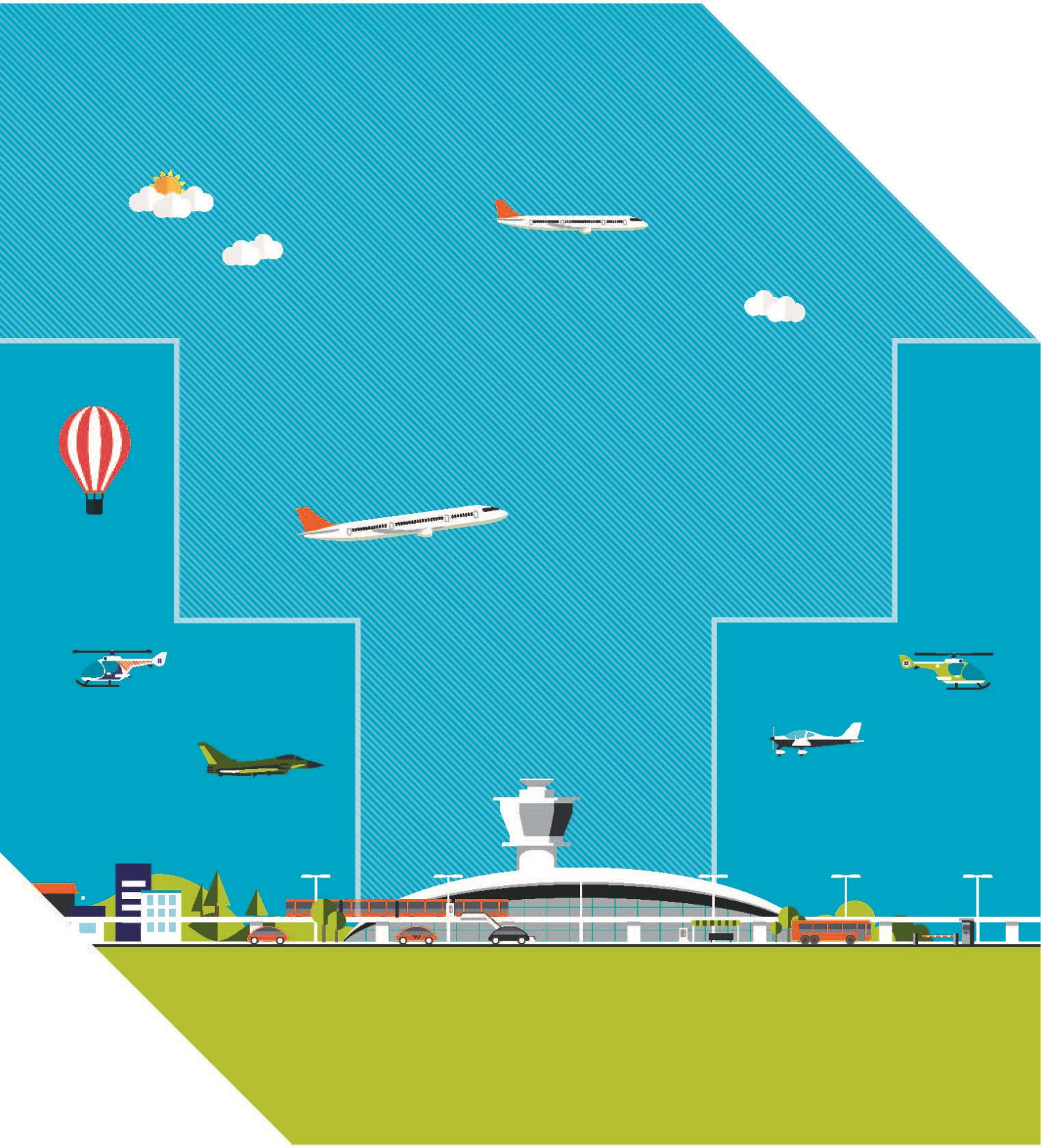
Draft Airspace Modernisation Strategy

CAP 1690



Published by the Civil Aviation Authority, 2018

Civil Aviation Authority

Aviation House

Gatwick Airport South

West Sussex

RH6 0YR

Enquiries regarding the content of this publication should be addressed to airspace.policy@caa.co.uk

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

Contents

Executive summary

1. Airspace is a crucial part of the UK's infrastructure. It must be maintained and enhanced to provide more choice and value for consumers, through the capacity for airlines to add new flights, reduced flight delays and enhanced global connections that can help boost the UK economy, while continuing to improve safety standards.

2. The Government tasks the CAA with **preparing and maintaining a co-ordinated strategy and plan for the use of UK airspace for air navigation up to 2040, including for the modernisation of the use of such airspace.**

3. This Airspace Modernisation Strategy responds to that requirement. It supersedes and replaces the Future Airspace Strategy (FAS), although many key elements of FAS remain relevant and are included in this new strategy. This strategy document has been developed and will be updated by the CAA.

4. Working together, the Government and the CAA have developed **a shared objective for modernising airspace**. This objective states that modernising airspace means changing and developing its structural design, and the operational concepts and technology that are used to fly and manage air traffic. It states that we want to ensure that airspace capacity is not a constraint on the growth of commercial aviation, with the constraint to growth instead becoming the number of runways or restrictions imposed on the use of those runways by government or planning authorities as a condition of that growth.

5. The strategy sets out the **ends**, **ways** and **means** of modernising airspace. The **ends** are derived from UK government and relevant international policy and the **ways** of achieving them include new airspace design, new operational concepts and new technologies. To establish the **means** of delivering modernised airspace, such as the resources needed,

this strategy requires deployment plans be drawn up including, in the future, a macro-level roadmap to be drawn up detailing the interdependent airspace changes that are deemed necessary and when.

6. We have also worked with NATS (in its role as sole provider of UK en-route and London Approach air traffic services) and the Infrastructure and Projects Authority to develop a **new governance structure for airspace modernisation**. The new governance structure includes a 'UK Airspace Strategy Policy Board' chaired by the Aviation Minister. The Government and the CAA will seek to develop a vision for airspace modernisation through this new Board. Further details of the governance structure and groups are set out in Chapter 2.

7. This new governance structure replaces the previous FAS groups, but many of them will remain as industry-coordination groups that provide a useful focus-point and mechanism for including representation of particular stakeholder interests.

8. The CAA must consult the Secretary of State about the preparation and maintenance of its strategy, and must give a delivery report annually. This draft Airspace Modernisation Strategy begins this process.

9. The CAA is publishing this draft for public engagement so that any interested stakeholders can offer feedback on the document by 10th September 2018 – including its approach and the initiatives it sets out as the primary ways to deliver modernisation – before it is finalised and delivered to the Secretary of State in December 2018. In future years the strategy may be revised, but the CAA will not always publish a full draft document for engagement.

10. Chapter 1 of this strategy introduces the need for airspace modernisation and describes its objective, and the approach taken in this strategy.

11. Chapter 2 sets out the roles and responsibilities of the Department for Transport, the CAA, NATS and other relevant stakeholders.

12. Chapter 3 sets out the ends that modernised airspace must deliver, all of which are derived from UK and international policies and laws. All the CAA's responsibilities in the Air Navigation Directions must be carried out having regard to section 70 of the Transport Act 2000. We therefore describe the ends to be achieved under the following headings consistent with our obligations:

- maintaining and enhancing high aviation safety standards
- securing the efficient use of airspace and enabling integration
- avoiding flight delays by better managing the airspace network
- improving environmental performance by reducing emissions and by better managing noise
- facilitating defence and security objectives

13. In Chapter 4, 14 initiatives are identified as the primary ways of modernising airspace. They cover five areas of airspace infrastructure:

- upper airspace (above c. 25,000 ft)
- terminal airspace (complex lower airspace around airports from c. 25,000 ft to c. 7000 ft)
- airspace at lower altitudes (below c. 7000 ft)
- uncontrolled airspace
- the UK's communications, navigation and surveillance infrastructure.

14. The 14 initiatives are summarised in Table 1 below.

15. Chapter 5 identifies that there are a number of current foreseeable 'unknowns' that could change and reshape the context for this strategy. These include areas in which the Government has signalled it may develop new or amended policy positions, or new technologies that we think are becoming ubiquitous and may impact on how airspace is designed or used. There will be a need to consider the economic and financial models that will be used to the deliver the services required by new types of airspace users. We note what these gaps or emerging policies are, and note that they may shape future iterations of this strategy and associated deployment plans.

16. The means of delivering airspace modernisation – such as the resources needed to bring in changes – must rest with the industry organisations that will use airspace. For example, the CAA can set out, within this strategy, why airspace redesign is needed and the policy ends it must achieve, but we cannot do that airspace change ourselves. Timelines and delivery plans must be set out by the organisations that will undertake this design, and integrate the concepts and technologies.

17. The need for these plans is addressed in Chapter 6, in which it is proposed that the CAA will commission further design, operational and technology studies required to support the development and deployment of this strategy.

18. In Chapter 7 we set out our assessment of progress towards completion of each major initiative and the supporting designs, operational procedures and technology enablers. This has been done in the form of a RAG status and a key risks assessment. Six of the initiatives are assessed as on track overall, with eight requiring attention.

19. A number of risks are also presented which should be considered and managed through the new governance structure.

Table 1 – Summary of 14 initiatives

	Initiative	Obligation and timeframe
Upper Airspace	**1) Direct Route Airspace:** deployment of additional waypoints to the existing route network.	European legislation (2018–2022)
	2) Free Route Airspace: removal of all fixed waypoints so aircraft can fly fully optimised routes	European legislation (from 2022)
	3) Advanced Flexible Use Airspace: new airspace, procedures and technology to improve booking and release of segregated areas	European legislation (2018–2022) UK strategic ambition
Terminal Airspace	**4) Terminal Airspace Redesign in Southern England** **5) Terminal Airspace Redesign in Northern England and Scotland** Fundamental redesign of the terminal route network using precise and flexible satellite navigation.	European Legislation (by 2024) UK Government Airports NPS, in the London terminal airspace (by 2024)
	6) Arrival Management: streaming traffic into the terminal and absorbing delays in the upper airspace.	European Legislation (by 2024) EU Master Plan Ambition
Lower Altitude	**7) Satellite navigation route replications:** replication of existing arrival and departure routes to satellite-based navigation standards.	ICAO upgrade programme priority Pending EASA Implementing Rule
	8) Satellite navigation route redesign: redesign of new arrival and departure routes using satellite-based navigation standards.	European Legislation (by 2024)
Uncontrolled Airspace	**9) Review of FIS provision in the UK**	EASA Regulation (from 2022)
	10) Airspace classification review	EASA Regulation (from 2022) A review of ATS provision in uncontrolled airspace to align with international standards.
	11) Electronic surveillance solutions	Fully interoperable electronic conspicuity solution (by 2022/25)
CNS Infrastructure	**12) Cross-industry plan for the efficient use of radio-frequency spectrum**	EASA Implementing Rule (2020)
	13) Cross-industry plan for the full adoption of datalink communications	Indirectly from EASA Regulations (from 2022)
	14) A satellite navigation implementation plan	EASA Implementing Rule (pending – 2022)

Chapter 1

Introduction

Chapter summary

This introductory chapter sets out:

- the need for airspace modernisation
- what has been achieved so far
- how modernisation is supported by changes in government policy
- a shared objective for modernising airspace
- how this draft Airspace Modernisation Strategy document is structured

The context for airspace modernisation

1.1 Demand for air travel has grown strongly in recent decades, and the Government expects that demand will continue to rise significantly between now and 2050.[1] Growth in demand for air travel means increasing pressure on our airspace. The strategic case for airspace modernisation and the resultant benefits were set out by the Government in 2017.[2] Those benefits include more choice and value for consumers, through the capacity for airlines to add new flights, reduced flight delays and enhanced global connections that can help to boost the UK economy, while continuing to improve high safety standards.

1.2 The UK's airspace structure is an essential, but largely invisible, part of our national transport infrastructure. It is divided into controlled and uncontrolled airspace. Aircraft in **controlled** airspace fly under the

[1] *Beyond the horizon, the future of UK aviation, next steps towards an Aviation Strategy*, HMG, April 2018

[2] 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

positive monitoring and direction of air traffic control to maintain safe distances between them. **Uncontrolled** airspace typically incorporates areas where there is no operational safety reason for aircraft to be identified and managed by air traffic control, so aircraft are able to fly freely; they may request information or a more limited service from air traffic controllers.

