the performance of such systems.

Other design aspects of such systems also need to be taken into consideration, from ensuring efficient and robust data fusion methods are used in the case of multiple sensors, to ensuring compliance with relevant regulations around spectrum usage.

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Technology Demonstrators

Electronic Conspicuity

Electronic Conspicuity is an umbrella term for technologies that can help airspace users and air traffic services (ATS) to be more aware of the aircraft operating in the same piece of airspace. The phrase 'EC solutions' refer to the devices, systems and infrastructure that bring these technologies to market and ensure they are interoperable. Airborne transponders, moving map displays, air traffic data displays, ground-based antennas and satellite surveillance services are examples of EC solutions. The information generated by EC solutions can be presented to pilots and ATS visually, audibly, or both.

EC solutions are co-operative, requiring users to carry suitable devices to transmit and receive real-time data about an aircraft's position, trajectory, and speed. The requirement for co-operation creates challenges when the goal is to establish a fully known surveillance environment using EC.

One of the main challenges around EC is the lack of a common technological standard. Co-operative systems rely on the co-operation of all aircraft within airspace, and it is therefore only effective if all the aircraft are communicating on a common or interoperable technological standard.

There is also a lack of approved EC devices specifically for RPAS. The CAA RPAS unit approves any EC device for UK use only if it is either on the list of CAP1391 approved EC devices or holds approval from the FAA or EASA in the form of a TSO. Currently, the majority of the RPAS EC devices falls outside the scope of CAP1391 and manufacturers rely on FAA/EASA TSO to sell their products in the UK. Furthermore, CAP1391 devices are generally low power ones and there are limitations on airspace usage.

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Technology Demonstrators

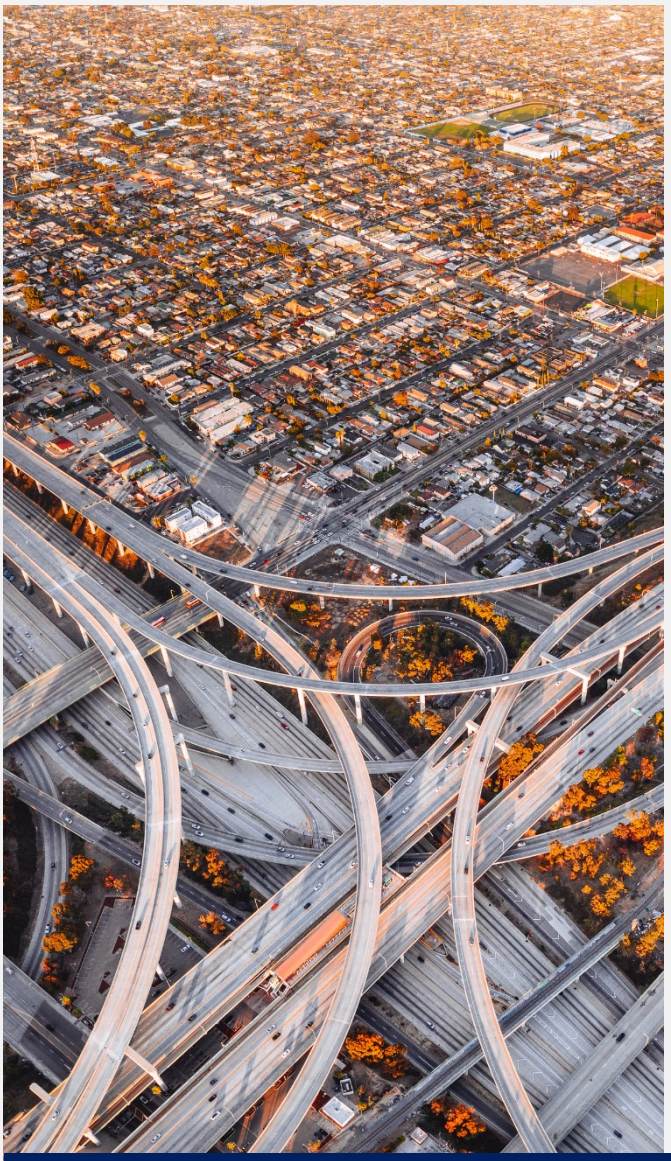
Traffic Management including UTM

Complementary to non-cooperative sensors and electronic conspicuity, traffic management technologies and services are necessary to ensure the safe and efficient movement of aircraft during all phases of operation (as stated by ICAO). In parallel with typical air traffic management functions, such as approvals for take-off and airspace access, compliance monitoring, and flight planning, traffic management will provide the RPAS operator with additional DAA information beyond what is provided by non-cooperative sensors and electronic conspicuity.

There are specific elements of the traffic management ecosystem that can directly support DAA. For example, strategic deconfliction services may allow the operator to understand the likely air traffic that they will encounter during the flight; tactical deconfliction may provide additional awareness of live local traffic and even present recommendations to maintain suitable separation; weather information may allow the operator to ensure that a flight is either adjusted or cancelled depending on the weather conditions.

As a subset of Air Traffic Management (ATM), UAS Traffic Management (UTM) provides a seamless set of services in collaboration with all parties and involving airborne and ground-based functions. This digital ecosystem enables bespoke traffic management services to be provided for specific operations, allowing them to be tailored to the needs of the local environment and the operation itself.

There are initial indications of the challenges associated with utilising traffic management, including UTM, within a DAA solution. Further work is required to explore and understand these in detail. Simultaneous to this Technology Demonstrator, the CAA is also exploring the regulatory challenges associated with the setup, running, and oversight of UAS Traffic Management providers and services. This is expected to uncover regulatory gaps in legislation, regulations, guidance material, or elsewhere. There are expected to be a subset of regulatory challenges which originate specifically from DAA, and how UTM contributes to the quantitative and qualitative safety arguments for BVLOS in non-segregated airspace.



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Expression of Interest

We welcome expressions of interest from DAA manufacturers, developers, and operators, to participate in any, or all, of the three technology demonstrators.

Expressions of interest and any eventual applications are welcome from outside the UK, but they will be assessed from the perspective of the regulatory framework applicable in the UK.

More information as to the application requirements and assessment criteria will be made available as part of each of the Technology Demonstrators when they're launched.

Visit the CAA Innovation Hub online for latest updates, guidance and challenges – caa.co.uk/innovation

To register your interest, please send an e-mail to innovation@caa.co.uk with the following information:

- Company/Entity name
- Individual (point of contact) full name
- E-mail address (if different)
- Which of the three TDs you intend on applying for (one or more):
    1. Non-Cooperative Sensors
    2. Electronic Conspicuity
    3. Traffic Management including UTM

Please note that expression of interest does not guarantee you a place for any of the technology demonstrators. Each demonstrator will be launched independently with its own application process and criteria, and each application will be reviewed on its own merit.

The Innovation Hub does not provide regulatory approvals or define CAA Policy. Approvals will be assessed independently by our regulatory teams and their decision about whether or not to grant an authorisation or approval will be subject to current regulatory requirements. Whilst the Innovation Hub endeavours to ensure the accuracy of its guidance and materials, the nature of innovation is one of forecasting, continuous development and change and you should seek independent advice on your specific circumstances.

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