PHASE 3 REPORT

DEFINITION OF THE REGULATORY STANDARDS AND REGULATORY FRAMEWORK ROADMAP

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Document information

GENERAL INFORMATION

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V0.2	01-July-2022	Andrew Burrage, Ludo Gabris		First draft of roadmap.
V0.9	02-Aug-2022	Andrew Burrage, Ludo Gabris	Andrew Burrage	Updated roadmap based on CAA comments
V1.0	30-Aug-2022	Andrew Burrage, Ludo Gabris	Andrew Burrage	Updated based on DFT and CAA comments

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Executive Summary

The Civil Aviation Authority (CAA) was tasked by Department for Transport (DfT) to "*develop Surveillance specifications that take into account future requirements for all aviation including drones and not be an unintended barrier to innovation in future electronic conspicuity functionality*".

This is the third report (D3) developed by Egis following previous two project phases exploring the potential minimum specifications to support beneficial applications enabling Remotely Piloted Aircraft Systems (RPAS) and the wider Airspace Modernisation Strategy (AMS).

In order to understand the conclusions from Phase 3, this Executive summary provides also overview of the first two phases.

The aim of the first report was to address:

- Impact of evolving environment and implications from Airspace Management Strategy (AMS), what this means in terms of a need for Electronic Conspicuity (EC) and the benefits enabled by having EC;
- What this evolution means in terms of the required changes to regulations / standards and the direction that the international community is going to address these same problems similar to the UK – including TIS-B and
- Presenting the impact of the CAA commissioned study exploring the most efficient way to use 1090MHz and 978MHz frequencies.

The Phase 1 report outlined an analysis of the role for and existing solutions for EC today within the UK and an initial estimate of the penetration of these solutions within the aviation sector applicable to the airborne and ground segments. Considering these solutions and the future evolution of requirements in the airspace, a number of options have been proposed and assessed from which a possible electronic roadmap could be developed. This was fully in line with the task the CAA received from the Department for Transport to "develop Surveillance specifications that take into account future requirements for all aviation including drones and not be an unintended barrier to innovation in future EC functionality".

The publication of the UK's Airspace Modernisation Strategy (CAP2298) has at its heart the ambition to enable better integration of all airspace users. This is central to the future evolution of airspace providing greater openness and access to controlled airspace for existing users but also facilitating the introduction of new airspace users such as drones and urban air mobility in particular. An expansion of EC is considered an enabler for dynamic use of the airspace, accommodate different stakeholder needs in a more sustainable way and supporting the provision of additional services that these users may require. Creating a known traffic environment with interconnectivity between aircraft can be expected to lead to additional innovative use of new platforms and development of advanced control systems and automation applied to drones and drone traffic management. All this is in line with the UK governments strategy to support aviation innovation.

The concept of EC has for several years been recognised as being of benefit to all airspace users, but there has not been a definitive step taken forward that provides a clear roadmap of what solution would be needed to support the operational environment of tomorrow. Indeed, without any requirements being tabled, a number of innovative solutions have been developed and are available today although not fully interoperable. The lack of interoperability has been addressed in some solutions that provide a way to merge data received from multiple sources to provide a composite solution to flight crew as an aid to situational awareness.

Despite these innovations, the airspace today is not integrated, and the integration of the new users requires the creation of Temporary Danger Areas (TDAs) for Beyond Visual Line of Sight (BVLOS) operations. In an already congested airspace environment, this does not encourage interoperability and has safety implications of constricted airspace and increasing reliance on the use of EC and position information for avoidance of other traffic and, in some cases, controlled airspace. The alternative is the creation of known traffic environments using Transponder Mandatory Zones (TMZs). The recent change enabling the use of EC devices as part of a TMZ (subject to sponsor need and safety case) enables more aircraft to use the TMZ.

The recent publication of updates to the CAA CAPs (797, 670) on the use of a flight information display brings the possibility of EC data received and displayed on the ground for situational awareness aids. The need to enable deconfliction advisories and (potentially) crossing services, requires some guarantee of the quality of the data transmitted and received, which then becomes critical to maintaining confidence in the performance of systems. This point is highlighted in the CAA's own guidance on the safety considerations for the use of applications without obtaining the necessary approvals and authorisations associated with a conventional surveillance system. Thus situational awareness can cause confusion when used as supplementary input without assurance on the quality.

The solutions have been shown to reach a good level of penetration across the different aviation stakeholders supporting new ground and air applications of surveillance and system interoperability – in addition to situational awareness – that enable the goals of the AMS, and the vision of an integrated future airspace such as:

- ICAO Flight Information Services using surveillance (Class G or Class E), particularly deconfliction advisories,
- Crossing service (e.g. Danger Area, ATZ),
- Supporting UAS detect-and-avoid, and
- Supporting on-board deconfliction and collision avoidance systems (Hybrid Airborne Collision Avoidance System (ACAS) / ACAS X).

The phase 1 report has shown that there are a number of possible options which could be deployed to provide the proposed roadmap towards an EC policy and deployment. To assess the options, a number of drivers and constraints were defined which the different solutions would need to pass to meet the goals of the AMS and the applications listed above.

The impact of each of the options has taken into account the analysis earlier in the document including the existing regulatory environment, ability to support the applications, cost implications of making any changes to the existing fleet equipage and changes that would be necessary on the ground and assessed against the drivers and constraints. Based on the Multiple-criteria decision analysis (MCDA) analysis the top 5 options, in order, were assessed as:

- **Option 5B:** This is a general mandate for all airspace users to equip with regulated EC devices. In this option, manned aircraft use 1090MHz, drones will use 978MHz.
- **Option 3A:** This option is a mirror of Option 5B with the adoption of existing global standards for EC. The option is only mandated in specified airspace volumes and remains voluntary elsewhere.
- **Option 3D:** In this model, the same approach as taken by the FAA in the United States is followed. This results in a general mandate for 1090MHz for aircraft operating in Class A airspace and above FL180. Other specified airspace requires equipage of 978MHz EC solutions. Given the wider mix of solutions, this option also utilises ADS-R/TIS-B to provide a complete air picture for situational awareness.
- **Option 5C:** This option provides a mandate for all airspace users to equip with EC devices like option 5B. However, unlike Option 5B, this option proposes that aircraft already equipped with EC on 1090Mhz do not change. All other aircraft not equipped fit equipment that meets a new Design Assured Performance Based Standard operating within the aviation protected spectrum.
- **Option 4D:** This option is a mirror of Option 5C requiring the development of a new Design Assured Performance Based Standard that can be voluntarily used by aircraft except where mandated for specific airspace. Existing aircraft equipped with EC on 1090MHz do not have to change.

The analysis performed under Phase 1 has determined that for the new applications to be provided that are envisaged within the AMS, position data of a known quality needs to be provided to ATM systems (or other systems as may be providing deconfliction services to other aircraft – manned or unmanned). This data of a known quality needs to be standardised and protected to ensure that the performance remains controlled and a known quantity. The option assessed as bringing the most benefit is a full mandate.

However, the introduction of a full mandate brings with it numerous constraints – not least of which is the opposition of the airspace users which would be affected by the mandate. The cost and the transition need to

be timed to ensure that the burden is proportionate to the general population of the airspace users wishing to gain access – and noting that a cost effective solution may – or may not exist. Integration on the ground and in the air also takes time with systems interfaces systems upgrades being required..

The analysis has also shown that the penetration of 1090MHz within the UK aviation fleet is still low overall. It has improved rapidly over the previous survey undertaken by Airspace4All at the LAA rally, but is still below a threshold of 80% equipage in which a general mandate would normally be expected to apply with existing penetration.

Nevertheless, it is clear from the options appraisal that moving towards an environment in which EC was based on 1090MHz for manned aviation and 978MHz for unmanned aviation would deliver against known performance standards, ease the integration with existing ATM systems – including additional certification – and allow for more airspace users to be accommodated without overloading spectrum.

Therefore, rather than taking the step straight to a mandate (Option 5B) it has been recommended that the intermediate step of **Option 3A** is implemented as the UK solution to EC. This option allows for the certainty of knowing what the end goal of implementation is to address the current and future EC goals.

It has been recommended that Option 3A be taken to Phase 2 of the study to further develop the concept of operations, information needs, architectures and high level safety and interoperability assessment within the context of current and future environments identifying what new requirements may be needed, indicative costs, and what regulatory changes (primary and secondary legislation) and policy would support an effective deployment of Option 3A.

Considering the Option 3A, the bounded requirements give some viable minimum specifications which could act as a building block for the supported applications. It has been recommend that a more formal analysis should be conducted to ensure that the safety and performance of the enhanced EC data will be sufficient.

A regulatory approach similar to CAP1391 gives flexibility in specifying an appropriate standard for enhanced EC devices, leveraging existing regulatory and standards work from around the world. Use of ADS-B OUT over 978MHz (UAT) allows new airspace users to leverage protections provide for aviation spectrum, without risking frequency occupancy issues.

Using ADS-B standards greatly simplified the required regulatory/standards framework changes (compared to a novel standard) and enables hybrid ACAS and wider interoperability. The changes that would be required in the UK regulatory framework extend well beyond simply Minimum Aviation System Performance Standards (MASPS) or Minimum Operational Performance Standards (MOPS) for EC devices, however there are global standards that could be referenced in most cases, and changes to overarching CAPs (such as CAP 670) would be very minor. The adoption of 978MHz for EC and analysis to derive appropriate standards to balance performance needs against cost will be the most challenging aspects, but again can leverage standards develop elsewhere.

In terms of costs, both avionics, and ground-based receivers are available on the market (potentially through assembly of existing components in the case of avionics), to support the rapid adoption of the proposed enhanced EC solution.

It will be necessary to tackle specific issues around achieving the required probability of detection performance whilst balancing costs for airspace users. Probability of detection depends upon both the ground and airborne elements of the system, although the ground elements are mature and their performance is not constraining. The airborne contribution is more complex:

- Basic EC devices (CAP1391) are not subject to any requirements in terms of installation and antenna capabilities, which means the performance cannot be assured.
- Certified devices have strict installation requirements, which would meet performance needs, but drive costs outside the desirable range.

This results in the need for novel installation guidance, sensitive to the constraints of different airspace users, developed through activities are identified within the roadmap.