1.3 The vast majority of commercial flights operate in controlled airspace. General Aviation[3] and aerial sports operate largely in uncontrolled airspace below 6000 feet alongside a few commercial flights. The military is also a significant user of both types of airspace and occasionally also operates within the confines of segregated training or danger areas. The creation of controlled airspace may impinge on the availability of airspace for other users, and an appropriate balance is needed to satisfy both the safety needs and economic requirements of the various types of, often conflicting, operational requirements. At lower altitudes there is more of a challenge in balancing the differing requirements of a wider range of affected parties.

1.4 The main interested parties in the design of airspace are, at higher altitudes, NATS (the air traffic control provider for upper airspace[4]), and the Ministry of Defence, and, at lower levels, airport operators and localised air traffic service providers. UK airspace is also a key gateway between Europe and North America, the world's busiest air corridor, and its efficient operation is crucial for international air traffic management.[5] It is also the case that lack of capacity leads to less ability for NATS to handle additional traffic when there is disruption in European airspace

4 For clarity, we sometimes refer in this document to the parent company NATS in the context of en-route airspace even though the service provider is actually its subsidiary NATS En Route plc (see Chapter 2).

5 Air traffic services in the eastern half of North Atlantic airspace are provided by NATS on behalf of the UK under its obligations to the International Civil Aviation Organisation (ICAO).

1.5 UK airspace is some of the most complex in the world, yet its design dates back to the 1950s and 1960s. Although it has been added to and adapted in response to growing traffic levels, many departure routes at major airports, for example, have been little changed for many years, even several decades. Successfully accommodating the growth in demand for air transport has meant adding significant complexity to the UK's airspace system, particularly where volumes of traffic are highest, principally over South-East England.

1.6 Many air routes and air traffic management practices are not utilising the modern technologies available, and aircraft continue to use flightpaths that are outdated. Those flightpaths are often longer than they need to be, taking more time for the aircraft to reach their optimum cruising altitude. This creates inefficiencies and results in greater fuel burn and more emissions. Flightpaths may not be optimised to reduce noise impacts or designed to offer relief from noise. This inefficient and ineffective use of airspace causes unnecessary delays for passengers, poor resilience to bad weather or other forms of disruption, as well as excessive impacts on the environment and those living near our airports. The outdated design is also, crucially, constraining the number of flights that the airspace can safely accommodate.

1.7 In addition to accommodating increasing commercial flights, military activities and an active General Aviation sector, the UK's skies are hosting different types of airborne vehicles. Unmanned aerial vehicles, which can be remotely piloted or autonomous and are often called drones, are an example of such new technology.[6] UK airspace will also need to accommodate commercial spaceflight (spaceplanes) in the future, and other new technologies are constantly emerging. These technologies affect what flies, and also how vehicles are flown, meaning new concepts for operating aircraft are also emerging. Incorporating this ever more

[6] There are several terms currently in use to describe unmanned or remotely piloted systems. For the final version of the strategy, we will review terminology for both consistency and gender neutrality.

complex and growing mix of traffic requires advanced technological tools and air traffic solutions. Such a high rate of change cannot be accommodated within the current airspace structure. The economic and financial models that will be used to the deliver the services required by new types of airspace users will also need to be developed.

1.8 It is therefore essential that the UK's airspace is modernised. Unlocking the benefits of modernisation, such as reduced stacking and allowing flights to climb and descend continuously, will make each journey faster and more environmentally friendly, benefiting consumers while maintaining the already high safety standards. Implementing new airspace design will also affect overflown communities in different ways, both in terms of the increased number of flights and the flightpaths that are used. Those who are affected by airspace change must therefore be involved in the decision-making process, and fully informed of the pros and cons of such a transformation.

1.9 Modernisation of relevant airspace structures, systems and processes can also further improve the flexible use of airspace, whereby airspace is considered as a shared resource and is allocated for specific periods of time to particular users, such as the military.

1.10 If the structure of UK airspace is not modernised to incorporate new technology, the demand on the system, exacerbated by the current worldwide shortage of air traffic controllers, is expected to lead to a sharp increase in air traffic delays.

1.11 In broad terms, UK airspace will require modernisation if we are to achieve the following objectives:

- enable and facilitate continuous improvements in safety standards within the system through innovation
- accommodate growing demand from airspace users, including commercial airlines providing a key element of the UK's transport infrastructure supporting economic growth

- maximise the utilisation of available runway capacity, including the government's policy for a new runway at Heathrow airport
- enable policies that determine how noise should be distributed to manage the impact of growth on communities
- deal with 'hotspots' of congestion within the current system
- improve resilience of the system to bad weather or other forms of disruption
- develop a genuinely sustainable framework to guide the aviation industry in its investment and technological development
- take advantage of those technological developments to improve efficiency
- safely and efficiently accommodate new technologies that change the types of craft we fly, and how they operate, such as drones and spaceplanes
- implement internationally agreed requirements designed to increase the overall safety, capacity and efficiency of the global air traffic management system, while making commensurate environmental improvements, such as the Single European Sky
- further enable greater access to airspace for non-commercial users
- help the UK to mitigate the impact of disruptions in neighbouring European airspace
- provide flexibility within the system to enable continuing development and improvement.

1.12 Key to delivering airspace modernisation successfully is that each of the entities involved has the right role, powers and/or incentives, underpinned by appropriate governance and enforcement.

What has been achieved so far

The 2011 Future Airspace Strategy

1.13 In June 2011 the CAA published the UK's Future Airspace Strategy (FAS), which addressed the development of the UK's airspace system from 2011 to 2030. FAS was developed by the CAA, with contributions

from the Department for Transport, Ministry of Defence and NATS. FAS had its genesis in the Department for Transport's *The Future of Air Transport* White Paper in 2003 and the subsequent *Future of Air Transport Progress Report* in 2006.

1.14 FAS set out how the planning, management and regulation of UK airspace should be developed to:

- maintain and improve the UK's high levels of safety
- address the many different requirements on the airspace system
- deliver balanced or 'optimal' outcomes, taking into account all those involved in, or affected by, the use of airspace.

1.15 FAS did not provide a detailed roadmap or plan for the implementation of changes to the UK's airspace system. Similarly, it did not provide a blueprint or future design for the UK's airspace structure, but it did set the direction for future detailed pieces of work.

1.16 FAS addressed UK implementation of the EU's air traffic management masterplan and deployment of SESAR (Single European Sky Air Traffic Management Research, the technological pillar of the EU Single European Sky initiative).[7]

Changes in government policy

1.17 In 2015 the Department for Transport and CAA both commenced work on reviewing the policy and regulatory approaches to the design and use of airspace, tackling directly some of the most pertinent challenges to airspace modernisation.

1.18 The Department for Transport subsequently published new policies in October 2017, including new Air Navigation Guidance and new Air

[7] The EU Single European Sky initiative was launched in 2004 with the aim of reforming air traffic management in Europe in order to accommodate sustained air traffic growth. https://ec.europa.eu/transport/modes/air/single_european_sky_en https://ec.europa.eu/transport/modes/air/sesar_en.

Navigation Directions to the CAA.[8] The changes to government policy and guidance on the CAA's decision-making role included:

- clarifying how the noise impacts of airspace change should be distributed and measured
- requiring the sponsor of a given airspace change to carry out and consult on an options analysis that allows the impacts of different airspace designs to be compared
- a new power for the Secretary of State to call-in an airspace change proposal of national strategic importance
- the establishment of the Independent Commission for Civil Aviation Noise, which will provide advice on the noise aspects of airspace changes.

1.19 In December 2017 the CAA published a new process for its airspace change decision-making role and supporting guidance, based on these government policy changes and on the CAA's own review of the process.[9] The new process came into effect in January 2018.

An updated airspace strategy to replace FAS

1.20 Since 2011, much progress has been made in delivering FAS, but the world within which it sits has also shifted. Recent and forthcoming government policy changes, coupled with technological developments, mean that while many sections of FAS remain relevant, they must be rearticulated within this new context, taking into account:

---

8 *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* www.gov.uk/government/publications/uk-air-navigation-guidance-2017. The Civil Aviation Authority (Air Navigation) Directions 2017 form Annex D to the Air Navigation Guidance.

9 Airspace Design: Guidance on the regulatory process for changing airspace design including community engagement requirements, CAP 1616 www.caa.co.uk/cap1616 with supporting documents CAP 1616a, CAP 1617, CAP 1618 and CAP 1619 www.caa.co.uk/cap1616a etc.

- a new runway at Heathrow: outlined in the Airports National Policy Statement designated in June 2018, and any other new runways due to be developed by 2040
- the need to coordinate multiple inter-related airspace changes across different airports
- potential policy changes arising from government reviews, such as more explicit policy on how noise must be considered, and relevant international policy changes
- unmanned aerial vehicles (i.e. drones)
- spaceplanes.

1.21 The CAA has reviewed and rearticulated its strategy in light of these anticipated changes and in response to a government policy change that redefined our role when the Government's Air Navigation Directions were updated and republished in October 2017. The CAA is now directed to prepare and maintain a **co-ordinated strategy and plan for the use of UK airspace for air navigation up to 2040, including for the modernisation of the use of such airspace**.

1.22 This **Airspace Modernisation Strategy** will address upper and lower airspace in the controlled and uncontrolled environments more comprehensively than FAS.

1.23 The CAA must consult the Secretary of State about the preparation and maintenance of this Airspace Modernisation Strategy and the detail to be included in the **delivery plan**, and must give a delivery report to the Secretary of State annually.

1.24 This Airspace Modernisation Strategy forms part of the Government's new arrangements to take forward the delivery of the airspace modernisation programme. Airports will need to develop their own airspace modernisation proposals in conjunction with each other where there are interdependencies between their airspace designs. Changes may also be necessary to comply with UK and international policy and law (such as any further new National Policy Statements, ICAO Standards and

Recommended Practices, or new EU implementing regulations) for which the UK must have a delivery plan.

A shared objective for modernising airspace

1.25 Working together, the Government and the CAA have developed a shared objective for modernising airspace.

Department for Transport and CAA shared objective for modernising airspace

The airspace and associated air traffic management network is recognised as part of the UK critical national infrastructure requiring an immediate and sustained evolution to deliver long term economic benefits for the country in a global marketplace.

If the structure of UK airspace is not upgraded, the lack of capacity is expected to lead to a sharp increase in air traffic delays, which will in turn create costs and disruption for passengers and businesses, and unnecessary noise and emissions around airports.

The Department for Transport and the CAA are working together to act as co-sponsors for a programme to modernise the UK's airspace.

Modernising airspace means changing and developing its structural design, and the operational concepts and technology that are used to fly and manage air traffic.

Our objective is to ensure that airspace capacity is not a constraint on the growth of commercial aviation, with the constraint to growth instead becoming the number of runways or restrictions imposed on the use of those runways by government or planning authorities as a condition of that growth.

This growth has to be managed to ensure that noise and other environmental impacts are managed in alignment with policy and law, and that other airspace users maintain appropriate access to airspace.

Our approach in undertaking this programme is to be transparent, inclusive, and to take into account the needs and views of all airspace users and affected parties, including airports, airlines, communities and General Aviation representatives.

1.26 The Government and the CAA cannot deliver this objective alone. Airspace modernisation will need to be delivered by a range of aviation organisations, and a wide range of stakeholders will need to be engaged throughout this delivery. The Government and 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 described above.

Stakeholders affected

1.27 Airspace modernisation will affect a wide range of stakeholders, including passengers, airspace users, airports, air navigation service providers, companies that rely on air transport to conduct their business and communities that may be affected by aircraft noise.

- **For passengers,** the benefits of airspace modernisation are clear. Fewer flight delays and service disruptions at short notice will save time and improve the passenger experience. A more efficient airspace will increase capacity while continuing to improve current high safety standards, leading to better value, including consistent quality of service, and more choice.
- **For aircraft operators**, the airspace structure is a key determinant of costs, punctuality and environmental performance. More direct and efficient flightpaths will mean lower costs for operators because they will save on fuel and be able to enhance the utilisation of their aircraft. Airspace modernisation is expected to improve access to airspace for General Aviation, by enabling greater integration (rather than segregation) of different airspace user groups. The same is true for new airspace users such as drones and spaceplanes.

- **For airports,** the sharing of accurate flight information about traffic using our airspace is expected to improve runway throughput and the resilience. Additional airspace capacity will provide airports with the scope to develop their operations in line with their business plans. Enhanced technology combined with updated airspace design enables safe, expeditious and efficient management of increased traffic.
- **For the UK economy,** efficiency and enhanced global connections and emerging aviation technologies can help drive growth.
- **For communities** airspace modernisation offers environmental improvements because aircraft can follow more fuel-efficient routes, climb sooner, descend more quietly and navigate more accurately around populated centres. In some areas, the increase in traffic can lead to an increase in noise, or the concentration of traffic can concentrate noise over a smaller area, which can reduce the areas in which noise is heard and offer the opportunity for respite routes. This means that not every community will benefit, so it is important that noise is managed as well as possible, in adherence to government policy.

