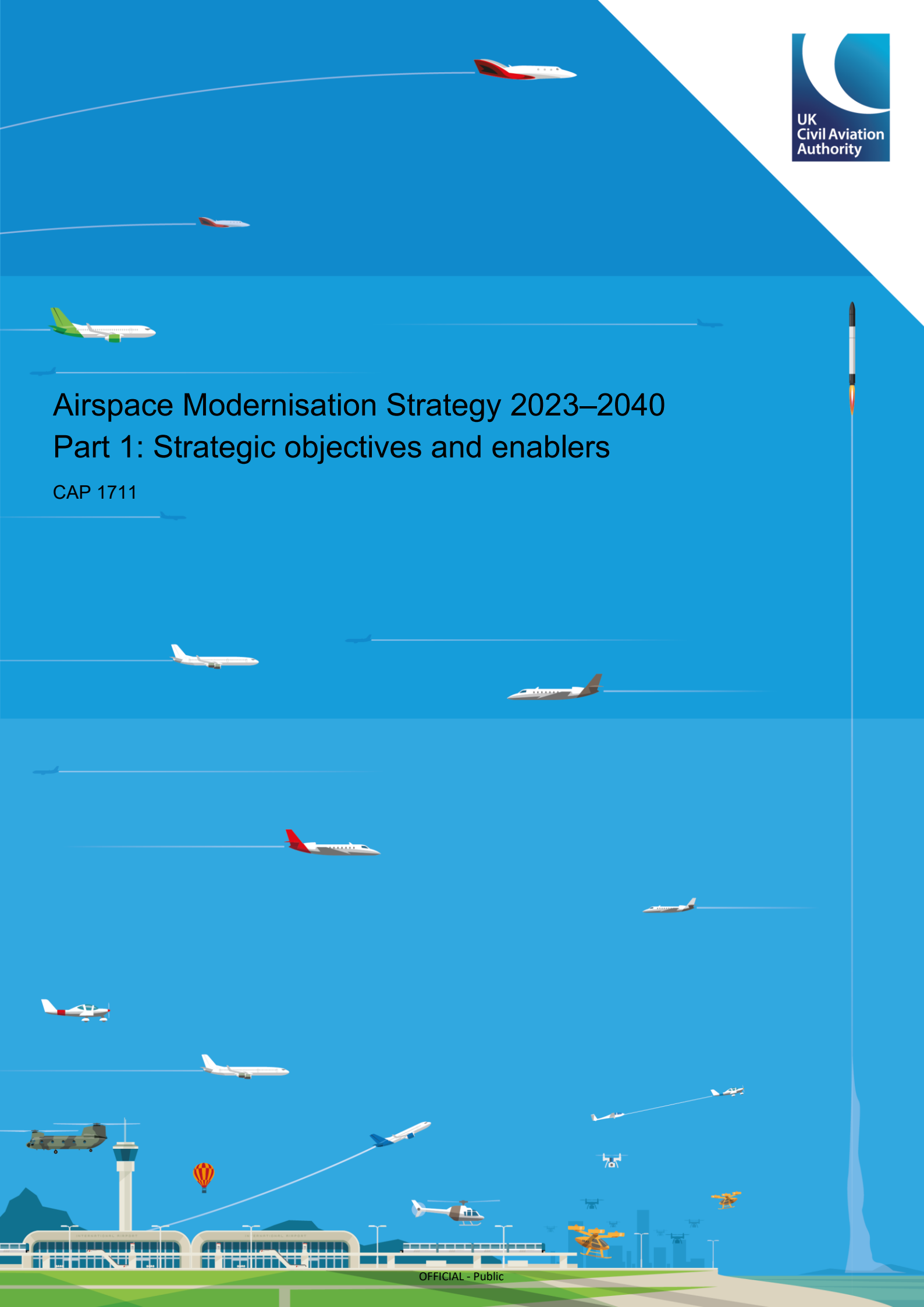

UK Civil Aviation Authority

Airspace Modernisation Strategy 2023–2040
Part 1: Strategic objectives and enablers

CAP 1711

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The latest version of this document is available in electronic format at: www.caa.co.uk/cap1711

Contents

The strategic vision for airspace modernisation to 2040

The vision

Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace

Our objectives (the 'ends')

Safety

Safety:
Maintaining and, where possible, improving the UK's high levels of aviation safety has priority over all other 'ends' to be achieved by airspace modernisation

Integration

Integration of diverse users:
Airspace modernisation should wherever possible satisfy the requirements of operators and owners of all classes of aircraft, including the accommodation of existing users (such as commercial, General Aviation, military, taking into account interests of national security) and new or rapidly developing users (such as remotely piloted aircraft systems, advanced air mobility, spacecraft, high-altitude platform systems)

Simplification

Simplification, reducing complexity and improving efficiency:
Consistent with the safe operation of aircraft, airspace modernisation should wherever possible secure the most efficient use of airspace and the expeditious flow of traffic*, accommodating new demand and improving system resilience to the benefit of airspace users, thus improving choice and value for money for consumers

Environment

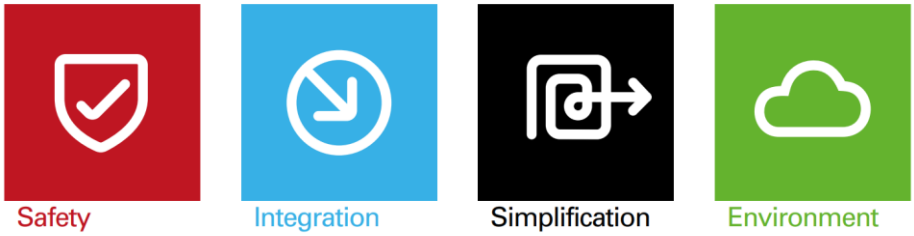
Environmental sustainability:
Environmental sustainability will be an overarching principle applied through all airspace modernisation activities. Modernisation should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance and, in doing so, will take account of the interests of all stakeholders affected by the use of airspace

* 'most efficient use of airspace' and 'expeditious flow' are defined at the foot of page 22.

Figure 1: Strategic vision and objectives for modernising airspace

Chapter 1

Overview



Purpose of this document

This document is the CAA's Airspace Modernisation Strategy Part 1. It sets out the vision and objectives for the modernisation of UK airspace, as summarised in Figure 1 above. It also discusses, at a high level, the enablers; that is, what will be required to achieve the vision and objectives, over the period 2023 to 2040.

This part of the strategy is not a detailed delivery plan. That is set out in Part 2 (Delivery elements) and Part 3 (Deployment). The CAA will lead on development of that delivery plan, but it will mostly be delivered by industry.

Background to the Airspace Modernisation Strategy

1.1 Under the Civil Aviation Authority (Air Navigation) Directions (the Air Navigation Directions), the Secretary of State has given the CAA the function to prepare and maintain a **co-ordinated strategy and plan for the use of all UK airspace for air navigation up to 2040, including for the modernisation of the use of such airspace**.[1] This is consistent with the CAA's role as specialist aviation regulator and its statutory responsibilities. In line with these duties, in December 2018, we published the **Airspace Modernisation Strategy** (AMS), initially focusing on the period to 2024, replacing our earlier Future Airspace Strategy.

1.2 This document refreshes the 2018 AMS:

- to extend the strategy's focus from 2024 out to 2040, as required by the Air Navigation Directions (the need for which we recognised in the 2018 strategy)

[1] Direction 3. https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Legislative-framework-to-airspace-change/

- to take account of the latest developments in innovation and technology, placing integration of all airspace users at the core of the strategy, including accommodating new types of vehicle like remotely piloted aircraft systems[2], advanced air mobility[3] and spacecraft
- to aim for simpler airspace design and supporting regulations
- to treat environmental sustainability as an overarching principle to be applied through all modernisation activities, taking account of the latest government policy and environmental guidance
- to meet the UK's international obligations, aligning delivery of the AMS with the ICAO[4] Global Air Navigation Plan (GANP) and ensuring interoperability of the UK network with neighbouring air traffic management areas
- to make the AMS the single roadmap to guide the CAA's approach to its policy development on airspace modernisation and related legislation (otherwise known as rulemaking), now that the UK has left the European Union and the European Union Aviation Safety Agency (EASA)

all without undermining the initiatives from the 2018 AMS, delivery of which continues and which are subsumed into the refreshed AMS.

1.3 The refreshed AMS therefore pulls together the ICAO GANP, the 2018 AMS initiatives and also new requirements that the CAA has identified through extensive stakeholder engagement in 2021–2022.[5] It also now provides a clear strategic path for rulemaking activities.

1.4 As required by the Air Navigation Directions, the CAA must consult the Secretary of State about the preparation and maintenance of this strategy and the detail to be included in the delivery and deployment plans (which form Parts 2 and 3 of

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2 Remotely piloted aircraft systems (RPAS) may be referred to as unmanned aircraft systems (UAS), unmanned aerial vehicles (UAV), uncrewed aircraft, drones, model aircraft or radio-controlled aircraft. This terminology may change as aircraft capability evolves through technological development such as autonomy. For more information see https://www.caa.co.uk/drones/.

3 References in the AMS to the advanced air mobility concept generally mean eVTOL (electric vertical take-off and landing) aircraft i.e. aerial taxis, but this terminology may change.

4 The International Civil Aviation Organization, a specialist agency of the United Nations responsible for international standards for civil aviation which the UK has by international treaty agreed to implement. ICAO's strategic objectives (in respect of global aviation, not just airspace) can be read here https://www.icao.int/about-icao/Council/Pages/Strategic-Objectives.aspx.

5 This engagement, which included numerous listening, feedback, requirements-gathering, co-creation and review group sessions, is described in CAP 2281 Airspace Modernisation – 2021 Progress Report www.caa.co.uk/cap2281 and CAP 2494 Airspace Modernisation – 2022 Progress Report www.caa.co.uk/cap2494.

this strategy). The CAA also reports to the Secretary of State annually on the delivery of the strategy.[6]

1.5 The CAA will continue to review and update the AMS in the light of ongoing developments, to measure progress against the delivery plans and in order to continue providing annual delivery reports to the Secretary of State. Where appropriate, we may seek stakeholder comments on these updates before implementing them, but we will not necessarily do so in every case.

The shared vision and objectives for modernising airspace

1.6 The Department for Transport and CAA are co-sponsors for airspace modernisation and are working together to deliver our shared **strategic vision and objectives for the modernisation of UK airspace** (Figure 1 above).

1.7 There are two distinct roles within this co-sponsor arrangement:

- the **Department for Transport** develops and owns national aviation policy, including the strategic case for airspace modernisation and the objectives it must deliver; the Secretary of State directs the CAA's role with regard to air navigation through the Air Navigation Directions
- the **CAA**, as independent regulator as well as technical adviser to the Government, will develop and maintain an AMS in consultation with the Secretary of State for Transport and oversee and report annually to the Secretary of State on its delivery, consistent with our duties under section 70 of the Transport Act 2000, the Air Navigation Directions and the policy framework set by the Government, including the UK's international obligations. The CAA's focus is on the technical policy framework required to enable the changes and to identify and propose new rulemaking activities. The CAA also ensures adherence to the CAP 1616 airspace change process.[7]

1.8 The AMS shared strategic vision and objectives are therefore informed by government policy, legislation and the CAA's statutory duties. They also remain aligned with the strategic objectives of ICAO.

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6 These progress reports can be seen at www.caa.co.uk/cap1862 (2019), www.caa.co.uk/cap2016 (2020), www.caa.co.uk/cap2281 (2021) and www.caa.co.uk/cap2494 (2022).

7 CAP 1616 *Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information.* www.caa.co.uk/cap1616

Delivering airspace modernisation

1.9 Although the Department for Transport and the CAA have developed the shared strategic vision and objectives for airspace modernisation, we cannot deliver these alone. Airspace modernisation will need to be delivered collaboratively by a range of aviation organisations, such as air navigation service providers, airports, airlines, manufacturers, representative organisations and, where appropriate, bespoke delivery bodies. A wider range of other stakeholders will need to be engaged throughout this delivery. Modernisation must also happen in a coherent and consistent way. These interactions are managed through the governance structure set out in Appendix A.

1.10 The co-sponsors may commission specific projects necessary for airspace modernisation – for example the airspace change masterplan that ACOG (the Airspace Change Organising Group) is developing[8] – agreeing what must be delivered and the outcomes. The co-sponsors may also set parameters for delivery groups tasked with planning and delivering modernisation projects.

1.11 The AMS will guide the delivery of relevant and timely policy and regulation across the whole CAA that supports the delivery of airspace modernisation goals. In particular, it will be used to assist in the prioritisation of UK airspace rulemaking activity to help ensure its timely and coordinated implementation.

Structure of the AMS – ends, ways and means for modernising airspace

1.12 The AMS sets out the **ends**, **ways** and **means** of modernising airspace:

- the **ends** are the policy objectives for achieving the shared strategic vision for airspace modernisation
- having explained those ends, the strategy describes the **ways** of achieving them (the enablers) – such as new airspace design, new operational concepts and implementable new technologies
- to establish the **means** of delivering modernised airspace, such as the resources needed, this strategy requires organised project teams, led by industry and other entities, to draw up delivery plans, with delivery overseen by the CAA.

[8] The masterplan will form part of the deployment plan in AMS Part 3. The masterplan is a single coordinated implementation plan for airspace changes in the UK up to 2040 to upgrade the UK's airspace and deliver the objectives of airspace modernisation at a system level. It will identify which UK airspace design changes may need to be developed in coordination to achieve the range of benefits that modernisation can deliver, and when. For more information about the masterplan please see https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-change-masterplan/.

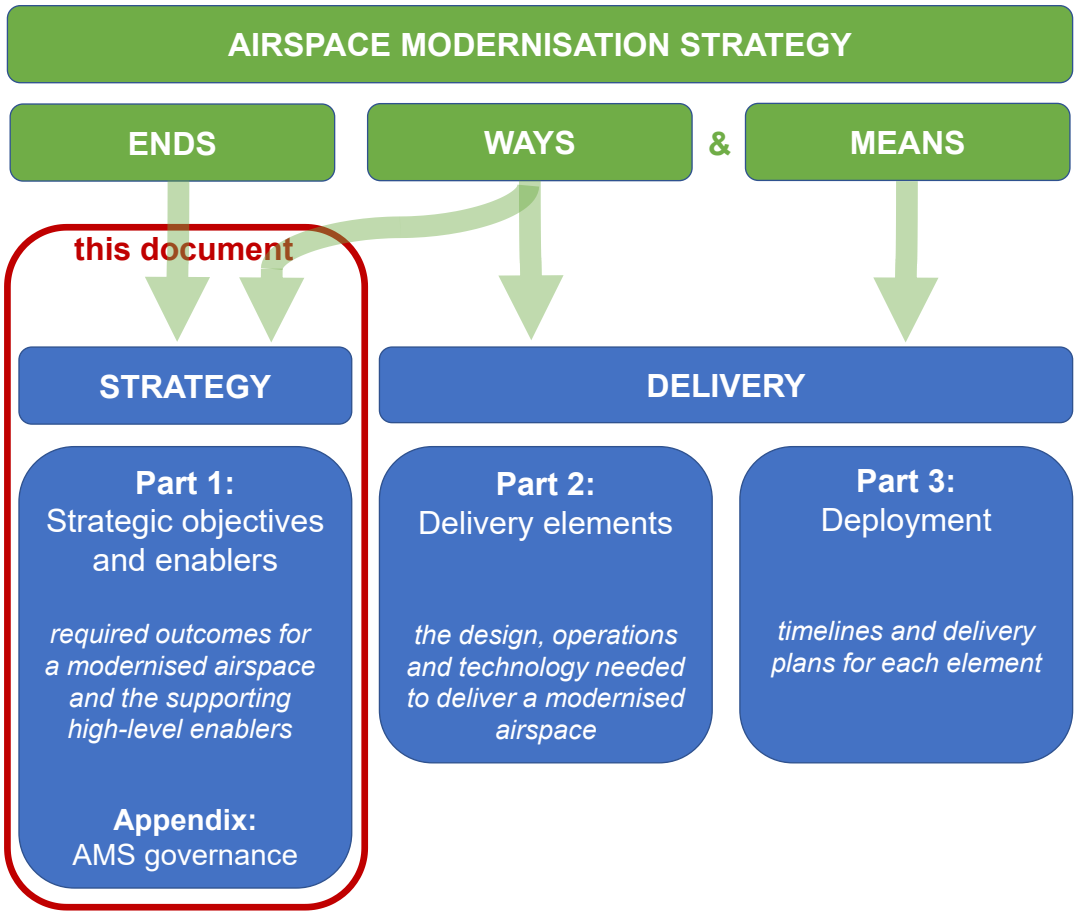

Figure 1.1 Structure of the AMS

1.13 The AMS 2023–2040 is split into three parts, published separately (Figure 1.1 above). **Part 1 (Strategic objectives and enablers)** – this document – explains the strategy's objectives (the **ends**), a high-level overview of what will enable those objectives to be fulfilled (the enablers or **ways**), and governance arrangements for overseeing delivery. Part 1 does not specify detailed solutions, allowing space for innovation.

1.14 **Part 2 (Delivery elements)** and **Part 3 (Deployment)** describe the short-term ambition and explain how the strategy is being delivered. Parts 2 and 3 are likely to be updated more frequently than Part 1 as the elements evolve and mature for delivery.

1.15 Part 2 (CAP 1711a) explains the different elements that make up delivery (the **ways,** in more detail). It includes a linked online database. Part 3 sets out progress with deployment and related activities for those elements (the **means**). We have yet to determine the form of Part 3, which is still being developed. Because it will be an online collection of plans that is constantly evolving, we envisage that it will not form a single document.

1.16 Our intent is for stakeholders to be able to readily identify the modernisation elements that are most relevant to them and that will help to deliver their ambitions. As a high-level strategy, the purpose of AMS Part 1 is not to set out all the answers in the form of relevant technology solutions; that will fall to the ongoing development and deployment work in AMS Part 3.

1.17 Key to delivering airspace modernisation successfully is **AMS governance**: ensuring that each of the entities involved has the right role, powers and/or incentives, underpinned by appropriate governance and enforcement (see Appendix A).

Content of each part of the strategy

Part 1: Strategic objectives and enablers

1.18 Part 1 comprises:

- the overall vision for airspace modernisation
- **Chapter 1:** Overview of the AMS
- **Chapter 2:** The 'ends' that airspace modernisation must deliver:
  - the **strategic objectives** to achieve that vision, grouped under four headings: safety, integration, simplification and environmental sustainability
  - the **drivers** for airspace modernisation, grouped under four headings: meeting airspace demand sustainably, innovation, international obligations and defence
  - the **benefits** of airspace modernisation, by stakeholder group
- **Chapter 3:** The key 'ways' of modernising airspace, aligned with the ICAO Global Air Navigation Plan: information, operational and technology
- **Chapter 4:** Overview of AMS delivery elements
- **Chapter 5:** Use cases – a vision of airspace in the 2030s
- **Chapter 6:** Funding
- **Appendix A:** AMS governance
- **Appendix B:** The legal and policy framework with which the AMS must comply
- **Appendix C:** Glossary of terms.

Part 2: Delivery elements

1.19 Part 1 explains the longer-term vision. Part 2 is more focused on the near term, and will evolve over time, aligned with the ICAO GANP programme. GANP uses a guiding deployment framework known as the Airspace System Block Upgrade (ASBU) with workstreams organised into 'threads' and 'elements' (see Chapter 3). Part 2 expands on the ASBU threads to provide the essential detail of the development activities – known as delivery elements – making up the strategy. While the ASBU threads have extensive operational and technical descriptions, not everything will be wholly applicable to the UK, while some activities necessary for modernisation of UK airspace will be specific to the UK.

1.20 The delivery elements in Part 2 are therefore based on ICAO operational and technical descriptions but tailored to the needs of UK airspace. They form the basis of research and development activities over the near term in support of deployment, including how those activities are funded. Part 2 also identifies legislative, policy or regulatory gaps that need to be addressed, for example how to accommodate new types of aircraft in UK airspace like remotely piloted aircraft systems or spacecraft, or trade-offs between increased capacity, greenhouse-gas emissions, noise, or other factors.

Part 3: Deployment

1.21 Part 3 of the AMS is still being developed. It sets out the industry (and other entity) deployment plans and activities, including research activities in support of deployment. As noted above, the UK delivery elements will use the ASBU deployment framework, aligned with the ASBU threads.

1.22 We envisage that Part 3 will be collated online. Because it will be a collection of plans that is constantly evolving, we envisage that it will not form a single document.[9] In due course, as the Part 3 deployment plans are developed, we may need to consult on certain aspects of them, although we will not necessarily do so in every case.

1.23 These activities are subject to the oversight of the CAA's airspace modernisation oversight team with progress reported through the AMS governance structure, which will be used to facilitate more plans from development and deployment entities. The output informs the CAA's annual progress report to the Secretary of

[9] Please see https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-modernisation-strategy/ for the latest position. The airspace change masterplan (see page 101) is an example of an industry-developed deployment plan. Iteration 2 of the masterplan is already accepted into the AMS. https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-change-masterplan/.

State on the AMS, as well as the UK's progress reports to EUROCONTROL through the Local Single Sky implementation monitoring (LSSIP).[10]

Areas where more work is needed

1.24 As the deployment plans in Part 3 of the AMS are developed, we will, where necessary, strengthen relevant requirements or detail as to how the elements should be delivered, and with what aim. The means of delivering some of the ends required for airspace modernisation are still being developed in detail – for example, the approach to integrating operations of new types of airspace user. The CAA will develop or implement a solution or enabler to better respond to a change or gap where it is within our remit and appropriate for us to do so.

1.25 We have set out in the AMS where these foreseeable 'unknowns' exist that could change and reshape the context. There will also be 'unknowns' that are not foreseeable; for example, these may include:

- ICAO developments with which the AMS has committed to remain aligned
- changes in UK government policy
- developments in neighbouring air traffic management areas, especially our European neighbours, given the need to manage traffic effectively end to end.

1.26 We have grouped the areas where we know more work is needed under three headings:

- demonstrating how environmental sustainability will be treated as an overarching principle, in line with the recently published CAA Environmental Sustainability Strategy[11]
- how to / who will deliver and deploy key aspects of airspace modernisation, including the role of the Airspace Change Organising Group, NATS and airports
- funding and resourcing the broader modernisation programme envisaged by the refreshed AMS

and we have flagged these three areas at relevant points in this document.

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10 For example, UK LSSIP 2021 https://www.eurocontrol.int/sites/default/files/2022-04/eurocontrol-lssip-2021-uk-released_0.pdf. LSSIP documents provide an annual view of how 41 member states of EUROCONTROL (plus Israel and Morocco) and relevant stakeholders are progressing in planning and deploying the mature elements of the European ATM Master Plan. https://www.eurocontrol.int/service/local-single-sky-implementation-monitoring

11 *CAA's Environmental Sustainability Strategy* www.caa.co.uk/cap2360 and related areas of work www.caa.co.uk/cap2361.

Updating the AMS

1.27 Bearing in mind the 2040 timescale specified by the Government, the CAA will continue to keep the context for the AMS under review and update it where necessary, drawing on appropriate work through the AMS governance structure. This particularly applies to AMS Parts 2 and 3 containing the delivery elements, as technological innovations are forthcoming or become ubiquitous, gaps in the policy or regulatory framework emerge that are affecting delivery, or where the Government has signalled upcoming or widescale policy developments.

1.28 We will monitor developments, including through our oversight function and our annual AMS progress reports to the Secretary of State, collating aspects that need amendment. The pace of change may mean that for practical reasons we review and update the AMS in stages. In other words, some developments aligned with the AMS Part 1 vision may move on before the CAA is able to review and update the other parts of the strategy.

1.29 Where appropriate, the CAA may seek stakeholder comments on these updates before implementing them, but will not necessarily do so in every case.

Chapter 2

Ends: strategic objectives, drivers and benefits of airspace modernisation

Chapter summary

This chapter considers the strategic objectives, drivers and benefits of airspace modernisation, notably:

- A: Strategic objectives:
  - Maintaining and, where possible, improving the UK's high levels of aviation safety
  - Integration of diverse users – including needs of defence and security
  - Simplification – reducing complexity and improving efficiency
  - Environmental sustainability – an overarching principle applied through all modernisation activities, in accordance with the Government's environmental objectives
- B: Drivers for change: a reminder of why UK airspace is in need of modernisation
  - Meeting the demand for airspace, more sustainably
  - Encouraging aviation innovation to support UK economic growth
  - International obligations
  - Facilitating defence and security objectives
- C: The benefits and impacts of airspace modernisation
  - UK economy and society
  - Passengers and shippers
  - Climate change impacts
  - Communities impacted by aircraft noise
  - Aircraft operators
  - Airport operators
  - Air navigation service providers
  - Government

Introduction

2.1 This chapter considers the '**ends'** to be achieved from airspace modernisation, and the background. Ultimately the ends, and the '**ways'** those ends are delivered, are driven or shaped by the UK legal and policy framework, and by our statutory duties and international obligations to ICAO. Section 70 of the Transport Act 2000 sets out how the CAA should exercise its air navigation functions including those related to airspace and the use of airspace, however, other legislation and government policy may also be relevant when the CAA discharges its functions in this area, as described in more detail in Appendix B. For example, the UK's climate change obligations and how the Jet Zero Strategy will achieve net zero aviation by 2050; transition to a route structure designed using performance-based navigation[12] as recognised in the Government's Air Navigation Guidance to the CAA; and the Government's Airports National Policy Statement regarding additional runway capacity in the South East.

2.2 We have arranged this chapter under three headings:

A: Strategic objectives for modernisation

B: Drivers for change (a reminder of why modernisation is essential)

C: Benefits and other impacts of modernisation.

A: Strategic objectives for modernisation

2.3 The strategic case for airspace modernisation and the resultant benefits were set out by the Department for Transport in 2017.[13] The aviation industry has already started a major investment programme to upgrade the UK's airspace structure because it was outdated, inefficient, and reaching its capacity. As noted in Chapter 1, the roadmap to modernisation was set by the CAA's first AMS, published in December 2018, replacing our earlier Future Airspace Strategy.

2.4 The co-sponsors' vision and strategic objectives for airspace modernisation are summarised at the beginning of this strategy document, on page 5. Below we

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12 Performance-based navigation is a concept developed by ICAO that moves aviation away from the traditional use of aircraft navigating by ground-based beacons to a system more reliant on airborne technologies, utilising area navigation and global navigation satellite systems. Its use enhances navigational accuracy. For more information, see Annex B of the Air Navigation Guidance 2017 https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017 and https://www.caa.co.uk/Commercial-industry/Airspace/Communication-navigation-and-surveillance/Performance-based-navigation/.

13 For more information see *Upgrading UK airspace, strategic rationale*, Department for Transport, 2017. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/586871/upgrading-uk-airspace-strategic-rationale.pdf

explain some of the background to these objectives under four overarching headings: **safety**, **integration**, **simplification** and **environmental sustainability**.

2.5 The operational challenges set out in the AMS are not specific to the UK. This makes international alignment and cooperation vital, so we can learn from each other and help foster solutions that benefit the industry while helping to reduce any adverse impacts. The global vision and leadership embodied in the ICAO GANP outlines an evolution in the air navigation system for all States and stakeholders.[14]

Safety

Maintaining and, where possible, improving the UK's high levels of aviation safety has priority over all other 'ends' to be achieved by airspace modernisation

2.6 Maintaining a high standard of safety has priority over all other ends to be achieved by airspace modernisation. This is a statutory duty for the CAA under section 70(1) of the Transport Act.

2.7 The UK's airspace has an excellent safety record that is underpinned by a well-established system of structures, rules and procedures. As this system has matured and demand from users grows, there are areas highlighted through our comprehensive safety reporting mechanisms that require improvement.

2.8 The potential to deliver further safety improvements has become limited. However, the pace of change across the aviation industry is set to quicken as traffic levels recover post-pandemic across the commercial air transport, General Aviation[15] and military sectors, at the same time as demand from innovative new airspace users, such as remotely piloted aircraft systems[16], continues to develop rapidly. **There is a requirement for airspace modernisation to enable aviation innovation while at the same time maintaining and, where possible, improving the UK's high levels of aviation safety**. This includes reducing the complexity of airspace structures and introducing new technologies that help to manage any residual operational risk. We say more about these different benefits below.

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14 ICAO's stated purpose for the GANP is to equitably accommodate all airspace users' operations in a safe, secure and cost-effective manner, while reducing the aviation environmental impact.

15 Essentially all civil flying other than commercial airline operations, which therefore encompasses a wide range of aviation activity from paragliders, microlights, gliders and balloons to corporate business jets and aerial survey aircraft, and includes all sport and leisure flying. https://www4.icao.int/ganpportal/document/inputGA

16 Accepting that the model aircraft community are not new airspace users.

2.9 ICAO's safety strategy[17] supports the prioritisation and continuous improvement of aviation safety. It has an aspirational safety goal of zero fatalities in commercial operations by 2030 and beyond, and to reduce the risk of fatalities associated with accidents. The Government is committed, through the UK state safety system, to maintaining and improving the high safety standards in aviation. The goal of the Government's State Safety Programme is that the UK's aviation safety performance remains among the best in the world.[18] Complementing this and directly linked to the ICAO safety strategy is the UK National Aviation Safety Plan. This lists the actions that the CAA will implement to continuously improve aviation safety management and, accordingly, to reduce the risks of aviation operations.[19]

Integration of diverse users

Airspace modernisation should wherever possible satisfy the requirements of operators and owners of all classes of aircraft, including the accommodation of existing users (such as commercial air transport, General Aviation operations, military, taking into account interests of national security) and new or rapidly developing users (such as remotely piloted aircraft systems, advanced air mobility (aerial taxis), spacecraft, high-altitude platform systems)

Current UK airspace structure

2.10 UK airspace is an essential, but largely invisible, part of our national transport infrastructure. It is a shared and (in certain regions) scarce resource. The current segregation[20] applied in UK airspace to meet the needs of users is primarily there for safety reasons. The structure specifies the routes that aircraft fly and the procedures and systems used by air traffic controllers to manage traffic flows.