Government subsidies may also be required to encourage initial enhanced EC devices to achieve a desirable cost for airspace users to adopt and trigger a positive cycle that sees manufacturers invest in developing the devices.

Factoring the gap analysis of the UK regulatory regime for the selected option 3a from the Phase 1, the Phase 3 report sets out a proposal for the roadmap for update of existing and development of the new regulations needed to implement the chosen option 3A.

This report provides list of actions in all relevant domains related to the proposed change of the aeronautical environment such as Policy making, Frequency management, Standard for enhanced Electronic Conspicuity (EC) devices, Global Navigation Satellite System (GNSS) requirements, ICAO Flight Information Service (FIS) with surveillance.

There is a desire to accelerate the deployment of BVLOS operations, enabling the beneficial applications (including social and safety benefits) and impact on United Kingdom Gross Domestic Product (UK GDP). To do so, the current barriers found in segregated airspace and difficult airspace planning to enable the new users must be overcome. One facilitator for more integrated airspace planning is the provision of a known traffic environment using assured position.

New supported applications (with safety impact) could include:

- ICAO Flight Information Services using surveillance (Class G, E, and VFR traffic in Class D), including traffic information and a course of traffic avoidance advice.
- Supporting Unmanned Aircraft System (UAS) detect-and-avoid (DAA).
- Supporting on-board deconfliction and collision avoidance systems (Hybrid ACAS / ACAS X).

The existing aid to situational awareness is intended to remain, and could be enabled by existing CAP1391 devices or these new enhanced EC devices defined within an updated version of CAP1391.

The application or operational service requirements are not defined for these applications at this time. Likewise, the exact role for enhanced EC compared to other sources of position information is not yet agreed – for example, the emerging UAS detect and avoid concept may in the future rely on computer vision and radar-based systems for uncooperative detection when the technical standards are in place. It is not clear today how such technical standards would be specified to allow for certification of these new systems. The existing environment, including EC in use today, is complex. The international benchmarks, whilst facing common challenges, are not aligned.

The previous phases identified the option for the EC implementation in the UK environment covering manned and unmanned aircraft, minimum viable standards for the enhanced EC device which will enable the anticipated applications aiming to provide stakeholders with a means to enable the applications (e.g. providing a trusted source for DAA), ensure interoperability with other surveillance systems and safety nets (e.g. Hybrid ACAS) to enable application benefits associated with these systems and be deployable in the short term (i.e. not depend on development of novel technology, standards, or assurance approaches with unknown timelines)

Additional to that, the Phase 3 report more concretely define how the proposed minimum technical standards for electronic conspicuity and surveillance need to be supported by the existing regulatory landscape and policies i.e. RPAS, AMS, CAPs, frequency spectrum regulations, training standards, etc. The implementation steps will include liaison with various CAA departments, DfT, working groups, task forces and other regulatory bodies (e.g. OFCOM).

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

No table of figures entries found.

1 - INTRODUCTION

1.1 - General

This document has been produced by EGIS as part of the project working on behalf of the UK Civil Aviation Authority (CAA) to Develop Minimum Technical Standards for enhanced Electronic Conspicuity (EC[1]) and associated Surveillance.

1.2 - Background and objectives

The CAA wish to develop minimum technical standards for EC and associated surveillance in order to:

1. Realise the full benefits outlined in Airspace Modernisation Strategy (AMS) CAP 1711 and drafts of the Airspace Modernisation Strategy 2022–2040 Part 1 (CAP 2298a) and Part 2 (CAP 2298b) published in January 2022
2. Respond to the request from the Department for Transport (DfT) to develop specifications which take into account future requirements for all aviation and thus take account of a wider set of use cases, and
3. Enable innovation in future EC capability.

The objective of the AMS is to deliver quicker, quieter and cleaner journeys, and more capacity for the benefit of those who use and are affected by UK airspace. Importantly, one of the parameters within which this must be achieved is ensuring a shared and integrated airspace that facilitates safe and ready access to airspace for all classes of airspace users, including Commercial Air Transport (CAT), General Aviation (GA), military, and new entrants such as Unmanned Aircraft Systems (UAS) and spacecraft. To achieve the objective while delivering airspace for all airspace users, the AMS outlines the UK's communications, navigation and surveillance infrastructure and air traffic management as specific enablers that will help deliver the expected benefits. Specifically, the enablers identified within the AMS are:

- Review of Flight Information Services (FIS) provision in the UK.
- Airspace classification review.
- Electronic surveillance solutions.

The CAA's requirements listed above are directly relevant to this third point, i.e. the deployment of electronic surveillance solutions to aircraft and at airports (and other airspace) to aid integration of traffic. This includes the development of new airspace structures such as transponder mandatory zones, new procedures for air traffic services, and the deployment of EC devices and electronic surveillance information displays. The deployment of electronic surveillance solutions (depending upon solutions selected, may depend upon:

- The widespread introduction of interoperable EC devices.
- The further development of airborne and ground-based equipment.
- The development of national standards for the core requirements the devices and equipment should meet.

  Note: It is assumed that the national standards will be based on international standards (e.g. RTCA) or regulations (e.g. FAA) where such standards or regulations exist, for example by adoption of the standard within a TSO "wrapper". This will ensure interoperability as far as possible.

The CAA established an Electronic Conspicuity Deployment Programme (ECDP) to manage the elements highlighted above and was tasked by the Department for Transport to develop surveillance specifications that consider the future requirements for all airspace users including new entrants such as UAS operators and spacecraft. This would serve as an evolution of the current limited use of EC to mitigate the risk of collisions for the wider GA community in controlled airspace to a scenario whereby all aircraft will need to be electronically conspicuous to each other and to air traffic services on the ground to enable the concept of future airspace described in the AMS.

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[1] *EC refers to Electronic Conspicuity; European Commission is spelt in full.*

This project is to develop a suitable minimum technical standard for EC and associated surveillance that will evolve the current limited use of EC in support of the objective of the AMS.

1.3 - Scope of the report

The project is has broken down the services required into three phases:

- Phase 1: Assessment of the current environment and existing standards concluding in a high-level recommendation for a future approach.
- Phase 2: Assessment of the recommended approach from Phase 1 with industry stakeholders to define the future environment.
- Phase 3: Definition of the regulatory standards and regulatory framework required to proceed with the implementation of the minimum technical standards for EC and associated surveillance in the UK to cover both Air to Air, Ground to Air and Air to Ground.

This report is **Phase 3** (as described above) which maps the regulatory landscape against the minimum standards identified in Phase 2 and proposes a roadmap for the activities required to develop, refine, test and deploy the minimum standard within the UK.

Associated activities, for example in relation to defining the safety applications that could utilise enhanced EC devices are identified here to the extent that they influence the activities which are required to for the EC standards. They are not fully defined in this document, as that is beyond the scope of the study.

1.4 - Intended readership

The primary intended readership of this report is the UK CAA and DFT.

The report may be distributed to UK aviation stakeholders such as ATS providers, Avionics manufacturers and airspace user group representatives.

1.5 - Document structure

The document follows a structure as presented in Figure 1.

Section 1: - Introduction

- This chapter, which presents the context in which this document is presented and the scope of the content.

Section 2: - Regulatory Landscape Mapping

- Chapter 2 provides a summary of the regulatory landscape.

Section 3: - Implmentation Strategy Roadmap

- Chapter 3 provides a scheduled roadmap for implementation of changes to deliver the minimum standard for EC devices. This includes a breakdown of potential workstreams into relevant described activties, as well as their relationship with other activities.
- Related activities which are beyond the scope of defining a mimum standard (for example activities around defining ICAO FIS with surveillance in the UK) are identified as they influence the roadmap, but they are not fully detailed here.

Section 4: Conclusions

- Chapter 4 provides conclusion on the key aspects of the roadmap strategy and recommendations for considerations when applying it.

FIGURE 1: DOCUMENT STRUCTURE

2 - Regulatory Landscape Mapping

This section provides a mapping of the UK regulatory landscape which relate to the minimum standards identified in Phase 2 for enhanced EC devices. The columns provide, from left to right:

- The "theme" (area of work) where the framework needs updating.
- The applicable documentation within the UK regulatory framework (or relevant international guidance from ICAO where UK-specific regulation does not exist (shown in light green).
- The changes that would be needed.
- Examples of where international regulations and standards could provide base material for incorporation into the UK framework through Policy action (for example by reference, or adoption within a TSO wrapper as needed suitable).

