UK Civil Aviation Authority

Innovation Hub

Detect & Avoid Ecosystem

For BVLOS in Non-Segregated Airspace

Overview

The purpose of this guide is to build on the concept of a Detect & Avoid Ecosystem, and to provide a framework to support the development and eventual approval of a proposed DAA solution.

In October 2020 we updated our guide, CAP1861, on the fundamentals of flying Beyond Visual Line of Sight (BVLOS), the current need for airspace segregation, which also shared our thoughts on the concept of a Detect & Avoid *Ecosystem*. Page 3 provides a quick reminder.

There are a number of functions that contribute to the DAA Ecosystem, outlined on page 4. It is your responsibility to consider each of these in the context of your operation.

The definitions of each function of the DAA Ecosystem are provided on page 5 to help you define the design of your DAA solution.

The DAA Ecosystem functions have the potential to demand complex technological and procedural solutions. The DAA Evidence Framework on page 6 is provided to help you to understand and describe your proposed solution.

To further explore these issues and opportunities, we will be working closely with our Sandbox participants, and will continue to share learnings of the DAA Solutions that are tested. Page 7 provides a brief overview of the next steps.

Finally, it should be noted that CAP722, CAA's Unmanned Aircraft Systems Policy & Guidance, referenced on page 8, remains as the primary reference point for operating BVLOS.

BVLOS in Non-Segregated Airspace

In October 2020 we updated our guide, CAP1861, on the fundamentals of flying Beyond Visual Line of Sight (BVLOS), the current need for airspace segregation, which also shared our thoughts on the concept of a Detect & Avoid Ecosystem.

This additional guidance takes the next steps on from CAP1861 by further describing the methodology for Detect & Avoid (DAA). But before we do, here's a reminder of the key points.

- Detect & Avoid is an Ecosystem
- There is no 'silver bullet' solution for DAA
- A DAA solution is dependent on the specifics of the operation and the environment.

DAA Ecosystem

The DAA Ecosystem describes the architectural framework for DAA.

This CAP provides more information on the DAA Ecosystem.

DAA Solutions

A DAA Solution is the method by which you will apply the DAA Ecosystem to your specific operation.

There will be many DAA Solutions for different operations.

The DAA Solution Matrix

We also identified that a DAA Solution is likely to include some combination of the following technologies:

Ground-Based Infrastructure
Supplementing the ability to detect cooperative and non-cooperative aircraft

Electronic Identification & Conspicuity*
Identification, position, speed, heading and altitude

On-Board Detect & Avoid Equipment
Sensors for detect & flight controllers for avoid

Traffic Management
Data fusion, processing and presentation, traffic management services, plus ATM interaction

**Electronic Conspicuity primarily contributes to being detected by other aircraft, but is also intended here as a means to detect other cooperative aircraft.*

Detect & Avoid (DAA) Definition

The capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.