2.11 UK airspace is divided into three-dimensional volumes of controlled and uncontrolled airspace using a system of classifications.[21] Within these volumes,

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17 *Global Aviation Safety Plan*, ICAO. https://www.icao.int/safety/GASP

18 *State Safety Programme for the United Kingdom*. https://www.caa.co.uk/safety-initiatives-and-resources/how-we-regulate/state-safety-programme/

19 CAP 2393 *The UK National Aviation Safety Plan 2022–2024* www.caa.co.uk/cap2393

20 Where we use the term "segregation" we mean in the plain English sense (separation), rather than, for example, the ICAO definition where segregated airspace is reserved exclusively for a specific user.

21 Controlled airspace is airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification. Its purpose is to create a known air traffic environment to achieve the objectives of the air traffic control service: to prevent collisions between aircraft and to expedite and maintain an orderly flow of air traffic. https://www.caa.co.uk/consumers/guide-to-aviation/airspace/how-is-uk-airspace-structured/

various levels of air traffic service may be available. Typically, the type of airspace may range from the most constraining classification, containing dense and complex air transport operations, within which all aircraft are for safety reasons managed by air traffic controllers who provide a separation service between those aircraft; to an airspace classification which is uncontrolled, within which only flight information services, providing limited advice to pilots, may be available, and where there is no specific requirement for aircraft to participate in or receive those services.

2.12 The majority of commercial air transport flights operate in controlled airspace. General Aviation operates largely, but not exclusively, in uncontrolled airspace below 6,000 feet, alongside a few commercial air transport flights. The military also has requirements to use both types of airspace, to secure the UK's borders and carry out training, and also operates within the confines of segregated training or danger areas.[22] Remotely piloted aircraft systems will want to make use of lower levels, both inside and outside controlled airspace, with an increasing number looking to use higher levels for longer-distance, beyond visual line of sight operations.

2.13 In the interests of safety, some airspace users (such as commercial air transport) require separation from all other air systems. To achieve this, controlled airspace is established. The use of controlled airspace may impinge on the availability of airspace for other users. An appropriate balance is needed to satisfy both the safety and economic requirements of the various types of (at times, conflicting) user operational requirements. At lower altitudes there is more of a challenge in balancing the differing requirements of a wider range of affected parties.

2.14 The main parties responsible for the design of controlled airspace are NATS (En Route) plc (NERL) – a subsidiary of NATS Holdings – which is the regulated monopoly air traffic services provider for en route[23] and some terminal approach airspace[24]; airport operators; and other air traffic services providers, including the Ministry of Defence.

Future integration of air traffic

2.15 The forecast recovery and growth in traffic and continuing technological advancements (see 'B: Drivers for change' below) will require access to, and

https://publicapps.caa.co.uk/docs/33/Policy%20for%20the%20Design%20of%20Controlled%20Airspace%20Structures%20110822.pdf

22 Military requirements vary widely from, among other things, electronic warfare training to air-to-ground ranges or access for remotely piloted aircraft systems.

23 En route means that part of the flight from the end of the take-off and initial climb phase to the commencement of the approach and landing phase.

24 NERL is subject to economic regulation by the CAA. See https://www.caa.co.uk/Commercial-industry/Airspace/Air-traffic-control/Air-navigation-services/NATS-En-Route-plc-NERL-Licence/

management within, the finite volume of UK airspace. The strategy aims to safely facilitate access by diverse airspace users, **with a transition towards greater integration of air traffic, where it is safe to do so**. Achieving this will require a consideration of new airspace designs, operating procedures, technologies and equipment while taking into account other relevant areas of Government policy.

In the context of this document, **electronic conspicuity** is an umbrella term for the technology that can help pilots, remotely piloted aircraft systems and air traffic service providers be more aware of what is operating in surrounding airspace. Electronic conspicuity includes the devices fitted to aircraft that send out the information, and the supporting infrastructure to help them work together. Airborne transponders, air traffic data displays, ground-based antennas and satellite surveillance services are all examples of electronic conspicuity technologies. The information generated by these can be presented to pilots and air traffic services visually, audibly or both to provide them with information on other traffic nearby. This strengthens the principle of 'see and avoid' by adding the ability to 'detect and be detected'. To be most effective it needs 100% of users operating in a designated block of airspace to be using compatible electronic conspicuity devices, and to be able to be detected by others.

2.16 An area of concern within uncontrolled airspace is the risk of mid-air collision. Military aircraft, General Aviation aircraft, remotely piloted aircraft systems and some commercial air transport aircraft can be operating in an environment where the overarching operating principle is 'see and avoid', at times with limited supporting air traffic services and surveillance coverage. Each has responsibility for maintaining a lookout for other aircraft in order to avoid them. This can be of particular concern around smaller aerodromes that have no airspace surveillance capability themselves and in areas with a high density of airspace users that may be harder to see with the naked eye, such as light aircraft, gliders, hang-gliders and remotely piloted aircraft systems.

2.17 Technology will be an important enabler in delivering a safe integration of diverse users in UK airspace. There will be significant benefits through the technology deployed. To the extent that this technology brings disbenefits (such as additional cost to some stakeholders), the AMS will aim to minimise those disbenefits through better articulation of the vision and management of the development and deployment phases, rather than the somewhat piecemeal approach to date.

2.18 Modernisation of air traffic management and airspace will use technology to manage airspace in a flexible, near real-time operation, from high-altitude airspace to very low urban airspace environments.

2.19 **A vital aid to better sharing and access among different users of airspace is electronic conspicuity of UK airspace users** between each other and with air navigation service providers as required, to ensure that this integrated air operation is safe. Electronic conspicuity will allow airspace users to detect and be detected by others. Airspace users will include crewed operations as well as

remotely piloted aircraft systems and advanced air mobility operations.[25] The AMS will be aligned with the outcome of a study commissioned by the Department for Transport on specifications, which concluded in December 2022. A roadmap of electronic conspicuity deployment will be developed in conjunction with the Department for Transport.[26]

2.20 Air and ground systems, including airports, will act as a single integrated infrastructure to accommodate the growth of air traffic and a better performing aviation system supporting development of an intermodal environment. Traditional aviation business models will adapt and accelerate the transition towards an environment that is rich in digital information. At the core of this transformation is a strong need for a fully harmonised global air navigation system, able to utilise and distribute digital information and built on agreed performance-based standards with interoperable and scalable systems.

2.21 New entrants, operating at the lowest and highest altitudes, will have different expectations of the services needed to support their operations, but require access to and to be integrated into the UK airspace operation. Existing infrastructure and services will evolve to serve new entrants with the aim of UK airspace being as available and easy to access as possible. In order to accommodate the growing demand for access to the airspace by such operations, a cooperative model of shared information will be adopted on a wider scale. The AMS ambition is to enable the widest possible use of electronic conspicuity, supporting a range of information and separation services by ground service providers.

2.22 This information-rich environment encourages greater collaboration through shared knowledge, allowing more operations-focused decisions that enable users to fly their preferred operational trajectory. Information also plays an integral role in the highly interconnected systems that will increasingly enable simplification through digitisation.

2.23 There will be an ongoing requirement to provide areas of restriction in the airspace for safety reasons when certain activities are underway, such as military or emergency services operations and training, or space launches. Interoperability of airborne and ground systems will help enable more flexible

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25 For more information on innovative air vehicles and their integration into UK airspace see CAP 2122 *Advanced Air Mobility: Taking a Use Case Approach* www.caa.co.uk/cap2122 and CAP 1868 *A Unified Approach to the Introduction of UAS Traffic Management* www.caa.co.uk/cap1868.

26 In November 2021, the CAA and Department for Transport established the Surveillance Standards Task Force with industry to develop surveillance specifications, including a national, voluntary standard for electronic conspicuity. To facilitate this work, a study was commissioned by the Department for Transport to explore the options. For more information on the outcome, see https://www.caa.co.uk/news/joint-statement-from-caa-dft-on-the-development-of-a-national-standard-for-electronic-conspicuity/.

designs of airspace, encouraging integration rather than segregation, whereby airspace is considered as a shared resource and segregated only when necessary. For example, the Flexible Use of Airspace concept where the military reserves airspace temporarily and releases it for civil use when it is not required.

2.24 Operators of commercial spacecraft and larger remotely piloted aircraft systems that require access to airspace will also gain that access through a reservation system, with separation managed in the same way as conventional piloted aircraft. The airspace requirements for the operation of spacecraft will be large, in order to provide suitable protection for the operation. This is likely to place restrictions on other airspace users, albeit for relatively short periods of time.

2.25 Ideally, the air traffic management/air navigation services system should avoid to the greatest extent possible imposing restrictions on individual flight operations. In practice, this is rarely feasible because of external constraints or the conflicting needs of airspace users, among other reasons. In such cases, the overall ambition is to seek an optimum combination of trade-offs that maximises the collective performance of all members (i.e. network optimisation), while upholding predefined requirements for safety, security, the environment, access and equity. This will be achieved through collaborative decision-making.

2.26 The overall goal is to continuously seek optimum network performance under a variety of operational conditions. The aim is to progressively reduce the impact of trade-offs and, essentially, to enable airspace users to fly their preferred trajectories. The air traffic management/air navigation services system should therefore be flexible enough to integrate changes in business and operational trajectories at the frequency required by airspace users.

Simplification – reducing complexity and improving efficiency

Consistent with the safe operation of aircraft, airspace modernisation should wherever possible secure the most efficient use of airspace and the expeditious flow of traffic[27], accommodating new demand and improving system resilience to the benefit of airspace users, thus improving choice and value for money for consumers

2.27 The aim of simplification is to take a holistic approach to reducing the complexity of UK airspace so as to improve safety, efficiency and environmental sustainability. This includes uncontrolled airspace, as described under the 'Integration of Diverse Users' objective above and on page 51.

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27 The CAA uses the following overall definition of 'the most efficient use of airspace': *The most aircraft movements through a given volume of airspace over a period of time in order to make the best use of the limited resource of UK airspace from a whole-system perspective*. The CAA uses the following definition of 'expeditious flow': *The shortest amount of time that an aircraft spends from gate to gate, from the perspective of an individual aircraft, rather than the wider air traffic system*. (CAP 1616 Appendix G www.caa.co.uk/cap1616)

Reducing complexity

2.28 UK airspace is among the most complex in the world, yet its underpinning design dates back to the 1950s. In recent years, successfully accommodating the growth in demand for air transport has meant adding significant complexity to the UK's airspace system, particularly where traffic volumes are highest, principally over south-east England. Aircraft performance and navigation capabilities have changed significantly. To fully utilise the performance capabilities of modern aircraft, aviation needs an efficient and effective airspace structure.

2.29 As described in Chapter 1, the iterative approach to developing the airspace structure has created several issues that limit the potential to increase airspace capacity without making fundamental changes. For example, upper airspace was structured around a fixed network of waypoints that are based on the position of ground navigation beacons, which modern aircraft no longer require. The fixed number of established routes limits capacity in the cruise phase of flight, constraining the flow of traffic.

2.30 Much of the controlled airspace that serves multiple airports (often in close proximity) in the busy lower airspace areas has become a complex web of intersecting flightpaths. Although added to and adapted in response to growing traffic levels, many arrival and departure routes at major airports, for example, have hardly changed for years, even decades. These outdated arrival and departure routes are again based on obsolete ground navigation beacons and restrict the potential improvements in environmental performance.

2.31 By not utilising the modern technologies available, current flightpaths constrain aircraft climb performance, increasing the time taken to reach optimum cruising altitude. This creates inefficiencies and results in more emissions and greater fuel burn.

2.32 There will be changes to the way we utilise the UK's available airspace; the integration of a complex mix of different user needs will require some flexibility from users to ensure everyone can be safely accommodated. Technology deployments will, where possible, utilise standards developed through international cooperation to ensure consistent and interoperable deployment.

2.33 A significant redesign is needed to enable the most efficient use of available airspace. Airports' standard arrival and departure routes need to be upgraded using performance-based navigation to provide more efficient routes[28] and

[28] The most efficient routing for any aircraft is one that enables it to reach its destination most directly using the least amount of fuel. https://www.caa.co.uk/consumers/guide-to-aviation/airspace/how-is-uk-airspace-structured/

introduce the flexibility that, in collaboration with impacted communities, can allow industry to better manage noise and fuel/CO_2 impacts.

Securing the efficient use of airspace

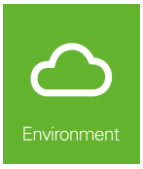
2.34 Airspace modernisation can improve the management of airspace as a network by gathering and sharing more accurate flight information. The consequent gains in efficiency create more capacity allowing the removal of restrictions and better resilience.

2.35 In today's operation, the decisions made by air traffic control to manage the flow of traffic through controlled airspace sectors in line with available capacity are not always based on accurate flight information. Real-time data about when flights plan to arrive in a particular sector, land at an airport, turnaround (reload, refuel etc) and then depart is not always available. The gaps in flight information, and the time and effort needed to close them, reduce the effective capacity of the airspace and create delays.

2.36 Air traffic controllers manage the interactions between traffic in controlled airspace, providing voice or digital instructions to ensure aircraft are separated. The high workload placed on controllers to manage conflicting traffic itself introduces safety risks that are managed by limiting the flow of traffic when its volume is predicted to exceed a certain level or when disruptive circumstances occur, such as extreme weather conditions. These restrictions regularly create bottlenecks which cause flight delays in the air and congestion on the ground, as aircraft slow down, re-route or wait longer to depart. As traffic grows, new routes that are separated by design (i.e. routes that do not cross) and new technologies that automate controller tasks are needed to maintain high safety standards.

2.37 Airspace modernisation will also strengthen resilience, for both the network and locally at specific airports. The gaps in flight information and lack of spare capacity have weakened the resilience of the airspace network to bad weather and disruption (such as technical problems or unexpected closure of a runway). Unplanned events often lead to significant delays. Normal service is typically only resumed on the next day of operation.

Environmental sustainability



Environmental sustainability will be an overarching principle applied through all airspace modernisation activities. Airspace modernisation should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance and, in doing so, will take account of the interests of all stakeholders affected by the use of airspace

AMS topic requiring further work

Demonstrating how environmental sustainability will be treated as an overarching principle, in line with the recently published CAA Environmental Sustainability Strategy

2.38 Modernisation will take account of the interests of all stakeholders affected by the use of airspace, in line with government policy and guidance on environmental objectives setting out how greenhouse-gas emissions, air quality and noise should be considered. The goal is to enhance the sustainability framework to guide the aviation industry in its investment and technological development. As explained above, many air routes and air traffic management practices are not fully utilising the modern technologies available, and aircraft continue to use flightpaths that are outdated.

2.39 In accordance with the Government's key environmental objectives with respect to air navigation, as set out in the Government's Air Navigation Guidance (see below), modernisation should minimise the environmental impact of aviation by:

- ensuring that the aviation sector makes a significant and cost-effective contribution towards reducing greenhouse-gas emissions
- limiting and, where possible, reducing the number of people in the UK significantly affected by adverse impacts from aircraft noise, and
- minimising local air quality emissions and in particular ensuring that the UK complies with its international obligations on air quality.

CAA duties to take environmental factors into account when carrying out modernisation activities

2.40 The CAA has a duty, after maintaining a high standard of safety, to take into account the Government's Air Navigation Guidance when exercising its air navigation functions.[29] As explained above, that guidance sets out the

[29] *Air Navigation Guidance 2017: Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management,*

Government's environmental objectives with respect to air navigation – on noise, greenhouse-gas emissions and air quality – which apply to all modernisation activities. Where elements of the AMS are being delivered through airspace change, the Air Navigation Guidance establishes a set of altitude-based priorities[30] to be taken into account when considering the potential environmental impact of airspace changes (see section 3.3 of the Air Navigation Guidance).

2.41 Where AMS elements are being delivered outside of airspace change and where the CAA has discretion in how we take the environment into account, i.e. where there are no explicit environmental targets or priorities set by government or in legislation, the CAA will apply its **Environmental Sustainability Strategy** and the proposed 'prioritisation principle'.[31] For example, prioritising (after safety) a deliverable in an AMS element which enables CO_2 emissions savings. In 2023 we will consult on the proposed prioritisation principle before we apply it to our decision-making, including on how that principle might shape, influence or otherwise impact the delivery of airspace modernisation. More information on our Environmental Sustainability Strategy and the proposed prioritisation principle is in Appendix B.

2.42 The CAA will align the delivery elements in the AMS consistent with the Government's aviation and environmental policies. As the deployment plans in Part 3 of the AMS are developed, and environmental outcomes become clearer, we will, where necessary, strengthen relevant requirements or detail in this respect as to how the elements should be delivered and with what aims. We aim to maintain a clear and consistent narrative on this principle through the AMS, including the nine delivery elements.

2.43 The CAA must factor into its decision-making how to deliver the Government's key environmental objectives while also achieving the strategic objectives for modernised airspace relating to safety, integration and simplification.[32] **It is important to recognise that while environmental sustainability forms an**

Department for Transport, October 2017. https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017 https://www.caa.co.uk/media/p2kc0rum/additional-air-navigation-guidance-spaceflight.pdf Section 70(2) of the Transport Act 2000 requires the CAA to take account of any guidance on environmental objectives given to the CAA by the Secretary of State in exercising its air navigation functions. We summarise the legal and policy framework in Appendix B.

30 The altitude-based priorities are a set of rules, incorporated in statutory guidance and used by the CAA. They are designed to ensure that potential noise impacts are prioritised over other factors such as greenhouse-gas emissions in airspace change decisions (i.e. changes to flightpaths) up to 7,000 feet above sea level.

31 CAA Environmental Sustainability Strategy www.caa.co.uk/cap2360 and related areas of work www.caa.co.uk/cap2361.

32 A proposed change in airspace design must follow the CAA's decision-making process. www.caa.co.uk/cap1616

overarching principle across the breadth of the delivery workstreams forming a part of the AMS, any airspace redesign must adhere to government policy and guidance.[33] **Environmental impacts often involve trade-offs**[34] **between differing airspace objectives, such as increasing airspace capacity, reducing emissions and managing noise. Public policy informing such decisions is for elected representatives, not the CAA or industry**. The CAA will continue to engage with the Government on its evolving environmental policies, including on how they may lend weight to the CAA's own environmental policies and inform the refreshed AMS. For example, one piece of work set out in the CAA's Environmental Sustainability Strategy will lead to CAA advice to the Government on a proposed set of options to help in prioritising trade-offs between different policy interests more clearly, including between additional capacity, CO_2 emissions and noise.[35]

2.44 The CAA anticipates that in terms of our air navigation functions, operations using advanced air mobility and remotely piloted or unpiloted aircraft systems will be subject to the same, or similar, legal and policy framework as operations by other airspace users.

Jet Zero Strategy and sustainable aviation growth

2.45 In July 2022 the Government published its Jet Zero Strategy[36] which outlined the framework and plan for the aviation sector to achieve net zero greenhouse-gas emissions by 2050, and a target for UK domestic aviation to reach net zero by 2040 and for all airport operations in England to be zero emission by the same year.

2.46 The strategy framework is based on three guiding principles (international leadership, delivering in partnerships and maximising opportunities) and six core policy measures (system efficiencies, sustainable aviation fuels, zero-emission flight, markets and removals, influencing consumers and addressing non-CO_2 impacts). The strategy sets an in-sector CO_2 emissions reduction trajectory for

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33 Principally the *Air Navigation Guidance 2017*, Department for Transport, October 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918507/air-navigation-guidance-2017.pdf, and *UK Airspace Policy: A framework for balanced decisions on the design and use of airspace*, Department for Transport, February 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/588186/uk-airspace-policy-a-framework-for-balanced-decisions-on-the-design-and-use-of-airspace-web-version.pdf

34 A trade-off is the choice or decision to resolve a conflict, and could be between two sponsors of separate airspace changes, or between two objectives (such as achieving noise reduction and achieving fuel efficiency).

35 This is not an activity under the AMS, but under the CAA's Environmental Sustainability Strategy.

36 *Jet Zero strategy: delivering net zero aviation by 2050*, Department for Transport July 2022. https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050

aviation to 2050 against which the Government will regularly review progress, with a review of the strategy every five years.

2.47 The Jet Zero Strategy considers improvements in system efficiencies, which includes airspace modernisation, as one of its key foundations, providing important short- to medium-term savings in emissions before 2050. The Jet Zero Strategy's Systems Efficiency chapter notes that moving to best-in-class aircraft, operations and airspace modernisation could deliver 12–15% of CO_2 savings by 2050.

2.48 Subject to operational constraints (including safety), the design of airspace and the CAA's airspace decisions do not specify, or limit future increases in, the volume of air traffic using a portion of airspace at any given point in time. The volume of air traffic using an airport may however be addressed by land-use planning conditions, where relevant.

2.49 The AMS cannot be used to cap capacity. It can help to reduce aviation's environmental impacts, but other factors in combination will determine the net impact. These factors could be planning restrictions, technology improvements, or commercial and operational decisions by industry (such as airline route networks and how they are incentivised, airline choice of aircraft fleet and type deployed on a route, industry operating procedures, and so on).

2.50 In its Jet Zero Strategy and the accompanying consultation response document[37], the Government confirmed its view that the aviation sector can achieve Jet Zero without the Government needing to intervene directly to limit aviation growth, with knock-on economic and social benefits. More information is in Appendix B.

ICAO long-term aspirational goal for international aviation CO_2 emissions reductions

2.51 The 41st ICAO Assembly adopted a long-term global aspirational goal for international aviation of net-zero carbon emissions by 2050 in support of the UNFCCC Paris Agreement's temperature goal.[38] The agreement does not attribute specific obligations or commitments in the form of emissions reduction goals to individual States. Instead, it recognises that each State's special circumstances and respective capabilities (for example, the level of development, maturity of aviation markets, sustainable growth of its international

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37 *Jet Zero consultation: summary of responses and government response*, Department for Transport July 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1096928/jet-zero-consultation-summary-of-responses-and-government-response.pdf

38 https://www.icao.int/environmental-protection/Pages/LTAG.aspx The adopted resolution can be downloaded at https://www.icao.int/Meetings/a41/Documents/WP/wp_658_en.pdf

aviation, just transition, and national priorities of air transport development) will inform the ability of each State to contribute within its own national timeframe. Each State will contribute to achieving the goal in a socially, economically and environmentally sustainable manner and in accordance with its national circumstances.

2.52 ICAO's goal is therefore fully aligned both with the UK's Jet Zero Strategy and the global industry's commitment to net zero carbon emissions by 2050.

The role of airspace modernisation in respect of emissions

2.53 In the upper airspace, aircraft often fly further than necessary on flightpaths that are determined not by the shortest or most cost-effective route to their destination, but by airspace design or by controllers needing to safely separate traffic. Aircraft experiencing delays often have to fly sub-optimal routes, at less efficient altitudes and speeds, to avoid bottlenecks in the airspace network. **Airspace modernisation enables aircraft to follow more efficient flightpaths** thereby reducing fuel burn and emissions per flight.

2.54 In today's operation, controllers tactically manage the complex interactions between climbing and descending traffic. Continuous climbs and descents are routinely interrupted because of a lack of capacity at the airport or in the surrounding airspace, requiring aircraft to return to level flight until they are able to continue climbing or descending. The introduction of these 'steps' of level flight means more time is taken for climbing aircraft to reach their optimum cruising altitude, increasing emissions and fuel burn per flight. Similarly, descending aircraft that level off require higher engine power and consequently increased fuel burn. In modernised airspace, flights in lower airspace that are transitioning between the take-off or landing phase and the cruise in upper airspace would be able to climb and descend continuously more often, thereby reducing fuel burn and emissions per flight.

2.55 Flights inbound to airports that operate at close to maximum capacity often suffer congestion that results in queuing and delays. In the current airspace structure, arrival queues are managed using holding patterns such as 'stacks' or 'arcs' that cause traffic to circle in lower airspace burning extra fuel. Aircraft may also be held in take-off queues. Modernised airspace will reduce the need for holding by better managing arrival times through optimised routes and speeds, thereby reducing fuel burn and emissions per flight.

2.56 As noted above, the Government's Jet Zero Strategy considers improvements in system efficiencies, which include airspace modernisation, as one of its key foundations, and that moving to best-in-class aircraft, operations and airspace modernisation could deliver 12–15% of CO_2 savings by 2050. A 2018 NATS report into the technical feasibility of airspace modernisation in the south-east of the UK, commissioned by the Department for Transport, suggested that

modernising airspace in the UK offers the potential to reduce future CO_2 emissions within the affected south-east airspace by up to 20% by 2050 compared with a growth scenario without modernisation and increased delay.[39] The Government committed to working with the CAA as co-sponsors of the airspace modernisation programme, and to support the Airspace Change Organising Group in ensuring carbon savings are realised and that plans for airspace modernisation account for the introduction of zero-emission aircraft.

The role of airspace modernisation in respect of noise impacts

2.57 One of the most significant environmental impacts associated with the airspace, particularly at lower altitudes near airports, is aircraft noise. The AMS objectives lead to a set of deliverables for which the strategy is responsible. They do not aim to encapsulate the entire government policy on aviation noise.[40] Instead, the strategy aims to identify where airspace has a specific role relating to noise, as described below. Where planning decisions have been approved and enabled growth, which may adversely affect noise, noise impacts are considered through the airspace design process and clearly communicated.

2.58 Aviation noise performance has improved significantly in recent decades, driven by the introduction of quieter aircraft. Airspace modernisation is expected to result in a further reduction in the average noise levels *per flight*.[41] Currently, flightpaths may not be optimised to reduce noise impacts or designed to offer relief from noise. For example, modernisation could enable aircraft to climb more quickly and descend more quietly, and to navigate more accurately around population centres or other noise-sensitive areas. Reducing noise impacts could itself be a driver for a new design.

2.59 However, the creation of more airspace capacity, while not directly generating more air traffic, can, where planning decisions allow it, facilitate further traffic growth. This is because the outdated airspace design will eventually constrain the number of flights that the airspace can safely accommodate. The potential for

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39 *NATS Feasibility Report into Airspace Modernisation in the South of the UK and the CAA Assurance into the NATS Feasibility Report*, Department for Transport December 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/763085/nats-caa-feasibility-airspace-modernisation.pdf
Iteration 2 of the ACOG airspace change masterplan, December 2021, notes (paragraph 13) that almost 50% of all the environmental inefficiency in the UK airspace system, as recorded by NERL in 2019, arose in the terminal airspace. www.caa.co.uk/cap2312b

40 For example, the Government expects industry to follow the ICAO 'Balanced Approach', but the strategic objective here focuses on the measures within that Balanced Approach where airspace is most relevant. The Government also imposes noise restrictions on night flights at certain airports.

41 The expectation of a reduction in the average noise levels per flight does not mean that there will be a reduction in noise on every individual flight, or that there will necessarily be an overall reduction in noise, as this will be dependent on the overall number of flights.

this effect is considered as part of the CAA's airspace change process decision-making. The total impact on noise of modernisation is therefore dependent on several factors. What is more, modernisation may result in the redistribution of noise impacts between different areas on the ground, depending on the airspace design and the way it is used. Those changes may impact communities living under flightpaths in different ways, both positively and negatively.

2.60 Those who are affected by airspace change must therefore be engaged in the decision-making process, and fully informed of the benefits and drawbacks of such a transformation. The effects of new, more frequent or concentrated flightpaths may increase the risks of causing general annoyance, sleep disturbance, lower levels of productivity and health impacts. The introduction of performance-based navigation routes can be used beneficially, for example by introducing, within practical limits, multiple flightpaths for noise respite. However, the improved navigation precision can also result in greater aircraft (and therefore noise) concentration in certain locations.

2.61 In the Air Navigation Guidance 2017, the Government issued revised environmental guidance to the CAA to clarify that in assessing the number of people 'significantly affected by aircraft noise', the total adverse effects must be considered. This clarification of existing policy builds in an assessment of health impacts into airspace change proposals so that, for example, the creation of a respite route could reduce the total adverse health effects while increasing the absolute number of people affected. As a result, the aviation industry is required to consider options when designing airspace to find ways to manage the distribution of noise that best reflects this policy objective, including taking into account local circumstances and preferences.

2.62 Figures 2.1 and 2.2 give examples of the possible noise management options in a modernised airspace network. Figure 2.1 illustrates using the enhanced navigational accuracy of performance-based navigation to manage noise impacts by avoiding population centres. Figure 2.2 illustrates how an increased minimum climb gradient will, in general, result in some of the slowest-climbing aircraft reaching a higher altitude sooner in their vertical profile. This has potential operational benefits and also some noise benefits as, in general, noise experienced on the ground reduces with height. However, heavier aircraft may have to increase engine thrust to achieve the steeper gradient which may alter noise impacts and also reduce engine service life. More information and other examples are explained in CAP 1378.[42]

[42] CAP 1378 *Performance-Based Navigation: Airspace Design Guidance – noise mitigation considerations when designing PBN departure and arrival procedures* www.caa.co.uk/cap1378.