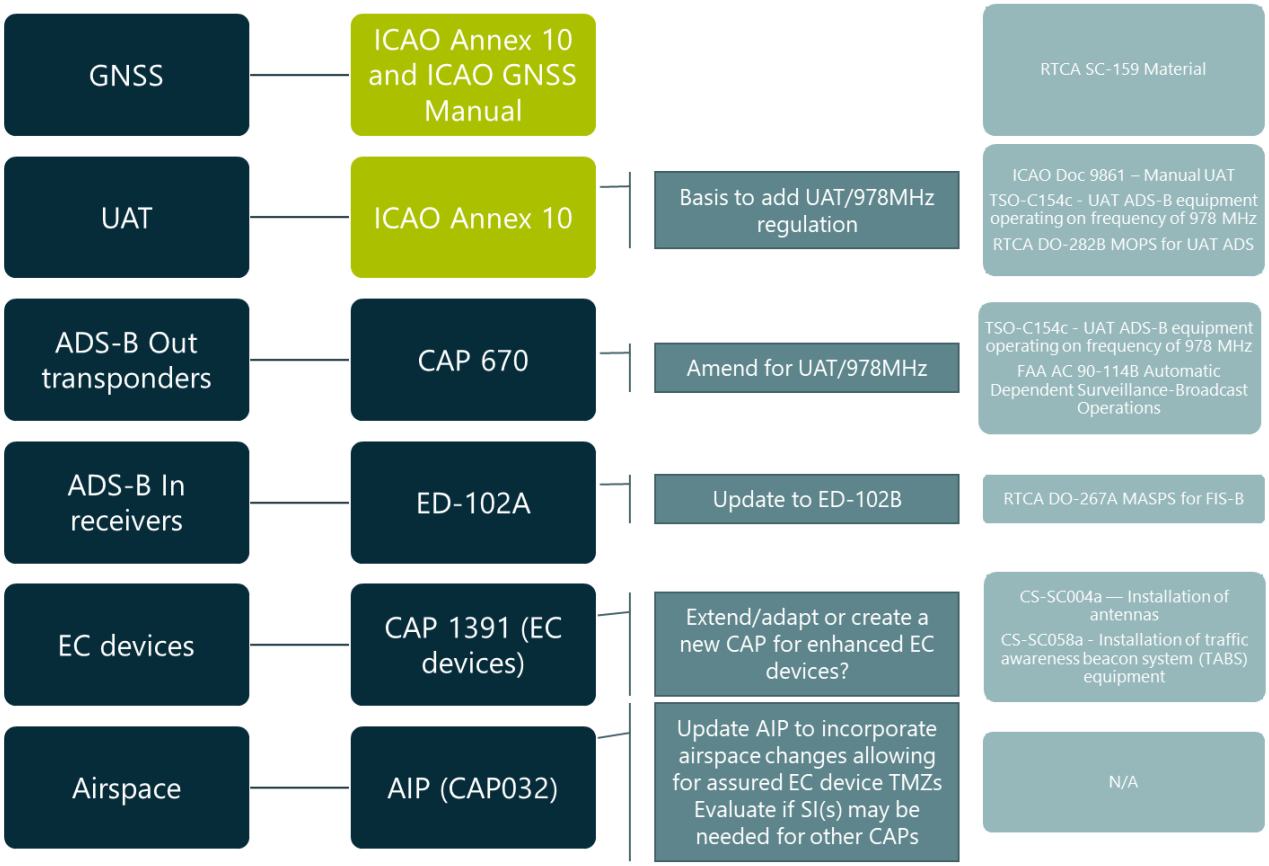


FIGURE 2: UK EC REGULATORY FRAMEWORK - AVIONICS AND AIR OPS

The figure above represents the key elements of the regulatory framework in relation to avionics and air operations. The figure below covers surveillance and services.

Each figures shows the relevant regulatory area on the left, connected to the applicable UK regulation (or international guidance when highlighted in green). The next column identifies the main action, and the final column provides examples of available standards that could be utilised to address the gap.

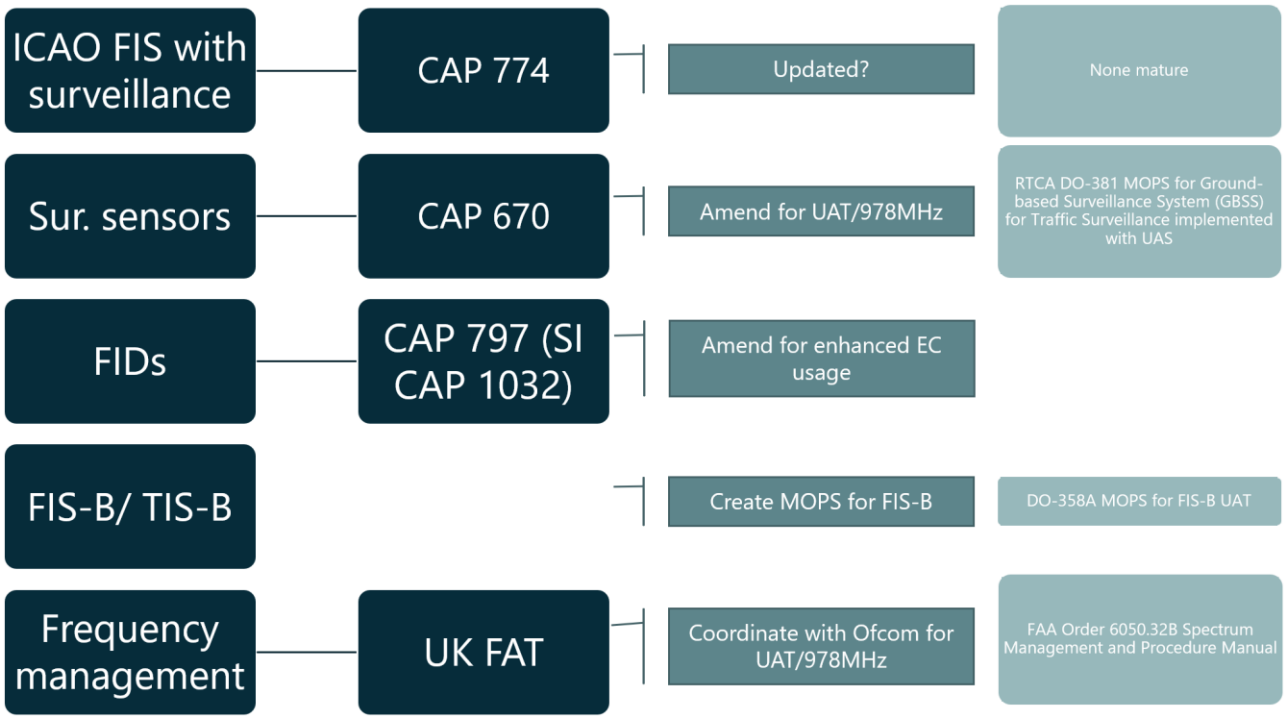


FIGURE 3: UK EC REGULATORY FRAMEWORK - SURVERILLANCE AND SERVICES

3 - Implementation Strategy Roadmap

This section describes a proposal for the regulatory roadmap aiming for establishment of the regulatory environment which would enable implementation of the Option 3A concept which was selected at the end of Phase 1 and which would support Option 3A Concept of Operations which was developed at Phase 2 of the project.

Overall, the CAA will need to conduct standards updates and implementation planning, which will be based upon cost and impact assessments. As there are different regulatory areas which will require development of the new regulatory acts or update of the existing regulatory framework, the roadmap is split to several logical workstreams:

- Communication
- Frequency management
- Policy making
- Standard for enhanced EC devices
- Performance
- GNSS
- ICAO FIS with surveillance
- TIS-B / FIS-B

The workstreams are not fully independent and the identified dependencies are highlighted. The dependencies determine the sequence of actions and also the overall duration of regulatory roadmap.

The detailed roadmap with all proposed actions and steps is provided in the electronic POD format and can be modified and updated as necessary. The high level example of the regulatory roadmap Gantt diagram is provided in Figure 4.

Important note: the start date of the roadmap is arbitrary, based on the time of development of the report. The timelines are indicative, Egis suggestions for consideration by the CAA, and intended to reflect the likely execution times of the activities themselves They do not account for limitations on parallelisation of activities which can be supported due to CAA resources, or mobilisation times for activities (including those requiring contracting of external entities), or decision times on behalf of the relevant agencies (e.g. DfT, Ofcom) and the impact of available rulemaking slots, as Egis are not privy to the details of these constraints. The roadmap does consider the serial nature of the activities within the workstreams themselves. Finally, it should be noted that the applications which the enhanced EC devices should support are all undergoing active development and refinement at the time of writing, and any changes to their programmes will influence the work within this roadmap.

The intended use of this roadmap is to provide a starting point for CAA development of an internal programme of works, which accounts for the above factors that Egis is not privy to. The roadmap presented here should ***not*** be considered a commitment on behalf of the CAA in any way.

Figure 4, below, provides an overview of the roadmap, and the further sections expand each workstream to provide more detailed descriptions of the activities within each.

FIGURE 4 HIGH LEVEL REGULATORY ROADMAP GANTT CHART

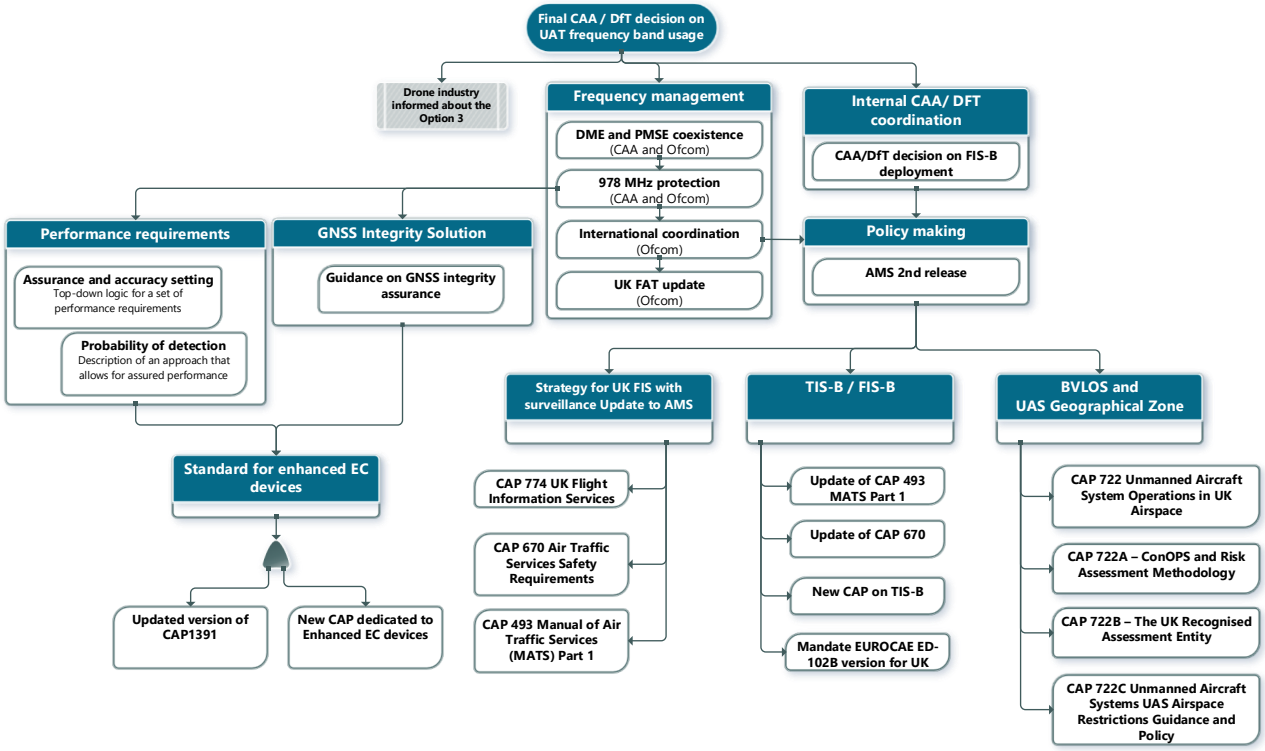


FIGURE 5: HIGH LEVEL REGULATORY ROADMAP WBS

3.1 - Prerequisites

Before any regulatory proposals for amendment activities are initiated, a key dilemma regarding the Option 3A and usage of UAT frequency band shall be solved internally within UK CAA and DfT.