- ICAO

DAA Ecosystem Introduction

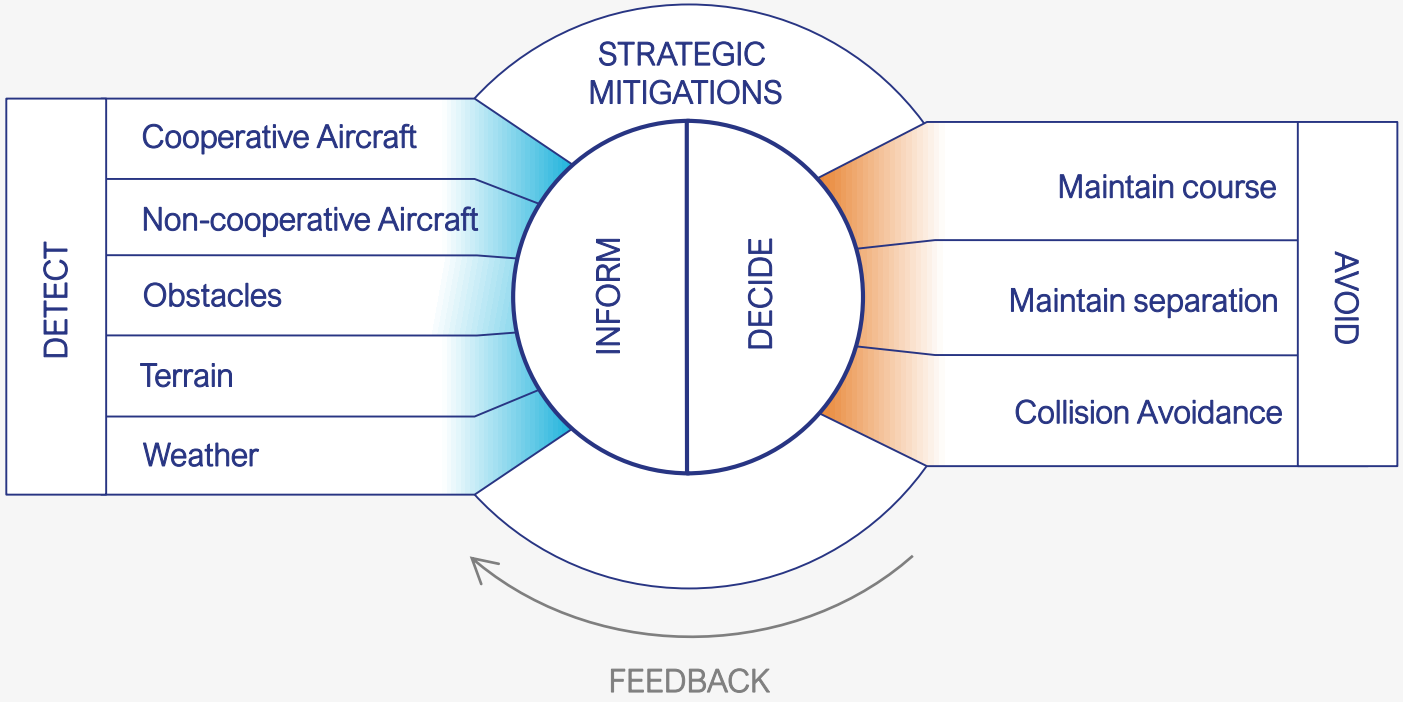
There are a number of functions that contribute to the DAA Ecosystem. It is your responsibility to consider each of these in the context of your operation, and proposed DAA solution.

The DAA Ecosystem is shown below and divides DAA into a number of phases including detection of hazards, informing the remote pilot, deciding the appropriate action, and carrying out that action.
It is described here in a way that reinforces the importance of key attributes, such as the 5 necessary functions of 'detect'.

It also includes strategic mitigations, such as agreed deconfliction procedures with local airspace users. These provide a context for a specific DAA Solution and are necessary for each operation.

While the DAA Ecosystem indicates an end-to-end process, any solution should cycle through detect, inform, decide and avoid throughout the operation, as per the feedback loop shown.

Page 5 provides descriptions of each function, and Page 6 gives you a template for capturing the specifics of your DAA Solution.



DAA Ecosystem Definitions

The definitions of each function of the DAA Ecosystem are provided to help you define the design of your DAA solution.

Strategic Mitigations - Any risk reduction measures that are established before the operation is conducted, but which are applicable during the flight, e.g. defining the safe separation distance between your aircraft and others.

Cooperative Aircraft - Any other airspace user who is able to 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 - Any other airspace user who is not a Cooperative Aircraft.

Obstacles - Either man-made or natural obstacles, such as buildings, cranes and trees.

Terrain - Land and its physical features, including local sea level where appropriate.

Weather - That might affect the safe operation of the aircraft.

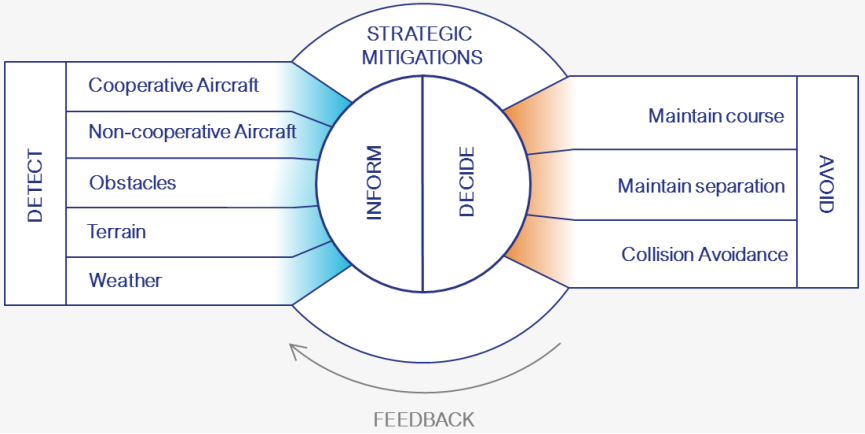
Inform - How is the information regarding a detected hazard processed and used to inform the remote pilot?