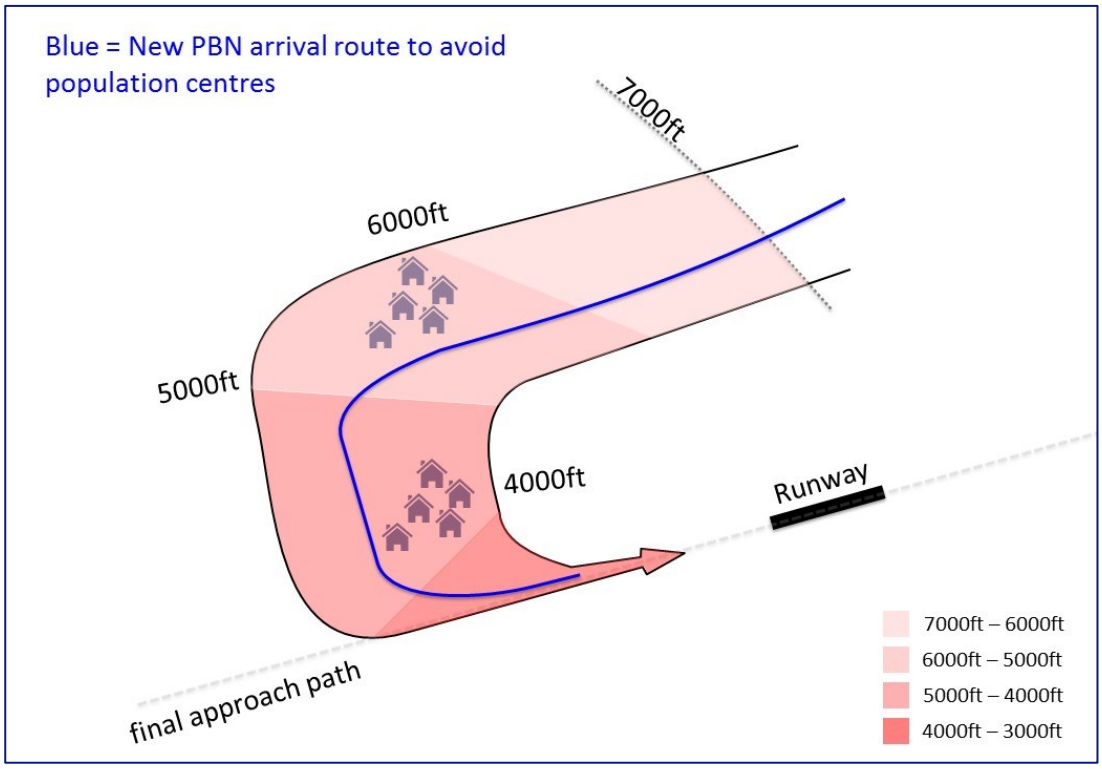

Figure 2.1: Illustration of a new arrival route using performance-based navigation to manage noise impacts by avoiding population centres

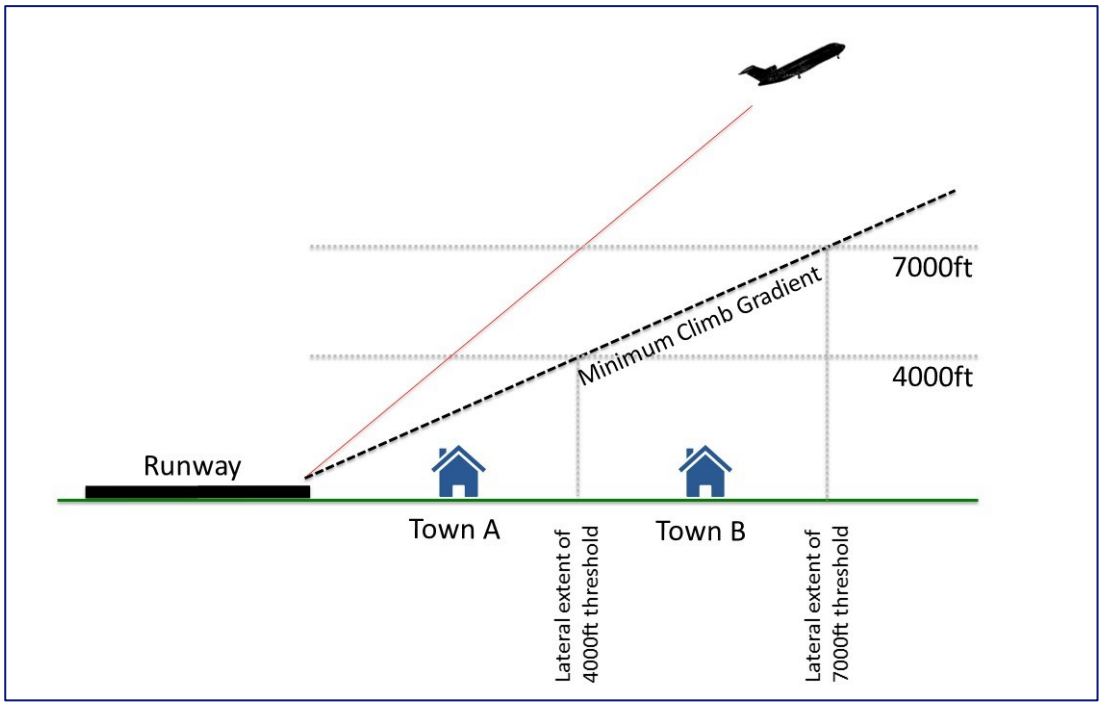

Figure 2.2: Illustration of an increased minimum climb gradient to lessen noise impacts through greater height over the ground

Source for Figures 2.1 and 2.2: www.caa.co.uk/cap1378

2.63 It is not the role of the airspace modernisation programme to limit airspace capacity for each airport. Airport capacity at individual airports is dealt with through the planning process, for example, through limits on the number of passengers or flights at individual airports. The AMS therefore focuses on the impact that airspace design can have on limiting and, where possible, reducing aviation noise impacts in accordance with the Government's environmental objectives as set out in the Air Navigation Guidance.

2.64 The noise impacts of changes to airspace design are evaluated as part of the CAA's regulatory process for airspace change proposals through the CAP 1616 process. The sponsors of airspace change proposals are required to consider and find ways to manage the distribution of noise that best reflects this objective of the AMS and the Government's environmental objectives, including taking into account local circumstances and preferences.[43]

Local air quality

2.65 Because of the effects of atmospheric mixing and dispersion, emissions from aircraft above 1,000 feet are unlikely to have a significant impact on local air quality.[44] Therefore, the impact of airspace design on local air quality is generally negligible compared to changes in the volume of air traffic and that of the local transport infrastructures feeding the airport. However, as part of the modernisation programme, the CAA evaluates whether local air quality could be impacted when assessing individual airspace change proposals through the CAP 1616 process.

2.66 The Environment Act 2021 provides a legal framework for environmental governance and brings in measures for the improvement of the environment including in relation to air quality. It does so by providing the Government with duties to set new binding targets. The Government is also required to regularly update its National Air Quality Strategy. More information is in Appendix B.

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43 Nevertheless it is conceivable that the CAA may, through this process, need to take a decision to limit the capacity of an airspace design on safety grounds.

44 ICAO Doc. 9889 Airport Air Quality Manual, Second Edition, 2020 (Chapter 4) states: "Aircraft emissions generated during take-off and landing operations also occur off the airport and up to the local mixing height, which is often assumed to be 1,000 metres or 3,000 feet in height."
https://www.icao.int/publications/Documents/9889_cons_en.pdf
However, most air quality impacts occur below 1,000 feet with a very rapid drop-off in impact with greater altitude. Because commercial aircraft will not turn below 500 feet, airspace design will therefore materially impact air quality only between 500 and 1,000 feet. In practice, the CAA uses 1,000 feet for the purposes of environmental assessment of the impacts of airspace change.
CAP 1616a *Airspace Change: Environmental requirements technical annex* www.caa.co.uk/cap1616a.

B: Drivers for change

2.67 Above we set out the strategic objectives for airspace modernisation. These objectives are what is needed to satisfy the drivers for change – i.e. why UK airspace is in need of modernisation. We have categorised these drivers under four headings:

- Meeting the demand for airspace, more sustainably
- Encouraging aviation innovation to support UK economic growth
- International obligations
- Facilitating defence and security objectives.

Meeting the demand for airspace, more sustainably

2.68 Aviation in the UK has grown significantly in the last 50 years driven by globalisation, the growth in real incomes and a greater desire from the public to travel abroad. The aviation sector brings significant benefits to the UK and is a key driver for future economic growth.

2.69 The aviation sector in the UK has changed considerably with demand for access to the airspace driven by new users as well as existing operations. The use of technology and the need for information sharing is critical to enable the necessary sharing of the airspace in a safe and sustainable way enabling further innovation by users. The use of technology by new users should be a catalyst to challenge the existing methods of operation and will require a willingness for airspace users to embrace change.

2.70 In 2018, prior to the Covid-19 pandemic, the Government was expecting demand to continue to rise significantly in the period to 2050[45], bringing increasing pressure on UK airspace. Flight delays were forecast to increase sharply if the UK's airspace was not modernised. Delays can lead airlines to build buffers into their flight schedules limiting the number of round trips that can be completed in a day, and therefore potentially reducing frequency to some destinations in order to maintain the reliability of their operation. The outcome is less choice, greater cost and inconvenience for passengers and shippers, and constraints on UK connectivity and on UK economic growth. Modernisation provides greater efficiency and system resilience to disruption, failures, or against cybersecurity threats. It therefore brings benefits for consumers in the form of choice and

[45] *Beyond the horizon, the future of UK aviation, next steps towards an Aviation Strategy*, HMG, April 2018. https://www.gov.uk/government/consultations/a-new-aviation-strategy-for-the-uk-call-for-evidence

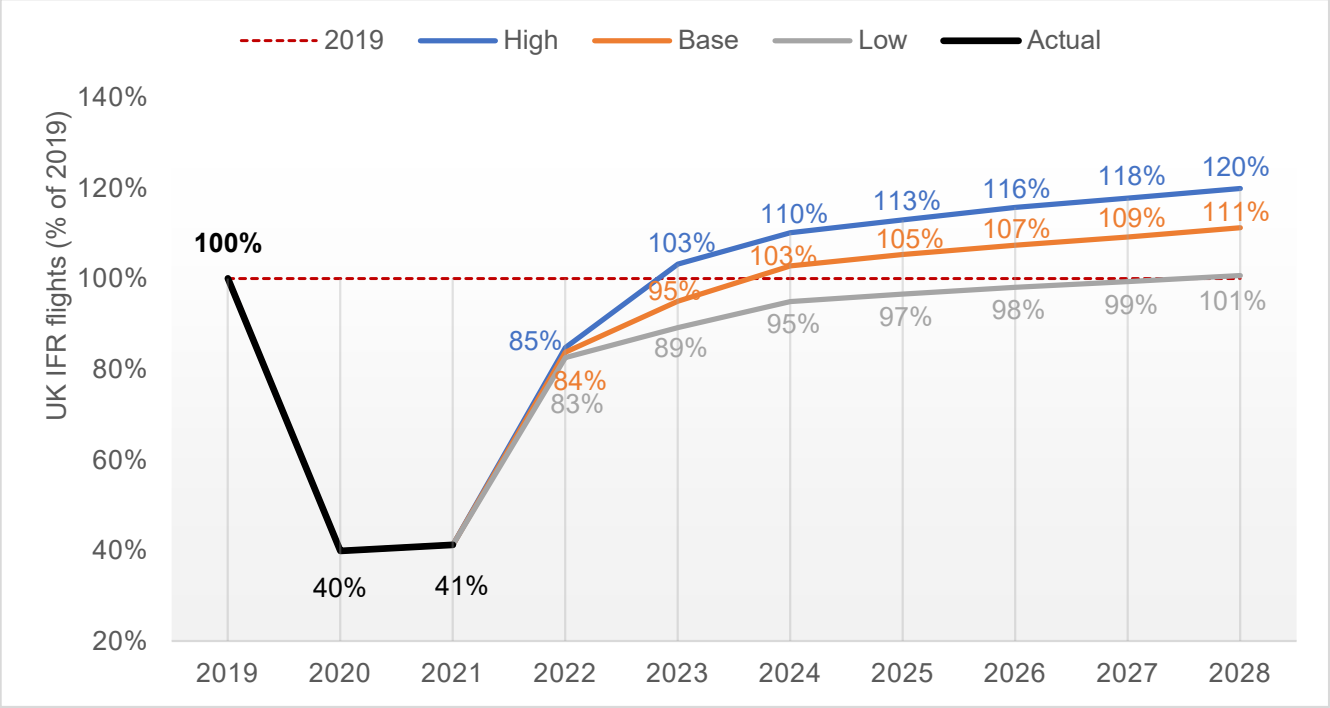
value. The strategic case for airspace modernisation and the resultant benefits were set out by the Department for Transport in 2017.[46]

2.71 The AMS has a strategic objective (see above) that environmental sustainability will be an overarching principle applied through all airspace modernisation activities, and that modernisation should deliver the Government's key environmental objectives with respect to air navigation. While airspace modernisation itself neither delivers nor caps growth – that is governed by the land-use planning regime – more efficient operations and improved system resilience to disruption facilitated by modernised airspace and exploiting technology improvements will allow quicker, quieter and cleaner journeys. This will contribute to growth being achieved more sustainably.

2.72 As noted above, the Government has reaffirmed that it wholeheartedly supports flying as a social and economic good, and believes that even if returning to a pre-Covid-19 demand trajectory, the UK could achieve net zero emissions without the Government needing to intervene directly to limit aviation growth providing technology solutions are implemented effectively. The Government's Jet Zero Strategy considers improvements in system efficiencies, which includes airspace modernisation, as one of its key foundations, providing important short- to medium-term savings in emissions before 2050, helping aviation to meet increasing demand in a sustainable way.

2.73 Most flights using the UK's controlled airspace and route network are commercial air transport aircraft carrying passengers and freight. At the time of writing, while recovery of the sector from the Covid-19 pandemic has become more established, there are a number of global factors that present sizeable downside risks to the pace of that recovery. Notably these risks come in the form of a weaker economic outlook, the war in Ukraine and the potential resurgence of Covid, which may see a return of some travel restrictions. As a result, there is still considerable uncertainty regarding the path and speed of post-pandemic traffic recovery, and forecasts vary as to when commercial air transport will recover to at least 2019 traffic levels. **Those forecasts also continue to change**. At the time of writing, the more optimistic forecasts suggest 2023 and the more pessimistic ones suggest towards the end of the decade: Figure 2.3 shows a EUROCONTROL forecast for IFR (instrument flight rules) flights in UK airspace (October 2022) – essentially those flights using controlled airspace.

46 *Upgrading UK airspace, strategic rationale*, Department for Transport, 2017. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/586871/upgrading-uk-airspace-strategic-rationale.pdf



Note: Forecast published October 2022.
https://www.eurocontrol.int/publication/eurocontrol-forecast-update-2022-2028

Figure 2.3: Eurocontrol seven-year forecast of future UK IFR movements vs 2019 (October 2022)

2.74 The potential demand from new airspace users (such as remotely piloted aircraft systems, advanced air mobility, space) is difficult to quantify, but in time could be very significant.[47]

2.75 The AMS must take into account changing trends, including any structural changes in air travel or changes in the types and numbers of airspace users, and must look at the long-term outlook. If these forecasts are realised modernisation will be needed to secure the most efficient use of airspace and the expeditious flow of traffic in a safe and sustainable way.

[47] For example, PwC estimates the UK's total population of drones in use by commercial organisations and government at more than 920,000 by 2030, of which more than a fifth could be used by the public sector. *Skies without limits v2.0,* PwC July 2022 https://www.pwc.co.uk/intelligent-digital/drones/skies-without-limits-2022.pdf.

Also see *European ATM Masterplan: Roadmap for the safe integration of drones into all classes of airspace*, SESAR March 2018: https://www.sesarju.eu/sites/default/files/documents/reports/European%20ATM%20Master%20Plan%20Drone%20roadmap.pdf

Encouraging aviation innovation to support UK economic growth

2.76 Technology will drive radical changes in transport in the next 10 years, with profound implications for transport users and businesses. Electrification, connectivity, automation and real-time data usage are driving the development of new modes of travel and new ways to do business. As part of the UK's industrial strategy, the Government's Future of Transport programme[48] aims to stimulate innovation in the transport sector, create new transport markets, secure a 21st-century transport system, and secure the UK's position as a world-leading innovator, decarbonising the transport system for the benefit of all society.

2.77 The Government's ambition is for the UK to lead the world in innovative aviation technology that has a transformative effect on the movement of people and goods, and delivers tangible benefits to communities, industry and users in a safe, secure and sustainable way.

2.78 These emerging forms of aviation are developing rapidly and will create new ways to travel and new forms of aviation. Examples include remotely piloted aircraft systems, advanced air mobility (aerial taxis), high-altitude platform systems including balloons (for example, to provide a telecommunications network), commercial spacecraft (launching from the UK), and upper-atmosphere supersonic and hypersonic flights. Some of these users, although labelled as new entrants, have actually been operating for several years. Technology has increased the ease and cost of their manufacture and operation, which has expanded the range of use, including surveying, delivering products and telecommunications, serving new locations and providing new or existing services to society in a new or more cost-effective way, creating jobs and economic activity.

2.79 Remotely piloted aircraft systems may be used for civil or military aviation purposes. They will require changes to airspace structures and rules if they are to integrate seamlessly into UK airspace alongside the demand for commercial air transport flights, military activities, and an active General Aviation sector. The commercial spaceflight sector is also now becoming a reality. These innovative technologies not only affect what flies, but also how aircraft are flown, meaning new concepts for operating aircraft are also emerging.

2.80 Such a high rate of change cannot be accommodated within the current airspace structure, potentially impacting existing airspace users. Incorporating this ever more complex and growing mix of traffic requires advanced technological tools and air traffic management solutions. For example, the CAA and Department for Transport formed the Surveillance Standards Task Force with industry to

48 https://www.gov.uk/government/collections/future-of-transport-programme

develop surveillance specifications, including a national, voluntary specification for electronic conspicuity. The broad scope of the task force was to:

- identify the operational need for an electronic conspicuity standard from future airspace scenarios
- identify the minimum standards which would satisfy the operational needs
- identify the minimum standards that could fill the recognised gaps in the UK regulatory framework, and
- create a roadmap for updates to the regulatory framework that support implementation.

2.81 Creating interoperability between airspace users and service providers will enable future airspace design to accommodate better information-sharing accurately and reliably, promoting safe integration and growth for all users of airspace. Compliance with the specifications will be required in airspace where mandated, but outside that airspace, users can still benefit from using these or other systems in a limited way that gives useful functionality alongside similarly equipped operators.

2.82 The economic and financial models that will be used to deliver the services required by new types of airspace users will also need to be developed. In the electronic conspicuity example above, some users of airspace may need to adopt new equipment or adapt existing devices to meet the new specifications. The Department for Transport and CAA will set out more details in due course about support to help manufacturers and airspace users make those changes. As regards environmental impact, as noted earlier, the CAA anticipates that in terms of our air navigation functions, operations using advanced air mobility and remotely piloted or unpiloted aircraft systems will be subject to the same, or similar, legal and policy framework as operations by other airspace users.

2.83 The need to exploit appropriate technology improvements including modernising old technology can also be a driver. For example, rationalisation of DVOR (Doppler VHF omnidirectional range) conventional ground-based radio navigation aids requires changes to instrument flight procedures to adopt performance-based navigation. Where existing technology needs replacement or upgrade or new technology is replacing it, the AMS will aim to utilise development and deployment oversight activities to manage the transitions.

International obligations

2.84 The UK's international treaty obligations, in particular adherence to the ICAO Global Air Navigation Plan (see Chapter 3), is a significant driver of airspace modernisation. The UK also needs to maintain interoperability with the systems

and procedures of international partners to ensure connectivity and efficiency of cross-border operations.

Facilitating defence and security objectives

2.85 The military relies on access to airspace to help secure the UK's borders and carry out training. Military aircraft, land and maritime systems use the full range of upper, lower and terminal airspace, including all classifications of airspace. These operations sometimes require dedicated areas to be reserved for activities which may be hazardous to other airspace users such as high-energy manoeuvring and testing munitions.

2.86 Military airspace requirements are under constant review in response to technological developments, geopolitics and government direction. The UK and its allies have brought into service more technologically advanced and capable aerial systems, for example 'fifth-generation' fast jets and large remotely piloted aircraft systems. Although tactical training for this latest generation does include the use of ground-based simulators and training systems, it is anticipated that it will also drive greater airspace requirements over the next 10 years. The need for airspace to support specialised training will continue to evolve. To exercise the full capability of fifth-generation systems and present a sufficient training challenge, airspace must accommodate areas of an appropriate size, shape and location that allows tactics and systems to be fully and realistically tested.

2.87 Much of the current special-use airspace[49] was developed to support the operational and training needs of aircraft and systems that in many cases are now retired, and it is neither optimal for current missions nor emerging requirements. Together with other new platforms such as remotely piloted aircraft systems based in the UK, new weapons technology and operational approaches, these bring a new airspace requirement.

C: The benefits and impacts of airspace modernisation

2.88 We have described above the strategic objectives for modernisation, and the main drivers. This section considers the benefits and impacts from the perspective of individual stakeholders. This theme is picked up in the use cases in Chapter 5. Modernisation will also provide flexibility within the system to enable continuing development and improvement of UK airspace in the future.

UK economy and society

2.89 The capacity to add routes, accommodate new flights, make existing operations more efficient and encourage new technology and associated infrastructure will enhance the UK's global connections, give better value and more choice for

[49] A general term covering all types of airspace that could be used for military purposes (see Appendix C).

businesses and individual travellers, helping to stimulate UK economic growth benefiting the UK population. New types of aerial vehicle have the potential to bring economic benefits not just to aerospace but to the wider economy including the transport network and businesses at the local level. They could also bring societal and environmental benefits through their provision of new or more effective services, replacing more polluting traffic, and enhancing State activities such as medical flights, search and rescue or law enforcement.

Passengers and shippers

2.90 Modernisation will add capacity to the system, addressing 'hotspots' of congestion within the current system that may otherwise give rise to delays, such as 'stacking' in holding patterns by flights inbound to an airport. Modernisation will generally improve resilience of the system to bad weather or other forms of disruption, including disruption in neighbouring airspace outside the UK's area of responsibility.

2.91 Passengers and shippers (including companies in the supply chain that rely on air transport to conduct their business) will therefore experience fewer flight delays and service disruptions at short notice, saving them time through shorter journeys with a more reliable service. Coupled with the improvement in the passenger experience, increased capacity may allow more choice of connections to more destinations.

Climate change impacts

2.92 The Government expects that to meet its commitment to achieving net zero emissions, a significant proportion of the emissions reductions will come from improving the efficiency of the existing aviation system, including aircraft, airports and airspace. These efficiency improvements also offer the best opportunities for short- to medium-term emissions reductions, given the lead times associated with other measures, such as sustainable aviation fuels and zero emissions flight. In the longer term, modernisation will reduce the need for potentially expensive climate mitigations such as carbon capture and storage.

2.93 Airspace modernisation will therefore be an important contributor to reducing UK aviation greenhouse-gas emissions. Where aircraft are able to follow more fuel-efficient routes, wider society will benefit from the reduction in climate change impacts.

Communities impacted by aircraft noise

2.94 The fourth strategic objective on environmental sustainability above explains the environmental improvements that airspace modernisation can offer to

communities[50] impacted by aircraft noise – as a result of designing airspace around the more advanced technology available and better aircraft performance. It also explains that not every community will benefit.

2.95 When an airport is changing airspace (for a planned increase in capacity or any other reason) it must develop its design proposal in accordance with policy and law and follow the CAA's airspace change process.[51] In the Air Navigation Guidance 2017, the Government has also provided guidance[52] to the CAA and industry on how the decisions they make can best give effect to the Government's key environmental objectives, including managing the impacts of aircraft noise.

2.96 The objectives of the AMS are also bound by this overarching government policy. The AMS can only be responsible for delivering noise reduction where it has an element of control. Where a decision has been taken through the planning process to increase airport capacity, this is outside the responsibility of the strategy. The objectives of the AMS therefore do not focus on the overall level of noise, as this is in part contingent on planning decisions and government policy.

Aircraft operators

2.97 **Access:** UK airspace will more readily and more safely accommodate additional demand from airspace users, including:

- Commercial airlines providing a key element of the UK's transport infrastructure, supporting connectivity, better choice and value for consumers and UK economic growth.
- The General Aviation sector, including recreational flyers, by providing greater access to the controlled airspace predominantly used by

50 When referring to 'communities' the AMS generally means those on the ground affected by aviation's environmental impacts in the vicinity of an airport, usually by noise but also sometimes local air quality (where there is an impact on the distribution or volume of emissions below 1,000 feet). Communities may in turn be represented in different ways: by local authorities and elected representatives in national or local government; community leaders or representative groups/forums, airport consultative committees, and bodies with a specific interest in aviation's environmental impacts or directly impacted, for example, those responsible for public open spaces.

51 In respect of which the Secretary of State has given Directions to the CAA, see Air Navigation Directions at https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Legislative-framework-to-airspace-change/.

52 Section 70(2) of the Transport Act 2000 states that the CAA "must exercise its air navigation functions in the manner it thinks best calculated […] to take account of any guidance on environmental objectives given to the CAA by the Secretary of State..." https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017 https://www.caa.co.uk/media/p2kc0rum/additional-air-navigation-guidance-spaceflight.pdf

commercial air transport flights, greater integration of different types of airspace user, or more flexible use of airspace, as described in more detail under 'integration' above.

- New technologies currently being deployed that are changing the types of aerial craft and how they operate. These new aerial craft include remotely piloted aircraft systems, advanced air mobility and high-altitude platform systems (for example, to provide a telecommunications network). Rather than having to segregate these operations from other types of airspace user, and therefore potentially restrict those users' access to that segregated airspace, these new users – with the exception of space-launch activities – would gain better access through more integrated airspace.
- Space-launch activities that will require segregation for limited periods of time; although we would seek to utilise, while further refining, existing processes to enable those activities, similar to the need for segregation for military and related activities.
- The Ministry of Defence. Timely access to appropriate airspace is essential for the maintenance of military capability. Modernisation of airspace structures, systems and processes helps to secure the most efficient use of airspace consistent with ever-changing safety, defence and security objectives. It creates greater opportunities and options for the integrated operation of air traffic services provided by or on behalf of the Ministry of Defence, while also allowing non-military traffic to access more effectively what might otherwise remain segregated areas when they are not in use.

2.98 **Cost:** The airspace structure is a key determinant of an operator's costs, punctuality and environmental performance. More direct and efficient flightpaths will mean lower costs for operators because they will save on fuel and increase the utilisation of their aircraft. Commercially, operators will be able to offer a more attractive proposition.

Airport operators

2.99 Sharing digital information about the inbound and outbound traffic flows using the airspace is expected to improve runway throughput and resilience to disruption through greater traffic predictability. Additional airspace capacity will give airports more scope to develop their operations in line with their business plans, subject to planning considerations.[53] Enhanced technology combined with updated

[53] It is important to note that at some airports, where a planning authority has placed a condition which limits the number of aircraft or passenger movements, and where an airport has reached that limit, additional

airspace design enables safe, expeditious and efficient management of increased traffic and increases operational resilience.

Air navigation service providers

2.100 More capacity and more efficient use of modernised airspace will help to alleviate the significant demands placed upon air traffic control that can occur at times of peak traffic, during bad weather or other forms of disruption. Modernisation will facilitate the need for interoperability of the UK network with neighbouring transatlantic and European air traffic management areas, given the need to manage air traffic effectively end to end.

2.101 The greater use of new technology, improving aircraft capability and cooperative aircraft-derived position information changes the task of the air traffic controller, who becomes more reliant on supporting tools to manage the airspace volume and interactions between different operating platforms. It will be essential to consider human factors, such as controller workload management, and develop robust training solutions to ensure a safe transition.

Government

2.102 As explained above in respect of the UK's climate change commitments, the Government's Jet Zero Strategy considers improvements in system efficiencies, which includes airspace modernisation, as one of its key foundations, providing important short- to medium-term savings in emissions before 2050.

2.103 Airspace modernisation must implement both domestic and internationally agreed requirements designed to increase the overall safety, capacity and efficiency of the global air traffic management system, while making commensurate environmental improvements. International requirements are driven by the ICAO Global Air Navigation Plan, described in Chapter 3.

2.104 The UK manages part of the North Atlantic's oceanic airspace, a gateway between Europe and North America. This airspace is the world's busiest oceanic, intercontinental air corridor, and its efficient operation is crucial for international air traffic management.[54]

airspace capacity created to deliver safe and efficient growth of commercial aviation can only be used if and when planning approval is given for airports to grow.

54 Air traffic services in the eastern half of North Atlantic airspace are provided by NATS on behalf of the UK under its obligations to ICAO.

Chapter 3

Key ways of modernising airspace through ICAO GANP

Chapter summary

This chapter gives an overview of the key 'ways' of achieving modernisation of UK airspace (more detail is in Parts 2 and 3 of the strategy). The key 'ways' are based on:

- the ICAO ambition for modernisation through the Global Air Navigation Plan (GANP), which the UK has by international treaty agreed to implement
- the building blocks of the GANP, known as Aviation System Block Upgrades (ASBUs)
- evolutionary steps for modernisation, using the ASBU framework
- workstreams organised into ASBU 'threads' and elements under three headings:
  – information
  – operational
  – communications, navigation and surveillance technology and services

Introduction

3.1 A comprehensive modernisation programme across UK airspace is needed to achieve the 'ends' described in Chapter 2. This chapter explains the key 'ways' of doing this, based on ICAO's Global Air Navigation Plan (GANP), and how the strategy tailors the building blocks of the GANP to the specific requirements of UK airspace.

3.2 Alignment with ICAO Standards and Recommended Practices and global air navigation safety and security plans are the State commitment as a signatory to the Chicago Convention.[55] Where appropriate, 'differences' may be filed by a State and will continue to be a tool utilised by the UK where a rationale exists, either because it is impracticable or inappropriate to align, or because a safety and/or efficiency benefit can be realised. ICAO provides a robust international

[55] *The Convention on International Civil Aviation* established the core principles permitting international air transport, and led to the creation of ICAO in 1947. https://www.icao.int/publications/pages/doc7300.aspx

coordination forum where aligned methodologies covering modernisation, safety management, cybersecurity etc are developed.

3.3 Although the GANP forms the foundation for airspace modernisation, there are many other parts around infrastructure, information sharing (such as the International Aviation Trust Framework[56]) and other global best practices that we will utilise from the ICAO working environment.

ICAO GANP

3.4 The global ambition for airspace modernisation is set out by ICAO in the form of the GANP.[57] The GANP drives the evolution of the global air navigation system; its stated purpose is to equitably accommodate all airspace users' operations in a safe, secure and cost-effective manner, while reducing aviation's environmental impact. To this end, the GANP provides a series of operational improvements to increase capacity, efficiency, predictability and flexibility while ensuring interoperability of systems and harmonisation of procedures. The GANP is supported by the ICAO Global Air Safety Plan (GASP).[58]

3.5 The GANP operational improvement areas should not be seen as a constraint. The UK can and will develop solutions appropriate to the UK, aligned with this framework to ensure interoperability. The ASBU operational improvements are there to provide structure to development plans, not to constrain innovation.

GANP Aviation System Block Upgrades (ASBUs)

3.6 Aviation System Block Upgrades (ASBUs) are the building blocks of the GANP. They provide a global planning framework to ICAO and its member states, associated air navigation service providers and other stakeholders with the goal of implementing regional performance improvements.