As there is no common opinion on the implementation of the selected Option 3A within the CAA and DfT, it is absolutely essential to internally achieve endorsement of Option 3A,, particularly regarding the use of UAT frequency band for RPAS operations and potential TIS-B / FIS-B services.

This prerequisite step should be taken as soon as possible to ensure harmonised opinion and consistent responses to industry.

Additional element which shall be considered is military as the new frequency band in surveillance may cause interoperability issues to military. Due to that, the final decision regarding the implementation of Option 3A and the new enhanced EC devices shall be coordinated with the appropriate military units.

Activity: <ID> **Internal coordination**		Start date: **ASAP**
Workstream:		End date: <date>
Dependencies	Inputs	Output
None	This study	- Final CAA decision on UAT frequency band usage
Description		Stakeholders
- Internal discussion within CAA and DfT to achieve coherent attitude to Option 3A – Use of UAT frequency band for RPAS operations and potential TIS-B / FIS-B services		- Internal CAA and DfT

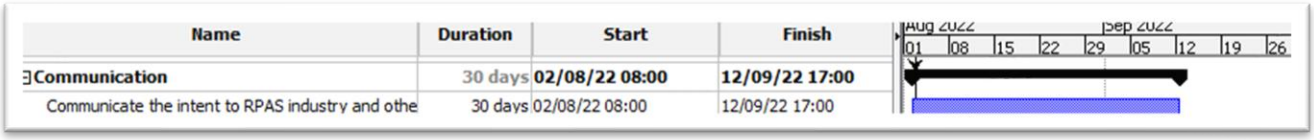
3.2 - Communication

When the internal agreement within CAA and DfT is achieved it is important to inform military, industry and airspace users about the intentions to mandate UAT band for RPAS operations. This is particularly important for those stakeholders which were not involved in this project to ensure that they do not invest to systems and technologies which may not be interoperable or acceptable when the new regulatory framework comes into force.

As the GA community representatives and avionics manufacturer representatives were involved in different phases of this project, the most important stakeholders which need to be informed about the regulatory intentions are RPAS manufacturers and operators.

The CAA and DfT shall consult on the planned intentions particularly to RPAS industry (through Drones Industry Action Group. Future Flight Industry Group and RPAS safety leadership group) and all airspace users (including GA, military and RPAS operators) as soon as the internal agreement is achieved.

Further consultations with RPAS industry and impact assessment on RPAS domain should be conducted later on as part of AMS 2 when it is confirmed that there are no significant barriers which would prevent from Option 3A deployment.



Activity: <ID> **Statement on 978 /1090 MHz**		Start date: ASAP
Workstream: Communications		End date: 3 months
Dependencies	Inputs	Output
- This study - AMS updates - CAA internal coherence - Alignment with Ofcom	Roadmap activities need to be defined	RPAS industry informed about the Option 3A
Description		Stakeholders
- Joint statement between DfT and CAA, on planned activities in the enabling of BVLOS and wider (e.g. AMS), including expectations around dates for enablers to become available, and broad path being undertaken. - Clarity on direction of travel - Avoid unnecessary adoption of 1090MHz by RPAS industry (except e.g. Certified and Specific Category BVLOS, RPAS/UAS operating IFR)		

3.3 - Frequency management

UAT frequency band on 978 MHz is protected band which is according to existing UK Frequency Allocation Table allocated to Aeronautical Mobile and Aeronautical Radionavigation service. In order to avoid any future conflicts of interest, it is recommended to allocate the 978 MHz band to RPAS ADS-B and to future TIS-B and

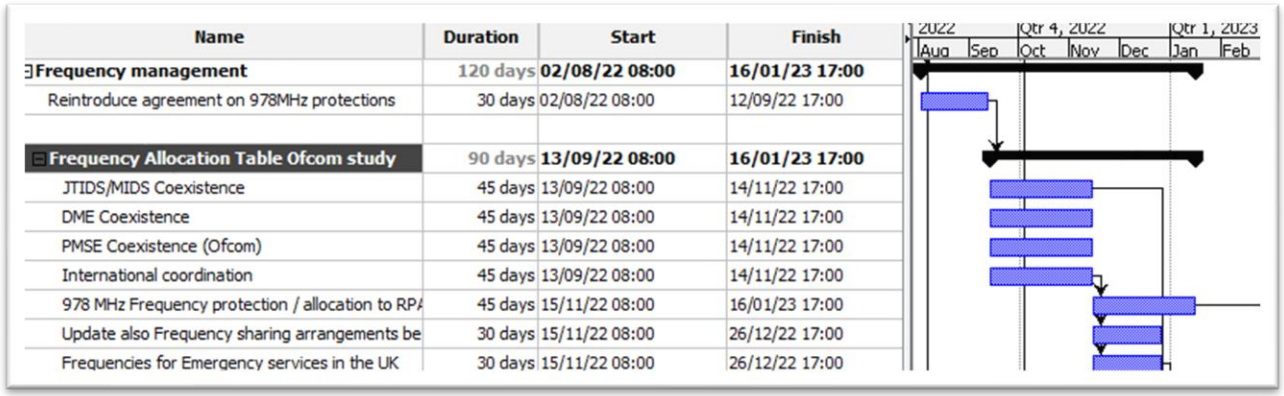
FIS-B services. In order to do so, this step shall be performed in coordination between CAA and Ofcom to establish/introduce an agreement on protections around 978MHz.

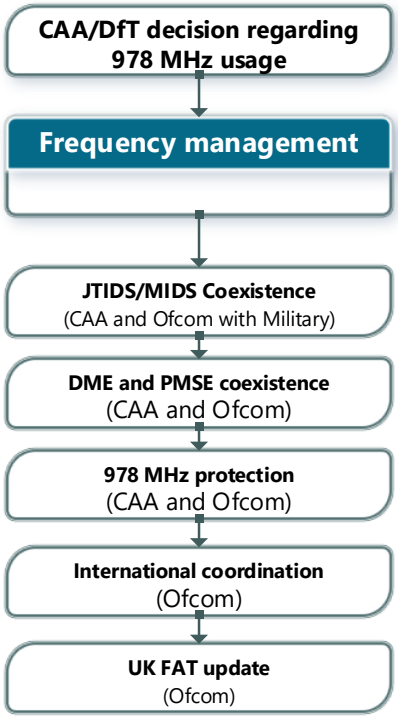
Ofcom and CAA will need to perform an impact assessment on PMSE, DMEs (Alderney) and JTIDS/MIDS Coexistence. If no issue or frequency interference is identified, Ofcom should ensure also international coordination to ensure that the band will be protected for the UK specific applications. The international coordination through existing international relationships shall include neighbouring countries which could be affected by UAT transmissions or which could have an impact on the UAT band and intended applications (Ireland, France, others).

When issues or potential frequency band conflicts on international level are identified, Ofcom shall take necessary measures to protect UAT band for RPAS operations and FIS-B/ TIS-B services to ensure that the necessary bandwidth is reserved for the planned services to be applied in a safe and effective manner. Possible means for UAT frequency band protection will be coordinated by Ofcom. An update of the UK Frequency allocation table is deemed as one of the possible means.

Additional to that Ofcom may need to update also Frequency sharing arrangements between civil and military services and Ofcom document on Frequencies for Emergency services in the UK if the new frequency allocation has an impact on decision requires to do so.

Name	Duration	Start	Finish
Frequency management	120 days	**02/08/22 08:00**	**16/01/23 17:00**
Reintroduce agreement on 978MHz protections	30 days	02/08/22 08:00	12/09/22 17:00
Frequency Allocation Table Ofcom study	90 days	**13/09/22 08:00**	**16/01/23 17:00**
JTIDS/MIDS Coexistence	45 days	13/09/22 08:00	14/11/22 17:00
DME Coexistence	45 days	13/09/22 08:00	14/11/22 17:00
PMSE Coexistence (Ofcom)	45 days	13/09/22 08:00	14/11/22 17:00
International coordination	45 days	13/09/22 08:00	14/11/22 17:00
978 MHz Frequency protection / allocation to RPA	45 days	15/11/22 08:00	16/01/23 17:00
Update also Frequency sharing arrangements be	30 days	15/11/22 08:00	26/12/22 17:00
Frequencies for Emergency services in the UK	30 days	15/11/22 08:00	26/12/22 17:00





Activity: **JTIDS/MIDS Coexistence**		Start date: **ASAP**
Workstream: Frequency management		End date: **90 days / 3 months**
Dependencies	Inputs	Output
- **Internal coordination** (decision on UAT usage)	- Current MIL usage of UAT band for JTIDS/MIDS - Existing plans for JTIDS/MIDS -	- Agreed measures to protect UAT band which will be reflected in the - Updated UK Frequency allocation table
Description		Stakeholders
- Coordination with MIL on JTIDS/MIDS Coexistence to assess/agree risks as it operates also over UAT band - Agree on measures to protect UAT band and maintain the remaining part of the band for MIL usage		CAA MIL

Activity: **978MHz protection**		Start date: **ASAP**
Workstream: Frequency management		End date: **120 days**
Dependencies	Inputs	Output
- **Internal coordination** (decision on UAT usage) - JTIDS/MIDS Coexistence	UK Frequency allocation table	- Agreement that 978MHz is suitably protected - Coordinated usage of the frequency -
Description		Stakeholders
- Coordination between CAA and Ofcom to establish/introduce an agreement on protections around 978MHz, with particular reference to PMSE.		CAA Ofcom
- Ofcom may identify this as a non-issue with current PMSE, DMEs (Alderney), JTIDS/MIDS Coexistence - International coordination - Update of the UK Frequency allocation table to protect UAT band for RPAS operations and FIS-B/ TIS-B services		Ofcom