Decide - How the decision is made as to the appropriate action, based on the information provided.

Maintain Course - Maintaining the present course may be the most appropriate action to reduce the risk of collision.

Avoid to maintain separation - Avoidance manoeuvres in order to maintain the safe separation distance that has been set as part of your strategic mitigations.

Tactical Collision Avoidance - The intruding aircraft has reached a closer proximity and therefore immediate or emergency manoeuvres are required in order to avoid a collision.



DAA Ecosystem Evidence Framework

The DAA Ecosystem functions have the potential to demand complex technological and procedural solutions. The DAA Evidence Framework is provided to help you to understand and describe your DAA Solution.

The evidence framework helps you to appreciate the breadth of capabilities demanded by a DAA Solution. It also helps the CAA to understand the technological and regulatory readiness of your proposal and provides a structure for our discussions with you.

Applicants to the CAA Regulatory Sandbox for BVLOS operations in Non-Segregated Airspace are asked to complete this framework.

DETECT & AVOID ECOSYSTEM		CONOPS	TARGET PERFORMANCE	TESTING
STRATEGIC	Mitigations			
DETECT	Cooperative Aircraft			
	Non-cooperative Aircraft			
	Obstacles			
	Terrain			
	Weather			
INFORM				
DECIDE				
AVOID	Maintain Course			
	Maintain Separation			
	Tactical Collision Avoidance			

Refer to the BVLOS in Non-Segregated Airspace Sandbox Challenge v2 (CAP1827) for more information

Concept of Operations (ConOps)

How will your solution satisfy the DAA functions and how will these functions perform for your proposed operation and location?

Target Performance

What are the target performance measures that you believe you are able to achieve for a safe, routine and sustainable operation?

Testing

How will you incrementally test your DAA Solution and demonstrate that it meets the performance targets?