ASBU series of system upgrades designed to meet GANP objectives

- Block 0 2013 – 2018
- Block 1 2018 – 2023
- Block 2 2023 – 2028
- Block 3 2028 – 2033
- Block 4 2033 +

ASBU threads:

- Information
- Operational
- CNS Technology and Services

3.7 The ASBU concept focuses on four performance improvement areas: airport operations; global interoperable systems and data; optimum capacity and flexible flights; and efficient flightpaths. Work-streams are organised into 'threads' and 'elements', under three headings, that together will, over time, deliver those performance improvements (see Figure 3.1 below). ASBUs outline

56 https://www.icao.int/airnavigation/Pages/IATF.aspx

57 https://www4.icao.int/ganpportal/

58 The GASP promotes the effective implementation of safety oversight and a safety management approach to oversight, including safety risk management to permit innovation in a managed way. https://www.icao.int/safety/GASP/Pages/Home.aspx

the air and ground equipment and timelines for standards and procedures implementation. More information about how these ASBUs translate to the UK airspace modernisation programme is in AMS Part 2.

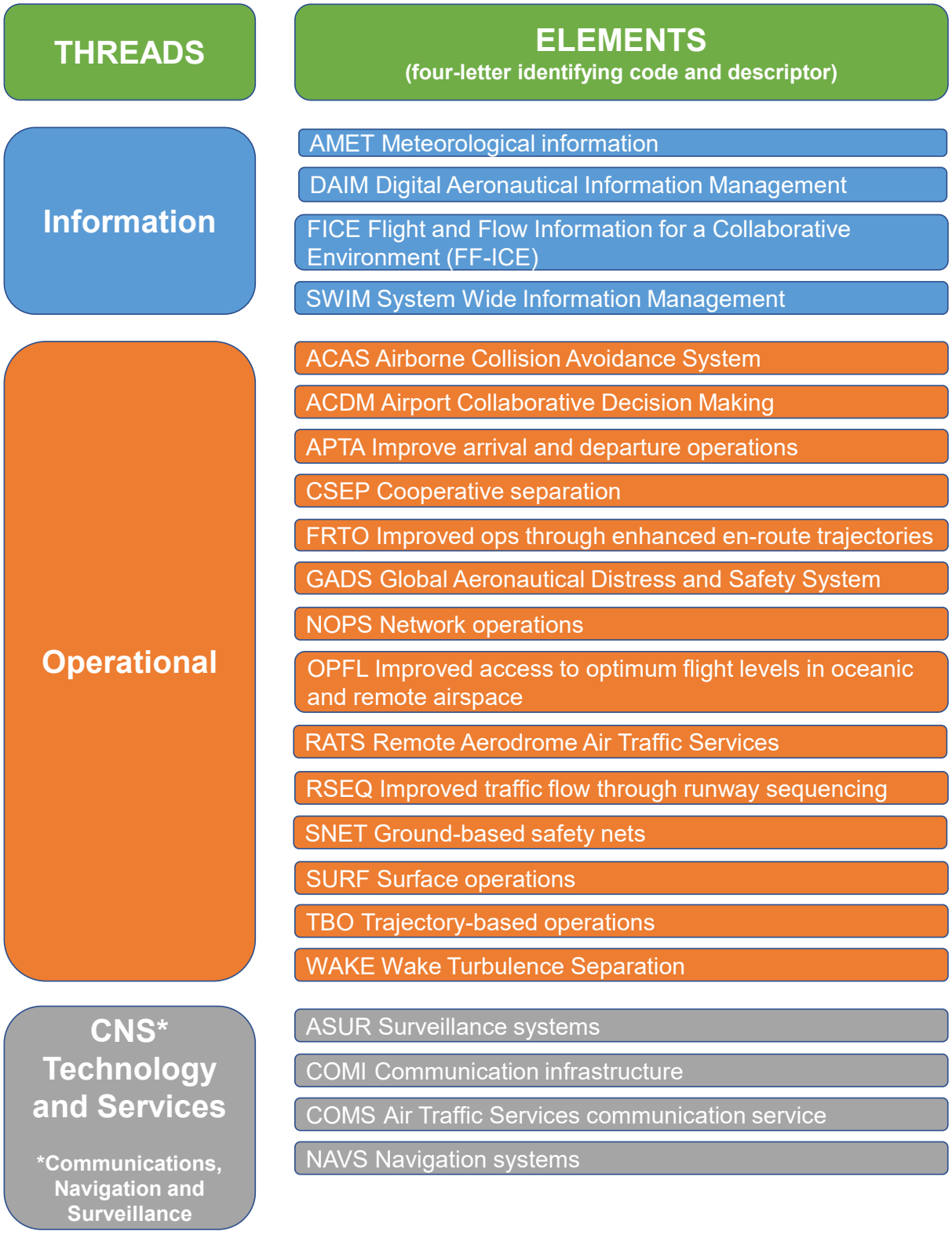


Figure 3.1: ICAO ASBU threads and elements

Key ways of modernising airspace

3.8 The air navigation system is becoming more complex as it supports new demand. To manage this complexity, meet the global performance ambitions and realise the GANP's purpose in the UK, the air navigation system must transform and build upon the use of emerging technologies, information and concepts of operations, many of which are not specifically designed for aviation purposes.

3.9 This evolution of the air navigation system is built on the notion of management by trajectory, empowered by access to timely and accurate shared information, which should improve mission and business trajectories[59] for both commercial and non-commercial operations.

3.10 Information exchanges between airspace users, air traffic management systems and aerodrome operations ensure that timely and consistent decisions are made on a network and flight-centric basis. New entrants such as spaceport operators, commercial space operators and new users of high-altitude airspace will all contribute to this dynamic decision-making process.

3.11 This evolution will be enabled by a progressive increase in automation, advancements in technology and the use of standardised, interoperable ground and air systems in an integrated infrastructure. This aviation infrastructure, based on the sharing of relevant operational information, will be able to interface with non-aviation transportation systems to achieve an efficient, multimodal transport system.

3.12 The conceptual roadmap presented below is aimed at not just improving but transforming the air navigation system, based on its strengths and opportunities, by providing a more holistic approach to its evolution.

Evolutionary steps, aligned with the ASBU steps

Evolutionary step 1: Flight operations in a digital-rich environment

3.13 Air navigation resources are limited. In a safety-critical environment, the capacity of the system relies on the ability to exploit air navigation resources. To unlock the inherent capacity and flexibility of the airspace system, a move towards a more tactical data environment is required. Without the necessary accurate data, the number of flights that can be handled is restricted. Real-time digital data

[59] All partners in the air traffic management network will, wherever possible, share trajectory information in real time from the earliest trajectory development phase through operations and post-operation activities. Air traffic management planning, collaborative decision-making and tactical operations will be based on the latest trajectory data. A 'business trajectory' for civil aviation or a 'mission trajectory' for military operations is developed and agreed for each flight, resulting in the trajectory that a user agrees to fly and the air navigation service provider and airport agree to facilitate.

would allow much better tactical management by service providers in the future, eliminating the possibility of excessive holding, sector overloads or diversions.

3.14 These limits on airspace and runway capacity currently result in delays, passengers receiving poor service and a loss of potential opportunities to accommodate demand and to improve environmental efficiencies. Airspace modernisation must embrace the opportunities that digital technologies are creating in order to unlock benefits for aviation, consumers and the environment.

Evolutionary step 2: Time-based operations enabled by an information revolution

3.15 Aviation is a global 'business of businesses' where customer satisfaction depends on the aviation system's predictability. Customer satisfaction varies from the passengers arriving at their destination on time, to the airlines maintaining daily schedules. Although the digital transformation has increased the capacity of the air navigation system, the isolated (local) nature of decisions can result in unforeseen delays to schedules and customer dissatisfaction, along with additional costs and inefficiencies. The second evolutionary step is therefore to adopt a regional, rather than local, approach to flight operations based on the timely integration of information.

Time-based operations: helping to manage traffic flows and trajectories by scheduling and metering aircraft through congested airspace resources or constraint points. Metering means time-regulating arrival traffic flow into a terminal area so as not to exceed a predetermined acceptance rate.

Evolutionary step 3: Trajectory-based operations enabled by full connectivity through the internet of aviation

3.16 One of the barriers to improving the regional air navigation system is the lack of full participation because the high cost of aviation-specific technologies is less affordable for some airspace users. Sub-optimal traffic management decisions are therefore made to accommodate all stakeholders. The lack of information on current wind, turbulence and weather conditions, resulting in a less accurate definition of constraints, is also part of the issue. Finally, the inability to connect cross-regional information sources is affecting global flights and the ability of air

Trajectory-based operations: Defined in four dimensions (4D) – latitude, longitude, altitude and time – the trajectory represents a common reference for where an aircraft is expected to be – and when – at key points along its route. The trajectory is defined prior to departure, updated in response to emerging conditions and operator inputs, and shared between stakeholders and systems. The aggregate set of aircraft trajectories on the day of operation (operating conditions on that day including operational issues, weather etc) defines demand, and informs traffic management actions.

navigation service providers and airspace users to further plan their operations. A move toward the global secure intranet of aviation will reduce such costs and inefficiencies.

Evolutionary step 4: Total performance management system focus on business/mission needs

3.17 Moving passengers and cargo worldwide is not the sole purpose of aviation. The emergence of multiple airspace users and different vehicles and business models has added significant complexity to decision-making among air navigation service providers. Without flexibility in the decision-making process, ultimate customer satisfaction will not be met. Air navigation service providers will only meet these various new demands by managing the process that enables their direct customers and other stakeholders to make their own operational and business focused decisions, based on pre-defined system performance requirements.

ASBU threads

3.18 The key ways to deliver these four evolutionary steps use the ASBU framework of threads and elements under three headings (Figure 3.1 above):

- Information – new systems improving connectivity into the network and information-sharing
- Operational – aircraft capability and airspace management
- Technology – CNS (Communications, Navigation and Surveillance) technology and services.

3.19 Below we explain more about each of these, from a UK airspace perspective. Chapter 4 sets out how these GANP threads and elements translate to UK delivery elements (pages 61 to 64).

Information

3.20 This involves the deployment of new air traffic management systems and tools to improve connectivity into the network and share accurate flight information about traffic flows. This includes meteorology, aeronautical information, Flight and Flow Information (FF-ICE) and System-Wide Information Management (SWIM) elements.

Data sharing (SWIM)

3.21 SWIM is a global air traffic management initiative to harmonise the exchange of aeronautical, weather and flight information for airspace users, civil and military air navigation service providers, airport operators, meteorological service providers and the European Network Manager. In simple terms it is a web-based

cloud for aviation data. At present there are multiple systems for weather, flight planning, airspace notification etc, whereas SWIM will provide a structure and accessible aviation system for this data.

3.22 For example, at present, information from multiple sources is required to plan a flight. Some or all of that flight information is provided to airspace service providers, whether as a flight plan, an aerodrome bookings request or request for air traffic services. Once airborne, that information stops or is not as forthcoming. Through SWIM, a single compatible system could enable a flight operator to plan a flight, with the system pulling in weather, aerodrome, airspace and other pertinent information. Once planning is complete, the information is submitted to the system for other users to use, not just in the traditional method, but also to provide situational awareness to the wider airspace user.

3.23 Once airborne, live flight information continues to be provided in real time; moreover, airspace users could also provide local information to the system such as weather and un-notified hazards. This information would also enable:

- air traffic service providers to better plan service provision based on real activity
- aerodrome operators to declare capacity more accurately, enabling bookings and planning of arrival and departure slots to minimise delays more efficiently, and
- operators (piloted or remotely piloted) to operate where and when they want through better self-management of their activity.

3.24 As an example, basic systems of this nature already exist for car drivers where satellite navigation provides fastest or most economical route options based on real-time traffic or disruption information, which is updated en route.

Operational

3.25 This thread can be explained under three headings:

- integration and flexibility
- simplification
- environmental sustainability.

Integration and flexibility

3.26 The strategic objective is a single airspace in which all airspace users may operate. Achieving this requires:

- traffic management services based upon digital data exchange between ground service providers and all types of aircraft

- separation services provided by a variety of means, for example evolving the current human-based tactical air traffic control service to become more automated
- airspace management for high-altitude airspace operations
- airspace management for low/urban airspace operations
- developing airspace structures and enabling technologies for the greater integration of piloted and remotely piloted operations as well as continuing to enable sport and recreational operations to better self-manage their desired operation when and wherever possible
- continued provision of joint and integrated air traffic services between the CAA, NATS (En Route) plc and the Ministry of Defence in accordance with the Air Navigation Directions.

Simplification

3.27 With alignment of the AMS with the ICAO GANP in mind, achieving this requires:

- airspace designed to better enable integration for all users
- flexible access to airspace: essentially airspace that has access restrictions assigned (by type of activity contained therein or other reason), such that it can be collapsed when not required, allowing access to other users, and re-established when necessary
- CAA review of airspace classifications in accordance with the published procedure[60] seeking to ensure that the amount of controlled airspace is the minimum required to maintain a high standard of air safety
- complete redesign of the route network in busy terminal airspace to take account of advances in new technology, especially satellite navigation and alternative position navigation and timing (A-PNT) systems for resilience, and to realise the potential for system design optimisation
- removal of the fixed structures in en route airspace, adding capacity and enabling more direct and free routes
- 'future-proofing' new airspace designs today to enable emerging requirements for Free Route Airspace and trajectory-based operations, thus minimising the potential need later on for lengthy changes in airspace design

60 https://www.caa.co.uk/commercial-industry/airspace/airspace-change/airspace-classification/airspace-classification/

- more use of electronic conspicuity through the use of transponder mandatory zones[61] (TMZ) as well as wider use of radio mandatory zones (RMZ) that have less impact than controlled airspace
- a transition altitude standardised at one altitude across UK airspace, for example 6,000 feet
- use of planned future means of surveillance and technology (SWIM, data sharing).

Environmental sustainability

3.28 Those aspects relating to airspace modernisation include:

- redesigning airport arrival and departure routes at lower altitudes to allow flights to climb and descend continuously, improving CO_2 performance and better management of aircraft noise
- other improvements in airspace design listed under 'Simplification' above
- minimising ground taxi distances and runway hold times with engines running, or ground taxi with reduced engine power or alternative power sources
- potential for avoidance of persistent contrail development[62]
- reducing adverse weather impacts, such as holding, through better access to meteorological information to improve resilience planning and tactical interventions
- efficient and sustainable use of CNS (Communications, Navigation and Surveillance) technology and the radio-frequency spectrum across the aviation sector.

Technology – integrated Communications, Navigation, Surveillance and Spectrum approach

3.29 This involves the modernisation of communications, navigation, surveillance and radio-frequency spectrum (CNS&S) infrastructure to support the migration to predominantly space-based technology; and to provide contingency by using a

61 Transponder mandatory zone (TMZ) is the term we are currently using to capture the need for the airspace user to have an electronic conspicuity capability. Although we use the word 'transponder', the intention is that entry to a TMZ would allow for a wide range of options for other, affordable forms of cooperative surveillance, rather than mandating a transponder.

62 There is uncertainty over the exact climate impact of contrails. We will keep under review the evidence of their impact and potential means of mitigation.

mixture of ground-based technology and multi-frequency, multi-constellation capabilities to mitigate any vulnerabilities of satellite navigation.

3.30 An integrated approach provides the opportunity to bring all assets and providers of those assets together, to ensure there is an efficient approach to service delivery and a robust fall back and resilience capability that supports a safe operation when systems fail or are degraded.

Ambition

3.31 The ambition is to provide an integrated airspace resource through enabling technologies that will allow new airspace users to flourish while preserving existing operational ambitions. But a modernised, integrated airspace cannot be delivered by changes to the airspace structure alone. CNS&S technology developments also form part of the critical supporting infrastructure and are the foundation of aviation's operational performance, helping to create the additional capacity that modernisation demands.

3.32 CNS has traditionally utilised extensive ground-based infrastructure to support the operation. This is increasingly transitioning to being space-based, retaining a limited, but vital, core ground infrastructure to provide resilience (Figure 3.2).

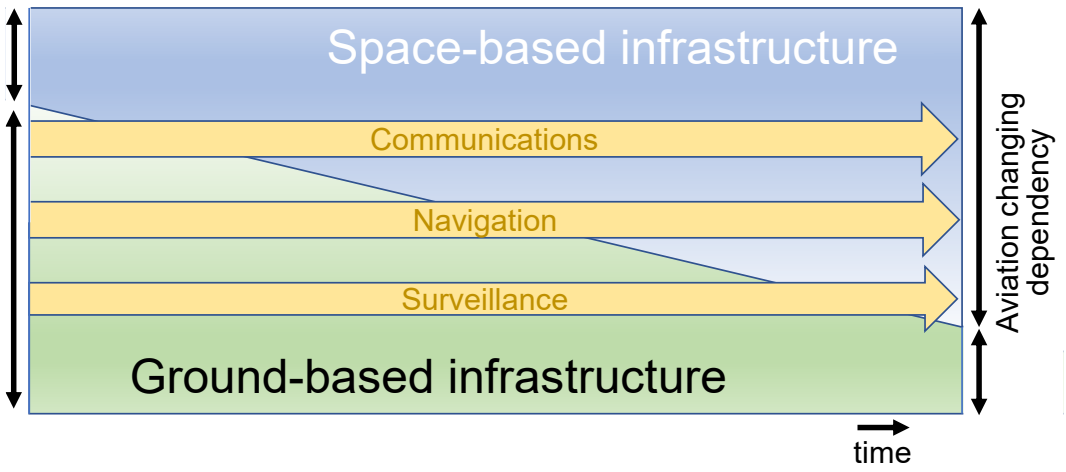


Figure 3.2: CNS shift from ground-based to space-based infrastructure

3.33 The core space-based infrastructure and the need for frequency spectrum (see below) are common enablers across all three strands of CNS services. We therefore consider CNS&S holistically with integrated requirements and similar service risks.

3.34 Commonality and interoperability are required across airspace users to ensure safe integration of the different operations. This will require coordination and investment across all stakeholders to deliver the necessary changes.

Integrated CNS

3.35 Integrated CNS is the next generation of CNS technologies supporting the modernisation and interoperability of the global air traffic management system envisaged by GANP in terms of airport operations, globally interoperable system data, optimum capacity and operational trajectories.

3.36 In 2018 ICAO resolved “to launch a study, built on a multi-disciplinary view of the C, N and S elements and frequency spectrum, to evolve the required CNS and frequency-spectrum access strategy and systems roadmap in the short, medium and long term, in a performance-based and service-oriented manner, to ensure that CNS systems remain efficient users of the spectrum resource".

3.37 This work was initiated under the Integrated Communication Navigation Surveillance and Spectrum – (ICNSS) project. The ICNSS project has two main tasks:

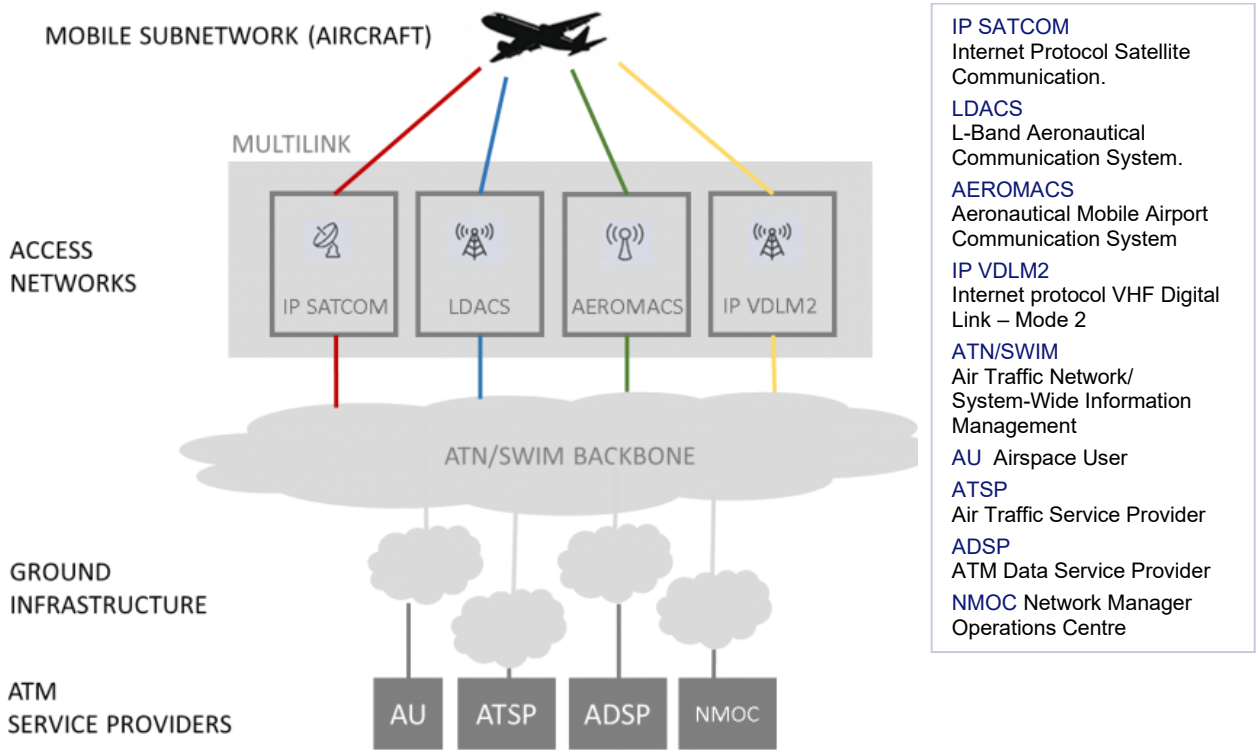
- ICNSS Roadmap, leveraging recent advances in the state-of-the-art of telecommunications technology, focusing on the medium and longer term, to ensure that the aviation sector remains a responsible user of spectrum resource
- CNS Standards, to define revised Standards and Recommended Practices (SARPs) and International Specifications/Standards Framework methodology, leveraging a more performance-based approach for CNS SARPs and better links to international industry specifications and their validation as required.

Communications

3.38 Efficient and stable communication channels are the bonds that ensure aviation operates efficiently, predictably and safely. They ensure that information exchange among airspace users is efficient, timely, accurate and reliable.

3.39 In order to increase efficiency and capacity, the aviation community is progressively digitalising its data exchanges with less reliance on voice exchanges over radio. This involves replacing or enhancing legacy communications systems to allow the digital transfer of flight-critical data and voice communications between aircraft and between aircraft and air traffic management services on the ground, reducing pilot and air traffic controller workloads and also providing interoperability and coordination with military flights. Initially this is likely to replace standard air traffic message exchanges, with more complex interactions developing as experience develops. Ground asset requirements for security, contingency and operational resilience of datalink communications need to be co-ordinated and managed.

3.40 Full 4D trajectory-based operations require higher datalink communication capacity and performance. In the long term, current technology is expected to be complemented by new datalink technologies with increased capabilities supporting more stringent operational requirements: satellite communications, L-band Digital Aeronautical Communication System and Aeronautical Mobile Airport Communication System. This next generation of aeronautical communication infrastructure will be service-oriented and performance-based, in order to support rationalisation, reliability and efficiency of the communication capabilities (Figure 3.3).



Source: © EUROCONTROL

Figure 3.3: Future use of datalink communication technology

3.41 The Future Communications Infrastructure (FCI) is a new internet protocol suite (IPS) System providing the digital and secure communication capabilities able to support integrated Communication, Navigation and Surveillance (CNS). It provides the network functionality necessary to interconnect air and ground end-systems via multiple IP broadband air/ground datalink (multilink) subnetworks and core networks (NewPENS) to support aeronautical data and voice applications for safety and regularity of flight. The FCI is based on communication standards including Aeronautical Telecommunications Network (ATN)/IPS and System-Wide Information Management (SWIM) to define the interoperability features needed for data exchange and network management

functionality. The FCI is also expected to interface with external networks for legacy ATN/OSI (Open Systems Interconnection) system accommodation, civil-military coordination and information exchanges with commercial IP networks.

Navigation

3.42 Navigation is a key enabler of aviation, involving sophisticated technology and efficient coordination between pilot and air traffic controller. And yet, knowing where an aircraft is and how it will get to its destination is still a challenge – laterally (the aircraft must follow the route centreline); vertically (the aircraft must remain at the right altitude, even when climbing or descending); longitudinally (being over a particular point within permitted margins); and temporally (reaching a point within a particular time); hence the term 4D trajectory (three-dimensional position, with time as the fourth dimension).

3.43 The avionics capability of the aircraft fleet has advanced significantly in the past two decades, allowing a shift from the reliance on wholly ground-based navigation beacons to aircraft operations utilising a more accurate space-based position navigation and timing (PNT) source. Consequently ICAO member states are required to submit a national implementation plan for the introduction of performance-based navigation routes that can utilise both ground- and space-based PNT sources.

3.44 The aim is to develop robust positioning based on satellite navigation for all phases of flight, taking advantage of signals from multiple constellations, using GNSS (global navigation satellite systems), for example GPS (global positioning system). There will be an emphasis on providing satellite-derived final approach guidance for approaches where criteria such as cloud base or visibility would ordinarily limit a pilot's landing options.

3.45 The greater use of performance-based navigation, and consequent rationalisation of old navigation equipment with its associated procurement and maintenance costs, is expected to:

- support the use of electronic conspicuity to enhance flight information service (FIS) delivery, enabling safe integration of approach operations at smaller General Aviation aerodromes
- provide an affordable airspace modernisation approach for smaller aerodromes that have less air traffic management technology and equipment where space-based augmentation is available
- provide an alternative to non-precision approaches that is safer and more efficient
- provide a back-up to current precision landing systems to enhance resilience.

3.46 The use of spectrally efficient ground-based navigation systems will continue to ensure a robust and resilient navigation service remains, and will mitigate the vulnerabilities of satellite navigation and support suitable area-navigation deployments.

Surveillance

3.47 Surveillance provides users with knowledge of 'who' is 'where' and 'when'. The application of space-based navigation and improved communication links will allow users to transmit positional information of necessary integrity both to airborne users, to enable 'detect and avoid', and to air navigation service providers, increasing both ground and airborne situational awareness. It is recognised that a primary surveillance capability (i.e. traditional non-cooperative radars[63]) will be required for the foreseeable future in support of the UK's defence and security objectives. However, there are opportunities that allow for the phased modernisation of the UK's surveillance capability, including:

- the greater uptake of aircraft broadcast position information and the advancements in available portable technology, allowing an affordable option for all aircraft operators (civil, military and General Aviation) to share electronic data about one another with one another
- the use of electronic conspicuity supporting the delivery of flight information services, in particular enabling safe integration of approach operations at smaller General Aviation aerodromes
- new technologies and equipment for air traffic services to gather, process and display aircraft position information from multiple sources thus enabling the safe integration of a mix of airspace users
- deployment of an interoperable conspicuity solution and the associated ground use of the data to support air traffic services.

3.48 The aim is to develop solutions that enhance, harmonise and integrate cooperative and emerging non-cooperative sensors, advanced multi-sensor data fusion capabilities and security-related functionalities, together with the methods and tools for surveillance performance monitoring. This is in line with a performance-based surveillance (PBS) approach. In the integrated CNS solution, all CNS developments will be benchmarked and aligned in order to ensure that the solutions are consistent in terms of:

- robustness
- spectrum use
- interoperability
- operational service quality for all airspace users.

63 Radar which can detect aircraft regardless of their equipment.

Air traffic management systems, tools and procedures

3.49 The modernisation of air traffic management systems, tools and procedures will provide stakeholders with more accurate and joined-up information about when flights plan to depart, when they do depart, the routes that they are expected to follow and when they are expected to arrive in particular sectors of airspace. The sharing of accurate and up-to-date flight information between air traffic controllers, network planners, flight crews and other operational stakeholders allows traffic flows to be sequenced and deconflicted earlier. Crossing traffic can be identified and resolved before the tactical interactions that characterise air traffic management today occur. This increases the options available to operational stakeholders and improves the management of network performance – increasing airspace capacity, safety, efficiency and resilience.

3.50 This modernisation is consequently a key enabler for:

- integration of new and existing users into UK airspace
- services that support new operations such as beyond visual line of sight operations
- the effective integration of UK airspace with the wider European and global air transport network, allowing air traffic controllers to manage a larger number of flights through the same volumes of airspace with greater efficiency, resilience and flexibility.

Spectrum

3.51 Radio-frequency spectrum is an asset in high demand, mainly due to increased usage from the telecoms industry. The growing volume of data required to be transferred between aircraft (including remotely piloted aircraft systems and spacecraft) and air traffic services in order to facilitate the evolution of airspace management places greater pressure on the radio-frequency spectrum currently allocated to aeronautical services. A cross-industry plan for the efficient use of radio-frequency spectrum and the potential implications and possibilities of new mobile data spectrum is therefore required. This will ensure that aviation needs are understood, justified and reflect a real-time requirement for safe air operations that can contribute to the ambition of an integrated airspace. The rationalisation of the current ground infrastructure will enable the deployment of additional spectrally efficient systems that can support the expected increase in data traffic.

GNSS resilience

3.52 Because of the increasing use and reliance on space-based systems for position navigation and timing (PNT), Initiative 14 in the 2018 AMS concerned the implementation of satellite navigation with the retention of sufficient ground

navigation aids, communications and surveillance capability to ensure the continued provision of air navigation services in the event of GNSS loss. Increasing reliance on GNSS makes this one of the key air traffic management security issues.

Transformation

3.53 In this rapidly changing landscape, the air navigation system must be transformed to address imminent challenges. Transformation is not an end goal in itself; rather, it is the way to achieve the AMS vision, the ultimate goal of which is to deliver a high-performing air navigation system, based on the ICAO GANP. The aviation industry needs to ensure its position at the forefront of innovation by adopting an increasingly cross-domain and global perspective.

3.54 Modernising and building necessary infrastructure within the air navigation system to generate new services and optimise current services is essential to accommodate growing demand and meet the requirements of existing and new users.

3.55 Innovations are required that meet unique situational demands, which the air navigation system as currently designed and anticipated cannot address, to obtain novel information that currently does not exist. Fostered by technology, increased automation in the air navigation system will:

- provide operators with enhanced functionality to enable better complex decision-making as well as reducing some repetitive operational tasks
- interact more collaboratively with operators, enabling the human and machine to function as a team to achieve operational work goals
- analyse large amounts of information presented in new ways, to support human decision-making and understanding, and
- enable all of the above to be undertaken when the technology and operator are geographically separated from each other.

3.56 Digital transformation and increased automation will require a parallel and structured approach that gives due consideration to the role of the human and the human-machine interface. The aim should be to make optimal use of human strengths and the capacity of humans to control tools while using the support of machines to manage situations, including those which are unexpected, quickly and safely.