Activity: <ID> **International coordination**		Start date: **T_0 -when depending activities are completed**
Workstream: Frequency management		End date: **T_0 + 45 days**
Dependencies	Inputs	Output

- Internal coordination - 978MHz protections - JTIDS/MIDS Coexistence	- Agreed measures to protect UAT band which will be reflected in the - Updated UK Frequency allocation table	Coordinated frequency band
Description		Stakeholders
- Dealing with cross-border collaboration (Ireland, France, others) - No need to involve ITU/ICAO.		Ofcom

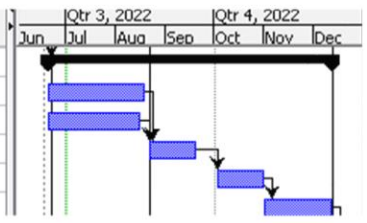
Activity: <ID> **FAT update**		Start date: **T_0 -when depending activities are completed**
Workstream: Frequency management		End date: **T_0 + 3 months**
Dependencies	Inputs	Output
- Internal coordination - 978MHz protections - JTIDS/MIDS Coexistence - International coordination	UK FAT	**Ofcom measures to protect UAT band for RPAS operations and FIS-B/ TIS-B services**
Description		Stakeholders
- If no negative impact on UAT band is identified, Ofcom to amend the UK FAT and define rules for UAT band protections		Ofcom

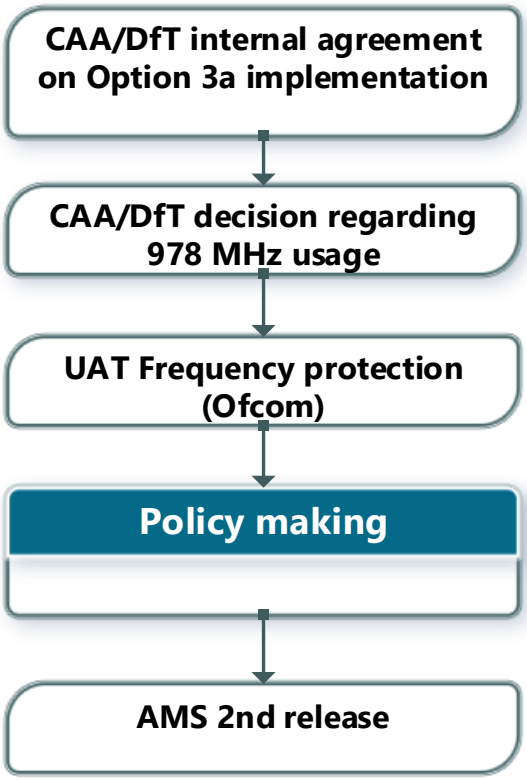
3.4 - Policy making

When DfT and CAA provide joint statement regarding a vision regarding EC conspicuity, the RPAS operations on 978 MHz (VLOS and BVLOS) and usage of 978 MHz frequency for TIS-B / FIS-B services and when Ofcom confirms that the frequency can be used for intended applications, CAA should initiate additional update of AMS regarding implementation of Option 3A as the AMS update is already under consultation process.

It is assumed that this AMS amendment will not go through the full NPA process again but simplified consultation process will be used to accelerate the whole amendment process because many of the stakeholders affected by the proposed AMS change have been involved in this study and thus are aware of the intended amendments.

Name	Duration	Start	Finish
AMS update	126 days	**20/06/22 08:00**	**12/12/22 17:00**
Final decision on Option 3A	45 days	20/06/22 08:00	19/08/22 17:00
CRD	42 days	20/06/22 08:00	16/08/22 17:00
Consulatations on specific topics	21 days	22/08/22 08:00	19/09/22 17:00
Final update of AMS	21 days	03/10/22 08:00	31/10/22 17:00
Updated AMS	30 days	01/11/22 08:00	12/12/22 17:00





Activity: **Update of the AMS**		Start date: **on-going**
Workstream: Policy making		End date: **end of Q4**
Dependencies	Inputs	Output
- This study - CAA internal coherence - Decision on frequency band allocation 978 / 1060 - Alignment with Ofcom	Roadmap activities need to be defined	AMS 2nd release
Description		Stakeholders
Joint statement between DfT and CAA, on planned activities in the enabling of BVLOS and wider (e.g. AMS), including expectations around dates for enablers to become available, and broad path being undertaken. AMS should include a vision regarding EC conspicuity and vision for TIS-B and FIS-B services on 978 MHz services.		CAA, DfT STF

3.5 - Performance

This study has proposed high-level surveillance requirements and performance requirements for Enhance EC device based on the benchmarks identified in phase 2 and initial first principles analysis, however, some of the parameters have to be validated to ensure suitability of Enhanced EC device for the applications. This will be necessary as, at the time of writing, the applications themselves are not fully mature. For example, the

performance required of a DAA system overall is not specified, nor is the system architecture (which would allow the allocation of performance required to an EC device as part of an overall EC system).

In order to validate or precise the requirements a full collision risk model and operational performance assessment (and related safety analysis) which would be able to show top-down derived functional and minimum performance requirements. This would be the responsibility of the CAA, but would likely be delivered through a contract to a competent research/safety organisation.

In all use cases, the safety driver for enhanced EC device performance is ultimately supporting mitigating Mid-Air Collision (MAC) risk. Enhanced EC devices are not claimed to be a sole solution for mitigating MAC risk, and instead merely contribute to part of the overall system of air traffic management which comprises everything from airspace design and flight planning, training, procedures, communication and rules of the air, to safety nets.

As an example, the CAA may wish to conduct a detailed safety analysis to identify if assured EC devices, within a TMZ, could be suitable to enable initial BVLOS operations using DAA, and what other conditions, limitations or complementary systems (e.g. UTM) would need to be in place.

Probability of detection

To achieve the best probability of detection, external installation of omnidirectional antenna would be ideal. However, one of the key elements that will have an impact on Enhance EC devices implementation by the airspace users is an affordability of the devices, and fixed external installation of the antenna would require additional administrative and a complex installation process which would significantly increase the initial installation and also operational costs. The advantage against standard certified avionics would be reduced to a minimum, which would cause decrease of GA airspace user interests.

Therefore, it is important to define such installation requirements which would on one hand ensure minimum performance requirements for the applications and on the other hand allow the installation cost to remain within the acceptable price range. Due to installation cost, internal installation would be preferred option if the signal propagation and the attenuation of the signal caused by the airframe allow to meet the minimum operational and performance requirements.

Therefore, different options for assuring probability of detection (between CAP1391 and certified installation) need to be assessed. The assessment will require a technical study including flight testing, and should define what will be needed to enable the assurance for the applications and the most demanding requirement can be then selected for the Enhanced EC device or define different categories of Enhanced EC devices. Based on that the certification standards with relevant Acceptable Means of Compliance and Guidance materials will be provided to cover all defined categories.

In order to verify Enhance EC device a verification and validation project will be required:

- Technical assessment of the signal propagation from the aircraft (different antenna placement, antenna pattern, etc.) will be needed..
- Other option is to define a guidance on installation and testing (on the ground and in the air) and assign a set of organisations that are able to check an aircraft for antenna placement (lite certification).

As part of the assessment, different aircraft - aircraft and aircraft - RPAS scenarios should be considered (e.g. aircraft flying under an RPAS that is trying to perform DAA on the basis of Enhanced EC). A set of trials would be required to validate the results of the assessment (noting that this may confirm the need for other elements within a DAA system in addition to EC).

We assume that the study will take about at least 12 months as it will ultimately require a complex research project involving multiple external contractors to provide the necessary aircraft and test equipment. The task should start as soon as possible so that the new installation requirements could be implemented into Enhanced EC device regulation.

Assurance and accuracy setting

Phase 2 report has identified the range for assurance and accuracy requirements where the upper bound of the requirements was based on the ED126 standards for airborne requirements for 3NM/1000ft separation and the lower bound was defined by the most lenient requirements needed to be used for the intended applications. In terms of global precedent, the TABS device specification has been used as a suitable benchmark for this lower bound on the performance requirements.

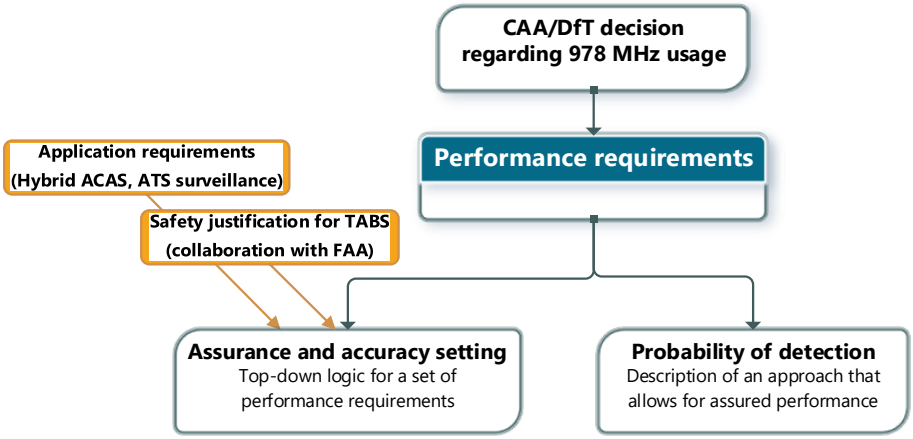
As there are no international standards on surveillance performance and avionics requirements which could be applied to FIS with surveillance, additional study should be performed to identify the minimum requirements – What is good enough for FIS with surveillance? We believe that the minimum requirements might lay within the rage identified in Phase 2 report. However, a detailed assessment should be conducted and should as a minimum cover:

- Collision risk model assessed across each application particularly or FIS with surveillance considering the separation between manned – manned aircraft and between unmanned – manned aircraft. The collision risk model could be based on geometries similar to ACAS collision risk models. This would necessarily track and align with any other development (within CAA activities or outside of the UK) of risk models applicable to UAS.
- Identification of nuisance, false or misleading
- Consideration of the existing most restrictive requirements on all intended applications (e.g. Hybrid ACAS, ground surveillance for ATC services, etc.).