Structure of this document – ends, ways and means for modernising airspace

1.28 This Airspace Modernisation Strategy sets out the **ends**, **ways** and **means** of modernising airspace. The **ends** are the policy objectives the UK must meet. This strategy notes those ends and describes the **ways** of achieving them, such as new airspace design, new operational concepts and new technologies. To establish the **means** of delivering modernised airspace, such as the resources needed, this strategy requires a macro-level roadmap to be drawn up detailing the interdependent airspace changes that are deemed necessary and when. This itself will require a timeline of airspace change proposals needed as part of a modernisation effort, a critical path outlining the deadlines for individual airspace change

proposals within it, and individual deployment plans, which the CAA could commission from industry.

1.29 It is important to recognise that, for example, a change to the airspace at a particular airport may be completely dependent on linked changes to the lower airspace in the immediate vicinity, and cannot be implemented without it. A roadmap will therefore be a crucial element in airspace modernisation. This is discussed in Chapter 5 in the context of the 'feasibility assessment' that the Government asked NATS to carry out.

1.30 In the following chapters we explain the CAA's airspace responsibilities, the roles played by others; our strategic airspace role; and how and why we are changing our published strategy for airspace, including the case for modernisation.

1.31 The main **ways** in which these ends should be delivered, namely by updating airspace designs, operational procedures and enabling technologies, are described in Chapter 4.

1.32 There are other ends which airspace modernisation may need to deliver that are still being developed in detail – for example, the approach to integrating unmanned aerial vehicles with piloted aircraft. Current gaps such as these are considered in Chapter 5.

Reviewing the strategy

1.33 The CAA will review the Airspace Modernisation Strategy regularly in order to report to the Secretary of State annually on its delivery. The CAA will use those opportunities to continue to update the strategy, and also to measure progress against the delivery plans.

Chapter 2

Roles, responsibilities and definitions

Chapter summary

This chapter explains:

- the accountabilities of the different entities involved in airspace modernisation
- the relevant legal framework, including what powers or levers are available to enable delivery, and where there are gaps
- a new governance structure required for airspace modernisation
- any tensions between roles in airspace modernisation, and how risks will be mitigated

Accountabilities of the entities involved

Government

2.1 The Department for Transport develops national policy and law, and also ensures the UK contributes to and meets its obligations under relevant international policy and law. As part of this policy responsibility the Government will also play a role in making the strategic case for airspace modernisation. The Government is considering whether to develop new policies to support airspace modernisation through the Aviation Strategy. The Government is in the process of setting up an Independent Commission on Civil Aviation Noise (ICCAN) which may also have a role in the future.

2.2 For certain types of airspace change, the Secretary of State may also decide to call-in a particular airspace change proposal in order to make a decision instead of the CAA.

2.3 The Ministry of Defence must have access to airspace in order to train and maintain competency for the UK's defence needs. It acts as an airspace change sponsor where requesting dedicated airspace that is reserved for activities which may be hazardous to other airspace users, such as high-energy manoeuvring and testing munitions.

CAA

2.4 The CAA is the airspace regulator and primary decision-maker. Parliament and the Government are responsible for setting the CAA's objectives, outlining the CAA's functions and responsibilities and providing guidance to the CAA. More specifically, the Air Navigation Directions[10] (given by the Secretary of State under Sections 66(1) and 68 of the Transport Act 2000) set out several airspace responsibilities for the CAA. In all its responsibilities, the CAA is obliged to consider certain factors set out in Section 70 of the Transport Act 2000[11] which include safety, security, operational impacts and environmental guidance from the Government (covering impacts such as aircraft noise and emissions), and the needs of all users of airspace.

2.5 The Air Navigation Directions set a strategic role for the CAA (Direction 3). The CAA is tasked with developing a strategy to modernise UK airspace and a plan setting out the best approach to a new design, operational concepts and technology. The Directions and supporting government policy provide the framework for the strategy and for the roles and accountabilities of the CAA and other bodies in delivering that strategy. While the CAA must own the strategy and plan, delivery (including the design of any airspace changes) is undertaken by other entities, such as airports, air navigation service providers or airspace users.

2.6 The Directions give the CAA responsibility for deciding whether to approve a proposal for a change to the published design of airspace,

---

10 The Civil Aviation Authority (Air Navigation) Directions 2017 form Annex D to Air Navigation Guidance 2017. www.gov.uk/government/publications/uk-air-navigation-guidance-2017

11 These factors are explained in more detail later in this chapter.

administering the airspace change process and providing guidance on the process to stakeholders (Direction 4).[12] Airspace design includes the airspace structure and the instrument flight procedures for the use of that airspace (i.e. procedures which enable aircraft to fly in a more technologically automated manner). The airspace designs approved by the CAA are published in the UK Aeronautical Information Publication (AIP).[13]

2.7 Changes may be proposed, for example, to enable UK airspace to maintain or further improve safety, to accommodate more flights, to incorporate new technology, to mitigate the effects of aircraft noise, to allow aircraft to fly more direct routes, to keep aircraft away from particular areas, or to integrate new technologies such as drones.

2.8 The Directions and legal framework are discussed more fully below. The approach the CAA adopts when undertaking its regulatory assessment of airspace change proposals, and how it takes the factors in Section 70 into account, is set out in CAP 1616 and on our website.[14]

2.9 As noted in Chapter 1, in October 2017 the CAA reformed the airspace change process to ensure that it meets modern standards for regulatory decision-making, and is fair, transparent, consistent and proportionate. The process must be impartial and evidence-based, and must take account of the needs and interests of all affected stakeholders. To ensure that the needs of all stakeholders are met, the process emphasises the importance of engagement, i.e. developing relationships with stakeholders. Whilst some changes to the UK's airspace design can be contentious with aviation stakeholders and local communities, it is a key

12 The CAA's process and guidance is set out in CAP 1616 and associated documents, as referenced in Chapter 1. www.caa.co.uk/cap 1616

13 http://www.nats-uk.ead-it.com/public/index.php.html.

14 www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Legislative-framework-to-airspace-change/

requirement that the methods used to reach those decisions are well understood and respected.

2.10 The CAA runs an online airspace portal where airspace changes are submitted and monitored, stakeholder comments can be made and viewed, and relevant documentation can be viewed.[15]

2.11 The CAA is not responsible for developing airspace designs or instigating airspace changes, other than in exceptional circumstances.

2.12 The CAA also has additional duties in respect of the regulation of the provision of air traffic services under Section 2 of the Transport Act 2000. In carrying out these duties, the CAA is responsible for the economic regulation of NATS' monopoly service provision activities under a licence.

Airspace change sponsor

2.13 The change sponsor owns the airspace change proposal and is responsible for developing it, including taking into account feedback from relevant stakeholders, in accordance with the CAA's airspace change process and the guidance provided by the CAA and by the Government. Anyone can sponsor an airspace change proposal – although it is usually an airport or an air navigation service provider. An airport will typically sponsor a change to the airspace design in its immediate vicinity, while NERL (the air navigation service provider for en-route airspace, as discussed below) will typically sponsor changes to upper airspace.

Airports

2.14 The airport operator is responsible for the arrival and departure routes serving its runways. It will therefore typically sponsor a change to the airspace design and associated routes in its immediate vicinity, and is required to consult and collaborate closely with those affected by the change. The airport will work closely with the air navigation service

15 Full functionality of the portal is still under development. www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Permanent-airspace-change-proposals-under-the-new-process/

provider that manages the approach and en-route airspace to ensure seamless and safe connectivity.

NATS

2.15 NATS Holdings Ltd, the biggest air navigation services provider in the UK, provides air traffic control services through two principal subsidiaries: NATS (En Route) plc (called NERL) and NATS (Services) Ltd (called NSL), which provides air traffic services on a commerical basis. This strategy concerns NERL only, and not the commercial work of NSL.[16] **NERL** is the sole provider of air traffic control services for aircraft flying **'en route'** in UK airspace and 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. It is regulated by the CAA within the framework of:

- the EU Single European Sky, which sets out measures to improve the overall performance of air navigation services, through setting targets to drive performance in four key performance areas (safety, environment, capacity, and cost-efficiency)
- the Transport Act 2000, which sets the need for NERL to operate under a licence from the Secretary of State. NERL has duties under the Transport Act to provide, develop and maintain a safe system for the provision of air traffic services that is efficient and coordinated and meets the demand for air traffic services. NERL is also tasked through its licence and directions from the Government with a role in maintaining the effectiveness of the UK's air traffic management network.
- The CAA sets out a performance plan, including targets and incentives, that covers NERL's monopoly air navigation service activities. NERL is required to report on its performance and delivery against targets and uses its annual service and investment plan to

16 We therefore usually say 'NERL' throughout this document; where we mention 'NATS', we mean NERL, unless otherwise stated.

provide updates and to propose 'in-period' changes with a view to achievement of those targets.[17]

Stakeholders impacted by airspace change

2.16 There are stakeholders who may be impacted by individual airspace changes, and who may also be interested in the national policy and strategy that those changes are nested within. Stakeholders who may be impacted by individual airspace changes will normally have the opportunity to discuss with change sponsors the principles underlying the airspace change and the development of options for the change. These stakeholders may include: airspace users, such as airlines, General Aviation or the military; airports within the area of interest; affected air navigation service providers; local communities; local government and elected representatives; and non-governmental organisations.

Shared role

2.17 Some of the organisations listed above have a strategic role, meaning they have a responsibility for the management, organisation or use of airspace as a piece of national infrastructure. We will return to the strategic modernisation of airspace later in this chapter.

Law and policy governing the CAA's role

2.18 The CAA's statutory duties and functions regarding airspace are contained in The Civil Aviation Authority (Air Navigation) Directions 2017, Section 70 of the Transport Act 2000 and the Air Navigation Guidance 2017.

[17] Commission Implementing Regulation (EU) No 390/2013 of 3 May 2013 laying down a performance scheme for air navigation services and network functions and Commission Implementing Regulation (EU) No 391/2013 of 3 May 2013 laying down a common charging scheme for air navigation services. Both regulations are under review.

The Civil Aviation Authority (Air Navigation) Directions 2017

2.19 All the CAA's responsibilities in the Air Navigation Directions must be carried out having regard to section 70 of the Transport Act 2000. Section 70 (see below) gives the CAA a duty to take a number of factors into account when exercising its air navigation functions. This includes our consideration of an airspace change proposal and the Directions on our strategic role.

Direction 3 on airspace design

2.20 In October 2017 the Direction to "prepare and maintain a co-coordinated strategy and plan for the use of UK airspace for air navigation" was replaced with the following three points (Direction 3, paragraphs e to g):

- (e) prepare and maintain a co-ordinated strategy and plan for the use of 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.

Directions on airspace change process and supporting guidance

2.21 The Secretary of State has given the CAA the function to approve changes to the design of airspace in the Civil Aviation Authority (Air Navigation) Directions 2017. In particular these Directions require the CAA to develop and publish procedures, and guidance on such procedures, for the development, making and consideration of a proposal for a permanent change to airspace design, a temporary change to airspace design, or an airspace trial. As noted earlier, this is published by the CAA as CAP 1616. Any such procedure must be proportionate and reflect published Government policy, taking account of specific guidance

on our environmental objectives contained within the Air Navigation Guidance.

Section 70 of the Transport Act 2000

2.22 Section 70 of the Transport Act 2000[18] 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 calculated so that:

- it secures the most efficient use of airspace[19] consistent with the safe operation of aircraft and the expeditious flow of air traffic[20]
- it satisfies the requirements of operators and owners of all classes of aircraft
- it takes account of the interests of any person[21] (other than an operator or owner) in relation to the use of any particular airspace or airspace generally
- 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

18 https://www.legislation.gov.uk/ukpga/2000/38/section/70

19 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.*

20 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.*

21 The CAA considers the words "'any person (other than an operator or owner of an aircraft)" to include airport operators, air navigation service providers, members of the public on the ground, owners of cargo being transported by air, and anyone else potentially affected by an airspace change proposal.

- it takes account of any international obligations of the UK notified to the CAA by the Secretary of State.

2.23 If in a particular case there is a conflict in the application of these provisions, 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.

2.24 The CAA must have regard to Section 70 when complying with all its airspace Directions. In respect of our strategic role, the list of factors in Section 70 are applied as guiding factors that shape the ends that a modernised airspace must deliver, as discussed in Chapter 3.