Emerging, new and adapted business models

3.57 The transformational change in the aviation sector must be business-oriented and an enabler of new markets, as well as responsible in terms of global

harmonisation and interoperability. Business decisions must support cross-industry operational requirements and the needs of customers.

3.58 Regulators such as the CAA continue to play an important role, but this role needs to evolve. Our strategy is that the UK has a regulatory framework that facilitates and encourages innovation, meets performance requirements and supports the evolution of the air navigation system, while providing for monitoring and oversight.

3.59 States remain responsible for the regulations and services in the airspace under their responsibility. The UK must ensure that its regulatory processes support B2B (business to business) and/or B2C (business to consumer) approaches, specifically by allowing more options for service provision and enhancing the quality of services. Aviation is a global business and should deliver a consistent quality of service at a global level.

3.60 Because of the critical factor of aviation safety, the pace and uptake of innovation can be slower than desired. However, the aviation industry is beginning to look at other industries for emerging technologies that may be applied to aviation. These tried and tested technologies have the potential to reduce innovation life cycles and accelerate change in aviation, while ensuring that the net cost per consumer remains steady or is reduced. It is also possible to speed up change by including early-stage research, industrial research and development, and implementation experiences within the innovation life cycle.

3.61 An aviation system that is at the forefront of innovation, and that actively addresses cybersecurity and ensures adequate integration of military requirements, needs to be capable of providing suitable and timely responses to threats and attacks. The system must be capable of maximising human capacity and strongly supported by technology. Since aviation consists of a system where the servicing of mobile assets (including commercial aircraft, General Aviation, space launch vehicles and remotely piloted aircraft systems) is the primary objective, ensuring the integrity of all information is of utmost importance. Embracing mainstream information and network technology can lead to a more cost-effective and rapid modernisation of the aviation system.

Chapter 4

Overview of AMS delivery elements

Chapter summary

- This chapter gives an overview of the delivery elements that structure the delivery plans set out in Parts 2 and 3 of the AMS.
- There are nine elements arranged under two headings: aircraft-based navigation and airspace management. The 15 initiatives from the 2018 AMS, delivery of which will continue, are subsumed into these nine elements.

4.1 For the purposes of the AMS and the delivery plans that are set out in more detail in AMS Parts 2 and 3, we have grouped the 'ways' of modernising airspace into individual delivery elements under two headings:

- **aircraft-based navigation**
- **airspace management**.

4.2 There are nine elements under these two headings, as shown in Table 4.1, derived from the ICAO GANP Aviation System Block Upgrades (ASBU) framework (described in Chapter 3). The table also shows how each element relates to the 15 delivery initiatives set out in the 2018 AMS.[64] These initiatives will continue to be delivered as part of the new structure, as they are required stepping-stone elements to future ASBUs. (See paragraph 1.2 in Chapter 1 for an explanation of the broadened scope of the refreshed AMS.)

4.3 AMS Part 2 gives more information about each of the nine AMS elements, including the individual related sub-elements and the focus for initial areas of work.

4.4 The structure is 'owned' by the CAA and Department for Transport as co-sponsors of airspace modernisation. The elements described below provide a

[64] The original 15 initiatives were based on European regulations that had direct legal effect in the UK and were in turn meeting the ASBUs. With the UK having now fully left the EU after the end of the UK/EU Agreement transitional period, from 31 December 2020 the UK law that applies is the retained EU Regulations, as amended by various UK Statutory Instruments (made under the European Union (Withdrawal) Act 2018). See Appendix B for more information.

UK framework that focuses on individual areas of capability (such as technical expertise). They will require industry and enabling organisations to identify and develop deployment solutions and plans that support each capability.

4.5 In preparing and maintaining the AMS, the CAA is bound by the legal and policy framework (see Appendix B), in particular section 70 of the Transport Act 2000, the Air Navigation Directions and the Air Navigation Guidance. As shown in Table 4.1, all the delivery elements must adhere to the overarching principle of government policy on minimising the environmental impacts of aviation within the context of supporting a strong and sustainable aviation sector (in accordance with the Government's Air Navigation Guidance). In addition, the delivery elements should align with the aim to deliver quicker, quieter and cleaner journeys for those who use and are affected by UK airspace, as set out in the Jet Zero Strategy.

4.6 Below Table 4.1, Figure 4.1 shows an overall summary of the delivery elements, aligned with the ICAO ASBU framework, in pursuit of the AMS strategic objectives.

Table 4.1: Structure for AMS delivery elements ('ways')

Category	AMS delivery elements	2018 AMS initiatives further developed through these elements	
Aircraft-Based Navigation	 UK-ABN/1. Trajectory-based operations	2, 7, 8, 11, 14	Overarching principle: implementing government policy on minimising the environmental impacts of aviation within the context of supporting a strong and sustainable aviation sector
	 UK-ABN/2. Terminal airspace redesign	4, 5, 14	
	 UK-ABN/3. Network management	3, 6	
	 UK-ABN/4. Integration	3, 9, 10, 11	
Airspace Management	 UK-AM/5. Airspace management		
	 UK-AM/6. Data services	13, 15	
	 UK-AM/7. Future surveillance and spectrum	11, 12	
	 UK-AM/8. Integration of communications, navigation, surveillance & spectrum	12, 13, 14, 15	
	 UK-AM/9. Aircraft capabilities	New	

Notes: Initiative 1 (Direct Route Airspace) in the 2018 AMS is complete.
More detail on delivery elements UK-ABN/1 to /4 and UK-AM/5 to /9 is shown in AMS Part 2.
More detail on the 15 initiatives from the 2018 AMS is in the annual AMS progress reports.

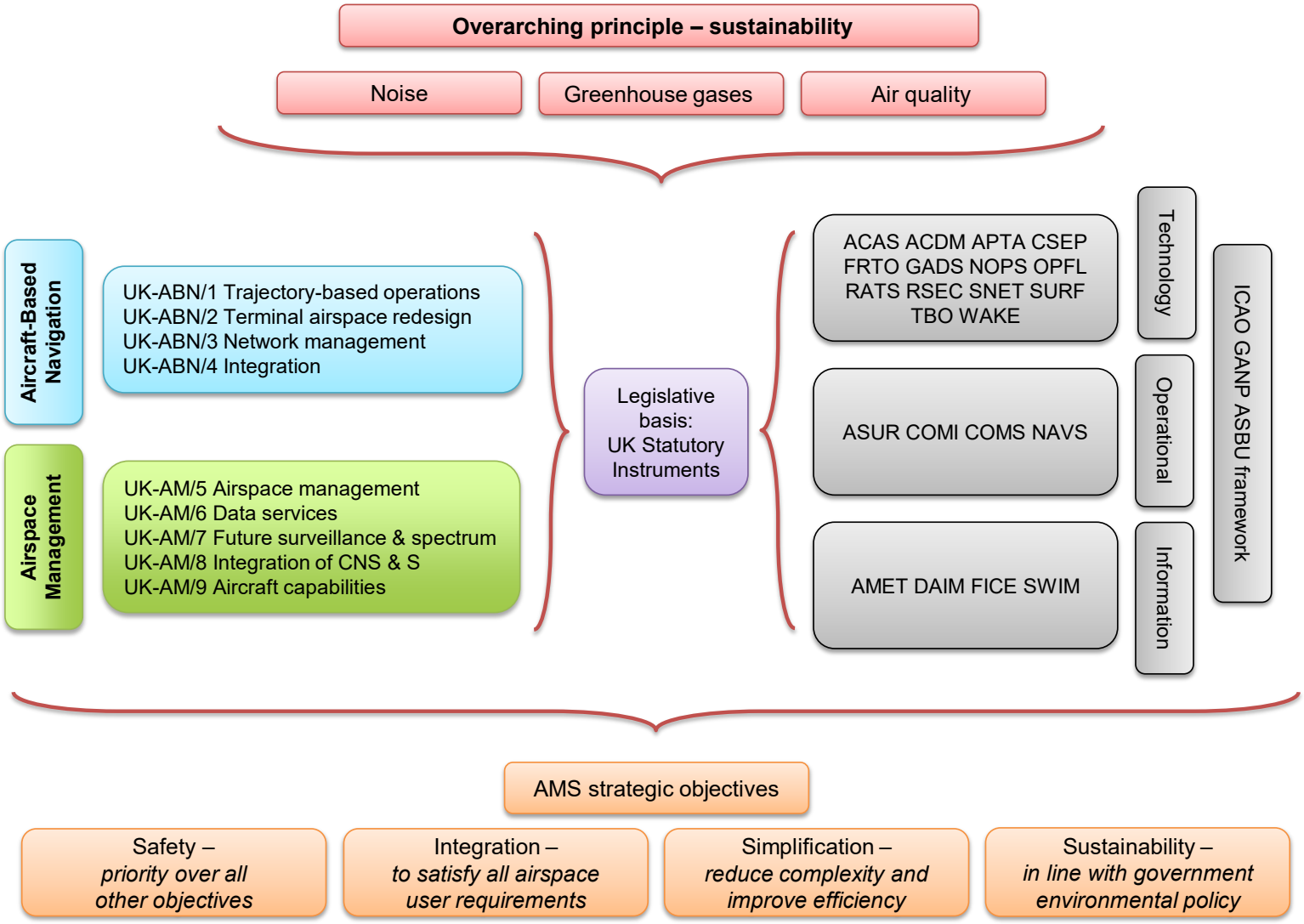


Figure 4.1: Overall summary of the delivery elements aligned with the ICAO GANP ASBU framework in pursuit of the AMS strategic objectives

Chapter 5

Use cases – a vision of airspace in the 2030s

Chapter summary

The UK has a limited airspace volume in which to integrate current and new user ambitions. Integration of users in the lower volumes of airspace is a key challenge. It requires significant change in the way we define and manage the operational use of such airspace. The changes required are wide-ranging and will require new and innovative methods of developing and deploying solutions.

This chapter describes five illustrative use cases relating to different aspects of modernised airspace from the perspective of different stakeholders:

- 1. The future structure of airspace
- 2. Air traffic service provision
- 3. Remotely piloted aircraft systems (RPAS) routine beyond visual line of sight (BVLOS) operations
- 4. Spacecraft (ground- or air-launched)
- 5. Recreational General Aviation flight between two small aerodromes in Class G airspace.

At the end of the chapter is an infographic giving a visualisation of the future lower airspace concept for users of Class G airspace. It illustrates the key elements:

- Radio mandatory zones in lieu of the current aerodrome traffic zone, regardless of the licensed status of that aerodrome
- Transponder mandatory zones in support of flight information service provision for operations in Class G, including required navigation performance (RNP) approaches and BVLOS remotely piloted aircraft system integration
- Enhanced airspace-sharing arrangements through switchable airspace
- FIS-B (Flight Information Service – Broadcast) and TIS-B (Traffic Information Service –Broadcast) deployment
- UK Flight Information Service replacement
- Flight plan data – voluntary submission and sharing of the intention of flight data
- Electronic obstruction beacons.

Acronyms in the use cases

Below are explanations of acronyms which are not always set out in full in the use cases. For more information please see the glossary at Appendix C.

AFISO Aerodrome flight information service officer	**IMC** Instrument meteorological conditions
AFUA Advanced flexible use of airspace	**METAR** Meteorological aerodrome report
AGCS Air ground communications service	**NOTAM** Notice to Aviation
AIP Aeronautical Information Publication	**PANS** Procedures for Air Navigation
ATC Air traffic control	**PBN** Performance-based navigation
ATM Air traffic management	**RA(T)** Restricted area (temporary)
ATS Air traffic service	**RMZ** Radio mandatory zone
ATZ Aerodrome traffic zone	**RPAS** Remotely piloted aircraft system
BVLOS Beyond visual line of sight **VLOS** Visual line of sight	**SARP** Standards and Recommended Practices
CTA Control area	**SIGMET** Significant meteorological information
CTR Control zone	**SWIM** System-Wide Information Management
D-ATIS Data link-automatic terminal information service	**TAF** Terminal aerodrome forecast
FIR Flight information region	**TMA** Terminal control area
FIS Flight information service	**TMZ** Transponder mandatory zone
FIS-B/TIS-B Flight/Traffic Information Service – Broadcast	**UAS** Unmanned aircraft system
FL Flight level	**UIR** Upper flight information region
FRZ Flight restriction zone	**UTM** Unmanned aircraft systems traffic management
GNSS Global navigation satellite system	**VFR** Visual flight rules
ICAO International Civil Aviation Organization	**VMC** Visual meteorological conditions
IFR Instrument flight rules	**VOLMET** Metereological information for aircraft in flight

Use case 1: The future structure of airspace

Type of airspace	Future structure of airspace vision
General	Although autonomous operations in UK airspace are a long-term aspiration, the UK will remain subject to ICAO airspace classifications. The aim is to develop UK airspace to allow wider access across all existing and future airspace structures. In the interim, we will need to develop UK airspace such that it will, where possible, enable increased access for all existing and future airspace users. There will be an intent to remove long periods of segregation in favour of 'switching on' airspace for a specific activity. For example, a control zone/area around an aerodrome should only be active when the unit is providing an air traffic control service to instrument flight rules (IFR) arriving and departing traffic. To enable equitable use of airspace, when controlled airspace is not required, the airspace can be replaced with a TMZ/RMZ (transponder mandatory zone/radio mandatory zone). (See Figures 5.1 and 5.2 below.) An aerodrome traffic zone (ATZ) for air traffic control service provision to visual flight rules (VFR) traffic may be created, but will be based upon traffic density/complexity at the aerodrome and not the licensed status. The ATZ will need to be of a controlled airspace classification which supports VFR flight. The introduction of CAA-regulated intensity-based minimum classification allocation, for example Class C at some airports, to allow VFR and IFR to be separated. Reduction of Class A. Airspace above FL95 to become Class C to enable free route and trajectory navigation with suitable airspace management processes in place, like Advanced Flexible Use of Airspace, to enable de-classification of areas for military activity and specific aviation sport and leisure activity, such as high-flying glider activity. Increased use of Class E with a TMZ in other areas to enable air traffic control provision to IFR while minimising impact to VFR. Aerodromes with AFIS will have a flexible TMZ/RMZ. This will allow the use of flight information displays (FID) to assist the aerodrome flight information service officer (AFISO) in providing information that is useful for the safe and efficient conduct of flights. The TMZ environment can also assist with the integration of IFR and VFR traffic where RNP approaches are being used, by airborne sharing of data, increasing the situational awareness of pilots. Around busy aerodromes with air ground communication service (AGCS), a RMZ will be used to provide a level of improved situational awareness for airspace users in the vicinity of the aerodrome, including during critical stages of flight. When an aerodrome with AFIS or AGCS is closed, or traffic is minimal, the airspace will be switched off. Segregation will still be required for activities such as certain military events and space launches, as well as the requirement for restricted/prohibited areas. Airspace establishment, disestablishment and classification should always be related to demonstrable utilisation and complexity criteria, and subject to routine review. Performance-based navigation (PBN) is an important element that provides highly accurate and repeatable flightpaths, reducing the need for large areas of controlled airspace to protect aircraft flying instrument flight procedures. Integration of new airspace users such as BVLOS (beyond visual line of sight) remotely piloted aircraft systems and advanced air mobility operations will normally be accommodated within the airspace classification, except when capacity is constrained because airspace user emergencies or exceptional circumstances dictate otherwise. It will utilise an overlay of air traffic services where additional digital services are provided to achieve safe integration, rather than relying on segregation from other airspace users. The need for airspace segregation will remain for some activities, such as certain military operations and space launch. [Continued overleaf]

Use case 1: The future structure of airspace (continued)

Type of airspace	Future structure of airspace vision
Class A	Where the complexity of the air traffic management task justifies a permanent IFR-only environment, and where no reliance can be placed upon the ability of VFR flights to see and avoid other airspace users.
Class C	The UK FIRs and UIRs between FL 195 and FL 660 are notified as Class C. The lower limit may be dropped to FL 95 to allow for free route and trajectory navigation. An airspace management process (such as Advanced Flexible Use of Airspace) will enable access to, for example, military operations or sports and leisure flights (such as gliders). Within the UK FIRs below FL195, Class C may be notified for CTAs (or portions thereof) and TMAs (or portions thereof). Class D CTAs are to be progressively notified where appropriate as Class C, where this reflects actual operational conditions associated with each of the airways in question, and in accordance with principles outlined above. Class C may be notified for CTRs and CTAs in the vicinity of major international aerodromes as determined by the type, density and complexity of air traffic (including a consideration of forecast air traffic volumes) and particularly the volume of IFR flights.
Class D	Class D is normally notified for CTRs and CTAs in the vicinity of those aerodromes where an air traffic control service is provided to aerodrome traffic, except where the design principles identified by the airspace change sponsor identify the need for a more restrictive classification. Class D airspace is notified for locations where a known traffic environment is necessary in both visual meteorological conditions (VMC) and instrument meteorological conditions (IMC). Exceptionally, within the UK FIRs below FL195, Class D may also be notified for TMAs (or portions thereof) and for certain CTAs (or portions thereof). Where air traffic control services are required to support operations, a suitable Class D CTR may be used. Class D CTRs and CTAs can be switched off when such airspace is not required to support IFR operations.
Class E	Class E is to be notified where a recognised air traffic environment is necessary to support low complexity and/or low density IFR operations. Class E may be notified for certain airways (or portions thereof), or for CTA in the vicinity of certain aerodromes where an air traffic control service is provided to aerodrome traffic but where airspace Classes A to D cannot be justified. Class E shall not be used for CTRs. Class E airspace will normally be co-located with a TMZ to enable the additional safety net of a recognised air traffic environment where cooperative surveillance systems may be used in the management of such airspace.
Class F	Class F airspace is airspace within which an air traffic advisory service is made available to ensure separation, in so far as is practical, between IFR flights. IFR and VFR flights are permitted, all participating IFR flights receive an air traffic advisory service, and all flights receive flight information service if requested. Currently, Class F airspace is not utilised within the UK FIRs and UIRs. Class F airspace may be notified as a temporary measure, for a period not exceeding three years to facilitate the provision of air traffic advisory service until such time as it can either: • be replaced by airspace of an appropriate classification to support the provision of air traffic control service; or • where the traffic situation changes such that advisory service is no longer required and is replaced by flight information service, Class G airspace is re-instated.
Class G	This airspace classification applies to the remainder of the UK FIRs. [Continued overleaf]

Use case 1: The future structure of airspace (continued)

Type of airspace	Future structure of airspace vision
Radio mandatory zone / transponder mandatory zone (RMZ/TMZ)	Enhancements to the characteristics of airspace Classes D, E, F and G, such as the additional notification of the airspace as a transponder and/or radio mandatory zone (TMZ and/or RMZ respectively) as appropriate, should be considered in order to: • meet safety criteria identified by the air navigation service provider in its safety assessment • facilitate the provision of flight information, alerting and search and rescue services (applies to RMZ only) • facilitate the provision of enhanced flight information utilising surveillance data (applies to TMZ only) • facilitate coordination with appropriate military units or with ATS units in adjacent States in order to avoid the possible need for interception for the purpose of identification. Aerodrome traffic zones in Class G airspace will typically be replaced by an RMZ (related to traffic density and complexity rather than licensed status of the aerodrome) and associated TMZ, where electronic conspicuity data may be used to enhance flight information services. RMZs established at aerodromes and serviced via an AGCS will only be established when that service is provided. The switchable nature of such RMZs will be embedded in Advanced Flexible Use of Airspace procedures.
Air traffic services where additional digital services are provided	Enhancements to the characteristics of all airspace classes in support of BVLOS remotely piloted aircraft systems and advanced air mobility operations. The aim is a service designed specifically for lower airspace users rather than as a secondary service of an aerodrome.

Figure 5.1: Future airspace structure concept (cross-section) – airspace 'on'

Figure 5.2: Future airspace structure concept (cross-section) – airspace 'off'

Use case 2: Air traffic service provision

Type of service/ operation	Future air traffic service vision
General	Traffic management and services provided will be inclusive of both existing users and new entrants such as remotely piloted aircraft systems (RPAS) and spacecraft.
Conventional ATS	Aligned with ICAO Standards and Recommended Practices (SARPs) and Procedures for Air Navigation (PANS), hence air traffic control service provided only in controlled airspace with ICAO flight information service (FIS) outside of controlled airspace. Supplemented by data services providing FIS including airspace information and other platform activity through connected onboard SWIM-profiled systems such as FIS-B/TIS-B.
Remotely piloted aircraft systems (RPAS) and advanced air mobility	Service provision to support RPAS and advanced air mobility will form an element of air traffic management (ATM). This service will initially be provided by an air navigation service provider, who may be the operator of the RPAS platform, but more likely to be an (existing or new) air navigation service provider who is capable of servicing RPAS ATM requirements in Class G and above, ultimately moving to more automated data exchange and management of the operation.
UK Flight Information Services (FIS)	Replaced with ICAO FIS. Will be common to the service provided in mainland Europe.
Lower Airspace Radar Service (LARS)	Replaced by bespoke Lower Airspace Service which will: • be provided 24/7, concentrated in daylight hours • enable flexible access • act as lower airspace management cell • enable airspace crossing or access • act as UAS traffic management (UTM) conduit • act as a technology conduit to autonomous use of airspace – stepping-stone taking into account aircraft capability and technology advances necessary for self-management of piloted aircraft and RPAS • use cooperative surveillance to enhance the safe and efficient provision of FIS (traffic information and where necessary traffic avoidance advice – not separation)

Use case 3: Remotely piloted aircraft systems (RPAS) routine beyond visual line of sight (BVLOS) operations

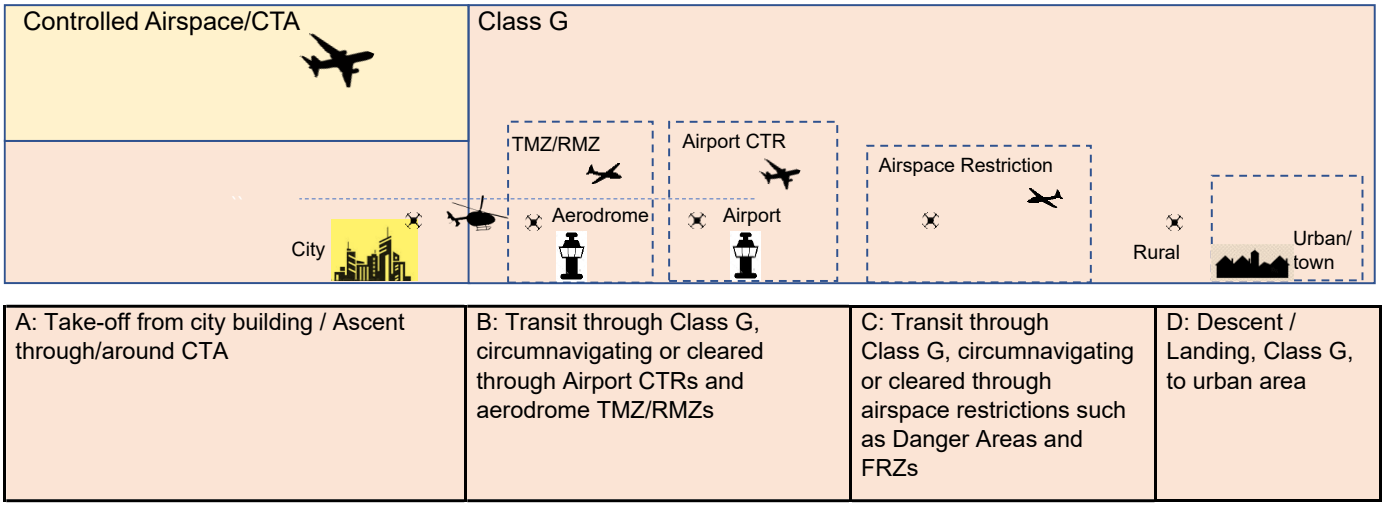


Figure 5.3: Future airspace structure concept – remotely piloted aircraft systems (RPAS) routine beyond visual line of sight (BVLOS) operations

Phase of flight	Future air traffic service vision
Prior to flight	The RPAS operator will pre-notify its planned activity using a SWIM-connected airspace management tool. This will inform the RPAS operator of other activity planned in the proposed operating area, airspace restrictions and other information relating to the flight, such as weather. This pre-notification would also be used to initiate clearances, such as being able to operate within controlled airspace or flight restriction zones etc. This information will then also be available to other airspace users, airspace control authorities and other interested parties. Pre-notification will apply to both beyond visual line of sight (BVLOS) and visual line of sight (VLOS) RPAS flights to give a complete picture of activity to all operators.
Airborne	Once airborne the RPAS platform will operate as planned. Re-tasking and changes will be allowed within uncontrolled airspace and the SWIM-enabled airspace management system can be updated as required. Electronic conspicuity will be required to enable 'detect and avoid' for all airspace users, thus reducing the risk of mid-air collisions.
Clearances	Before crossing airspace, the operator will need clearance to enter. Having been pre-notified to the airspace management system, the flight will be visible to the airspace controlling authority, allowing appropriate clearances to be provided. From the operator's perspective, the activity status of the airspace will be provided both pre-flight and en route, allowing early re-routeing of the flight if clearance is likely to be refused. This would also be the case for other airspace restrictions such as danger areas, flight restriction zones etc. For routine flights, such as advanced air mobility routes in and out of airports, delivery services or aerodrome security, clearances may be secured through prior written agreement.

Use case 4: Spacecraft (ground- or air-launched)

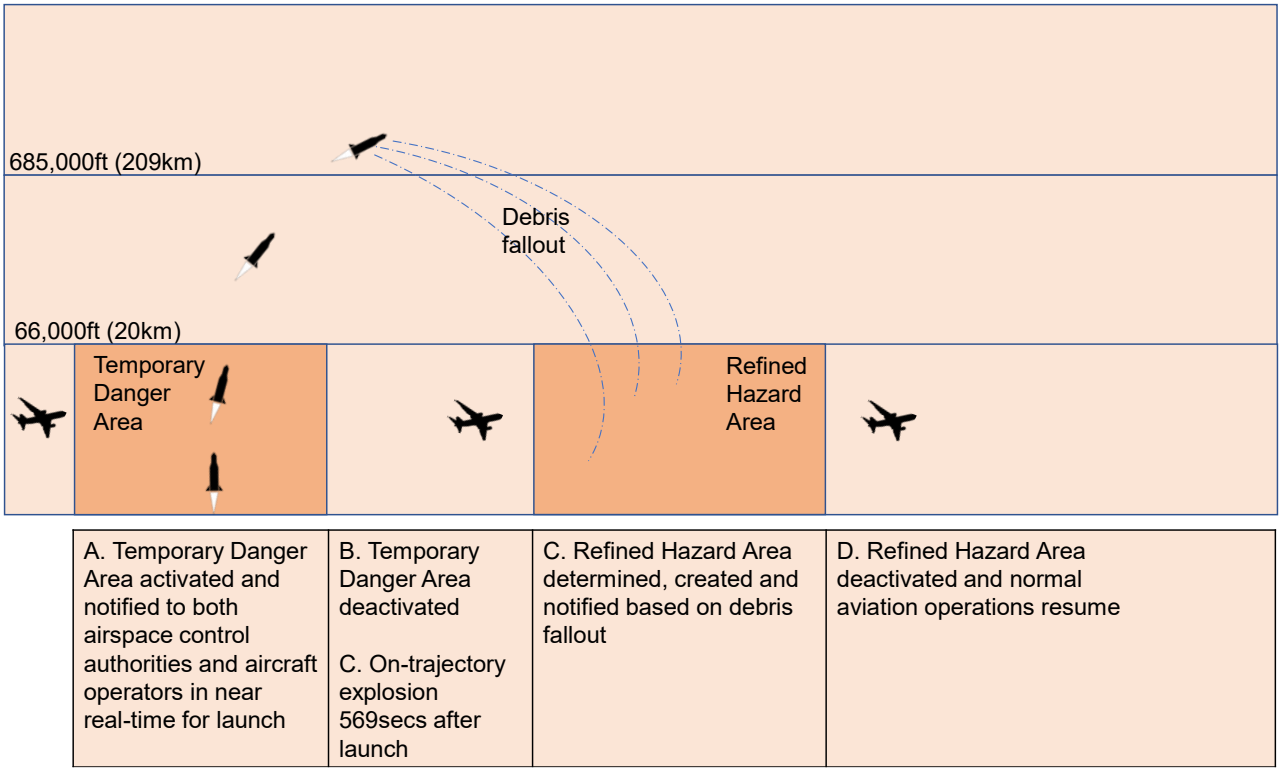


Figure 5.4: Future airspace structure concept – space launch

Future air traffic service vision
The long-term aspiration for airspace requirements for space launch is to use a concept based around dynamically used airspace, i.e. airspace which is tied to the platform rather than a location. This way when the platform launches, regardless of whether it is ground- or air-launched, a dynamic volume of airspace could be managed to protect other airspace users from rocket flight, falling spent stages or falling debris from an unplanned event. In practice this airspace activity data would be shared with other airspace users through an airspace management function on SWIM profiles. As with other scenarios, this will allow other airspace users to see real-time airspace availability. The full detail of what this airspace will look like is still to be determined as UK spaceflight continues to develop. In the interim, methods of reporting this activity will be through the future Lower Airspace Service, combining the use of technology solutions such as FIS/TIS-B and traditional voice. It is unlikely that space launches will reach the level of commercial flights in the timescale of this AMS. Therefore, early notification of intended airspace requirements would be planned through mission trajectory planning software, operating across SWIM profiles. The benefit of using the mission trajectory is that it will allow the operator to request the airspace with sufficient advance notification, like other airspace requests. As the launch date gets closer, the activation time will be firmed up and updated once the carrier platform gets airborne. Other airspace users utilising trajectory navigation would receive the notification in plenty of time to ensure minimal if any disruption to their planned routes.