As a baseline, TABS assessments and studies could be utilised if available through FAA cooperation.

We assume that the study may take about 6 months (if no FAA studies would provide a baseline) as the study on Probability of Detection and should start as soon as possible so that the new performance requirements could be implemented into the Enhanced EC device regulation.

Name	Duration	Start	Finish
EC devices	306 days?	02/08/22 08:00	03/10/23 17:00
Performance	120 days	02/08/22 08:00	16/01/23 17:00
Probability of detection	120 days	02/08/22 08:00	16/01/23 17:00
Assurance and accuracy setting	120 days	02/08/22 08:00	16/01/23 17:00
Standard for enhanced EC devices	150 days?	08/03/23 08:00	03/10/23 17:00
Study on expansion CAP1391 Proposes additions	60 days?	08/03/23 08:00	30/05/23 17:00
Update of CAP 1391/ Issue a new CAP to include	90 days?	31/05/23 08:00	03/10/23 17:00



Activity: <ID> **PoD**		Start date: **ASAP**
Workstream: ADS-B out requirements (Performance)		End date: **T_0+6m (or more)**
Dependencies	Inputs	Output
- Decision of CAA / DfT regarding 978/1090 MHz	Will need to be picked up by ECWG, BAA, LAA, etc.	Description of an approach that allows for assured performance at a lower overhead than certified antenna installation Guidance note
Description		Stakeholders
- Assess different options for assuring probability of detection (between CAP1391 and certified installation). What is needed to enable the assurance for the applications. - If Space based reception is considered as part of the solution, it will need to be accounted for in performance assessments. Space based reception of 978MHz may require some form of international recognition, noting 1090MHz footnote in FAT: 5.328AA - The frequency band 1 087.7-1 092.3 MHz is also allocated to the aeronautical mobile-satellite (R) service (Earth-to-space) on a primary basis, limited to the space station reception of Automatic Dependent Surveillance-Broadcast (ADS-B) emissions from aircraft transmitters that operate in accordance with recognized international aeronautical standards. Stations operating in the aeronautical mobile-satellite (R) service shall not claim protection from stations operating in the aeronautical radionavigation service. Resolution 425 (WRC-15) shall apply. (WRC-15) - Consider different situation – Aircraft flying under a RPAS that is trying to perform DAA on the basis of Enhanced EC (with or without additional systems to be evaluated). - Does it have to be external, if not what guidance do you put in place. - Assessment of whether guidance or a set of organisations that are able to check an aircraft for antenna placement (certification lite) would be suitable. - Internal would need some very smart calibration to determine PoD. - Trials will be needed to support the evaluation and V&V.		- CAA - Organisations authorised to install aircraft equipment - GA community - Research bodies – Universities, consultants, industry

Activity: <ID> **Assurance and accuracy setting**		**Start date: ASAP**
Workstream: ADS-B out requirements (Performance)		**End date: T0+6m**
Dependencies	Potential inputs <List of deliverables/ papers/regulations>	Output

Rest of the landscape moving in parallel and potentially changing – e.g. developments in the RPAS industry	Safety justification for TABS (collaboration with FAA) Application requirements? Gen-sur SPR	Top-down logic for a set of performance requirements.
Description		Stakeholders
- Defining what is "good enough" - TABS "any accuracy will do", without setting NACp, NIC=6, SIL=1 is unlikely to suffice, while TSOC-145/C146 accuracy requirements with SIL=1 may suffice – however this needs to be properly evaluated with evidenced justification - Collision risk model, assessed across each application. Is this possible in class G? Based on geometries, not a wider airspace piece, similar to ACAS collision risk models. - Identify nuisance, false or misleading. - Consider existing most restrictive requirements on intended applications – Hybrid ACAS and ground surveillance for ATC services -		- CAA - Organisations authorised to install aircraft equipment - GA community - Research bodies – Universities, consultants, industry - External consultants?

3.6 - GNSS

In order to minimise the cost of the Enhanced EC devices, the use of GNSS receivers not certified for avionics usage (as in TABS) should be investigated. The accuracy of many non-aviation certified COTS sensors could meet the accuracy requirements for NACp 6 or NACp 7. However, many of these sensors may lack the integrity monitoring module which would indicate when the position information integrity is lost or degraded. Some of the GNSS receivers can receive and process SBAS signal (WAAS, EGNOS, etc) but due to current relationship between UK and EU, the use of EGNOS signal may not be legally acceptable. Therefore, it is necessary to investigate how to achieve SIL and NIC requirements with the available GNSS signal and with EGNOS not guaranteed in UK. The study should identify the options to sort out the signal integrity assurance issue. RAIM FDE could be a potential option which does not require SBAS (e.g. EGNOS) and which could be sufficient for intended RPAS and GA operations.

The results of this task with be crucial for further development of the performance requirements and thus also for development of the standards for Enhanced EC devices. It is noted that the result of this task may likely be negative (i.e. that non-certified GNSS receivers are not suitable) and this possible outcome must be considered as realistic.

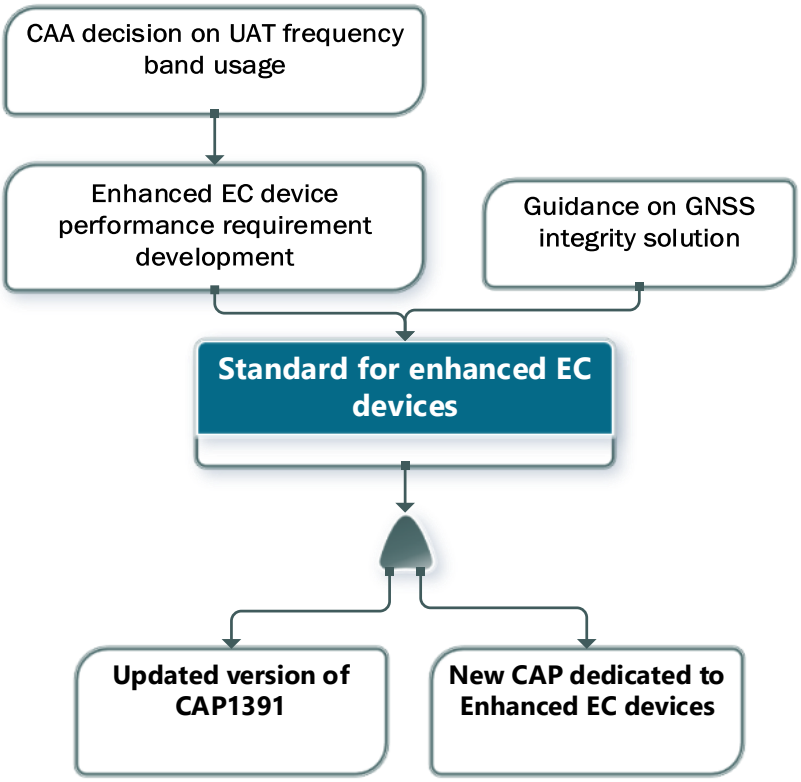
Activity: <ID> **GNSS integrity solution**		Start date: **ASAP**
Workstream: ADS-B out requirements (Performance)		End date: **T0+6m**
Dependencies	Inputs	Output
None	None	Guidance on GNSS integrity assurance
Description		Stakeholders
- Investigate the suitability of using EGNOS OS in the context of providing assured performance,, or identify state and expectations of the alternative (UK SBAS or other non-SBAS		CAA STF

sources that could support compliance with SIL/NIC requirements. - How to achieve SIL and NIC requirements with the available GNSS signal with EGNOS not guaranteed in UK? - Identify options to sort out the signal integrity assurance	Consultant

3.7 - Standard for enhanced EC devices

When the installation and performance requirements for the Enhanced EC device are developed and approved, either the amendment of CAP1391 or completely new CAP dedicated to Enhanced EC device can be published (or new AMC/GM structure publication). While a new CAP may seem to be less desirable option it does allow to keep the Enhanced EC device dedicated to new applications cleanly separated from existing EC devices. The new CAP could include relevant information from CAP 1391 and update it for Enhanced EC devices.

The works on the update of CAP 1391 or works on the development of the new CAP may start as soon as Ofcom confirms possibility to use UAT frequency for RPAS operations and for TIS-B / FIS-B services.



Activity: **1a Update of CAP1391**		Start date: <date>
Workstream: EC devices		End date: T0+9M+
Dependencies	Inputs	Output

- Performance requirement determination / confirmation activities	- Final CAA decision on UAT frequency band usage - Guidance on GNSS integrity assurance	**Updated version of CAP1391**
Description		Stakeholders
- Would introduce a new category of EC device into CAP1391 "enhanced" – sits between "intermediate" and "full", but aligned with new min performance standard. - Include all the requirements and references to standards to define the new device category as the Enhanced EC device should support not only air-to-air but also air-to-ground applications. - Introduces need for ground application support. Changes the argument for the purpose of the CAP itself. Effectively means re-writing CAP1391.		**CAA** **STF**

Activity: **1b New CAP**		Start date: <date>
Workstream: EC devices		End date: T0+9M+
Dependencies	Inputs	Output
- Performance requirement determination / confirmation activities	- Final CAA decision on UAT frequency band usage - Guidance on GNSS integrity assurance	- Potentially a new CAP
Description		Stakeholders
- Would introduce a new CAP, with a similar approach to CAP1391 (does the same stuff as above). - Less desirable option but does allow to keep the applications cleanly separated. - Might be easier to develop a new CAP and use only relevant sections of CAP1391.		**CAA** **STF**

3.8 - ICAO FIS with surveillance

At the moment, there clearly defined UK FIS but there is an aim to converge to ICAO FIS with surveillance. The strategy for this convergence process should be clearly formulised and the changes from the current system should be communicated to relevant stakeholders. The strategy should also include the role of FISO with regard to RPAS operations.

Definition of the FIS with surveillance strategy should provide key inputs to the Performance workstream in the form of operational requirements. Therefore the work should start as soon as possible to enable early start of the Performance workstream.

When the strategy is defined, a Guidance for UK FIS with surveillance should be developed and all relevant CAPs shall be amended as requirements on provision of FIS are spread over several CAPs:

- CAP 774 UK Flight Information Services shall be updated to FIS with surveillance in line with ICAO recommendations:
  - Update of basic ATS services to include
  - Update of the Traffic Service provisions
  - Update of the deconfliction service in class G airspace, active TRA and active MTA and
  - Description of Surveillance based FIS.