Air Navigation Guidance 2017

2.25 Section 70(2) 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 its air navigation functions. These functions are set out in the Secretary of State's Air Navigation Directions 2017, made under sections 66(1) and 68 of the Transport Act 2000. The Air Navigation Guidance was last issued in October 2017.[22]

2.26 The Air Navigation Guidance and Air Navigation Directions issued in October 2017 followed a consultation by the Department for Transport about airspace and noise policy.[23] The Air Navigation Guidance, in addition to being statutory guidance to the CAA on environmental objectives in respect of its air navigation functions, also gives more information on the Secretary of State's role in the airspace change

---

22 *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* https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017

23 https://www.gov.uk/government/publications/uk-airspace-policy-a-framework-for-the-design-and-use-of-airspace

process. In accordance with the 'call-in' provisions of the Air Navigation Directions 2017, in some cases the Secretary of State rather than the CAA may make decisions on a proposal to make permanent changes to airspace design. The Air Navigation Guidance is not just aimed at 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.

ICAO

2.27 As an ICAO contracting state, the UK has obligations concerning airspace modernisation under the ICAO Global Air Navigation Plan. These are currently fulfilled through EU law and initiatives, but the UK will remain committed to its ICAO obligations, which include the widespread adoption of routes based on satellite navigation, irrespective of the outcome of its exit from the EU.[24]

EU law

2.28 The Single European Sky (SES) initiative[25], through the SESAR air traffic management masterplan[26], sets out a range of airspace and air traffic management modernisation requirements in EU law that the UK and other European states must comply with, in the form of implementing regulations. SES aims to increase the efficiency of air navigation services to cope with traffic growth. It sets requirements for EU States and those

---

24 Accepting that it is possible for contracting States to file differences from ICAO standards.

25 https://ec.europa.eu/transport/modes/air/single_european_sky_en

26 *European ATM Master Plan*
https://www.sesarju.eu/sites/default/files/documents/ATM_MasterPlan_web.pdf
Within the framework of the Single European Sky, the masterplan is the main planning tool for defining air traffic management (ATM) modernisation priorities and ensuring that the SESAR (Single European Sky ATM Research) Target Concept becomes a reality. The masterplan is an evolving roadmap and the result of strong collaboration between all ATM stakeholders. As the technological pillar of the Single European Sky initiative, SESAR contributes to achieving the Single European Sky high-level goals and supports its regulatory framework.

that have agreed to follow EU law through basic and implementing legislation.

2.29 EU Regulation 2017/373[27], which applies from 2 January 2020, lays down common requirements for air traffic management service providers and for the oversight by the competent authorities of air traffic management, air navigation services and other air traffic management network functions. The regulation is based on various ICAO Standards and Recommended Practices and includes 13 supporting annexes, known as 'Parts' (for example, Annex IV is Part-ATS).

2.30 EU Regulation 923/2012[28] Standardised European Rules of the Air (as amended) lays down the common rules of the air and operational provisions regarding services and procedures in air navigation, and is also derived from ICAO Standards and Recommended Practices.

2.31 A significant proportion of traffic to/from Europe passes through UK airspace, and there is a continuing need for greater interoperability in airspace management arrangements between the UK and mainland Europe. Irrespective of the outcome of the UK's exit from the EU, the UK will remain part of the European air traffic management system and have cooperative arrangements with other European States. We are also likely to remain aligned with European air traffic modernisation.

---

27 Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management or air navigation services and other air traffic management functions and their oversight. The regulation repeals previous Commission implementing regulations. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0373&from=EN

28 Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending [various implementing rules]. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0923&from=EN

New governance structure for airspace modernisation

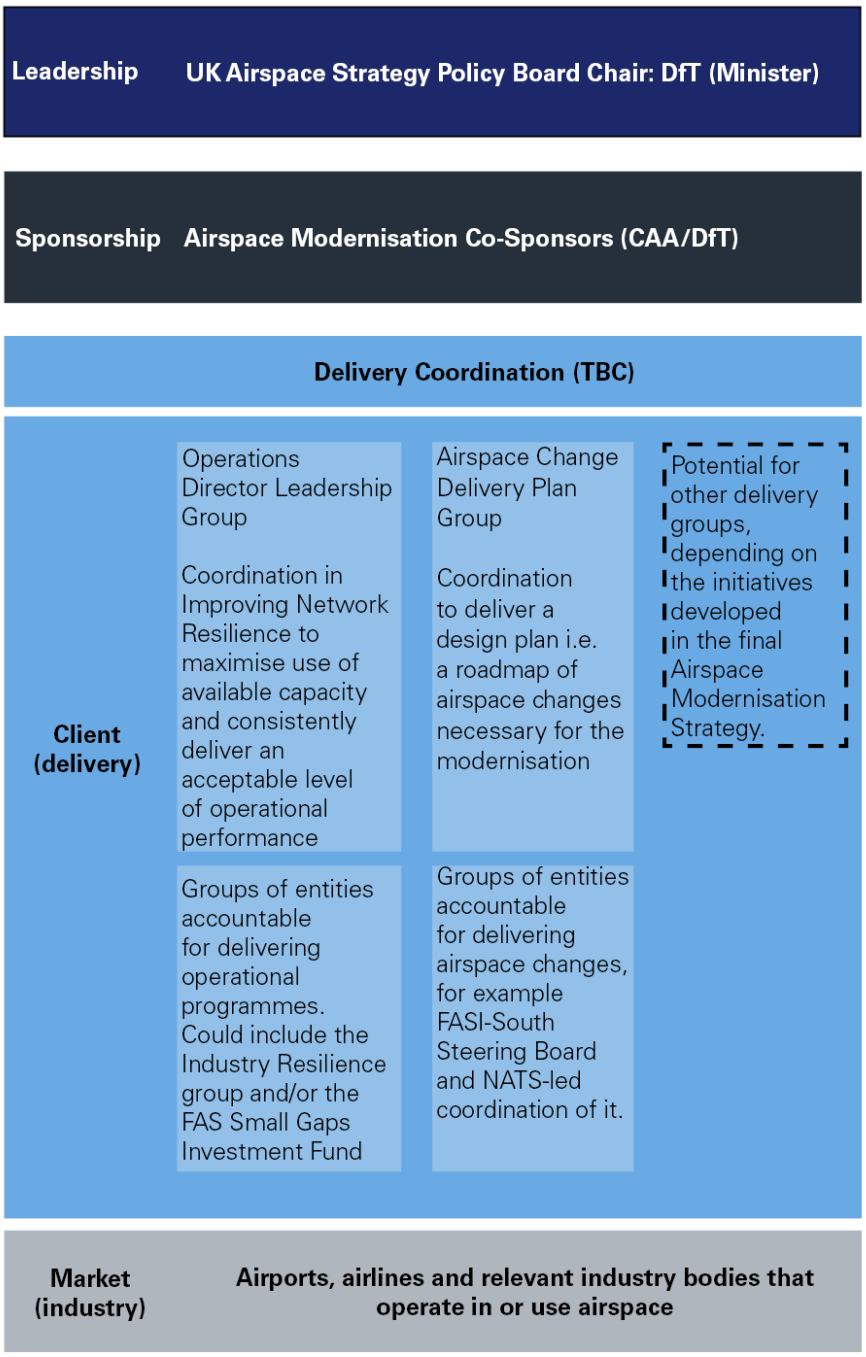
2.32 The Department for Transport and the CAA worked with NERL and the Infrastructure and Projects Authority to develop a new governance structure for airspace modernisation.

2.33 The governance structure for airspace modernisation is illustrated by Figure 2.1. It reflects the existing legal framework and Air Navigation Directions, and sets out which organisations make decisions and have accountabilities in the strategic direction of airspace, and the stakeholders they will engage and consult with as they carry out their strategic roles.

2.34 At the delivery level there will be a series of industry organisations brought together into coordinated groups that are chaired by an appropriate member of the group. These groups will be comprised of organisations involved in the delivery of the initiatives set out in the Airspace Modernisation Strategy (see Chapter 4) to deliver modernised design, operations and technology. As the strategy and the initiatives in it are not yet finalised, there is currently flexibility as to the nature of these groups. However, some of the work they will carry out is already clear.

2.35 The programme of airspace changes needed in the South East of England is already being developed, under the coordination of NERL. For this particular work programme, NERL is considering establishing a programme management function to run the south east airspace improvement programme to deliver effective programme management, delivery assurance and performance management. This function will also establish a consultation and communication framework to ensure transparency and engagement with industry partners and wider stakeholders.

Figure 2.1 Governance structure for the Airspace Modernisation Strategy



Airspace Modernisation Engagement

All groups listed below will be able to feed thoughts, papers, suggestions into the appropriate bodies. The CAA, Department for Transport and NATS commit to working with them to define what their engagement opportunity looks like.

- **ANEG**: Airspace and Noise Engagement Group run and chaired by the DfT
- **AEF**: Aviation community membership body
- **Airlines UK**: airline trade association
- **AOA**: Airports trade association
- **CDF**: Community Discussion Forum run by the CAA
- A **potential communications planning group** to include the sponsors and delivery groups
- **FASIIG**: Future Airspace Strategy Industry Information Group chaired by NATS and BAW.
- **FASVIG**: Future Airspace Strategy VFR Implementation Group Ltd, a group coordinating General Aviation roles and information
- **NATMAC**: National Air Traffic Management Advisory Committee, run by the CAA
- **Sustainable Aviation**: industry coalition

2.36 Between the sponsors and the delivery groups, it is proposed that there should be a coordination function. This function will be responsible for ensuring the initiatives in the delivery groups below are brought together into one coordinated whole. This function could be performed by an existing organisation, a group of organisations, or a bespoke independent organisation.

2.37 The Department for Transport and CAA act as co-sponsors. This shared role means that between them, the two organisations will make the strategic case for change, develop and publish a holistic strategy, and support the industry in securing benefits and mitigating adverse impacts and considering potential routes and merits of interventions. This governance activity does not necessarily take the form of a group, but the co-sponsors will ensure regular updates are published and engagement opportunities offered (including the publication of the CAA's draft Airspace Modernisation Strategy for stakeholder feedback).

2.38 The Aviation Minister-chaired UK Airspace Strategy Policy Board will engage stakeholders on the policies that will govern the strategy. Representatives from all interested major stakeholders will attend, including relevant public bodies such as the CAA and Ministry of Defence; NATS; commerical aviation; General Aviation; and community and environmental groups. This group sits at the top of the governance structure.

2.39 Alongside the groups that have strategy and delivery roles is an engagement plan, with a stated commitment to consider the views of several industry and community groups.

2.40 This governance structure replaces the previous FAS groups, but many of them will remain as industry-coordination groups that provide a useful focus-point and mechanism for including representation of particular stakeholder interests. For example, organisations such as the Future Airspace Strategy VFR Implementation Group Ltd (FASVIG) exist as a way of ensuring General Aviation organisations are involved in airspace

modernisation and have representation and a focused point of engagement.

2.41 The CAA hopes that the structure proposed will support our airspace modernisation objective, however we may recommend different or more radical options later on if progress is not sufficient and governance is a cause.

Potential tensions between roles in airspace modernisation

2.42 Some entities involved in airspace modernisation may find that their multiple roles may in some circumstances give rise to potential or perceived conflicts. The governance described here has been developed to make such conflicts transparent and, where possible, better manage them.

Decision-making

2.43 Later in this document we describe Government-led work to consider, through the Aviation Strategy, new policies to compel the initiation of an airspace change proposal that is necessary, but for which no sponsor is forthcoming. If these policies are taken forward Government could in future play a role in requesting that an airspace change is taken forward, and that decision would be taken in light of a plan or roadmap that the CAA had commissioned and/or assured.

2.44 This will have implications for maintaining the independence of the decision-maker of that proposal, whether that be the CAA or (where the proposal has been called-in) the Secretary of State. The governance structure for the strategy has therefore being designed to derisk the accountability for

a) identifying that an airspace change is necessary, and

b) deciding whether the final proposal produced for that change should be approved.

2.45 Roles a) and b) are separate within the CAA, carried out by different teams, and they have different outcomes: the CAA will oversee a plan that will set out where airspace changes are needed, but will not participate in the design of those changes. Instead the CAA would regulate them as they are developed. Similarly, if new powers were taken forward the Department for Transport would ensure that the team responsible for advising the Secretary of State on directing an airport to initiate an airspace change is appropriately separate from that deciding on a proposal that has been called-in.

NATS

2.46 As noted above, NATS has two separate businesses. As the sole provider of UK en-route and London Approach air traffic control services, and the designer of upper airspace, NERL has a strategic role in airspace modernisation.