Use case 5: Recreational General Aviation flight between two small aerodromes in Class G airspace

Future structure of airspace vision
Sports, recreational and private transport General Aviation often operates from private grass (unlicensed) aerodromes with a varying number of movements and activity types. These aerodromes are typically located within Class G airspace but may be notified, should the owner request, via the sharing of data to electronic flight bag providers and additionally centrally correlated via Aeronautical Information Publication (AIP) submission, regardless of their licensed status. The airspace immediately surrounding an aerodrome engaging in high-intensity General Aviation operations and/or training operations may be afforded the protection of a radio mandatory zone in lieu of the current aerodrome traffic zone. Additionally, those typically situated within Class G airspace and supporting frequent IFR operations including GNSS RNP approaches may additionally be protected by a transponder mandatory zone when the flight information service provision at that aerodrome, delivered by an air traffic control officer or aerodrome flight information service officer, is supplemented by cooperative surveillance data. Increasingly, switchable volumes of airspace, such as runway-dependent control areas (CTAs), will be temporarily deactivated when not required (possibly with a transponder mandatory zone/radio mandatory zone mandate associated), allowing transit without the necessity of a clearance. The tactical notification of this kind of airspace release will be achieved via NOTAM, generating a graphical depiction on avionics/electronic flight bag applications as well FIS-B (Flight Information Service – Broadcast).

Phase of flight	**Future air traffic service vision**
Prior to flight	Pre-flight planning by the pilot will typically be conducted using an electronic flight bag application connected to the internet. The application graphically depicts the current relevant aviation chart together with tactically updated airspace and meteorological information, including dynamically switched airspace volumes, temporary navigation warnings etc. Having planned the intended flight, the pilot can, via the electronic submission of the data, share that flight plan with air traffic service providers and other airspace users. This flight plan data will be transmitted in a common, internationally agreed, format and distributed to any relevant party that wishes to make use of the data. Route field validation of VFR flight plans will be achieved via a prescribed interface typically enabled via the electronic flight bag functionality. Once airborne, the activation and correlation of the planned intention of flight data will typically be achieved via the association with the flight identification field transmitted from the airframe. When, via route validation, the planned route requires the subject aircraft to transit a volume of controlled airspace, then that flight plan will be automatically shared with the controlling authority of that airspace. Flight data processing systems used by air navigation service providers will be capable of receiving and pre-notifying the relevant controller or flight information service officer of the pending flight details together with the planned track. [Continued overleaf]

Use case 5: Recreational General Aviation flight between two small aerodromes in Class G airspace (continued)

Phase of flight	Future air traffic service vision
Airborne	Once airborne, the General Aviation pilot may choose to take advantage of a revised UK Flight Information Service (FIS) based upon an ICAO-prescribed FIS with or without surveillance data enhancement. This service may be manually requested via radio contact with a nominated air navigation service provider; the service itself will instantly be recognisable as FIS provision like that provided in other states. Increasingly, FIS provision will be automated, with situational awareness within the cockpit being enhanced via directly detected traffic information and conflict prediction, displayed via an electronic flight bag application or avionics display. FIS-B will be available in many areas, in lieu of VOLMET and some D-ATIS capability, and will include a wide range of meteorological products (including near-real-time precipitation data, METARs, TAFs, SIGMETs) as well as selected 'pop-up' NOTAM information such as RA(T)s, and the activity status of any switchable airspace volumes. FIS provision, situational awareness and safety will be additionally enhanced by the use of electronic conspicuity or tactical switching of electronic obstruction beacons on the ground. These electronic beacons will be used to notify the activation of cluster-based activities such as large model sites, paragliding and hang-gliding activity, where electronic conspicuity of individual air systems is not practicable or desirable. The emissions from these beacons can be received via the reception of a broadcast in the cockpit and depicted on existing avionics or electronic flight bag applications. En route transit requests of controlled airspace will have been pre-notified to the controlling air navigation service providers via the voluntary submission of the flight plan. Those basic flight details and requested routeing will be available to the controller prior to establishing radio contact and may also be associated with the flight identity of the aircraft on a suitable surveillance system. The necessity of passing copious amounts of flight planning information over the radio is reduced and the ability for the controller to plan the integration of the transiting aircraft enhanced.
Arrival	Upon arrival at the destination General Aviation aerodrome in Class G airspace serviced by air traffic control officers or aerodrome flight information service officers, the flight information service provided to the pilot is enhanced by the use of cooperative surveillance data and provided to the pilot via relay of surveillance-based traffic information.

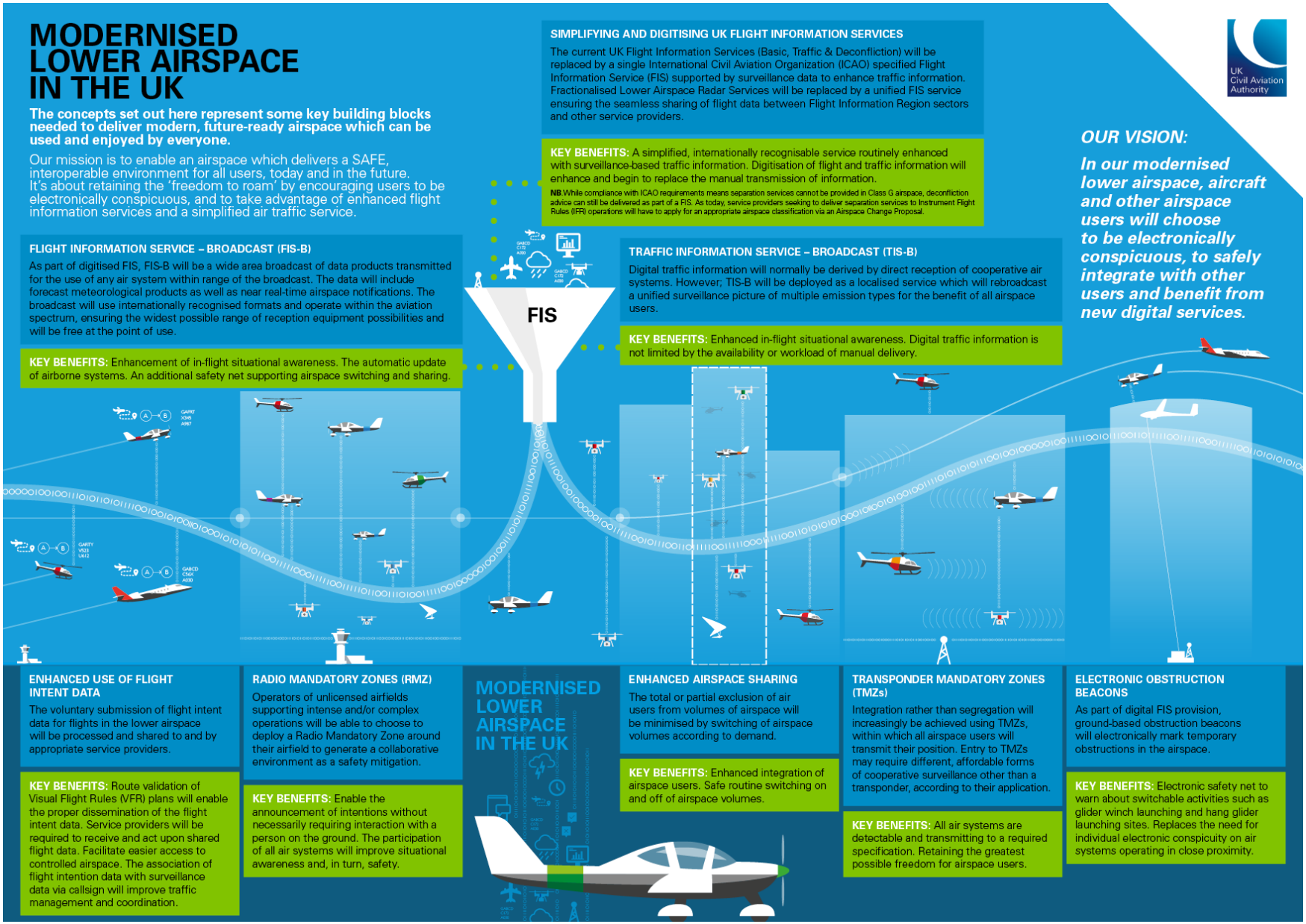


Figure 5.5: Modernised lower airspace in the UK

Chapter 6

Funding

AMS topic requiring further work

Funding and resourcing the broader modernisation envisaged by the AMS

Chapter summary

This chapter explains:

- that aviation, and therefore airspace modernisation, is almost entirely funded by the aviation industry
- certain AMS deliverables that may benefit from schemes funded by government or industry
- that where a delivery element has genuine stakeholder support, a standalone project will scope the concept concerned and try to identify the funding to develop, implement and support it
- the uncertainty over the source for funding some aspects of modernisation, in particular lower airspace and the integration of existing airspace users and new types of user.

Overview

6.1 Aviation in the UK is largely privately owned and managed, and therefore the investment required to upgrade UK airspace is almost entirely funded by the aviation industry. This is known as the user-pays principle.

6.2 In the case of NERL, the costs of providing monopoly en route (and certain approach) air traffic services and airspace management are recovered from the UK overflight charging mechanism (the en route rate), and thus from those airspace users paying en route charges. (Each EUROCONTROL member state establishes the unit rate of en route charges levied on airspace users in the airspace for which it is responsible.) For other aspects of airspace modernisation, in particular integration of existing and new airspace users at lower levels, the means of funding the changes necessary is less clear.

AMS Support Fund

6.3 Delivery of the AMS requires industry or other interested organisations to undertake supporting delivery or engagement work that benefits multiple stakeholders or research that will enable wider industry deployment. Where the modernisation cannot be funded by other means it may require a level of financial support to facilitate that delivery. For this purpose the CAA has set up the AMS Support Fund.[65] The fund follows on from the Future Airspace Strategy (FAS) Facilitation Fund (specifically the Small Gaps element) that ran from 2015 to 2019.

6.4 The dedicated fund (currently £2 million per annum) is funded through the UK en route unit rate. It was established as part of the UK RP3 performance plan, and we expect provision to continue in the new UK performance plan that supersedes RP3 covering the period 2023 to 2027, known as NR23. The fund will be collected through the CAA element of the en route unit rate and administered by the CAA. Any unutilised funds will be returned to airlines through an adjustment to the UK unit rate in a future regulatory period.

Funding other aspects of modernisation

6.5 To the extent that delivering a modernised airspace requires investment in new technology, or a new service, an issue arises as to how those costs are recovered and who pays.

6.6 In certain circumstances there may be a case for central funding from government or the industry generally. Two examples are given below.

Electronic conspicuity devices

6.7 To encourage greater take-up of electronic conspicuity devices within the General Aviation and remotely piloted aircraft system communities, the Department of Transport made available a funding scheme in the form of a 50% rebate of up to £250 (including VAT) per applicant.[66]

Future Airspace Strategy Implementation (FASI) Grant Programme Funding Support Package

6.8 This funding was in the extraordinary circumstances of the Covid-19 pandemic. Following the collapse of air travel during the pandemic, the Department for Transport and CAA confirmed a continued commitment to airspace

65 https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-Modernisation-Strategy/Airspace-Modernisation-Strategy-Support-Fund/

66 https://www.caa.co.uk/General-aviation/Aircraft-ownership-and-maintenance/Electronic-Conspicuity-devices/

modernisation and the need to consider how individual organisations might progress airspace change.[67] As part of a commitment to supporting restart in the aviation sector and decarbonisation, and in response to a recommendation in the Airspace Change Organising Group's July 2020 report on remobilising the airspace change programme[68], the Government announced a £5.5m financial support package.[69] This took the form of a grant managed by the CAA to enable eligible sponsors of airspace change to continue through Stage 2 of the airspace change process. In 2022 the Government announced that it was making a further £3.7m available.[70]

Future funding models

6.9 The CAA recognises that there has to be a fair and equitable funding model for users of a modernised airspace. Currently, aside from the UK Flight Information Service provided to meet ICAO obligations and specific arrangements for the North Sea, aircraft outside controlled airspace are either not receiving a service (relying on a traditional 'see and avoid' means of deconfliction) or are benefiting from navigation aids and/or air traffic services that are already established for commercial or military users.

6.10 We need to address questions on how to fund the support and implementation of modernisation such as (a) a future Lower Airspace Service (b) integration of new types of aerial vehicle (c) greater access to airspace for recreational General Aviation. This will take time to work through. Where a delivery element has genuine stakeholder support, a standalone project will work through the detail of what the concept concerned looks like in practice, and try to identify the funding stream to develop, implement and support it. It will need to be considered in parallel with other CAA activities, such as our economic regulation of NATS. Once proposals have been developed, we would expect to consult on them in due course, subject to advice from the Government.

67 https://www.gov.uk/government/publications/update-on-airspace-modernisation/dft-and-caa-update-on-airspace-modernisation-march-2021

68 https://www.acog.aero/blog/2020/07/17/acog-remobilising-airspace-change-report/

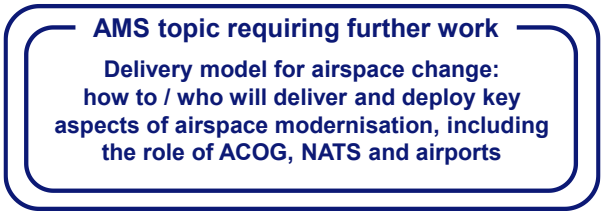
69 https://www.gov.uk/government/news/55-million-to-drive-improvements-to-uks-motorways-in-the-sky

70 https://www.gov.uk/government/news/government-commits-funding-to-build-back-better-and-greener-in-our-skies

APPENDIX A

AMS governance

Note: this appendix replaces CAP 1711b and the diagram which updated it published in CAP 1862.



Delivering airspace modernisation

A1. The Department for Transport and CAA are co-sponsors for airspace modernisation, working together to deliver our shared strategic vision and objectives for the modernisation of UK airspace. The Department for Transport develops and owns the policy framework, including the strategic case for airspace modernisation and the objectives it must deliver. It also sets the CAA's role, which includes preparing and maintaining the AMS.

A2. As explained in Chapter 1, the co-sponsors cannot deliver airspace modernisation alone, but work collaboratively with a range of aviation organisations, such as air navigation service providers, airports, airlines, manufacturers, representative organisations and, where appropriate, bespoke delivery bodies. A wider range of other stakeholders, including communities, will need to be engaged throughout this delivery.

Overview of the governance structure

A3. The AMS governance structure is designed to oversee delivery of the AMS delivery elements. It has been developed by the Department for Transport and the CAA to reflect the legal and policy framework set out in Appendix B, including the Air Navigation Directions. It sets out which organisations make decisions and have accountabilities, and the stakeholders they will engage and consult with as they carry out their strategic roles. It has evolved over time and will continue to evolve.[71]

[71] The governance structure was last published in CAP 1862 in December 2019, which itself updated the original 2018 CAA/Department for Transport AMS governance annex CAP 1711b. Further changes have occurred since 2019. For the most up-to-date position please see https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-modernisation-strategy/.

A4. The Department for Transport and the CAA are committed to working with relevant stakeholders and those tasked with delivery to ensure modernisation happens in a coherent and consistent way, delivering the benefits set out in the shared strategic vision and objectives.

A5. There are two distinct strands to governance of the AMS:

- ongoing review of the strategic content to ensure it remains appropriately aligned with the legal and policy framework
- oversight activities reporting progress on delivery activities through the CAA airspace modernisation oversight team including providing annual AMS progress reports to the Secretary of State.

A6. The pace of change may mean that for practical reasons we review and update the AMS in stages. Where appropriate, the CAA may seek comments on these updates before implementing them, but will not necessarily do so in every case.

A7. The co-sponsors may commission specific projects necessary for airspace modernisation – for example the airspace change masterplan that ACOG (the Airspace Change Organising Group) is developing[72] – agreeing what must be delivered and the outcomes. The co-sponsors may also set parameters for delivery groups tasked with planning and delivering modernisation projects.

A8. The AMS will guide the delivery of relevant and timely policy and regulation across the whole CAA that supports the delivery of airspace modernisation goals. In particular, it will be used to assist in the prioritisation of UK airspace rulemaking activity to help ensure its timely and coordinated implementation.

Future evolution and review of the governance structure

A9. The governance structure itself has evolved since the AMS was first published in 2018. In a programme as complex as this, we expect this to continue as we continue to develop deployment plans forming Part 3 of the AMS. The governance structure will therefore need to be regularly reviewed over time in the light of experience and in view of future developments, whether technological or otherwise.

A10. In the current delivery model, it is mainly airports and air navigation service providers that sponsor airspace change proposals. The CAA oversees the process and adjudicates in a pure regulatory mode. This model is complex, with multiple interdependencies. We will continue to evidence the problem statement to inform a CAA review of the current delivery model while remaining cognisant of existing airspace change activities.[73] The delivery model is not necessarily an

[72] The masterplan will form part of the deployment plan in AMS Part 3. See below for more information.

[73] For example, a review of the CAP 1616 airspace change process is underway at the time of writing.

AMS issue to resolve, but the outcome will have a bearing on the delivery of the airspace modernisation programme.

A11. As part of the governance structure, the CAA maintains a regular dialogue with the Department for Transport, including matters concerning governance itself. As noted above, the CAA is also required to formally report to the Secretary of State annually on the delivery of the AMS.[74] We will include in this report any recommendations for changes in governance, including in the light of stakeholder feedback, and any action taken as a result.

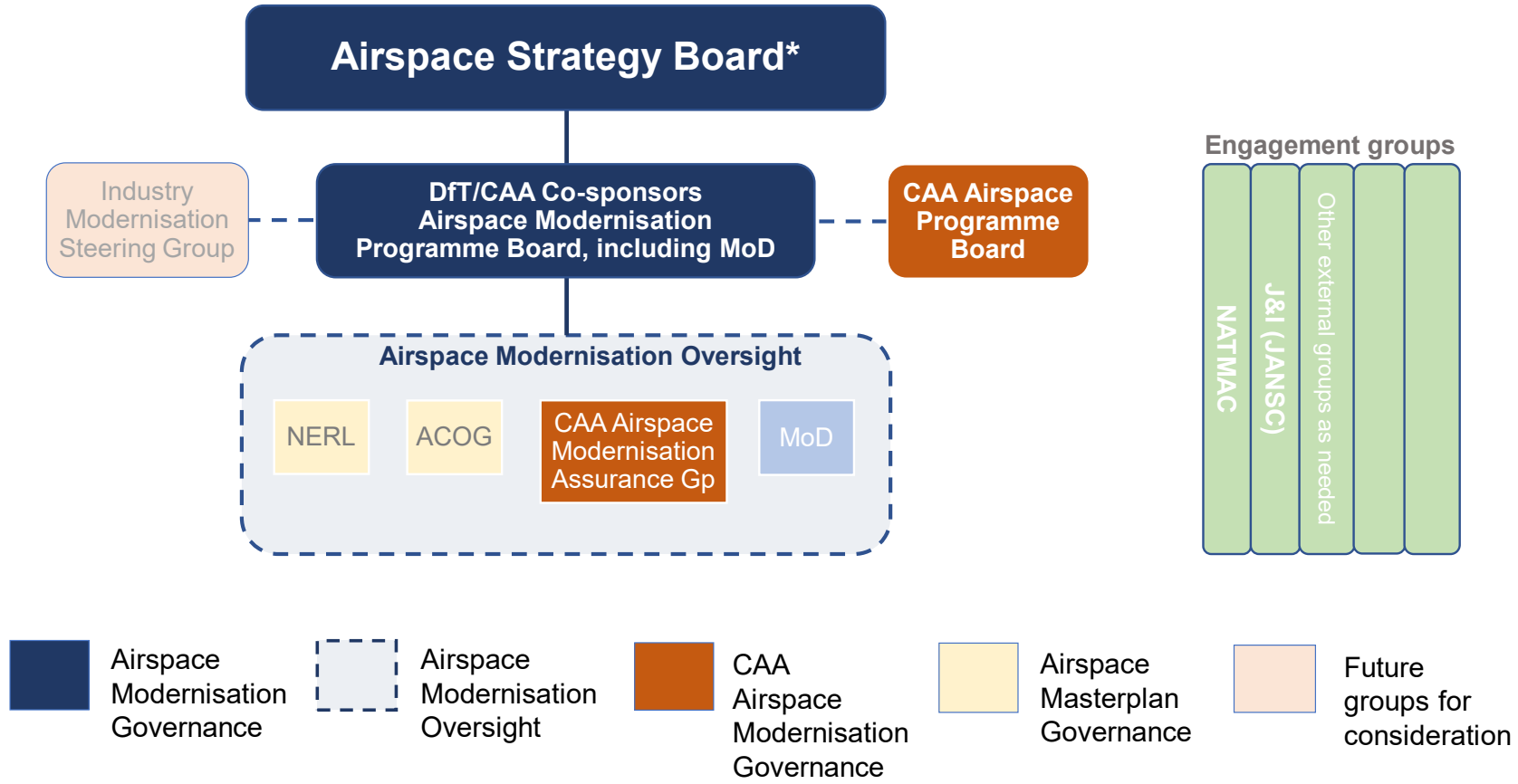
Governance structure hierarchy

A12. Figure A1 below shows the overall governance structure at the time of writing (note that the Department for Transport has committed to carrying out a review of the Airspace Strategy Board). The latest version of the governance structure is also published on the CAA's AMS webpages.[75]

A13. Reporting to the CAA Airspace Modernisation Assurance Group we expect there to be four steering groups covering different aspects of modernisation. Although we will not go as far as creating a steering group for each element, we will consider introducing an additional industry modernisation steering group, made up of industry representatives at operations director level, to help direct the short- and medium-term development of deployment activities. Figure A2 below shows more detail of what the airspace modernisation oversight governance encompasses and in particular CAA internal governance. Other groups may be added to the CAA internal governance as the AMS evolves.

74 These progress reports can be seen at www.caa.co.uk/cap1862 (2019), www.caa.co.uk/cap2016 (2020), www.caa.co.uk/cap2281 (2021) and www.caa.co.uk/cap2494 (2022).

75 https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-modernisation-strategy/

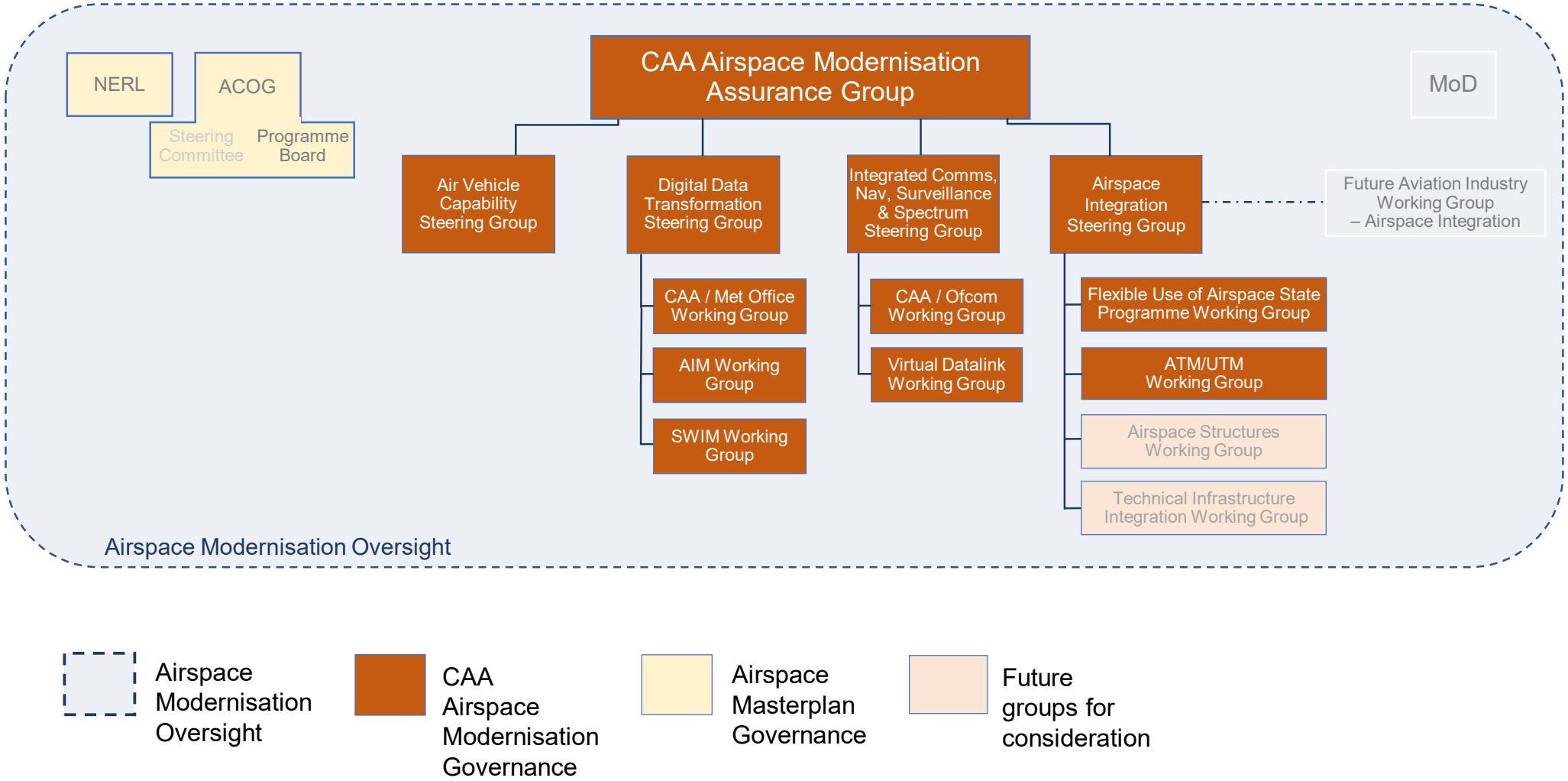


Notes:
* The Department for Transport has committed to carrying out a review of the Airspace Strategy Board.

The AMS governance structure is likely to change over time. For the latest up-to-date information please see https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-modernisation-strategy/

J&I = Joint and integrated air traffic services JANSC = Joint Air Navigation Services Council (see the Air Navigation Directions)
NATMAC = National Air Traffic Management Advisory Committee

Figure A1: Overall airspace modernisation governance structure



Note: The AMS governance structure is likely to change over time. For the latest up-to-date information please see https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-modernisation-strategy/

Figure A2: CAA airspace modernisation oversight and internal governance

Roles and responsibilities

A14. The CAA has reviewed the terms of reference of groups in the AMS governance structure to ensure consistency and identify any overlaps. Table A1 below summarises the groups, roles and responsibilities involved in AMS governance at the time of writing, although this will continue to evolve.

Table A1: AMS governance groups roles and responsibilities

Group	Role and responsibilities
Airspace Strategy Board	Chaired by the Aviation Minister. The first tier of the governance structure. Not a decision-making board, but it engages stakeholders on the policies that govern the AMS and advises the Department for Transport on potential changes to the overarching policy, regulatory, legal and funding framework if these are required to address delivery issues. Representatives from interested major stakeholders are invited to attend, including relevant public bodies such as local government, the CAA and Ministry of Defence; NATS; commercial aviation including airports and airlines; General Aviation; and community and environmental groups. The Terms of Reference and minutes of this group are published by the Department for Transport.[76] The Department for Transport has committed to carrying out a review of the Board.
Department for Transport	Co-sponsor of airspace modernisation to deliver the vision and strategic objectives of the AMS. It develops and owns the policy framework, including the strategic case for airspace modernisation and the objectives it must deliver. The Secretary of State also sets the CAA's role in the Air Navigation Directions.
CAA	Co-sponsor of airspace modernisation to deliver the vision and strategic objectives of the AMS. Independent regulator as well as technical adviser to the Government. Develops and maintains the AMS (including reporting annually to the Secretary of State on its delivery) consistent with the CAA's duties under section 70 of the Transport Act 2000 and the policy framework set by the Government, including the UK's international obligations. Assesses and accepts delivery plans into the AMS. Focuses on the technical policy framework required to enable the changes and to identify and propose new rulemaking activities. Various regulatory responsibilities including overseeing and decision-making in the CAP 1616 airspace change process.

76 https://www.gov.uk/government/groups/airspace-strategy-board

Group	Role and responsibilities
DfT/CAA Co-sponsors Airspace Modernisation Programme Board (including MoD)	To provide governance assurance for all AMS delivery including how delivery is being progressed by the various delivery groups; sharing updates on matters of strategy and policy; discussing issues and taking decisions as appropriate; and commissioning from delivery leads work relating to elements of the strategy.
CAA's airspace modernisation oversight team	Reporting to the co-sponsors, the airspace modernisation delivery, monitoring and oversight role is carried out by the CAA's airspace modernisation oversight team. The team's key function is to oversee, track and regularly report on progress, as well as annually to the Secretary of State. The oversight team agrees with delivery groups what the reporting should look like. The reporting includes assessing dependencies, risks and potential blockages. The oversight team identifies any potential solutions and where necessary escalates an issue to the co-sponsors.
Airspace Programme Board (CAA internal)	The Airspace Programme Board provides senior management level strategic direction on airspace short-term and long-term modernisation issues escalated by the Airspace Modernisation Assurance Group requiring internal CAA resolution ahead of being escalated to the co-sponsors. It is co-chaired by CAA Group Director Safety and Airspace Regulation and Director CAA Strategy and Policy.
Airspace Modernisation Assurance Group (CAA internal)	Coordinates across CAA on the implications of development or deployment of CAA activities and resources in the management of airspace modernisation and the CAA's delivery of the 'elements' defined within the AMS. This includes acting as the primary driver for responding to the ICAO Global Air Navigation Plan, and taking part in the governance of the AMS support fund. Accountable to the CAA Airspace Programme Board. Chaired by either Head of Airspace Modernisation, Head of Airspace, Aerodromes & ATM or Head of ATM Regulation in the CAA.
Steering groups and working groups	Led by the CAA and including relevant policy experts, these groups will engage with relevant industry experts and stakeholders to develop concepts of operations and roadmaps for coordination with other related workstreams. Not all of these groups are in place yet. The output of the steering and working groups is coordinated by the Airspace Modernisation Assurance Group.

Delivery leads and organisations

A15. The 15 initiatives from 2018 that the refreshed AMS absorbed into nine delivery 'elements' already have established delivery leads – for example, the Airspace Change Organising Group (see below) which acts as co-ordinator of masterplan airspace change sponsors, NERL (NATS (En-route) plc), and, for elements at the policy development stage, the CAA. The CAA continues to work on deployment plans that will form a future Part 3 of the AMS, tasking relevant delivery groups or organisations as appropriate. The plans are based on engagement with stakeholders about the AMS and the delivery elements in AMS Part 1 and Part 2.