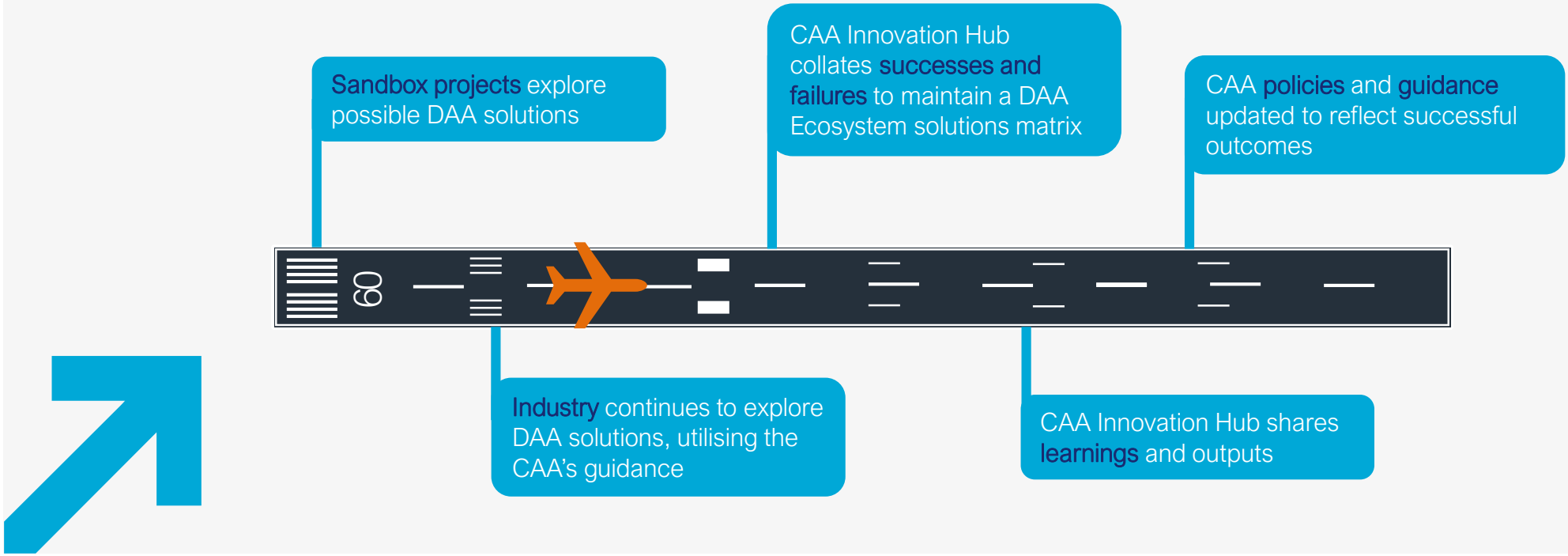
What Happens Next

To further explore these issues and opportunities, we will be working closely with our Sandbox participants, and will continue to share learnings from the DAA Solutions that are tested.

In August 2019 we published our first Sandbox call: Beyond Visual Line of Sight in Non-Segregated Airspace (CAP1827). Through further exploration of the issues, and working closely with applicants of the sandbox, we subsequently refined the regulatory challenges.

While it is recognised that there are a number of significant challenges of operating BVLOS, the Regulatory Sandbox for BVLOS Operations focuses on the importance of Detect & Avoid for operations in non-segregated airspace.

Through exploration of the DAA Solutions being proposed and tested in the Sandbox, as well as those being tested elsewhere across the world, we hope to begin to build up a case of evidence in partnership with our CAA regulatory teams to support new enabling policy and regulatory guidance in the future.



Further Information

Further Information

The CAA's Guidance and Policy for Unmanned Aircraft Systems in UK Airspace, CAP722, should always be your first point of reference.
https://publicapps.caa.co.uk/CAP722

The additional guidance below may help you to understand the challenges and ways of working with us to tackle them.

CAP1827 – Beyond Visual Line of Sight in Non-Segregated Airspace: Sandbox Call
https://publicapps.caa.co.uk/CAP1827

CAP1861 – Beyond Visual Line of Sight in Non-Segregated Airspace: Fundamental Principles & Terminology
https://publicapps.caa.co.uk/CAP1861

CAP1930 – Testing Novel Technology in UK Airspace
https://publicapps.caa.co.uk/CAP1930

CAP1900 – Social Licence to Operate: Concept Guide for New Technologies
https://publicapps.caa.co.uk/CAP1900

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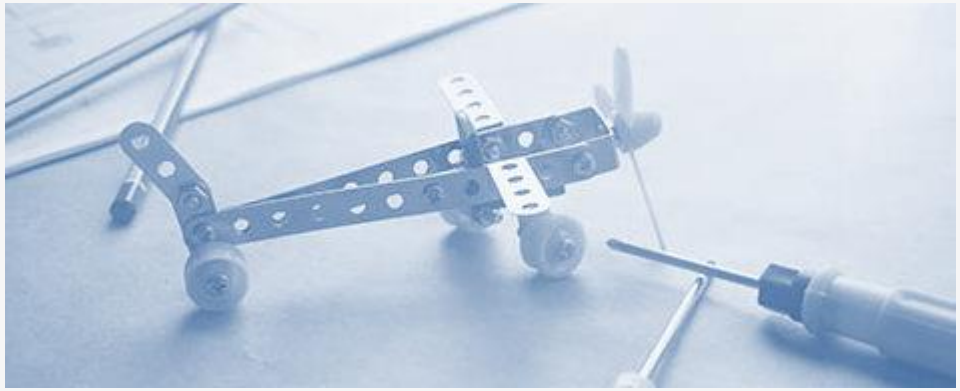

About the Innovation Hub

For technology innovators across the world developing the aviation solutions of tomorrow, the CAA is an important partner, advisor and enabler to help them bring their innovations to the market.

Our job is to help technology innovators working on drones, air taxis and other new aviation concepts, take their ideas to market in a safe, secure and sustainable way.

To do that we have to work collaboratively so that we can get regulation moving ahead of time to support their innovations, instead of holding them back.

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