2.47 NERL could potentially be asked to propose airspace changes in lower airspace where an airport or other air navigation service provider was not forthcoming and the strategy roadmap required the change. Tensions could arise where there is an actual or perceived conflict from NATS taking on or initiating an airspace change proposal in such circumstances, for example concerning any commercial relationships the commerical branch of NATS may have.

Challenges with delivery

2.48 The CAA will flag risks to the modernisation programme as appropriate, and before the event becomes critical, where a proposal is not fully aligned with the plan and anticipated timelines.

2.49 Chapter 5 explores how to address the issue of an airport deciding not to progress with an airspace change that has such interdependencies with other airspace changes, to prevent this holding up the modernisation programme. This includes:

- using the macro-level roadmap and timeline to identify which airspace changes not already in progress are critical and should be compelled, even when a sponsor is not forthcoming
- using the gateway approach in the CAA's airspace change process to monitor whether an airspace change proposal that is in progress is keeping to the required timescales and is of the required quality, for example whether the sponsor has engaged or consulted appropriately with sponsors of interdependent airspace change proposals.

Chapter 3

Ends: known outcomes a modernised airspace must deliver

Chapter summary

This chapter sets out the context in which the known outcomes, or **ends**, that are expected from airspace modernisation must comply

The know ends that airspace modernisation is expected to deliver are described under the following headings:

- maintaining and enhancing high aviation safety standards
- securing the efficient use of airspace and enabling integration
- avoiding flight delays by better managing the airspace network
- improving environmental performance by reducing emissions and by better managing noise
- facilitating defence and security objectives

Legal, policy and other obligations with which the ends expected from airspace modernisation must comply

3.1 The ends to be achieved from airspace modernisation are driven by UK and international policies and laws. Section 70 of the Transport Act 2000 sets out how the CAA should fulfil its statutory obligations regarding use of the airspace, as described in the previous chapter. Other policies or pieces of legislation may also be relevant; for example, the requirement for airspace changes to accommodate additional runway capacity in the

South East is driven by the Government's Airports National Policy Statement.[29]

3.2 Policies and laws also guide the ways in which the ends should be delivered, by setting principles and methods to achieve those ends. The Single European Sky initiative (see Chapter 2) sets out a range of airspace modernisation requirements for the UK and other European states to comply with in the form of implementing regulations that are defined in European law. The Single European Sky Implementing Regulations mainly focus on commercial air transport operations and larger airports with a significant impact on the core European airspace network. The Single European Sky 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. Other implementing regulations developed by EASA that cover navigation, surveillance and air traffic management are much broader in scope and include implications for the way a broad range of aerodromes and aircraft operations, inside and outside controlled airspace should be modernised.[30]

3.3 Some major ends are not linked directly to policies or laws but are nevertheless important aspects of airspace modernisation. For example, at most airports in the UK the redesign of arrival and departure routes using satellite navigation is not driven by any specific piece of legislation but by improved technology, and recent developments in EU law have introduced basic standards for the use of such equipment.[31] The UK's transition to a route structure designed using satellite-based navigation is

---

29 *Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England*. https://www.gov.uk/government/speeches/airports-national-policy-statement

30 The EASA PBN Implementing Rule has been adopted by the EC and is expected to be published in the OJEU in Autumn 2018, at which point it will become law. EU Regulation 2017/373 sets out the requirements for providers of Air Traffic Management and Air Navigation Services and their oversight. Regulation 2017/386 sets out the requirements for the performance and the interoperability of surveillance for the Single European Sky.

31 Some larger airports are required by Single European Sky legislation to implement satellite-based arrival and departure routes.

recognised by the Government in recent guidance.[32] The widespread adoption of routes based on satellite navigation is an international obligation for the UK set out in the ICAO Global Air Navigation Plan – a major international programme that seeks to harmonise airspace modernisation initiatives globally.[33]

The ends that modernised airspace must deliver

3.4 The known ends expected from airspace modernisation can be grouped into six broad areas that link directly to the CAA's obligations under Section 70 of the Transport Act 2000. These areas are:

- **safety:** maintaining a high standard of safety has priority over all other ends to be achieved by airspace modernisation
- **efficiency:** consistent with the safe operation of aircraft, airspace modernisation should secure the most efficient use of airspace and the expeditious flow of traffic
- **integration:** airspace modernisation should satisfy the requirements of operators and owners of all classes of aircraft across the commercial, General Aviation and military sectors
- **environmental performance:** the interests of all stakeholders affected by the use of airspace should be taken into account when it is modernised, in line with guidance provided by the Government on environmental objectives
- **defence and security:** airspace modernisation should facilitate the integrated operation of air traffic services provided by or on behalf of the armed forces and take account of the interests of national security

32 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 www.gov.uk/government/publications/uk-air-navigation-guidance-2017

33 ICAO The Aviation System Block Upgrades: The Framework for Global Harmonization: July 2016. https://www.icao.int/airnavigation/Documents/ASBU_2016-FINAL.pdf

- **international alignment:** airspace modernisation should take account of any international recommended practices or obligations related to the UK's air navigation functions, such as those from ICAO and the EU.

3.5 The sections below explain some of the key issues with today's airspace linked to the ends described above that modernisation is expected to address.

3.6 Across all of these – and related to efficiency in particular – is the need to enable growth. In its 'Beyond the Horizon' document (a response to the Aviation Strategy call for evidence) published in April 2018, the Government said that there is a need to increase aviation capacity in the South-East and they want to ensure this growth is sustainable (paragraphs 6.2 and 6.4).[34] The sustainable growth of aviation is therefore also a clear end that airspace modernisation must deliver.

3.7 This section considers each of the ends that modernised airspace must deliver. The following section goes on to describe the ways of achieving them.

Maintaining and enhancing high aviation safety standards

3.8 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, its potential to deliver further safety improvements (for example by adding more rules) has become limited.

3.9 With the traffic levels across the commercial, General Aviation and military sectors forecast to rise, new innovations such as drones already proliferating, and the pace of change across the aviation industry set to increase, there is a general consensus that airspace modernisation is required to maintain high standards of safety – especially by reducing the

[34] *Beyond the horizon, the future of UK aviation, next steps towards an Aviation Strategy*, HMG, April 2018.

complexity of the airspace structure and introducing new technologies that help to manage the residual risks. The goal of the Government's State Safety Programme is that the UK's aviation safety performance remains among the best in the world[35]

3.10 In controlled airspace, air traffic controllers manage the interactions between traffic, providing voice or digital instructions to make sure that aircraft stay safely separated. The high workload placed on controllers to manage conflicting traffic itself introduces safety risks that are managed by limiting the flow of traffic. As traffic grows, new routes that are separated by design (i.e. routes that don't cross) and new technologies that automate controller tasks are needed to maintain high safety standards.

3.11 One of the areas of greatest concern in uncontrolled airspace is the risk of mid-air collision where military, General Aviation and a small volume of commercial traffic are operating in a 'see and avoid' environment with limited air traffic services and surveillance coverage. Each has responsibility for maintaining its own visibility and keeping a lookout for aircraft in order to avoid them. The widespread adoption of electronic surveillance solutions that make all aircraft more visible is needed to maintain high safety standards in uncontrolled airspace, especially around smaller aerodromes that have no 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 drones. An additional mid-air collision risk arises from airspace infringements – where an aircraft flying in uncontrolled airspace inadvertently enters controlled airspace and comes into conflict with, say, a commercial flight. Such infringements highlight the limitations and potential safety implications of the current airspace design. Although areas are prescribed for different users, a simple navigational error or loss

[35] CAP1180: State Safety Programme for the United Kingdom, July 2014

of situational awareness in a complex system, combined with a lack of uniform electronic visibility, creates a safety concern

Securing the efficient use of airspace and enabling integration

3.12 As described in Chapter 1, a piecemeal approach to development of the airspace structure has created several issues that limit the sector's ability to continue to add airspace capacity without making some more fundamental changes. For example, much of the controlled airspace that serves multiple airports in the busy lower airspace areas has become a complex web of intersecting flightpaths and requires a wholesale redesign to secure the most efficient use. The fixed number of established routes in the upper airspace limits capacity in the cruise phase of flight, constraining the flow of traffic. At lower altitudes, outdated arrival and departure routes are linked to the location of ground navigation beacons. Not only does this restrict the potential improvements in environmental performance, but those routes will become obsolete as the beacons reach the end of their service life.

3.13 Most flights using the UK's controlled airspace and route network are commercial air transport aircraft carrying passengers and freight. Traffic forecasts from NATS suggest that commercial air transport will grow by around 2% a year in the UK, from 2.25m flights in 2015 to 3.25m flights in 2030.[36] Modernisation must accommodate growing traffic levels to secure the most efficient use of airspace and the expeditious flow of traffic.

3.14 In today's airspace, General Aviation is constrained to an extent by the segregation between controlled and uncontrolled airspace. Greater integration of airspace structures is needed to satisfy the requirements of all classes of General Aviation aircraft. Airspace modernisation can include new designs, operating procedures, technologies and equipment

[36] These forecasts do not include the additional flights that might be generated by a third runway at Heathrow.

that enable greater integration of General Aviation and commercial aircraft in both controlled and uncontrolled airspace.

Avoiding flight delays by better managing the airspace network

3.15 The performance of our airspace as a transport network depends on the ability of air traffic controllers to secure the expeditious flow of traffic through designated sectors. Traffic flow restrictions are applied to individual sectors when the volume of traffic is predicted to exceed a level that controllers can manage safely, or when unforeseen 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. Flight delays are forecast to increase sharply if the airspace is not modernised. In 2015, a lack of airspace capacity resulted in 78,000 minutes of flight delays. These delays, whilst not substantial, are forecast to grow to 5.6 million minutes by 2030 if airspace modernisation is not delivered successfully.[37]

3.16 Airspace modernisation can improve the management of airspace as a network by gathering and sharing more accurate flight information. In today's operation, the decisions made by controllers to manage the flow of traffic through 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, reduces the effective capacity of the airspace network and creates delays.

3.17 Airspace modernisation can also strengthen the resilience, both of the network and locally at specific airports. The gaps in flight information and lack of the spare capacity has weakened the resilience of the airspace network to bad weather and disruption (e.g. technical problems or strike

[37] www.gov.uk/government/publications/upgrading-uk-airspace-strategic-rationale

action). Unplanned events often lead to significant delays. Normal service is typically only resumed on the next day of operation

Improving environmental performance by reducing emissions per flight

3.18 Airspace modernisation can enable aircraft to follow more efficient flightpaths. Aircraft often fly further than necessary in the upper airspace 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 are often instructed to fly even longer routes at less efficient altitudes and speeds to avoid bottlenecks in the airspace network.

3.19 Flights in lower airspace that are transitioning between the take-off or landing phase and the cruise in upper airspacewould ideally climb and descend quickly and continuously. In today's operation controllers tactically manage the complex interactions between climbing and descending traffic. Continuous climbs and descents are interrupted by the need for aircraft to return to level flight to remain within the current outdated airspace structure, or to avoid conflicting traffic. The introduction of these 'steps' of level flight increases emissions and fuel burn per flight.

3.20 Flights inbound to airports that operate at close to maximum capacity often suffer congestion that results in queuing and delays. In today's operation arrival queues are managed using holding patterns such as 'stacks' or 'arcs' that cause traffic to circle in lower airspace burning extra fuel and creating visual blight owing traffic levels are putting greater pressure on runways which, if the airspace is not modernised, will lead to greater use of 'stacks' in the future.

Improving environmental performance by better managing noise

3.21 One of the most significant environmental impacts associated with the airspace at lower altitudes is aircraft noise. Overall, airspace modernisation is expected to result in a reduction in the average noise levels per flight, for example by enabling aircraft to climb and descend

continuously. However, the redistribution of noise impacts between different areas, as changes are made, will often impact communities living under flightpaths. The effects of new, more frequent or concentrated noise may increase the risks of causing general annoyance, sleep disturbance, lower levels of productivity and health impacts.

3.22 In 2017 the Government issued new 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 changes so that, for example, the creation of a respite route could reduce the number of people *significantly* affected whilst increasing the absolute number of people affected.[38] 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.

Facilitating defence and security objectives

3.23 The military relies on access to the airspace to enable appropriate defence of the UK, and requires dedicated areas to be reserved for activities which may be hazardous to other airspace users such as high-energy manoeuvring and testing munitions. The military's specific requirements for airspace are also changing over time with the introduction of new platforms, weapons technology and operational approaches.

3.24 Some areas of the UK's airspace are segregated for military use, thus excluding other airspace users. The military reserves the airspace temporarily and releases it for civil use when it is not required. The processes of sharing airspace and temporarily reserving and releasing segregated areas that are shared between civil and military users is known as Flexible Use of Airspace. Modernisation of such structures,

[38] Sections 70(2) and 70(3) of the Transport Act 2000 and in other directions and guidance which it has issued to the CAA.

systems and processes can help to secure the most efficient use of airspace consistent with safety, defence and security objectives by allowing traffic to use segregated areas more effectively when they are not booked.