A16. Such commissions will require delivery leads to work with other organisations responsible for delivery of each element to develop a realistic plan, appropriately evidenced, with any time-risk contingencies, dependencies and assumptions made explicit. In some cases delivery of elements is to comply with UK law and/or a CAA regulatory requirement. In other cases delivery may be to comply with the ICAO Global Air Navigation Plan or government policy and thus dependent on the cooperation of delivery groups or organisations.

A17. It will be important to ensure clarity over timelines and milestones for implementation and how delivery will be funded and resourced, given the long lead-in times required for equipment procurement, installation and testing, personnel training, subject-matter-expertise input and any relevant internal and third-party assurances. This could include a technology roadmap highlighted on the critical path of the delivery plan to ensure that the technology that needs to be put in place is deployed prior to the need being realised. We are considering how we might identify key performance indicators and measures of success linked to benefit realisation across all delivery elements, as an integral part of the modernisation programme.

A18. The refreshed AMS has a broader focus than the 2018 AMS, in particular around integration – for example, seamless integration of operations by beyond visual line of sight remotely piloted aircraft systems and advanced air mobility; use of electronic conspicuity; a Lower Airspace Service to better support both self-management of piloted VFR (visual flight rules) aircraft and remotely piloted aircraft systems in Class G (uncontrolled) airspace; flight intention information-sharing to facilitate increased VFR access to Class D airspace, improved Class G airspace structure, etc.

A19. Not all of these sit readily with the current AMS delivery, governance and resourcing/funding structures. Work to develop these structures will need to be undertaken, involving multiple stakeholders, in parallel with the work to evolve the new areas of focus themselves.

A20. The governance will continue to evolve over time. Ensuring that membership of the ongoing, core AMS governance groups is broadly reflective of airspace's diverse set of stakeholders will form part of the next phase of activity. Some groups are in place already. For example, a steering/working group in support of airspace integration, reporting to the Airspace Modernisation Assurance Group, is developing a concept of operations and roadmap for coordination with related workstreams, and helping to inform work on service delivery and charging.

A21. Our aim is that deliverables are supported by CAA, government and industry, but at the same time made as accessible as possible so as not to stifle competition and innovation, particularly among small/medium-sized enterprises and non-traditional aerospace entities that can bring new thinking and approaches. Delivery entities will need:

- capability and technical expertise to ensure safe delivery
- speed and flexibility to keep the UK competitive and ensure modernisation keeps pace with new technologies and industrial advances
- consideration of all diverse airspace users to facilitate integration via interoperability and simplification.

Airspace Change Organising Group

A22. The CAA and Department for Transport, as co-sponsors of airspace modernisation in the UK, commissioned NATS (En Route) plc (NERL) to create a single coordinated implementation plan for airspace changes in the UK to cover the period to 2040 to upgrade the UK's airspace and deliver the objectives of airspace modernisation at a system level, known as the airspace change masterplan.[77] Given the large number of parties involved in the development of the masterplan, including many airports and NERL itself, the co-sponsors required NERL to set up a separate and impartial body to coordinate the airspace changes necessary to deliver airspace modernisation and develop the masterplan. This body is known as the Airspace Change Organising Group (ACOG).[78] The masterplan is encompassed by Delivery Element UK-ABN/2 (see Chapter 4 and AMS Part 2).[79]

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77 https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-change-masterplan/ The commissions are published as Appendix A to CAP 2156a *Airspace change masterplan – CAA acceptance criteria* www.caa.co.uk/cap2156a.

78 ACOG www.acog.aero is a separate and impartial unit within NERL, as required by Condition 10a of NERL's air traffic services licence. https://www.caa.co.uk/commercial-industry/airspace/air-traffic-management-and-air-navigational-services/air-navigation-services/nats-en-route-plc-nerl-licence/

79 Formerly Initiatives 4 and 5 of the 2018 AMS: FASI-S, terminal airspace redesign in southern England; and FASI-N, terminal airspace redesign in northern England and Scotland. FASI-S and FASI-N mean Future Airspace Strategy Implementation–South and –North respectively.

A23. As part of coordinating the airspace change programme and developing the masterplan, ACOG will be engaging a range of stakeholders throughout each iteration.[80] More information on the regulatory process for accepting the masterplan can be found in Appendix B.

National Air Traffic Management Advisory Committee (NATMAC)

A24. NATMAC is an advisory body chaired by the CAA with representation across the UK aviation community. It assists the CAA in the development of airspace policies, configurations and procedures in order that due attention is given to the diverse requirements of all users of UK airspace, civil and military.

Joint Air Navigation Services Council

A25. The Joint Air Navigation Services Council (JANSC) is the principal mechanism for maintaining high-level oversight of arrangements between the CAA, NERL and the Ministry of Defence for the continued provision of joint and integrated air traffic services.[81] JANSC oversees the Flexible Use Airspace State Programme Steering Group. Flexible Use Airspace releases airspace for civil use when it is not required by the military, thus improving airspace efficiency while ensuring civil and military requirements are accommodated.

A26. We envisage that this group will continue to direct the development of Advanced Flexible Use of Airspace as a key deliverable within the ICAO GANP sub-element FRTO (Free Route Trajectory Operations). The FRTO sub-element supports the delivery of AMS Elements UK-ABN/1, UK-ABN/4 and UK-AM/5, the delivery of which will require changes by airlines and air navigation service providers and will therefore be tracked through the governance structure.

Stakeholder engagement

A27. We will continue to develop the AMS governance to ensure external organisations (including non-industry organisations, as appropriate) are fully involved and engaged. We plan to set out how we will continue fulfilling the engagement commitments we made during refresh activities by publishing periodic stakeholder engagement plans[82] from both a CAA oversight and co-sponsor perspective.

A28. At a strategic level, the CAA Sustainability Panel will provide guidance and challenge on our approach to airspace modernisation. We are also working with the Government to ensure that tasks related to its Future of Flight Plan are

80 https://www.acog.aero/airspace-masterplan/engaging-stakeholders/

81 See the Air Navigation Directions.

82 For the AMS refresh we published CAP 2175 *Airspace Modernisation Strategy Review: 2021 Stakeholder Engagement Plan and Process* www.caa.co.uk/cap2175.

allocated to the appropriate governance forum. We are considering establishing an industry modernisation steering group to help direct the short- and medium-term development of deployment activities. We are also considering how to reinvigorate existing entities and structures, such as NATMAC (see above).

Dependencies and risks of AMS delivery

A29. Dependencies and risks are managed through the governance structure. For example, the AMS depends on the development of ICAO Standards and Recommended Practices, the products of the Integrated Communications, Navigation, Surveillance and Spectrum project, the development of appropriate regulations on innovation and new business models via the CAA rulemaking process, the willingness of industry to plan, invest and consult, and so on.

A30. We are in the process of ensuring alignment with the UK National Aviation Safety Plan[83] to ensure consistency of approach and the ability to recognise and prioritise significant areas of risk.

A31. The CAA's decisions relating to delivery elements of the AMS – such as whether to accept an iteration of the airspace change masterplan, or setting the technical requirements for an aspect of airspace – have implications for maintaining the independence and objectivity of the decision-maker on other CAA functions, for example when deciding whether to approve an individual airspace change proposal.[84]

A32. The governance structure for the AMS has been designed to de-risk any potential conflicts of interest in the CAA's functions. Where these functions fall to the CAA, the roles are separated and carried out by different teams within the CAA. For example, the CAA's airspace modernisation team produces and maintains the AMS, commissions and tracks deliverables on behalf of the co-sponsors, decides whether an iteration of the airspace change masterplan should be accepted into the AMS, administers the FASI grant on behalf of the Department for Transport, provides an advisory board for the AMS Support Fund, and advises on whether powers to direct an airspace change to be developed should be triggered under the Air Traffic Management and Unmanned Aircraft Act 2021. These roles are functionally separated from the CAA's Safety and Airspace Regulation Group, whose many regulatory responsibilities include making decisions on airspace change proposals, reviewing airspace classifications and making a proposal to amend them where appropriate, devising and enforcing airspace-related rulemaking requirements, and so on.

83 www.caa.co.uk/cap2393

84 Where an airspace change proposal meets certain criteria, the Secretary of State may decide to call in the proposal and to make the related decision, instead of the CAA. https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Secretary-of-State-call-in-process/

APPENDIX B

Legal and policy framework

Summary

This appendix explains:

- the UK legal and policy framework underpinning airspace modernisation
- how this governs alignment of the AMS with the ICAO Global Air Navigation Plan and UK-specific requirements
- key developments in airspace policy in recent years illustrating the direction of travel, what we know of emerging policy, and where there may be gaps.

Overview

B1. The CAA's function is to prepare and maintain this AMS within the legal and policy framework set by the Government, as summarised in this section. The latest information can be found on the CAA's website.[85] More information is also available via the links at the end of this appendix and in the glossary in Appendix C.

B2. The CAA works closely with the Government to provide clarity around our respective policy and decision roles relating to airspace. As a regulator, the CAA is responsible for defining and setting policies relating to how it exercises its functions. The CAA is not responsible for developing or reviewing legislation and Government policy. The policy ultimately rests with our democratically elected Government.

B3. Where we believe there are opportunities for the legislation and policy framework to better support the carrying out of the CAA's functions, we will work with the Government to enhance our regulatory environment, where possible and appropriate, for the benefit of those that we regulate and wider society. For example, one piece of work set out in the CAA's Environmental Sustainability Strategy will lead to CAA advice to the Government on a proposed set of options

[85] https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Legislative-framework-to-airspace-change/. Page 13 of CAP 1616 also explains the relationship between CAA guidance and government policy www.caa.co.uk/cap1616

to help in prioritising trade-offs between different policy interests more clearly, including between additional capacity, CO_2 emissions and noise.

B4. While this appendix summarises relevant legislation and policy, it is not intended to be exhaustive, nor should it be taken as the only legislation and policy the CAA considers when exercising its regulatory functions in relation to airspace modernisation.

B5. Any nationally strategic infrastructure must respond to its immediate context – a context that is often continually developing and changing. Airspace is no exception. The political, economic, social, technological and environmental drivers within which airspace modernisation must happen will never remain still. There are innovations and disruptions that continually shift. As noted in Chapter 1, the CAA will keep the context for the AMS under review – including the legal and policy framework – and consider whether any changes to the AMS are needed.

The Civil Aviation Authority (Air Navigation) Directions 2017

B6. Referred to for convenience as the Air Navigation Directions, these give the CAA its functions in relation to air navigation, including to prepare and maintain the AMS. Among other things, the Air Navigation Directions also require the CAA to publish the UK airspace design; to approve changes to it or in some cases to the procedures for using it; to develop policy and strategy on the classification and use of airspace; to regularly review airspace classification and amend it as appropriate; and to develop and publish procedures and guidance on the development, making and consideration of airspace change proposals. All the CAA's responsibilities in the Air Navigation Directions must be carried out in compliance with the CAA's general duty under Section 70 of the Transport Act 2000.

B7. Specifically relating to the AMS, Direction 3 states, among other things, that the CAA must:

- (e) prepare and maintain a co-ordinated strategy and plan for the use of all UK airspace for air navigation up to 2040, including for the modernisation of the use of such airspace
- (f) consult the Secretary of State in relation to the preparation and maintenance of such strategy and the detail to be included in such plan, and
- (g) report to the Secretary of State annually on the delivery of the strategy referred to in sub-paragraph (e), the first such report to be provided by the end of 2018.

Transport Act 2000

B8. The CAA's statutory duties in respect of air navigation are contained in Chapter III of Part 1 of the Transport Act 2000 and the Air Navigation Directions.

B9. Section 70 of the Transport Act places the CAA under a general duty in relation to its air navigation functions to exercise those functions so as to maintain a high standard of safety in the provision of air traffic services. That duty is to have priority over the CAA's other duties in this area of work. Noting that priority, the CAA's duties in relation to air navigation is to exercise its functions in the manner it thinks best so that:

- it secures the most efficient use of airspace consistent with the safe operation of aircraft and the expeditious flow of air traffic
- it satisfies the requirements of operators and owners of all classes of aircraft
- it takes account of the interests of any person (other than an operator or owner) in relation to the use of any particular airspace or airspace generally
- it takes account of any guidance relating to spaceflight activities given to the CAA by the Secretary of State
- it takes account of any guidance on environmental objectives given to the CAA by the Secretary of State
- it facilitates the integrated operation of air traffic services provided by or on behalf of the armed forces and other air traffic services
- it takes account of the interests of national security
- it takes account of any international obligations of the UK notified to the CAA by the Secretary of State.

B10. The CAA's air navigation functions are the functions which we are required to perform under the Air Navigation Directions.

B11. In respect of our strategic role, the strategic vision for airspace modernisation to 2040 as articulated at the beginning of this document is informed by the material factors in section 70 of the Transport Act 2000. In addition, these material factors inform the ends or policy objectives of a modernised airspace, as discussed in Chapter 2.

B12. If, in a particular case, there is a conflict in the application of the material factors in section 70, the CAA must apply them in the manner it thinks is reasonable having regard to them as a whole. The CAA must also exercise its air navigation

functions so as to impose on providers of air traffic services the minimum restrictions which are consistent with the exercise of those functions.

B13. For more information on how the CAA interprets its statutory duty under section 70, see Appendix G of CAP 1616.[86]

Air Navigation Guidance 2017

B14. Section 70(2)(d) of the Transport Act 2000 requires the CAA to take account of any guidance on environmental objectives given to it by the Secretary of State when carrying out the air navigation functions set out in the Air Navigation Directions. This is subject to the CAA's primary duty of maintaining a high level of safety.

B15. The Air Navigation Guidance was last issued in October 2017[87] following a consultation by the Department for Transport about airspace and noise policy.[88] Additional guidance in relation to spaceflight activities was published in September 2021.[89] The Air Navigation Guidance is not just addressed to the CAA. The Government also expects that it will be taken into consideration by the aviation industry. The Air Navigation Guidance also acknowledges the important role which local communities have in the airspace change process.

B16. Underpinning the Air Navigation Guidance are a number of key overall objectives set by the Government. These include:

- to provide guidance to the CAA under section 70(2) of the Transport Act 2000 and which the aviation industry should take account of
- to ensure that aviation can continue to make its important contribution to the UK economy and at the same time seek to improve the sustainable development and efficiency of our airspace network
- to strengthen the UK's airspace change process and its transparency, particularly with respect to how local communities are involved within it, and

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86 CAP1616: *Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information.* www.caa.co.uk/cap1616

87 *Air Navigation Guidance 2017: Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management*, Department for Transport October 2017. https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017

88 *Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace,* Department for Transport October 2017. https://www.gov.uk/government/publications/uk-airspace-policy-a-framework-for-the-design-and-use-of-airspace

89 https://www.caa.co.uk/media/p2kc0rum/additional-air-navigation-guidance-spaceflight.pdf

- to emphasise that the environmental impact of aviation must be mitigated as much as is practicable and realistic to do so.

B17. The Air Navigation Guidance contains the Government's environmental objectives with respect to air navigation. These environmental objectives are designed to minimise the environmental impact of aviation within the context of supporting a strong and sustainable aviation sector. They are, in support of sustainable development:

- to limit and, where possible, reduce the number of people in the UK significantly affected by adverse impacts from aircraft noise
- to ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions, and
- to minimise local air quality emissions and in particular ensure that the UK complies with its international obligations on air quality.

B18. The Air Navigation Guidance recognises the degree of challenge which can exist in satisfying the expectations of local communities, those impacted by aviation, and the aviation industry's aspiration to further develop the efficiency of the UK airspace network. For example, a key policy issue is how to retain the benefits of aviation while addressing its environmental impacts, and how the CAA should integrate those considerations when making regulatory decisions on the necessary trade-offs between differing airspace objectives, such as increasing airspace capacity, reducing emissions and managing noise.

B19. Through the Air Navigation Guidance, the Government acknowledges that there are other legitimate operational objectives, such as the overriding need to maintain a high standard of safety, the desire for sustainable development, and the need to enhance the overall efficiency of the UK airspace network, which the CAA and others are required to take into account and consider alongside the environmental objectives of the Air Navigation Guidance.

B20. When devising this AMS, noting the overriding objective of safety, the CAA has applied the competing factors in section 70(2) in the manner it thinks is reasonable having regard to them as a whole.

Jet Zero strategy

B21. In July 2022 the Government published its Jet Zero Strategy[90] which outlined the framework and plan for the aviation sector to achieve net zero greenhouse gas emissions by 2050, and a target for UK domestic aviation to reach net zero by

[90] *Jet Zero strategy: delivering net zero aviation by 2050*, Department for Transport July 2022. https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050

2040 and for all airport operations in England to be zero emission by the same year.

B22. The strategy framework is based on three guiding principles (international leadership, delivering in partnerships and maximising opportunities) and six core policy measures (system efficiencies, sustainable aviation fuels, zero-emission flight, markets and removals, influencing consumers and addressing non-CO_2 impacts). The strategy sets an in-sector CO_2 emissions reduction trajectory for aviation to 2050 against which the Government will regularly review progress, with a review of the strategy every five years.

B23. The Jet Zero Strategy considers improvements in system efficiencies, which includes airspace modernisation, as one of its key foundations providing important short- to medium-term savings in emissions before 2050.

B24. In the strategy and the accompanying consultation response document[91], the Government confirmed its view that that the aviation sector can achieve Jet Zero without the Government needing to intervene directly to limit aviation growth, with knock-on economic and social benefits (see 'airport capacity' below).

Environment Act 2021

B25. The Environment Act 2021 entered into force in November 2021, although there are provisions of the Act which are not yet in force at the time of writing (January 2023). The Act provides a legal framework for environmental governance and brings in measures for the improvement of the environment in relation to waste, resource efficiency, air quality, water, nature and biodiversity, and conservation.

B26. It does so by providing the Government with powers to set new binding targets, including for air quality, water, biodiversity and waste reduction. The Department for Environment, Food and Rural Affairs published these targets in 2022 after consultation.[92]

B27. The Act also requires ministers to have due regard to the Environmental Principles Policy Statement when making policy. The Department for Environment, Food and Rural Affairs has published its draft Environmental Principles Policy Statement.[93] It contains five environmental principles: the

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91 *Jet Zero consultation: summary of responses and government response*, Department for Transport July 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1096928/jet-zero-consultation-summary-of-responses-and-government-response.pdf

92 At the time of writing (January 2023) the Government was intending to lay Statutory Instruments setting out the final targets that would then proceed for approval by Parliament. https://www.gov.uk/government/consultations/environment-act-2021-environmental-targets

93 https://www.gov.uk/government/publications/environmental-principles-policy-statement

integration principle; the prevention principle; the rectification at source principle; the polluter pays principle; and the precautionary principle. These principles are regarded as playing an important role in supporting environmental improvement plans (for example the 25-Year Environment Plan[94]) and in delivering on the Government's net zero commitment to tackle climate change.

B28. Other changes made by the Environment Act 2021 require the Government to review the National Air Quality Strategy[95] at least every five years and report annually to Parliament on the progress made to deliver air quality objectives in relation to England. Changes are also made in relation to Local Air Quality Management Frameworks.

B29. Many of the obligations in the Environment Act 2021 are directed particularly at the Government. The CAA will continue to engage with the Government on its evolving environmental policy, principles and targets, including on how they may lend weight to the CAA's own environmental policies and inform the refreshed AMS.

Airport capacity

B30. A key part of the 2018 AMS was the need to enable sustainable growth in capacity in the system, as discussed in Chapter 2.

B31. Following the designation of the Airports National Policy Statement (ANPS)[96] in June 2018, it has been subject to legal challenge, which was ultimately unsuccessful before the Supreme Court in December 2020. The ANPS sets out that there is a need to increase airport capacity in south-east England by 2030 and that the Government's preferred scheme is a new northwest runway at Heathrow. Following a number of requests to review the ANPS, the Secretary of State confirmed his decision in his open letter of 6 September 2021 stating that it was not appropriate to review the ANPS at that time. The Secretary of State set out that the question of whether or not to review the ANPS should be considered again after the Government's Jet Zero Strategy had been finalised, and that the timing of any re-consideration would need to have regard to the availability of long-term aviation demand forecasts.[97]

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94 https://www.gov.uk/government/publications/25-year-environment-plan

95 https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1

96 *Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England*, Department for Transport June 2018. https://www.gov.uk/government/publications/airports-national-policy-statementhttps://www.gov.uk/government/publications/airports-national-policy-statement

97 *Decision on requests to review the Airports National Policy Statement under the Planning Act 2008*, Department for Transport, September 2021.

B32. In June 2018 the Government also set out its approach to capacity at other airports in its 'Making best use of existing runways' policy, where it confirmed that it is supportive of airports beyond Heathrow making best use of their existing runways as long as they address the economic and environmental impacts and proposed mitigations.[98]

B33. In December 2018, the Government published Aviation 2050, a Green Paper consulting on how it saw sustainable growth being delivered.[99] In May 2022, in the context of the unprecedented impacts that the Covid-19 pandemic had on the aviation sector, the Department for Transport published Flightpath to the Future, a medium-term strategic framework for the sector in support of its vision for a modern, innovative and efficient sector over the following 10 years.[100]

B34. Building on the responses received to the Aviation 2050 consultation, this 10-point plan focuses on how government and industry can work together to deliver a successful aviation sector of the future. It focuses on four key themes: enhancing global impact for a sustainable recovery; embracing innovation for a sustainable future; realising benefits for the UK; and delivering for users. In view of the impacts of the pandemic, and having responded to one specific aspect[101], the Government decided not to publish a further formal response to the remaining parts of Aviation 2050.

B35. In respect of airport capacity, Flightpath for the Future reiterates the Government's position that "*Airport expansion has a key role to play in realising benefits for the UK through boosting our global connectivity and levelling up. We continue to be supportive of airport growth where it is justified, and our existing policy frameworks for airport planning provide a robust and balanced framework for airports to grow sustainably within our strict environmental criteria. They continue to have full effect, as a material consideration in decision-taking on applications for planning permission. The Government is clear that the expansion*

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015207/decision-on-requests-to-review-the-anps.pdf

98 *Beyond the horizon: the future of UK aviation, making best use of existing runways*, Department for Transport June 2018. https://www.gov.uk/government/publications/aviation-strategy-making-best-use-of-existing-runwayshttps://www.gov.uk/government/publications/aviation-strategy-making-best-use-of-existing-runways

99 *Aviation 2050: The future of UK Aviation: a consultation*, HMG, December 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/769695/aviation-2050-web.pdf

100 *Flightpath to the Future: a strategic framework for the aviation sector, Department for Transport, May 2022* https://www.gov.uk/government/publications/flightpath-to-the-future-a-strategic-framework-for-the-aviation-sector

101 In 2019 the Government responded in respect of introducing legislation for enforcing the development of airspace change proposals (which became The Air Traffic Management and Unmanned Aircraft Act 2021).

of any airport must meet its climate change obligations to be able to proceed." It also notes that airspace modernisation "*has an important role to play in ensuring the UK can meet its decarbonisation ambitions, and embrace opportunities presented by new and novel aircraft. The Government is committed to ensuring UK airspace can support the sustainable growth of the aviation sector*."[102]

B36. In October 2021, alongside its Net Zero Strategy[103] (setting out its plan to tackle climate change across all sectors of the economy), the Government published its response to the report by the Climate Change Committee *Progress in Reducing Emissions*.[104] The Committee had recommended that the Government assess its airport capacity strategy in the context of Net Zero and any lasting impacts on demand from Covid-19, as part of the aviation strategy. The Committee had also recommended that there should be no net expansion of UK airport capacity unless the sector was on track to sufficiently outperform its net emissions trajectory and could accommodate the additional demand.

B37. The Government's response stated that flying is a social and economic good, and one that it wholeheartedly supported as a key part of building a global Britain. The Government went on to say that it currently believed that the aviation sector, even if returning to a pre-Covid-19 demand trajectory, could achieve Jet Zero without the Government needing to intervene directly to limit aviation growth. Department for Transport analysis showed that there are scenarios where net zero targets can be achieved by focusing on new fuels and technology, rather than capping demand, with knock-on economic and social benefits. The Government also reaffirmed its commitments to increase system efficiencies including the airspace modernisation programme. As noted above, this position was confirmed in the Jet Zero Strategy (see above).[105]

ICAO and Europe

International Civil Aviation Organization (ICAO)

B38. ICAO is a specialist agency of the United Nations which acts as a global forum of States for international civil aviation. As a contracting state, the UK has agreed operational objectives regarding airspace modernisation under the ICAO Global Air Navigation Plan (GANP).

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102 Pages 7 to 8 and page 38.

103 *Net Zero Strategy: Build Back Greener*, HMG, October 2021. https://www.gov.uk/government/publications/net-zero-strategy

104 Climate Change Committee's 2021 progress report: Government response, HMG, October 2021 https://www.gov.uk/government/publications/committee-on-climate-changes-2021-progress-report-government-response

105 *Jet Zero consultation: summary of responses and government response*, Department for Transport July 2022. https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050

B39. Before the UK left the EU, the UK's obligations under the GANP were delivered through the Single European Sky and associated European ATM (air traffic management) Masterplan, which was used to produce the necessary regulations regarding airspace modernisation that had direct legal effect in the UK.

B40. While some of this legislation has been retained as domestic law and continues to apply in the UK through the European Union (Withdrawal) Act 2018, the UK's modernisation programme and the legislation underpinning it will need to be updated as developments occur to ensure its obligations under the GANP are met, while at the same time adopting a national approach, making best use of global learning and delivering globally interoperable capabilities. The AMS is now the single roadmap to guide the CAA's approach to its policy development on airspace modernisation.

Single European Sky

B41. The Single European Sky programme sets out a range of airspace modernisation requirements in EU law, mainly focusing on commercial air transport operations and larger airports with a significant impact on the core European airspace network. The legislation also requires en route air navigation service providers to meet a set of performance targets for safety, cost efficiency, environmental performance and delays, which are set at the national and EU level.

B42. Other implementing regulations developed by EASA that cover navigation, surveillance and air traffic management are much broader in scope and set requirements for the way certain aerodromes and aircraft operations, inside and outside controlled airspace, are to be modernised.

B43. As stated above, EU Regulations enabling the European ATM Master Plan are agreed and adopted by the European Commission and EU member states. Some of this legislation continues to apply in the UK – in an amended form such that it still applies and operates properly in UK law – through the European Union (Withdrawal) Act 2018. For example, the SESAR Pilot Common Project (PCP), with the first set of air traffic management functionalities or solutions, had direct legal effect in the UK and is now retained EU law.

B44. The UK's roadmap to meet its objectives in relation to the GANP is this AMS which will drive the UK's rulemaking process for airspace modernisation.[106] The delivery elements in AMS Part 2 will therefore be used to assist in the prioritisation of UK airspace rulemaking activity to help ensure their timely and coordinated implementation.

[106] https://info.caa.co.uk/uk-regulations/

Relations with Europe

B45. Around 25 percent of traffic passing through EU airspace also passes through UK airspace, including around 80 percent of transatlantic traffic. Consequently there is a continuing need for greater interoperability in airspace management arrangements between the UK and the rest of Europe. The UK remains part of the pan-European air traffic management system and has cooperative arrangements with other European states, principally through its membership of the EUROCONTROL intergovernmental organisation and industrial partnerships such as Borealis.[107]

Airspace change masterplan

B46. The airspace change masterplan is a single coordinated implementation plan for airspace changes in the UK to cover the period to 2040 to upgrade the UK's airspace and deliver the objectives of airspace modernisation at a system level.[108] In doing so, the masterplan will, in particular:

- identify where and when airspace change proposals may need to be developed in coordination to support delivery of the objectives of the AMS
- describe how individual airspace change proposals relate to each other (i.e. interdependencies) and where there are potential conflicts in their proposed designs
- explain how trade-off decisions to resolve those conflicts have been made
- set out the proposed timelines for implementation of the individual airspace changes
- demonstrate the anticipated cumulative impact of the airspace change proposals.

B47. The masterplan is encompassed by Delivery Element UK-ABN/2 (see Chapter 4 and AMS Part 2).[109]

B48. The CAA and Department for Transport, as co-sponsors of airspace modernisation in the UK, commissioned NERL to create the masterplan.[110] Given the large number of parties involved in the development of the masterplan, including many airports and NERL itself, the co-sponsors required NERL to set

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107 https://www.sesardeploymentmanager.eu/partners/borealis-alliance

108 https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-change-masterplan/

109 Formerly Initiatives 4 and 5 of the 2018 AMS: FASI-S, terminal airspace redesign in southern England; and FASI-N, terminal airspace redesign in northern England and Scotland. FASI-S and FASI-N mean Future Airspace Strategy Implementation–South and –North respectively.

110 The commissions are published as Appendix A to CAP 2156a *Airspace change masterplan – CAA acceptance criteria* www.caa.co.uk/cap2156a.

up a separate and impartial body to coordinate the airspace changes necessary to deliver airspace modernisation and deliver the masterplan. This body is known as the Airspace Change Organising Group (ACOG).[111]

B49. Part of the regulatory framework involves the co-sponsors assessing ACOG's progress to confirm that the masterplan is consistent with the masterplan commission, government policy and the CAA's own statutory airspace functions. Based on that assessment, and before the masterplan can be implemented, the CAA must decide to formally 'accept' the masterplan into the AMS, having consulted the Secretary of State. Each iteration must be accepted separately, except Iteration 1, which has already been assessed and published. ACOG envisages a minimum of four iterations of the masterplan.

B50. The CAA has published the criteria for accepting the masterplan into the AMS and the related assessment framework.[112] Once the masterplan is accepted into the AMS, the masterplan, together with the CAA's general duties in section 70 of the Transport Act 2000, will form the basis against which individual airspace change decisions are made by the CAA. This means that the CAA's decisions on airspace change proposals must not be inconsistent with the masterplan.

B51. Acceptance of the masterplan forms part of the delivery plans in the AMS Part 3. Progress with assessing individual iterations of the masterplan can be tracked on the CAA's airspace change masterplan webpages.[113]

B52. At the strategic level, the CAA will carry out a Strategic Environmental Assessment and Habitats Regulations Assessment of the airspace change masterplan that forms part of AMS deployment. This is in addition to the environmental assessments of individual changes in airspace design. More information is in the acceptance criteria mentioned above.

Procedure for the CAA to review the classification of airspace

B53. Initiative 10 of the 2018 AMS was an airspace classification review to optimise the integration of all classes of aircraft. This is consistent with the CAA's airspace classification functions under the Air Navigation Directions, including the function of regularly considering whether airspace classifications should be reviewed, carrying out such reviews and considering and making changes to airspace classification as the CAA considers appropriate.