- CAP 670 Air Traffic Services Safety Requirements will need to be updated to include FIS with surveillance in line with ICAO recommendations:
  - Update of the Flight rules as necessary considering use of Enhanced EC devices and RPAS operations
  - Specification of high level requirements on FIS surveillance based services
  - Update of the Surveillance services within Class G
  - Update of requirements on Conspicuity codes (as necessary)
  - Update of Transponder Mandatory Zones (TMZ) requirements considering selected Option 3A and use of transponders by RPAS.
  - Update of procedures for Unknown aircraft and RPAS
  - Update procedures for ATCOs on provision of Traffic Information to aircraft.

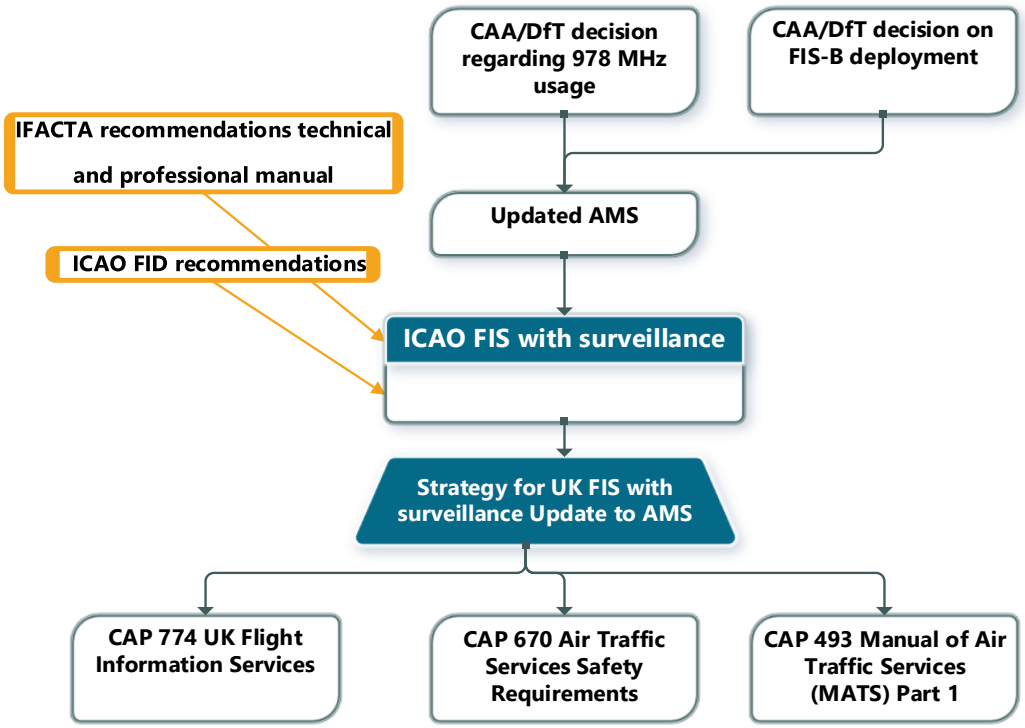
- CAP 493 Manual of Air Traffic Services (MATS) Part 1
  - Complement the CAP with generic requirements for FIS Surveillance Systems

Surveillance requirements for FIS environment

Required performance of surveillance system for FIR

- Add Surveillance Data Processing System Requirements (SDPS) for FIS services to support a country wide installations (if considered)
- Use of Surveillance Data for FIS and AFIS and
- Review the existing FID requirements to identify any missing gaps in the existing FID functionalities necessary for provision of the ICAO FIS service with surveillance considering the Selected Option 3A (split of frequencies) and update Display System Requirements for FIS and AFIS Surveillance Systems. When developing the new FID requirements, CAA may consider also definition of HMI recommendations (factoring the differences between manned and unmanned aircraft, quality of surveillance information, etc.). CAA should then initiate an update of the FID requirements to cover the identified gaps. This will be aligned with other CAA activities relating to FIDS.

When the new updated of the CAPs will be published, new procedures and training to ATCO/FISO will need to be provided.



Activity: <ID> **Strategy for UK FIS with surveillance**		Start date: **ASAP**
Workstream: ICAO FIS with surveillance		**End date: T0+6m**
Dependencies	Inputs	Output
- Final CAA decision on UAT frequency band usage		Strategy for UK FIS with surveillance Update to AMS
Description		Stakeholders
- Need clarity on what will happen with ICAO FIS. - Consistent update of CAPs - DAAIS - Project Marshal - Guidance on supporting BVLOS (TDA + TMZ) what benefit this brings.		CAA / DfT

Activity: <ID> **Guidance for UK FIS with surveillance**		Start date: **Strategy for UK FIS with surveillance**
Workstream: ICAO FIS with surveillance		**End date: T0+3m**
Dependencies	Inputs	Output

- Strategy for UK FIS with surveillance	- Results of the Performance studies - IFACTA recommendations on technical and professional manual	Updated CAP 744 UK FIS and CAP 797 Flight Information Service Office Manual CAP 493 MATS Part 1
Description		Stakeholders
- Guidance on role of enhanced EC in FIDs and how it can be deployed. - One extreme, airport with single ADS-B device, other is fully assured surveillance chain with ATC system. Definition of what you can do with each. - Today only use a FID to provide traffic information. Tomorrow the enhanced EC can support providing advice in relation to conflict resolution. - Update of the CAP 744 and CAP 797 - Update of the CAA oversight procedures		CAA FIS providers FISOs

Activity: <ID> **Surveillance solution for FIS**		Start date: **Strategy for UK FIS with surveillance**
Workstream: ICAO FIS with surveillance		**End date: T0+3m**
Dependencies	Inputs	Output
- Strategy for UK FIS with surveillance -	- IFACTA recommendations technical and professional manual	Decision on potential surveillance solution for FIS
Description		Stakeholders
- Study possible solutions for **Surveillance solution for FIS** - Local surveillance - Use of existing infrastructure - Country wide surveillance (Surveillance data provider)		- CAA

Activity: <ID> **FID functionality requirements**		Start date: **Strategy for UK FIS with surveillance**
Workstream: ICAO FIS with surveillance		**End date: T0+3m**
Dependencies	Inputs	Output
	- ICAO FIS requirements - AMS (split between 978 / 1090 MHz between manned and unmanned aircraft)	Either update of the existing CAP670 Annex A on FIDs or new CAP

Description	Stakeholders
- Review the existing FID requirements to identify any missing gaps in the existing FID functionalities necessary for provision of the ICAO FIS service with surveillance considering the Selected Option 3A (split of frequencies) - Definition of HMI recommendations (consider manned and unmanned aircraft, quality of surveillance information, etc.) - Update the FID requirements to cover the identified gaps	CAA FIS providers FISOs

3.9 - TIS-B / FIS-B

As TIS-B and FIS-B will be completely new services in UK airspace and CAA in cooperation with DfT will need to prepare concept of operations, guidance material for both services and also implementation plan for the following years 5-8 years.

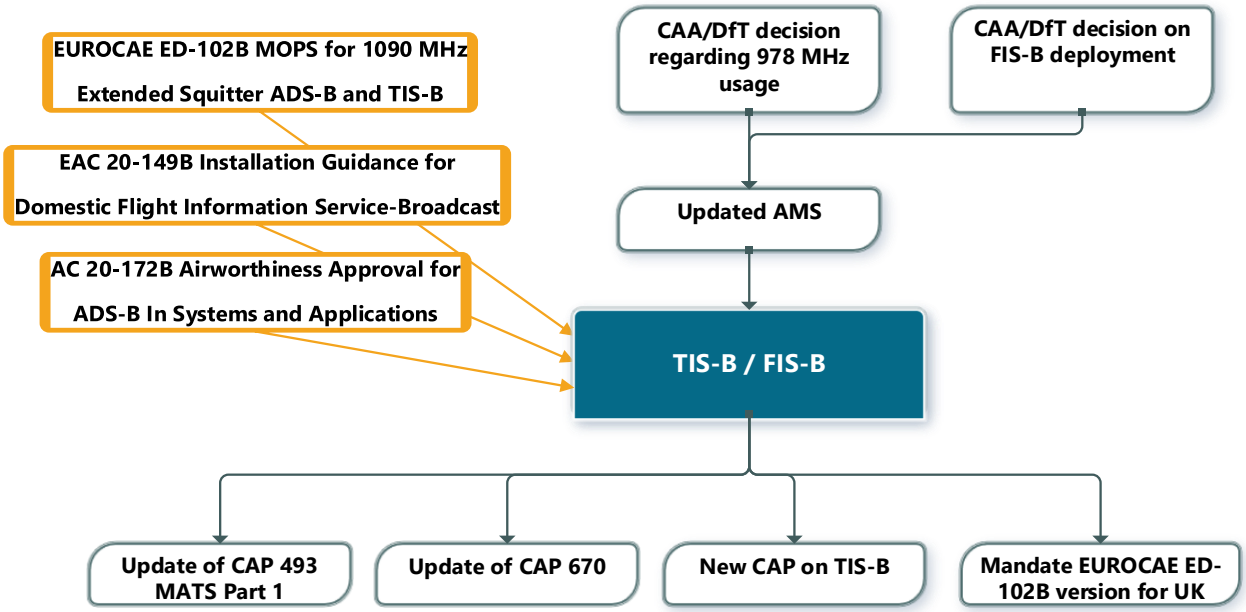
In order to avoid 1090 MHz frequency, TIS-B has been assumed to be deployed on 978MHz frequency. However, consideration should be given to a possibility that TIS-B could be, under certain circumstances, locally broadcast on 1090 MHz. FAA experience with TIS-B rebroadcasting positions of aircraft that have a UAT ADS-B Out equipment on 1090 MHz should be considered to avoid problems that FAA faced with ADS-R. It is highly like that in the majority of cases broadcasting on TIS-B on 1090MHz would not be favourable, owing to the impact on frequency congestion, however there may be specific cases where geography and user demand make this a viable approach (for example in offshore windfarms where the predominant airspace users are rotorcraft, but RPAS have an increasing role).