Chapter 4

Ways: the design, operations and technology needed to deliver airspace modernisation

Chapter summary

This chapter explains the ways of delivering modernising airspace in order to achieve the ends described in Chapter 3. Fourteen initiatives are identified and grouped under five headings:

- upper airspace
- terminal airspace (complex lower airspace around airports)
- airspace at lower altitudes
- outside controlled airspace
- the UK's communications, navigation and surveillance infrastructure

Further detail for each initiative in terms of the the main airspace design, operational concepts and technologies have been described. Key dependencies are also highlighted.

Introduction

4.1 A comprehensive modernisation programme across UK airspace is needed to achieve the ends described above. These ways of modernising airspace have been grouped into five broad areas:

- **changes to the upper airspace** (c.25,000 feet and above) that feature the removal of the fixed route network, the introduction of Free Route Airspace and enhancements to the management of the segregated areas reserved for military activity.
- **changes to terminal airspace (complex lower airspace around airports** from c.25,000 feet to c.7000 feet) that focus on a fundamental redesign of the route network to satellite navigation

standards and the introduction of new solutions to better manage the flow of traffic.

- **changes to airspace around airports at lower altitudes** (from c.7000 feet to the ground) that feature the modernisation of airport arrival and departure routes to increase the throughput of traffic and better manage aircraft noise impacts; and the reconfiguring controlled airspace structures to provide greater integration of different airspace user groups.
- **changes to uncontrolled airspace** that focus on the airspace structures, procedures, equipment and technologies needed to improve the integration of all users requiring access to that area. This includes commercial aircraft transiting uncontrolled airspace under a limited air traffic service, General Aviation and other recreational users flying freely without radio equipage or air traffic contact, or unmanned aerial vehicles. The outcome for all users is to operate within an overall management system that is proportionate and resilient for the future.
- **the UK's communications, navigation and surveillance (CNS) infrastructure** that focuses on the transition from primary radars, radios and ground beacons to satellite-based and datalink technologies.

4.2 The sections below explain the initiatives in each area in more detail.

Upper airspace

4.3 The upper airspace is considered to be the airspace above around 25,000 feet where flights have joined the airways network and entered the cruise phase. Aircraft often fly further than necessary in the upper airspace on flightpaths that are determined by a limited number of established waypoints, rather than the shortest route to their destination. A range of factors determine the sequence of waypoints that aircraft plan to follow, including weather conditions, entry into the airspace across the Atlantic which is managed in a different manner, the most efficient deconfliction

points, and the locations of segregated airspace that has been reserved for military or other activity.

4.4 There are three major initiatives that will modernise upper airspace:

1. the introduction of Direct Route Airspace
2. the introduction of Free Route Airspace
3. advanced flexible use of airspace reserved for military activity.

4.5 Direct Route Airspace refers to the introduction of a large number of additional waypoints in the upper airspace that supplement the established ones. Aircraft are offered a far greater number of options to fly directly between the quickest and most fuel-efficient combination of waypoints. Air traffic controllers can manage larger volumes of traffic by using the many additional waypoints to route aircraft away from common bottlenecks, adding capacity to the upper airspace. Introducing a large number of additional waypoint combinations also increases the options available to traffic that must route around areas of poor weather or segregated areas, improving flight efficiency and the resilience of the airspace network.

4.6 Free Route Airspace is a further improvement of the Direct Route Airspace concept that sees the removal of all waypoints from the upper airspace, allowing aircraft to follow the most efficient flight path to their destination without routeing via any intermediate points. This means traffic can plan and re-plan their flightpaths through large volumes of the upper airspace without the limitations of a rigid route structure. Aircraft can fully optimise their flight paths taking into account flight time, fuel burn, network delays and the weather.

4.7 As stated previously, some areas of the upper airspace are segregated for hazardous activities like military operations and in the future, also for spaceflight launches. Flexible Use of Airspace (FUA) refers to the arrangements for booking and releasing volumes of segregated airspace to ensure the limited resource is used as equitably as possible. Advanced Flexible Use of Airspace (AFUA) concepts will upgrade the airspace

structures, procedures and technologies used to manage segregated areas which will enable increases in capacity and flight efficiency by allowing civil traffic to route directly more frequently when hazardous activities are not taking place.

4.8 The implementation of Direct and Free Route Airspace and the upgrades to implement AFUA are all required by European legislation. The changes form a core part of a Commission Implementing Regulation known as the SESAR Deployment Pilot Common Project (PCP) that requires all European states to remove the established waypoints in the upper airspace before 1 January 2022. Improving the management of Flexible Use Airspace is also a UK State strategic ambition to accommodate the next generation of military aircraft that require greater volumes of airspace for testing and training.

4.9 Table 4.1 summarises the main upper airspace initiatives and how they relate to the strategic framework.

Table 4.1 Upper airspace initiatives

Initiative	Policy obligation and timeframe	Ends
1) Direct Route Airspace Deployment of additional waypoints to the existing route network.	European legislation SESAR PCP AF3 (2018–2022)	**Safety:** Additional airspace capacity reduces the risk factors associated with traffic congestion and peaks in controller workload. **Efficiency:** Removing dependency on a limited number of fixed waypoints, allows air traffic controllers to manage more flights through the same sectors. **Efficiency**: Aircraft have the flexibility to plan and re-plan flightpaths in response to poor weather, segregated areas and airspace restrictions. **Environment:** Aircraft have the flexibility to flight plan and fly more direct routes at more efficient altitudes and speeds than with limited fixed waypoints reducing emissions per flight and saving fuel. **Security:** Information on actual planned utilisation of reserved airspace is shared in real time, enabling airspace to be handed between users with minimal unutilised time.
2) Free Route Airspace Removal of all fixed waypoints so aircraft can fly fully optimised routes	European legislation SESAR PCP AF3 (from 1 Jan 2022)	
3) Advanced Flexible Use Airspace New airspace, procedures and technology to improve booking and release of segregated areas	European legislation SESAR PCP AF3 (2018–2022) UK strategic ambition	

Terminal airspace

4.10 The terminal airspace from c.25,000 feet to c.7,000 feet is designed to manage high volumes of traffic climbing and descending between individual airports and the upper airspace. The result is a complex web of intersecting flightpaths to and from airports that are operating in close proximity. The complexity of the interactions between traffic flows in the terminal airspace can lead to some aircraft flying longer routes and more inefficient profiles. The workload placed on controllers to manage high numbers of traffic interactions also limits capacity and efficiency, in order to protect safety. Terminal airspace contains airborne holding structures for aircraft queuing to land at the busiest airports.

4.11 There are three major initiatives to modernise terminal airspace;

4. The fundamental redesign of the terminal airspace in southern England
5. The fundamental redesign of the terminal airspace in northern England and Scotland; and
6. The introduction of better arrival management capabilities into terminal airspace.

4.12 The fundamental redesign of the terminal airspace is based on the widespread adoption of satellite navigation that removes the reliance on ground-based navigation aids and allows the route network to be overhauled, introducing routes with greater precision and flexibility. Significant airspace capacity gains can be achieved through terminal airspace redesign by implementing closely spaced arrival and departure routes that are dedicated to individual airports. Closely spaced routes are separated by design and do not require controllers to manage the traffic interactions tactically.

4.13 Designing routes with greater precision and flexibility reduces track miles and increases the potential for continuous climbs and descents, increasing flight efficiency and environmental performance. The redesign also offers opportunities to further enhance safety by reducing and/or removing risk factors from the operation, for example by removing pinch-points and unnecessary interactions. Additional capacity and the introduction of dedicated routes to and from each airport in the terminal area can strengthen the airspace's resilience to delays from poor weather or disruption.

4.14 Queue Management refers to the use of new sequencing tools by air traffic controllers to stream arrival traffic into the terminal airspace (Arrival Management) and coordinate departures from multiple airports (Departure Management). The use of holding stacks to manage arrival queues limits the capacity of terminal airspace and burns extra fuel. One of the main objectives of Arrival Management is to absorb arrival delays in the upper airspace, removing the need for as much stack holding in the terminal.

Holding in some form may always be necessary to maintain high runway utilisation rates but this should average at around 1 to 2 minutes rather than the 8 to 10 minutes that is typical today. Larger airports are expected to invest in Departure Management tools and procedures that improve the flow of outbound traffic and help to de-conflict flights from multiple airports that rely on the same volumes of airspace.

4.15 The introduction of satellite-based navigation and Queue Management solutions in the terminal airspace are core parts of the SESAR Deployment Pilot Common Project Implementing Rule required by 1st January 2024. The performance of Queue Management solutions is enhanced if they are integrated across neighbouring States. The SESAR European air traffic management masterplan sets out the ambition for cross-border Queue Management that allows air traffic controllers from multiple states to work together to useng the solutions to optimise the flow of traffic and avoid delays.

4.16 A major upgrade to the terminal airspace that serves the airports in London and the south east is required to support the development of an additional runway at Heathrow as laid out in the Governments Airports National Policy Statement.

4.17 Table 4.2 summarises the main terminal airspace initiatives and how they relate to the strategic framework.

Table 4.2 Terminal airspace initiatives

Initiative	Policy obligation and timeframe	Ends
4) Terminal Airspace Redesign in Southern England **5) Terminal Airspace Redesign in Northern England and Scotland** Fundamental redesign of the terminal route network using precise and flexible satellite navigation.	European Legislation SESAR PCP AF1 (by 2024) UK Government Airports NPS, in the London terminal airspace (by 2024).	**Safety:** Significant capacity gains achieved by more closely spaced arrival and departure routes to individual airports, reducing reliance on stack holding and controllers tactically managing interactions. **Safety:** Risk factors, pinch-points and unnecessary interactions are designed out of the route network. **Efficiency**: Additional airspace capacity helps to avoid airborne delays and dedicated routes to and from each airport strengthen the resilience of the network. **Environment:** Designing routes with greater precision and flexibility reduces track miles and improves climb/descent performance. **Environment:** Greater precision and flexibility offers opportunities to better manage noise impacts by avoiding population centres and deploying multiple routes for noise relief.
6) Arrival Management Streaming traffic into the terminal and absorbing delays in the upper airspace.	European Legislation SESAR PCP AF1 (by 2024) SES ATM Master Plan Ambition (regarding Departure Management and cross-border Queue Management).	

Lower altitudes around airports

4.18 Airspace modernisation at lower altitudes (below c.7000 feet) will provide sufficient capacity between the terminal airspace and runways, by implementing more precise and flexible satellite-based arrival and departure routes – while managing the impact of aircraft noise on local communities. Airspace developments at lower altitudes must also consider the need to safely integrate other airspace users within the airport vicinity, including General Aviation and unmanned operations.

4.19 Many of the UK's commercial airports are expected to upgrade their arrival and departure routes between 2018 and 2024 – introducing more

precise and flexible flightpaths based on satellite navigation and removing the reliance on ground navigation beacons.

4.20 There are two main initiatives at lower altitudes to modernise airspace:

7. the replication of existing arrival and departure routes with satellite navigation upgrades, and
8. the deployment of new arrival and departure routes designed to satellite navigation standards.

4.21 At lower altitudes, the impact of aviation on those on the ground takes greater precedence. The airports are responsible for managing the effects of redesigning routes on their local communities. Some airports may choose to replicate their existing arrival and departure routes with satellite navigation upgrades to minimise any changes in the established patterns of aircraft noise. However, the track-keeping precision of satellite navigation typically concentrates aircraft noise into narrower contours, which often has a more intense impact on the areas affected.