111 www.acog.aero

112 CAP 2156a *Airspace change masterplan – CAA acceptance criteria* www.caa.co.uk/cap2156a, CAP 2156b *Airspace change masterplan – assessment framework* www.caa.co.uk/cap2156b.

113 https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/airspace-change-masterplan/

B54. The procedure to review the classification of airspace, CAP 1991[114], is functionally separate from the CAP 1616 airspace change process, but plans for change under CAP 1991 are shared with those reviewing plans for change under CAP 1616. This will ensure that there is coherence with the broader programme to modernise UK airspace. Part of the regulatory framework involves a procedure where we undertake a review of UK airspace to draw up a plan that lists airspace volumes where a case could be made for a proposed amendment to the classification, and a proposed schedule for when we will address them. After stakeholder consultation and engagement, the final plan will be included in the AMS Part 3 deployment view. Formal proposals based on that final plan are then worked up and actioned. Progress can be tracked on the CAA's airspace classification webpages.[115]

CAA Environmental Sustainability Strategy

B55. In May 2022, the CAA published its Environmental Sustainability Strategy.[116] The strategy has been developed to provide clarity to those within the CAA, those we regulate and other stakeholders on our roles, remit and ambition as we work with those parties to improve environmental performance in the aviation and aerospace systems for the benefit of consumers, users and the wider community.

B56. Under the Environmental Sustainability Strategy, the CAA will focus its expertise and leadership in the following areas:

- enabling development of low and zero-emission novel technologies
- co-sponsoring the modernisation of airspace
- reporting on the sustainability performance of industry, including noise, and providing information to consumers on the environmental impact of aviation
- advising and supporting the UK Government on domestic and international policy
- reducing the impact of our corporate activities and operations
- assessing how relevant regulated activities impact the local environment

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114 CAP 1991 *Procedure for the CAA to review the classification of airspace*. www.caa.co.uk/cap1991 and CAP 1991a *Summary of the procedure for the CAA to review the classification of airspace*. www.caa.co.uk/cap1991a

115 https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Airspace-classification/

116 *CAA's Environmental Sustainability Strategy* www.caa.co.uk/cap2360 and related areas of work www.caa.co.uk/cap2361

- using our powers and duties to take account of the impact on the environment in our regulation and oversight.

B57. Airspace modernisation is therefore a core component of the Environmental Sustainability Strategy. There are several environmental improvements that airspace modernisation will bring, such as reduced fuel burn and emissions per flight through more efficient flightpaths and more frequent continuous ascent and descent, as well as less need for holding due to better management of arrival times through optimised routes and speeds. Modernisation could also enable aircraft to climb more quickly, descend more quietly, and to navigate more accurately around population centres of other noise-sensitive areas.

B58. The Environmental Sustainability Strategy is underpinned by a series of short-term deliverables which are the initial and immediate targets the CAA has set to deliver its sustainability ambition. For example, following the transfer of certain responsibilities of the Independent Commission on Civil Aviation Noise (ICCAN) to the CAA, the Department for Transport has commissioned technical advice from the CAA to inform government policy on trade-offs resulting from different airspace design options, including between noise and CO_2 emissions (for example, aircraft flying a longer routeing to provide noise respite). This is not an activity under the refreshed AMS, but rather a short-term deliverable under the Environmental Sustainability Strategy. The CAA will continue to engage with the Government on its evolving environmental policies, including how they may inform the refreshed AMS and its delivery elements (especially trade-offs in the context of the airspace change masterplan).

B59. As the Environmental Sustainability Strategy explains, there are a number of areas in the CAA's regulatory framework where we have a duty to take environmental factors into account when we make our decisions. This applies, for example, to the need to take into account the Air Navigation Guidance when we make decisions on airspace change, including prioritising noise over carbon below 4,000 feet, or when we assess the effects of spaceflight on people, wildlife and the marine environment.

B60. In some areas of the CAA's work, however, there are no explicit targets or guidelines set by the Government or in legislation to drive down the effects of emissions, noise or other local impacts. Although we always consider the specific facts of any case in our decision-making, where we have discretion in how we take the environment into account, the Environmental Sustainability Strategy proposes to apply the following prioritisation of impacts. This will help our stakeholders understand how we apply our discretion in seeking to mitigate the environmental impacts of the activities we regulate:

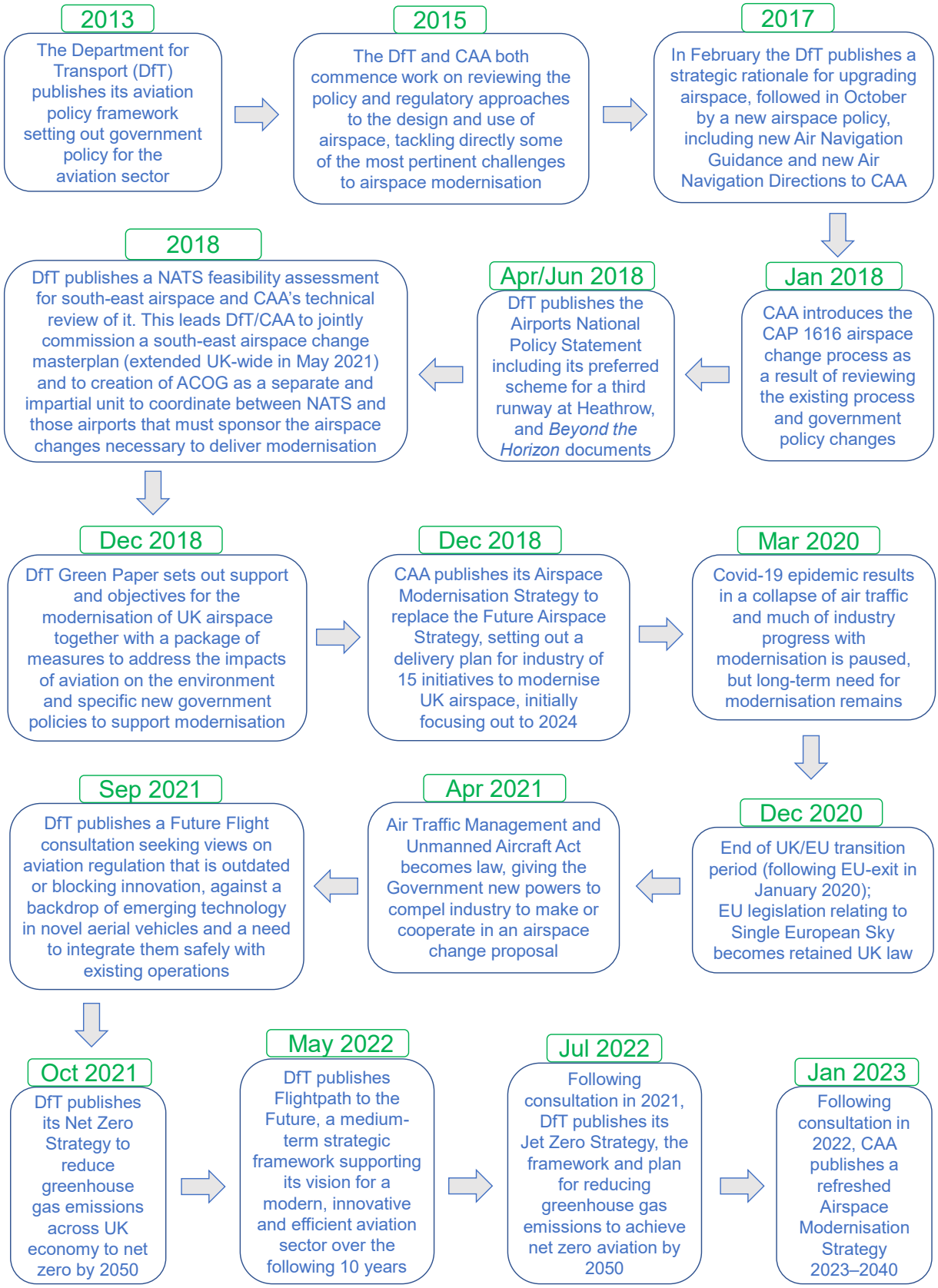
- first, mitigating the impact of global warming, with a focus on carbon emissions, then
- mitigating noise impacts on local communities, then
- mitigating impacts on tranquil spaces and biodiversity, then
- mitigating impacts on air quality and on other environmental elements.

B61. This hierarchy is known as the proposed 'prioritisation principle'. As noted elsewhere in the AMS, where delivery elements are being progressed outside of airspace change and where the CAA has discretion in how we take the environment into account, i.e. where there are no explicit environmental targets or priorities set by government or in legislation, the CAA will apply its Environmental Sustainability Strategy and the proposed 'prioritisation principle'. For example, prioritising (subject to safety) a deliverable in an AMS element which enables CO_2 emissions savings.

B62. In 2023 the CAA will consult with stakeholders and the public on the proposed prioritisation principle before we apply it to our decision-making, including on how that principle might shape, influence or otherwise impact the delivery of airspace modernisation. The CAA will keep this principle under review as science and government policy develop, and we will reconsult as necessary.

Summary of developments

B63. Key developments in the airspace legal and policy context are summarised in Figure B1 below. The developments presented in this figure are non-exhaustive and intended only to provide a general overview.



Notes:

The developments presented in this figure are non-exhaustive and intended only as a general overview. Links to the source documents are overleaf.

Figure B1: Key developments in the airspace legal and policy context

Source documents for Figure B1:

2013	*Aviation Policy Framework,* Department for Transport	https://www.gov.uk/government/publications/aviation-policy-framework
2017	*Upgrading UK Airspace – Strategic Rationale,* Department for Transport	https://www.gov.uk/government/publications/upgrading-uk-airspace-strategic-rationale
2017	*UK Airspace Policy: A framework for balanced decisions on the design and use of airspace,* Department for Transport	https://www.gov.uk/government/consultations/reforming-policy-on-the-design-and-use-of-uk-airspace https://www.gov.uk/government/publications/uk-airspace-policy-a-framework-for-the-design-and-use-of-airspace
2017	Air Navigation Directions	https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Legislative-framework-to-airspace-change/
2017	*Air Navigation Guidance 2017*, Department for Transport	www.gov.uk/government/publications/uk-air-navigation-guidance-2017
2018	CAP1616: *Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information*	www.caa.co.uk/cap1616
2018	*Beyond the horizon, the future of UK aviation, next steps towards an Aviation Strategy*, HMG	https://www.gov.uk/government/consultations/a-new-aviation-strategy-for-the-uk-call-for-evidence
2018	*Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England*, Department for Transport	https://www.gov.uk/government/publications/airports-national-policy-statement
2018	*Beyond the horizon: the future of UK aviation, making best use of existing runways*, Department for Transport	https://www.gov.uk/government/publications/aviation-strategy-making-best-use-of-existing-runways
2018	*NATS Feasibility Report into Airspace Modernisation in the South of the UK and the CAA Assurance into the NATS Feasibility Report*, Department for Transport	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/763085/nats-caa-feasibility-airspace-modernisation.pdf
2018	Commission of masterplan, see Appendix A to CAP 2156a *Airspace change masterplan – CAA acceptance criteria and* NERL air traffic services licence condition 10a	www.caa.co.uk/cap2156a https://www.caa.co.uk/commercial-industry/airspace/air-traffic-management-and-air-navigational-services/air-navigation-services/nats-en-route-plc-nerl-licence/
2018	*Aviation 2050: The future of UK Aviation: a consultation*, HMG	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/769695/aviation-2050-web.pdf
2018	CAP 1711 *Airspace Modernisation Strategy* ed1	
2020	Retained UK law	https://info.caa.co.uk/uk-regulations/
2021	Funding support packages	https://www.gov.uk/government/publications/update-on-airspace-modernisation/dft-and-caa-update-on-airspace-modernisation-march-2021 https://www.gov.uk/government/news/55-million-to-drive-improvements-to-uks-motorways-in-the-sky https://www.gov.uk/government/news/government-commits-funding-to-build-back-better-and-greener-in-our-skies
2021	Air Traffic Management and Unmanned Aircraft Act 2021	https://www.legislation.gov.uk/ukpga/2021/12/contents/enacted
2021	Future of transport regulatory review consultation: Future of flight	https://www.gov.uk/government/consultations/future-of-transport-regulatory-review-future-of-flight
2021	Net Zero Strategy	https://www.gov.uk/government/publications/net-zero-strategy
2022	Flightpath to the Future	https://www.gov.uk/government/publications/flightpath-to-the-future-a-strategic-framework-for-the-aviation-sector
2022	Jet Zero Strategy	https://www.gov.uk/government/publications/jet-zero-strategy-delivering-net-zero-aviation-by-2050
2023	CAP 1711 *Airspace Modernisation Strategy* ed2	www.caa.co.uk/cap1711 www.caa.co.uk/cap1711a

APPENDIX C

Glossary

Although we have only used abbreviations in this document where unavoidable, we have included below an explanation of some common terms and abbreviations that relate to airspace modernisation, in the interests of the non-technical reader. These explanations will not necessarily be the formal ICAO/CAA/SERA definition, which can be found in CAP 1430 *UK Air Traffic Management Vocabulary* www.caa.co.uk/cap1430.

Term	Abbreviation	Description
Advanced air mobility	AAM	A new concept of sustainable air transportation designed to transport people and goods (also known as urban air mobility where intended for use in built-up areas).
Advanced flexible use of airspace	AFUA	See flexible use of airspace.
Advisory airspace		An airspace of defined dimensions, or designated route, within which air traffic advisory service is available. (Class F is not currently used in the UK.)
Aerodrome flight information service officer	AFISO	A flight information service officer at an aerodrome (see Flight information service).
Aerodrome traffic zone	ATZ	A defined volume of airspace established around an aerodrome for the protection of aerodrome traffic.
Aeronautical Information Management	AIM	The dynamic, integrated management of aeronautical information services through the provision and exchange of quality-assured digital aeronautical data, in collaboration with all parties.
Aeronautical Information Publication	AIP	A publication that provides long-term information essential to air navigation, including the detailed structure of UK airspace and flight procedures, which forms part of the UK Integrated Aeronautical Information Package. Sometimes informally known as the Air Pilot.
Air Navigation Directions		The Civil Aviation Authority (Air Navigation) Directions 2017, as amended in 2018 and 2019. These Directions give the CAA its functions in relation to air navigation, including to prepare and maintain the AMS. They are jointly issued by the Secretary of State for Transport and the Secretary of State for Defence. A consolidated version is on the CAA's website. Legislative framework to airspace change | Civil Aviation Authority (caa.co.uk)
Air Navigation Guidance	ANG	Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management. Air Navigation Guidance 2017

Term	Abbreviation	Description
Air navigation service provider	ANSP	An organisation which operates the technical system, infrastructure, procedures and rules of an air navigation service system, which may include air traffic control.
Air traffic control service	ATC	A service provided for the purpose of preventing collisions between aircraft, and on the manoeuvring area between aircraft and obstructions; and expediting and maintaining an orderly flow of traffic.
Air traffic management	ATM	The combined processes of air traffic control, air traffic flow management, and aeronautical information services.
Air traffic service	ATS	Generic term that covers flight information services, alerting services, air traffic advisory services, air traffic control services (area control service, approach control service or aerodrome control service) and aerodrome flight information services.
Airspace Change Organising Group	ACOG	The CAA and Department for Transport, as co-sponsors of airspace modernisation in the UK required NERL to set up ACOG as a separate and impartial body to coordinate the airspace changes necessary to deliver airspace modernisation in the form of a masterplan. Airspace Change Organising Group (ACOG)
Airspace change process	CAP 1616 process	The staged process an airspace change sponsor follows to submit an airspace change to the CAA for a decision. CAP1616: Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information (caa.co.uk)
Airspace change proposal	ACP	A proposal (usually from an airport or air navigation service provider) to change the design of UK airspace.
Airspace design		Together, the airspace structure and flight procedures.
Airspace management cell		Responsible for the day-to-day management and temporary allocation of airspace to achieve the most efficient use of airspace.
Autonomous		There are multiple understandings of the term autonomous. In this document autonomous means the ability to operate independently, without input or reliance on air traffic services.
Aviation System Block Upgrade	ASBU	The building blocks of the ICAO Global Air Navigation Plan with workstreams organised into ‘threads’ and ‘elements’, ASBUs provide a global planning framework to ICAO and its member states, associated air navigation service providers and other stakeholders with the goal of implementing regional performance improvements.

Term	Abbreviation	Description
Beyond visual line of sight	BVLOS	The CAA's Drone Code describes how remote pilots should keep their drone in sight. This means that they can see and avoid other things while flying. This is known as flying within Visual Line of Sight (VLOS). A drone operating without the need or ability to keep the aircraft within view is known as beyond visual line of sight (BVLOS). CAP 1861: Beyond Visual Line of Sight in Non-Segregated Airspace (caa.co.uk)
Airspace Classifications		Airspace is broken down into different classes, defined by ICAO. In the UK, Classes A, C, D and E are controlled airspace and Class G is uncontrolled airspace.
Control area	CTA	Area of controlled airspace extending upwards from a specified limit above the surface to a specified upper limit.
Control zone	CTR	Area of controlled airspace extending upwards from ground level to a specified limit. Usually surrounding and aerodrome and situated below a control area.
Controlled airspace	CAS	Airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification. Classifications for controlled airspace range from Class A to Class E.
Danger area		Airspace within which activities dangerous to the flight of aircraft may exist at specified times.
Data link automatic terminal information service	D-ATIS	ATIS broadcasts contain essential aerodrome information, such as current weather information, active runways, available approaches, and any other information. D-ATIS is the digital provision of this information via datalink.
Electronic conspicuity	EC	An umbrella term for the technology that allows airspace users to detect and be detected. Electronic conspicuity can help pilots, remotely piloted aircraft systems and air traffic service providers be more aware of what is operating in surrounding airspace. It includes the devices fitted to aircraft that send out the information and the supporting infrastructure to help them work together; examples are airborne cooperative surveillance equipment, air traffic data displays, ground-based antennas and satellite surveillance services.
EUROCONTROL		An intergovernmental organisation with 41 European member states, plus Israel and Morocco, acting as the central organisation for coordination and planning of air traffic control across those member states.
European Union Aviation Safety Agency	EASA	The European Union authority for aviation safety.

Term	Abbreviation	Description
Flexible use of airspace	FUA	Concept promoted by EUROCONTROL wherein airspace is no longer designated as purely 'civil' or 'military' airspace but considered as one continuum and allocated according to user requirements. FUA is being replaced by advanced flexible use of airspace (AFUA).
Flight Plan		Specified information provided to air traffic services relative to an intended flight or portion of a flight of an aircraft (SERA.4001). The methods for submitting this information include traditional 'booking in/out' via telephone or radiotelephony and digital submission of flight intention data.
Flight and flow information	FF-ICE	Flight and flow information for a collaborative environment: information necessary for notification, management, and coordination of flights between members of the ATM community within the collaborative environment envisioned in the ICAO Global ATM Operational Concept.
Flight information region	FIR	Airspace of defined dimensions within which flight information service and alerting service are provided.
Flight information service	FIS	A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.
Flight Information Service–Broadcast	FIS-B	A wide area broadcast of data products such as weather, airspace availability or airspace restrictions transmitted for the use of any suitably equipped aircraft and other airspace users within range of the broadcast.
Flight level	FL	A nominal height (expressed in hundreds of feet) of an aircraft referenced to a standard pressure setting (1013.2 hPa).
Flight restriction zone	FRZ	Zones created around aerodromes that are designated as 'protected aerodromes'. Unmanned aircraft of any size must not be flown within the FRZ of a protected aerodrome without appropriate permission.
Free-route airspace	FRA	Specified airspace within which users may freely plan a route between defined entry and exit points either direct or via intermediate waypoints without reference to the ATS route network, subject to airspace availability.
Future Airspace Strategy	FAS	Replaced by the AMS, FAS was a collaborative initiative between a range of stakeholders for modernising the UK's airspace.
Future Airspace Strategy implementation	FASI-S FASI-N	Implementation of the Future Airspace Strategy separated by geographical location. FASI-N refers to terminal airspace redesign in northern England and Scotland. FASI-S refers to terminal airspace redesign in southern England.

Term	Abbreviation	Description
Future Communications Infrastructure	FCI	An internet protocol suite system providing the digital and secure communication capabilities able to support integrated Communication, Navigation and Surveillance (ICNS) by providing the network functionality to interconnect air and ground end-systems networks.
General Aviation	GA	Essentially all civil flying other than commercial airline operations, which therefore encompasses a wide range of aviation activity from paragliders, microlights, gliders and balloons to corporate business jets and aerial survey aircraft, and includes all sport and leisure flying. Introduction to the General Aviation unit (caa.co.uk)
Global navigation satellite system	GNSS	A worldwide position, velocity, and time determination system that includes one or more satellite constellations, receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the actual phase of operation – for example, GPS (global positioning system).
High-altitude platform system	HAPS	Typically a remotely piloted fixed-wing aircraft or airship/balloon operating for an extended period at high altitude (probably above 60,000ft) providing services such as broadband connectivity or remote sensing.
Independent Commission on Civil Aviation Noise	ICCAN	Originally an independent UK body responsible for creating, compiling and disseminating best practice to the aviation industry on the management of civil aviation noise and advising government in this area. The Government decided to wind down ICCAN at the end of September 2021 and some of its responsibilities were transferred to the CAA. Independent advice to government on civil aviation noise (www.gov.uk)
Instrument approach procedure	IAP	Published flight procedures followed by aircraft with reference to flight instruments and with specified protection from obstacles, positions the aircraft to safely approach and land (see also standard instrument arrival).
Instrument flight rules	IFR	The rules under which a pilot can fly and navigate with reference to flight instruments (see also visual flight rules).
Instrument flight procedures	IFP	Part of the airspace design. A set of predetermined route segments intended to be followed by a pilot when arriving to or departing from an aerodrome (also see standard instrument departure, standard instrument arrival and instrument approach procedure).

Term	Abbreviation	Description
Instrument meteorological conditions	IMC	Meteorological conditions expressed in terms of visibility, distance from cloud, and cloud ceiling, less than the minima specified for visual meteorological conditions. In IMC conditions pilots will fly primarily with reference to flight instruments (see also visual meteorological conditions).
International Civil Aviation Organization	ICAO	The agency of the United Nations responsible for international standards for civil aviation which the UK has agreed by international treaty to implement. https://www.icao.int/about-icao/Pages/default.aspx
Joint Air Navigation Services Council	JANSC	The principal mechanism for maintaining high-level oversight of arrangements between the CAA, NATS (En Route) plc and the Ministry of Defence for the continued provision of joint and integrated air traffic services.
Local Single Sky implementation monitoring	LSSIP	LSSIP documents provide an annual view of how 41 member states of EUROCONTROL (plus Israel and Morocco) and relevant stakeholders are progressing in planning and deploying the mature elements of the European ATM Master Plan. Local Single Sky implementation monitoring (LSSIP) | EUROCONTROL
Lower airspace radar service	LARS	A service available to all aircraft for the provision of the radar element of UK Flight Information Services, usually available within approximately 30nm of each participating Air Traffic Service Unit to all aircraft flying outside controlled airspace up to Flight Level 100, within the limits of radar/radio cover and set times.
Meteorological Aerodrome Report	METAR	Aerodrome observations report typically containing temperature, dew point, surface wind, precipitation, cloud cover and heights, visibility and barometric pressure. CAP 746: Requirements for meteorological observations at aerodromes (caa.co.uk)
National Air Traffic Management Advisory Committee	NATMAC	An advisory body chaired by the CAA with representation across the UK aviation community. NATMAC assists the CAA in the development of airspace policies, configurations, and procedures in order that due attention is given to the diverse requirements of all users of UK airspace, civil and military.
NATS		The biggest air navigation service provider in the UK, formerly National Air Traffic Services. Parent company of NERL (NATS (En Route) plc) and NSL (NATS Services Limited). nats.aero

Term	Abbreviation	Description
NATS (En Route) plc	NERL	Subsidiary of NATS Holdings Ltd and the sole provider of air traffic control services for aircraft flying en route in UK airspace. NERL also provides some air traffic control services in the eastern part of the North Atlantic, as well as providing a combined approach function (London Approach) for five London airports.
Non-cooperative radar		Radar which can detect aircraft and other airspace users regardless of their onboard equipment. Also known as Primary Surveillance Radar (PSR).
Notice to Aviation	NOTAM	A notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
Notified airspace design		Details of airspace structure and procedures published in the UK Aeronautical Information Publication (see also Aeronautical Information Publication).
Performance-based navigation	PBN	A concept developed by ICAO that moves aviation away from the traditional use of aircraft navigating by ground-based beacons to a system more reliant on airborne technologies, utilising area navigation and global navigation satellite systems (Air Navigation Guidance 2017). More specifically, area navigation based on performance requirements for aircraft operating along an ATS route, or an instrument approach procedure or in a designated airspace (see also required navigational performance).
Performance-based surveillance	PBS	Surveillance based on performance specifications applied to the provision of air traffic services.
Pilot common project	PCP	The first set of air traffic management functionalities identified for wide scale coordinated deployment under SESAR (see also Single European Sky air traffic management research).
(Alternative) Position navigation and timing	PNT A-PNT	PNT services are provided by the global navigation satellite system (GNSS) and have three elements: • Positioning, the ability to accurately and precisely determine one's location and orientation two-dimensionally (or three-dimensionally when required) referenced to a standard geodetic system (such as World Geodetic System 1984, or WGS84) • Navigation, the ability to determine the current and desired position (relative or absolute) and apply corrections to course, orientation and speed to attain the desired position anywhere around the world, from sub-surface to surface and from surface to space, and • Timing, the ability to acquire and maintain accurate and precise time from a standard

Term	Abbreviation	Description
		(Coordinated Universal Time, or UTC), anywhere in the world and within user-defined timeliness parameters. Timing also includes time transfer. Alternative PNT is the use of high precision back-ups to GNSS.
Prohibited area		An area of airspace of defined dimensions within which the flight of aircraft is prohibited.
Radio mandatory zone	RMZ	Airspace of defined dimensions wherein the carriage and operation of suitable/appropriate radio equipment is mandatory.
Remotely piloted aircraft system	RPAS	A powered aircraft without a human pilot on board which is piloted remotely, also known as an unmanned aircraft system or unmanned aerial vehicle (UAS or UAV), or drone. This terminology may evolve as aircraft capability evolves through technological development. https://www.caa.co.uk/drones/
Required navigation performance	RNP	PBN is the framework that defines the performance requirements for aircraft navigating on an air traffic service (ATS) route, terminal procedure or in a designated airspace. (Air Navigation Guidance 2017)
Respite		Planned and notified periods where overflight or noise impact are reduced or halted to allow communities undisturbed time.
Restricted area / Restricted area (temporary)	RA RA(T)	An area of airspace of defined dimensions within which the flight of aircraft is restricted in accordance with certain conditions.
Significant meteorological information	SIGMET	Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena which may affect the safety of aircraft operations.
Single European Sky	SES	European legislation that supports a programme of modernisation and harmonisation of airspace structures and air traffic control methods for a more systemised and efficient European air traffic management system.
Single European sky air traffic management research	SESAR	An institutionalised European partnership between private and public sector partners set up to accelerate through research and innovation the delivery of the Digital European Sky. SESAR Joint Undertaking (sesarju.eu)
Special-use airspace	SUA	A defined volume of airspace designated for operations of a nature such that limitations may be imposed on aircraft not participating in those operations and segregation of that activity is required from other users. It is the general term overarching all types of the airspace that could be used for military purposes.

Term	Abbreviation	Description
Sponsor (or change sponsor)		An organisation that proposes, or sponsors, a change to the airspace design in accordance with the CAA's airspace change process.
Standard instrument arrival	STAR	Published flight procedures followed by aircraft on an instrument flight rules (IFR) flight plan just before reaching a destination airport. More specifically, a STAR is a designated IFR arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.
Standard instrument departure	SID	Published flight procedures followed by aircraft on an instrument flight rules (IFR) flight plan immediately after take-off. More specifically, a SID is a designated IFR departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en route phase of a flight commences.
Standards and Recommended Practices	SARPs	Technical specifications set by ICAO, implemented and regulated nationally by states globally to manage safety risks.
State Safety Programme	SSP	The basis for managing aviation safety in the UK. State safety programme (caa.co.uk)
System-wide Information Management	SWIM	A set of internet-based information sharing standards and protocols that support aeronautical data. Supports exchanges between European civil and military air navigation service providers, airspace users, airport operators, meteorological service providers and the European network manager.
Terminal control area	TMA	A control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.
Traffic Information Service–Broadcast	TIS-B	TIS-B is a digital traffic information service aimed to improve pilots' in-flight awareness of the nearby traffic. TIS-B broadcasts are localised and rebroadcast a unified surveillance picture of multiple emission types for the benefit of all airspace users.
Trajectory-based operations	TBO	Defined in four dimensions (4D): latitude, longitude, altitude and time. The trajectory represents a common reference for where an aircraft is expected to be and when, at key points along its route. The trajectory is defined prior to departure, updated in response to emerging conditions and operator inputs, and shared between stakeholders and systems. The aggregate set of aircraft trajectories on the day of operation defines demand and informs traffic management actions.
Transition altitude	TA	The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes.

Term	Abbreviation	Description
Transponder		A receiver/transmitter which will generate a reply signal upon interrogation.
Transponder mandatory zone	TMZ	Defined airspace structure in which the carriage and operation of cooperative surveillance equipment is mandatory unless previously agreed.
Unmanned aircraft systems traffic management	UTM	A specific aspect of air traffic management which manages unmanned aircraft system (UAS) operations safely, economically and efficiently through the provision of facilities and a seamless set of services in collaboration with all parties and involving airborne and ground-based functions.
Upper airspace		Controlled airspace above Flight Level 245 (see also flight level).
Upper Flight information region	UIR	Flight information region in upper airspace.
Urban air mobility	UAM	See Advanced Air Mobility.
Visual flight rules	VFR	The rules under which a pilot can fly and navigate an aircraft, in certain weather conditions, by seeing where the aircraft is going (see also instrument flight rules).
Visual meteorological conditions	VMC	Meteorological conditions expressed in terms of visibility, distance from cloud, and cloud ceiling, equal to or better than specified minima (see also instrument meteorological conditions).
VOLMET	VOLMET	Meteorological information for aircraft in flight.