CAA should consider whether there are any use cases where TIS-B would be broadcasted on 1090 MHz taking into account the 1090MHz frequency congestion and FAA experience from ADS-R deployment. The use cases should be named in the strategy.

Discussion will need to be held with airspace users regarding the type of information to be broadcasted, particularly accounting for additional data services and information that could be provided, and the resulting impact of potentially competing with existing commercial services. The cost implications of such additional data should also be considered (throughout the value chain).

As both services will be new in UK, CAA may consider using as baseline the existing FAA manuals and guidance materials issued for TIS-B and FIS-B. The new regulation and guidance materials should include as a minimum the following:

- TIS-B / FIS-B Service provider requirements
- Installation guidance
- TIS-B/ FIS -B user requirements
- TIS-B provider licensing
- Additional pilot training
- User guidance and
- UK CAA procedures for TIS-B/ FIS-B safety oversight.



Activity: <ID> **TIS-B / ADS-R**		Start date: **Publication of updated AMS**
Workstream: TIS-B / FIS-B		End date: **12 months**
Dependencies	Inputs	Output
- CAA/DfT decision regarding 978 MHz usage as TIS-B is assumed to be broadcasted at 978 MHz - Updated AMS	EUROCAE ED-102A MOPS for 1090 MHz Extended Squitter ADS-B and TIS-B AC 20-172B Airworthiness Approval for ADS-B In Systems and Applications	Update of the existing CAPs e.g. CAP 670 or MATS Part 1 or new CAP dedicated to TIS-B
Description		Stakeholders
- How the TIS-B will be used in UK Use of TIS-B over 978MHz the next 5-8 years to address non-broadcasting transponders - What about TIS-B on 1090 MHz ? Are there any use cases where TIS-B would be broadcasted on 1090 MHz? - Information to be broadcasted - TIS-B Service provider requirements - Installation guidance - TIS-B user requirements - TIS-B licensing - Additional pilot training - User guidance - UK CAA procedures for TIS-B oversight		- CAA / DfT

Activity: <ID> **FIS-B**	Start date: **Publication of updated AMS**

Workstream: TIS-B / FIS-B		End date: **12 months**
Dependencies	Inputs	Output
- CAA/DfT decision regarding 978 MHz usage as FIS-B - Decision regarding local / country wide deployment of the FIS-B	FAA guidance documents: - AC 20-149B Installation Guidance for Domestic Flight Information Service-Broadcast - AC 20-172B Airworthiness Approval for ADS-B In Systems and Applications	Update of the existing CAPs e.g. CAP 670 or MATS Part 1 or new CAP dedicated to FIS-B
Description - How the FIS-B will be deployed in UK - Information to be broadcasted -development on what fields/info contained in UK FIS-B - Installation guidance - Service provider requirements - FIS-B service licencing - User guidance - additional pilot training - UK CAA procedures for FIS-B oversight		Stakeholders - CAA / DfT

3.1 - BVLOS and UAS Geographical Zones

The proposed Option 3A which expects all UAS wanting to access a TMZ to be using 978 MHz devices (with 1090MHz in). This will have an impact on the existing UAS regulatory framework which will need to be updated when the CAA/DfT decision regarding 978 MHz usage for UAS operations will be taken and when AMS strategy is updated accordingly.

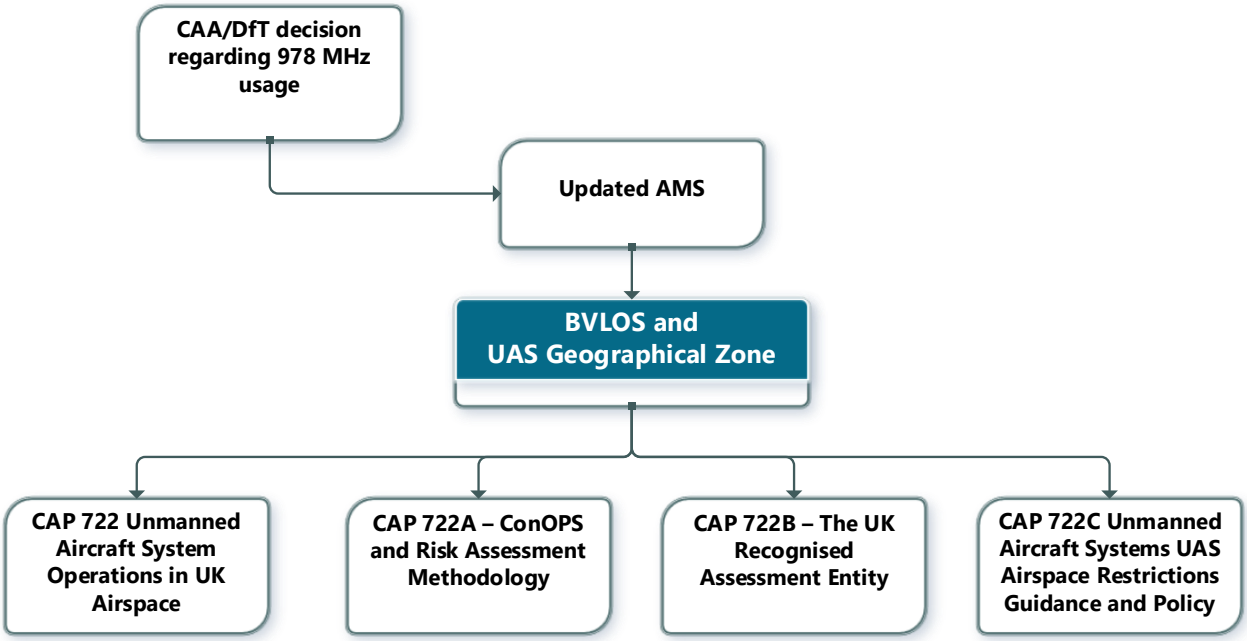
It should be noted that certified RPAS, operating IFR in controlled airspace, will still be required to equip appropriately to the airspace as today. In such cases, a 1090MHz ADS-B out equipped drone could enter the TMZ, as it would be visible to all other airspace users within the TMZ. If the RPAS was equipped with, for example, Mode-S without ADS-B then it could not enter the TMZ.

Besides development of Enhanced EC device requirements (applicable also for 978 MHz) which will be published in the CAP1391 or the new CAP, CAP 722 Unmanned Aircraft System Operations in UK Airspace – Guidance will need to be updated, particularly following sections:

- Operational Guidance
- Engineering and Technical Guidance and
- Acceptable Means of Compliance (AMC) and Guidance Material (GM) to the UAS Implementing regulation.

Depending on the changes proposed under Option 3A and changes in AMS, the following CAPs related to UAS operations may need to be updated:

- Update of CAP 722A- UAS Operations in UK Airspace –ConOPS and Risk Assessment Methodology
- Update of CAP 722B- UAS Operations in UK Airspace – The UK Recognised Assessment Entity and
- Update of CAP 722C Unmanned Aircraft Systems UAS Airspace Restrictions Guidance and Policy.



Activity: <ID> **UAT introduction to RPAS operations**		Start date: when **Statement on 978 /1090 MHz** is published by CAA and **978MHz protection** is arranged.
Workstream: **BVLOS and UTM**		End date: **9 months**
Dependencies	Inputs	Output
- CAA/DfT decision regarding 978 MHz usage for RPAS operations - AMS	- ICAO Doc 9861 – Manual UAT - TSO-C154c - UAT ADS-B equipment operating on frequency of 978 MHz - RTCA DO-282B MOPS for UAT ADS	Update of the existing CAPs e.g. CAPs: - CAP 670 update to allow UAT - CAP 722 RPAS operations to allow UAT
Description		Stakeholders
- Minimum requirements for Enhanced EC device for RPAS (ADS-B through UAT) - Use of TIS-B over 978MHz the next 5-8 years to address non-broadcasting transponders - Assessment of the level of alignment needed with U-Space proposals within Europe (which are still under consultation and active development).		- CAA / DfT

4 - CONCLUSIONS

The minimum specification is a new category of CAP1391 device with assured data, guidance on output (antenna) to ensure reception, and system design assurance. Extending the CAP and retaining alignment with existing international standards minimises the effort required to upgrade existing product lines and provides certainty for ground infrastructure deployment. This ensures onward costs to airspace users are as low as possible whilst delivering performance needed to support the applications.

The study has developed a roadmap to a minimum specification for EC which meets the criteria and is viable in the coming years. Whilst some challenges remain, we do not believe they are insurmountable. The roadmap / change programme to deliver the benefits is in consultation with the CAA, DfT and STF members.

Based on the selected option, almost all regulatory and standards material is available, but needs transposing and applying in the UK. There is work to do with OFCOM to enable safety-assured applications on 978MHz in the UK Frequency Allocation Table (FAT), but it is within the aeronautical mobile band and so we avoid significant delay with ITU etc.

A roadmap to a minimum surveillance (EC) specification established which enables integration of new users (UAS), access to airspace, and innovation towards the digitalised airspace in the AMS. As the roadmap shows, there are a number of interrelated workstreams that need to be conducted to first quantify, validate and justify the detailed performance requirements, these will need to be completed in-line with on-going international activities that are developing and finalising the applications themselves.

Identified key requirements for assured data (quality) and optimum technology to deliver it, aiming to be future proof to new applications being developed.

Challenges remain, including:

- Including 978MHz in UK regulations
- Ensuring interoperability between 1090/978MHz – the solution requires RPAS to be responsible for this, but allows for the possibility of re-broadcast on 1090MHz if deemed necessary in a specific airspace, but this would require consideration of the impact on spectrum.
- Pace of change introducing TMZs for BVLOS integration
- Interoperability with Europe (EASA/U-Space) – for example the U-Space proposal is under active development and EASA is launching a study on EC interoperability at the time of writing.
- Interoperability with the Military fleet, including the need for assurance from that fleet (a known issue)

Next steps could include:

- Joint statement by DfT and CAA, setting the strategy and roadmap (aligned with the AMS)
- Liaison with OFCOM, setting in motion the process to ensure 978MHz can be used by UAS in the UK
- Programme of updating of CAPs etc to include 978MHz, ICAO FIS with surveillance, and the new use cases / applications