4.22 Other airports may choose to go beyond simply replicating flightpaths and use the precision and flexibility of satellite navigation to offer noise abatement and respite options to local communities or deploy multiple departure routes that can increase runway throughput during peak times. Any proposal that has the potential to affect traffic patterns below 7000 feet must follow the CAA's airspace change process for a 'Level 1' change, which includes requirements to consult closely and in detail with other aviation stakeholders and those local communities which may be affected.[39]

4.23 The requirement for airports to upgrade their arrival and departure routes to satellite navigation standards is driven by the SESAR Deployment Pilot Common Projects regulation for the 25 largest airports across Europe (including Heathrow, Gatwick, Stansted and Manchester airports in the

39 www.caa.co.uk/cap1616

UK). There is currently no direct legislative requirement for other airports to upgrade their arrival and departure routes. However, the introduction of satellite navigation has been declared a top priority by ICAO for its programme to upgrade airspace[40] and is the subject of the European Commission Implementing Regulation on performance-based navigation.[41]

4.24 Table 4.3 summarises the main lower altitude airspace initiatives and how they relate to the strategic framework.

Table 4.3 Lower altitude airspace initiatives

Initiative	Policy obligation and timeframe	Ends
7) Satellite navigation route replications Replication of existing arrival and departure routes to satellite-based navigation standards.	ICAO upgrade programme priority Pending EASA Implementing Rule	**Safety:** Satellite-navigation routes are more precise and separated by design, enhancing safety. **Efficiency:** Greater route precision and flexibility can be used to increase runway throughput and secure the most efficient use of airspace. **Efficiency**: Satellite navigation offers resilience for established instrument landing systems, removes the reliance on outdated ground navigation beacons and allows access to airports that may otherwise be closed in poor weather. **Environment:** Designing routes with greater precision and flexibility reduces track miles and improves climb/descent performance. **Environment:** Greater precision and flexibility offers opportunities to better manage noise impacts by avoiding population centres and deploying multiple routes for noise relief.
8) Satellite navigation route redesign Redesign of new arrival and departure routes using satellite-based navigation standards.	European Legislation SESAR PCP AF1 (by 2024)	

40 ICAO The Aviation System Block Upgrades: The Framework for Global Harmonization: July 2016. https://www.icao.int/airnavigation/Documents/ASBU_2016-FINAL.pdf

41 The EASA PBN Implementing Rule has been adopted by the EC and is expected to be published in the OJEU in Autumn 2018, at which point it will become law.

Operations outside controlled airspace

4.25 Outside controlled airspace, General Aviation, predominantly recreational flying, operates alongside a limited number of commercial flights and the military. While air navigation service providers provide a flight information service and alerting service to those who request such support, it is not mandatory for a pilot to be in receipt of an air traffic service. This generates an unknown and unpredictable air traffic environment. The airspace user remains responsible for avoiding collision.

4.26 Further improvements are required for a simpler and more flexible airspace. It is also necessary to reduce the level of complexity and improve alignment with international standards.

4.27 There are three main initiatives to modernise uncontrolled airspace:

9. Review the provision of the Flight Information Service (FIS) to align with ICAO FIS and EASA Part-ATS
10. Review the use of airspace classifications, the associated airspace structures and related air traffic management requirements to ensure the arrangements are optimised for all classes of aircraft
11. The utilisation of cost effective electronic surveillance information and its consideration in designing new or revised airspace structures and procedures, including how electronic surveillance solutions and digital information services can be used to better integrate commercial and non-commercial operations in uncontrolled airspace

4.28 Table 4.4 summarises the main uncontrolled airspace initiatives and how they relate to the strategic framework.

Table 4.4 Initiatives outside controlled airspace

Initiative	Policy obligation and timeframe	Ends
9) Review of FIS provision in the UK	EASA Part-ATS (from 2022[42]	**Safety:** Significant potential safety enhancements from strengthening the mitigations for airspace infringements and mid-air collisions. **Efficiency:** Significant potential flight efficiency benefits from providing more airspace users with access to volumes of airspace that are in high demand.
10) Airspace classification review	EASA Part-ATS (from 2022) A review of ATS provision in uncontrolled airspace to align with international standards.	
11) Electronic surveillance solutions	Fully interoperable electronic conspicuity solution for all airborne craft (by 2022/25)	

CNS (communications, navigation and surveillance) infrastructure

4.29 The transition from predominantly ground-based CNS infrastructure to satellite-based capabilities is a key way that the ends expected from airspace modernisation will be delivered. In the near term to 2024, some ground-based infrastructure will need to be retained for defence, security and resilience purposes. Such infrastructure should be managed on a national basis, providing a comprehensive oversight of assets. In the longer term, beyond 2024, the expansion of satellite-based services will help mitigate the risk of single-source failures associated with the transition to satellite-based infrastructure and enable a further rationalisation of ground assets.

4.30 There are three main initiatives associated with the CNS infrastructure that contribute to the modernisation of airspace:

[42] Date proposed by EASA in Opinion 03/2018 Requirements for Air Traffic Services.

12. a cross-industry plan for the efficient use of radio frequency spectrum
13. a cross-industry plan for the full adoption of datalink communications
14. a satellite navigation implementation plan that includes the removal of all but essential ground-based assets

Communications

4.31 Radio-frequency spectrum is an asset in high demand, mainly due to the increased usage from the telecoms industry. The growing volume of data transferred between aircraft and air traffic services will place greater pressure on the radio frequency spectrum in the coming years. A cross-industry plan for the efficient use of radio-frequency spectrum is therefore required to ensure aviation needs are understood and reflect a real-time requirement for the safe operation of air operations that can contribute to the ambition of an integrated airspace.

4.32 New technology is expected to change the method of communication to allow greater volumes of information to be shared faster and more consistently via datalink transfer, with less reliance on voice exchanges over radio. The introduction of datalink services is an international ambition that aims to drive the reduction in voice communications and support a more consistent, reliable and less workload intensive exchange of information. 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 needs to be coordinated and managed.

Navigation

4.33 The avionics capability of the aircraft fleet has advanced significantly in the past two decades, allowing a shift from the reliance on ground-based navigation beacons to autonomous aircraft operations dependent on a satellite-based navigation source. This capability shift enables the removal of old navigation equipment, which have high procurement and maintenance costs.

4.34 ICAO Assembly Resolution A37-11 requires member States to submit National Implementation Plans concerning the introduction of satellite navigation routes and the removal of ground-based infrastructure. This resolution encourages States to deploy satellite navigation in the upper, terminal and lower altitude airspace (as described in the sections above). The rationalisation of ground-based assets and the transition to a satellite-based navigation infrastructure is expected to provide:

- an affordable airspace modernisation approach for smaller aerodromes that have less air traffic control technology and equipment
- an alternative to non-precision approaches that are safer and more efficient
- a back-up to current precision landing systems to enhance resilience.

Surveillance

4.35 The application of space-based navigation and improved communication links will allow users to transmit precise positional information to air traffic control, increasing both ground and airborne situational awareness. It is recognised that a primary surveillance capability (i.e. radars) 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 surveillance information about one another with one another
- new technologies and equipment for air traffic services to gather, process and display aircraft position information from multiple sources

- deployment of an interoperable conspicuity solution based on ADS-B[43] and the associated ground use of the data to support air traffic services

4.36 Table 4.5 summarises the main CNS infrastructure initiatives and how they relate to the strategic framework.

Table 4.5 CNS Infrastructure initiatives

Initiative	Policy obligation and timeframe	Ends
12) Cross-industry plan for the efficient use of radio-frequency spectrum	EASA Surveillance Implementing Rule (2020)[44]	**Safety:** Significant potential safety enhancements from the increase in situational awareness, aircraft navigational capabilities and resilience.
13) Cross-industry plan for the full adoption of datalink communications	Indirectly from EASA Part ATS (from 2022)	**Efficiency:** Significant potential to secure the most efficient use of airspace through deployment of equipment and technologies that enable all classes of aircraft with greater access to the airspace.
14) A satellite navigation implementation plan	EASA PBN Implementing Rule (pending – 2022)	**Efficiency**: Satellite navigation offers resilience for established instrument landing systems, removes the reliance on outdated ground navigation beacons and allows access to airports that may otherwise be closed in poor weather.

43 Automatic dependent surveillance – broadcast is a surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.

44 EU Regulation 2017/386 – Requirements for the Performance and Interoperability of Surveillance for the SES.

Further detail on the ways of modernising airspace

4.37 The main ways of delivering airspace modernisation are:

- changes to the established **airspace design**, meaning its structure and route network
- **new operational concepts** including procedures to manage the flow of traffic, and
- the introduction of **new enabling equipment and technologies**.

4.38 This section provides further detail on the main ways of modernising airspace that were introduced earlier in this chapter under five headings:

- changes to upper airspace
- changes to complex terminal airspace around airports
- changes to airspace around airports at lower altitudes
- changes to uncontrolled airspace
- the UK's communications, navigation and surveillance (CNS) infrastructure.

4.39 Under each heading the 14 initiatives are summarised and the main airspace design, operational concepts and technologies have been described. Key dependencies have also been highlighted, for example there may be a reliance on future rules and regulations, training or equipment to fully realise the expected benefits.

4.40 Progress with the 14 initiatives, in the form of a RAG status, is set out in in Chapter 7.

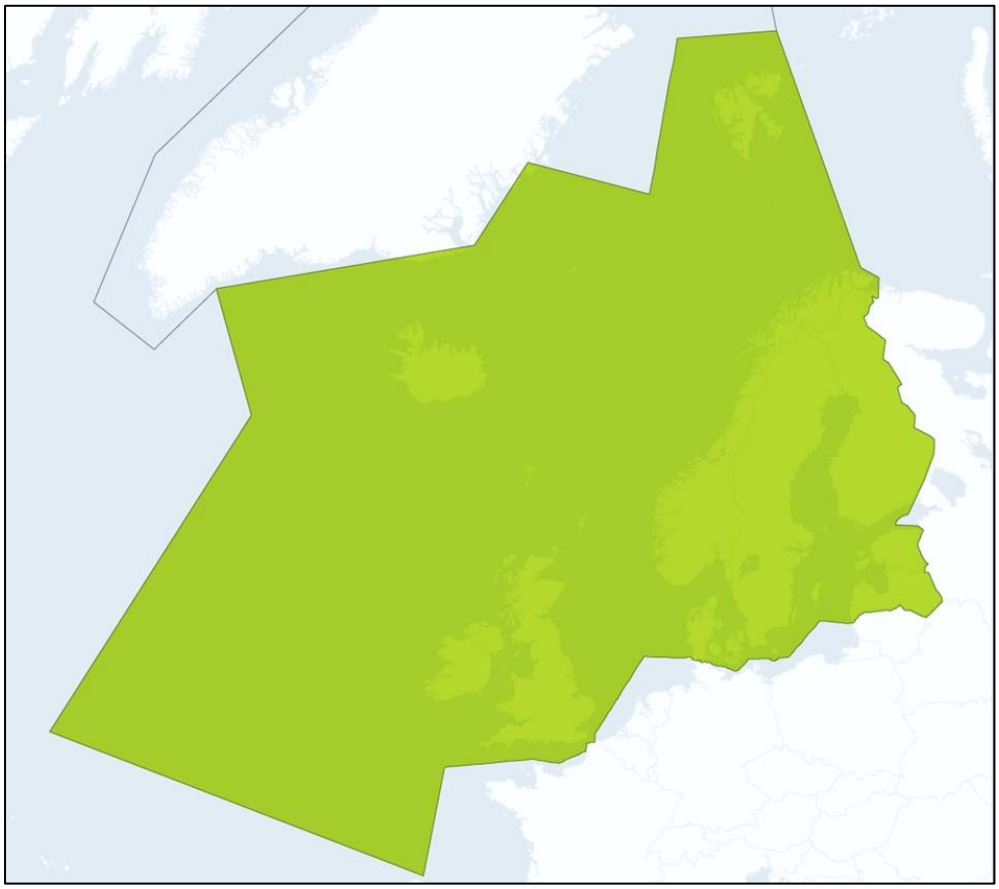
Modernisation in upper airspace

Ends

As traffic levels in upper airspace continue to grow, the ends, or known outcomes that modernisation must deliver, are:

- **safety**: reduce controller workload
- **efficiency:** remove bottlenecks and strengthen the resilience of the en-route network
- **security:** facilitate integrated civil/military operations
- **environment:** reduce emissions per flight.

Figure 4.1 Volume of Free Route Airspace by the UK and partners to be implemented by 2022



Ways

Airspace design	Operational procedures	Technology enablers
1. Direct Route Airspace: deployment of additional waypoints to the existing en-route network		
1.1. New waypoints to enable direct route airspace are being implemented by NERL as part of their Service and Investment Plan and funded by the unit rate*.	1.2. Flight crews and air traffic controllers will use today's established procedures in direct route airspace.	1.3. Airline flight-planning systems must be upgraded with the capacity to use the direct route options. The upgrades are only partly coordinated and funded by the airline community.
Timescale: by 2020		**Driver: Single European Sky legislation**
2. Free Route Airspace: removal of all fixed waypoints so aircraft can fly optimised routes		
2.1. Removal of the fixed route network to enable Free Route Airspace will be implemented by NERL as part of their Service and Investment Plan and funded by the unit rate.	2.2. New procedures for flight crews and air traffic controllers to operate safely and efficiently in Free Route Airspace will be developed and deployed consistently by the industry and regulators.	2.3. Airline flight planning systems must be upgraded with the capacity to operate in Free Route Airspace. The upgrades are only partly coordinated and funded by the airline community.
Timescale: by 2022		**Driver: Single European Sky legislation**
3. Advanced Flexible Use Airspace: new booking and release capabilities for segregated airspace		
3.1. New airspace structures to enable AFUA will be sponsored by the MoD and designed in collaboration with NERL and the airlines. Funding for the changes will be drawn from the unit rate.	3.2. New procedures for optimising booking and release within AFUA will be developed collaboratively by the CAA, NATS and MoD as part of the joint and integrated approach.	3.3. Airspace management tools to share information about the booking and release of shared airspace will be implemented to military outstations and funded by the MoD.
Timescale: by 2024		**Drivers: Single European Sky legislation and UK state priority**

Dependencies

1.3 & 2.3 For aircraft operators to flight plan and operate in Direct Route and Free Route Airspace, there is a dependency on the coordinated implementation of new flight planning systems.

2.2 There is a dependency on the new procedures for operating Free Route Airspace being deployed consistently across UK and European flight crews, and air traffic controllers. Regulators have a key role to play in establishing efficient standard procedures.

3.3 The implementation of new airspace management tools implemented to military outstations to book and release segregated airspace is a key dependency the operation of AFUA and Free Route Airspace.

* Each EUROCONTROL member state establishes the unit rate of en-route charges levied on airspace users in the airspace for which it is responsible.

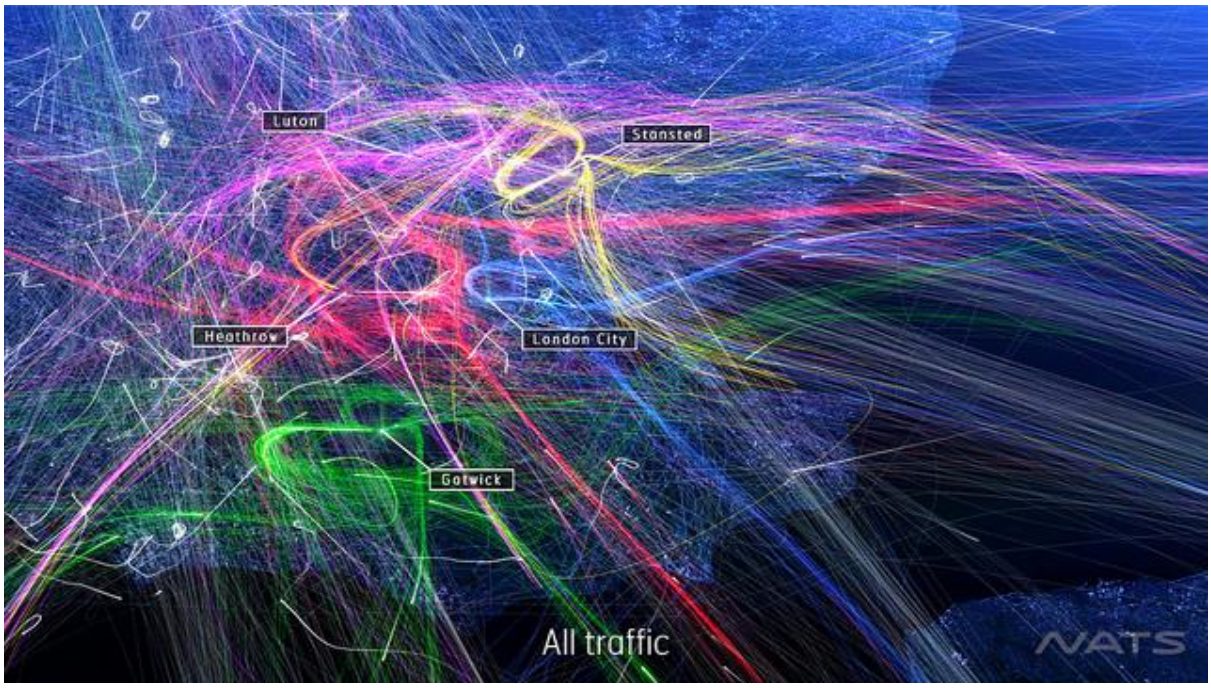
Modernisation in terminal airspace

Ends

As traffic levels in the complex terminal airspace grow, the ends, or known outcomes that modernisation must deliver, are:

- **safety**: capacity gains achieved whilst removing unnecessary interactions
- **efficiency:** expeditious flow of traffic
- **environment:** shorter track miles and continuous climbs / descents to reduce emissions per flight.
- **environment:** opportunities to better manage noise impacts.

Figure 4.2 Radar tracks showing high levels of crossing traffic in today's London terminal airspace



Source: NATS

Ways

Airspace design	Operational procedures	Technology enablers

4. FAS Implementation South:
redesign of the terminal network in southern England

4.1. Redesign of the southern terminal airspace above c.7000 feet will be implemented by NERL as part of their Service and Investment Plan and funded by airlines through the unit rate.	4.2. New procedures for Swanwick Centre controllers to operate in a systemised environment and minimise tactical intervention will be developed/deployed by NERL.	4.3. New tools for Swanwick Centre controllers to support systemisation, automate tasks and manage greater traffic levels will be implemented by NERL and funded by the unit rate.

Timescale: by 2024 **Drivers: Airports NPS, industry priority**

5. FAS Implementation North:
redesign of the terminal network in northern England

5.1. Redesign of the northern and Scottish terminal airspace above c.7000 feet will be implemented by NERL as part of their Service and Investment Plan and funded by the airlines through the unit rate.	5.2. New procedures for Prestwick Centre controllers to operate in a systemised environment and minimise tactical intervention will be developed and deployed by NERL.	5.3. New tools for Prestwick Centre controllers to support systemisation, automate tasks and manage greater traffic levels will be implemented by NERL and funded by the unit rate.

Timescale: by 2021 **Drivers: NERL RP2 plan, industry priority**

6. Arrival Management Solutions:
new capabilities to stream the flow of arrival traffic

6.1. Linear holding structures to replace stack holding and facilitate arrival management, along with system wide information sharing are being implemented by NERL as part of their Service and Investment Plan and funded by the unit rate.	6.2. New procedures for controllers to stream arrival traffic using speed controls and operate linear holds have been deployed by NERL. Flight planners and crew have been trained to operate with linear holds.	6.3. Arrival management tools that calculate the speed controls needed to stream arrival traffic are being deployed by NERL as part of their Service and Investment Plan and funded by the unit rate.

Timescale: by 2024 **Driver: Single European Sky legislation**

Dependencies

4.1 & 5.1 There is a significant dependency on the replication or redesign of airport arrival and departure procedures below 7000 feet (see 7.1 and 8.1).

4.2 & 5.2 There is a major dependency on the training and changes in working practices and behaviours to support the shift from terminal air traffic control procedures (based on tactical separation of conflicting traffic and management of the overall flow of aircraft) to systemisation (where traffic is separated by design and the flow is managed through aircraft speed control using electronic support tools).

4.3 & 5.3 Terminal airspace systemisation requires a new suite of air traffic control systems and tools that predict the trajectory of flights and resolve potential conflicts long before aircraft actually need to be managed tactically. These systems and tools are a major IT transformation for the air navigation service provider and must be closely coordinated with the introduction of new airspace designs and operating procedures in order to be effective.

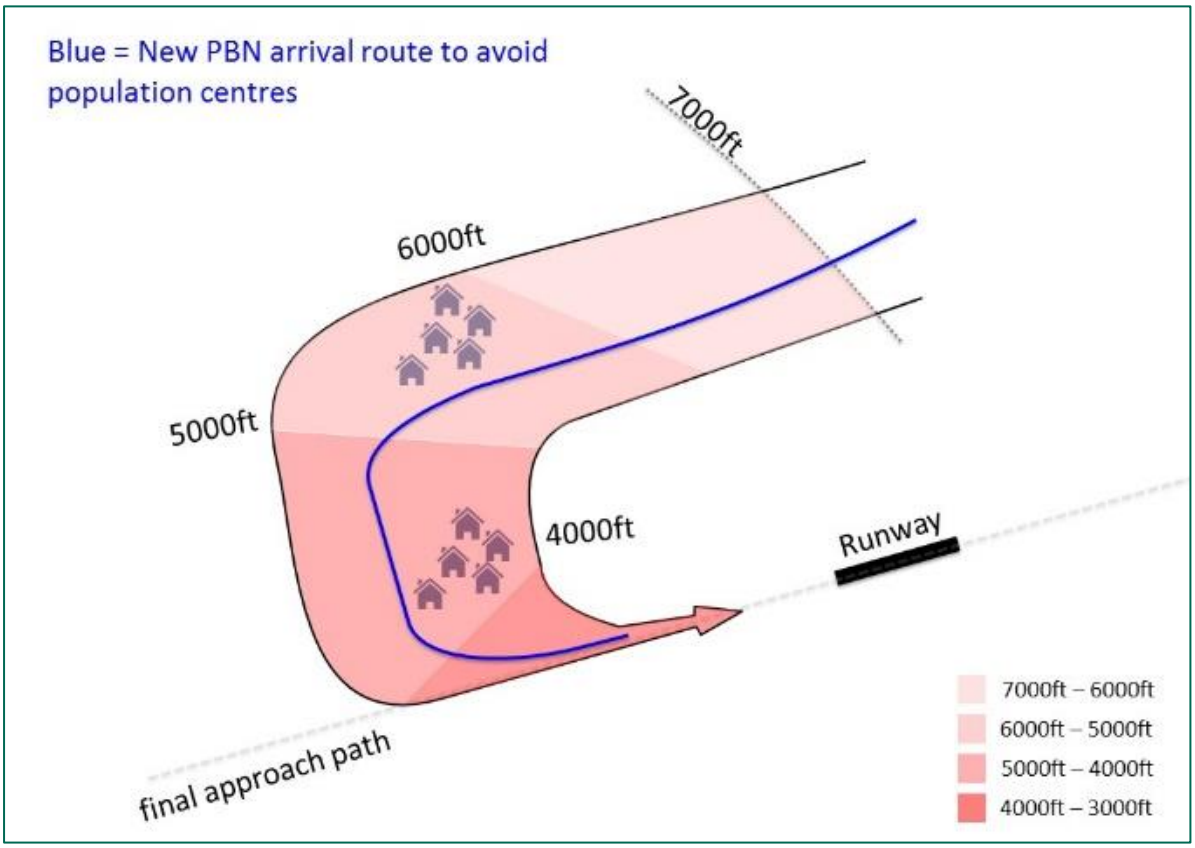
Modernisation in airspace at lower altitudes

Ends

As airports expand their operations, the ends, or known outcomes that modernisation must deliver, are:

- **safety**: precision routes, separated by design
- **efficiency:** greater runway throughput by deploying dedicated routes for each airport to secure more efficient use of airspace and strengthened resilience
- **environment:** shorter track miles and continuous climbs / descents to reduce emissions per flight
- **environment:** opportunities to better manage noise impacts

Figure 4.3 Illustration of a new arrival route to manages noise impacts by avoiding population



Ways

Airspace design	Operational procedures	Technology enablers
7. Replication of existing arrival and departure routes with satellite navigation upgrades		
7.1. Route replications below c.7000 feet to a satellite-based standard, enabling more precise and flexible flightpaths will be implemented and funded directly by the airports.	7.2. New procedures for controllers to minimise tactical intervention will be deployed by NERL. Procedures for flight crews to fly satellite-based routes are being implemented by the aircraft operators.	7.3. Aircraft avionics upgrades required to fly satellite-based routes are been implemented and funded by aircraft operators.
Timescale: by 2024		**Drivers: ICAO GANP, EU PBN implementing rule**
8. Deployment of new arrival and departure routes designed to satellite navigation standards		
8.1. Route upgrades below c.7000ft to a satellite-based standard, enabling more precise and flexible flightpaths will be implemented and funded directly by the airports.	8.2. New procedures for controllers to minimise tactical intervention will be deployed by NERL. Procedures for flight crews to fly satellite-based routes are being implemented by the aircraft operators.	8.3. Aircraft avionics upgrades required to fly satellite-based routes are been implemented and funded by aircraft operators.
Timescale: by 2024		**Driver: SES legislation for larger airports**

Dependencies

1.3 & 2.3 For aircraft operators to flight plan and operate in Direct Route and Free Route Airspace, there is a dependency on the coordinated implementation of new flight planning systems.

2.2 There is a dependency on the new procedures for operating Free Route Airspace being deployed consistently across UK and European flight crews and air traffic controllers. Regulators have a key role to play in establishing efficient standard procedures.

3.3 The implementation of new airspace management tools implemented to military outstations to book and release segregated airspace is a key dependency the operation of AFUA and Free Route Airspace.

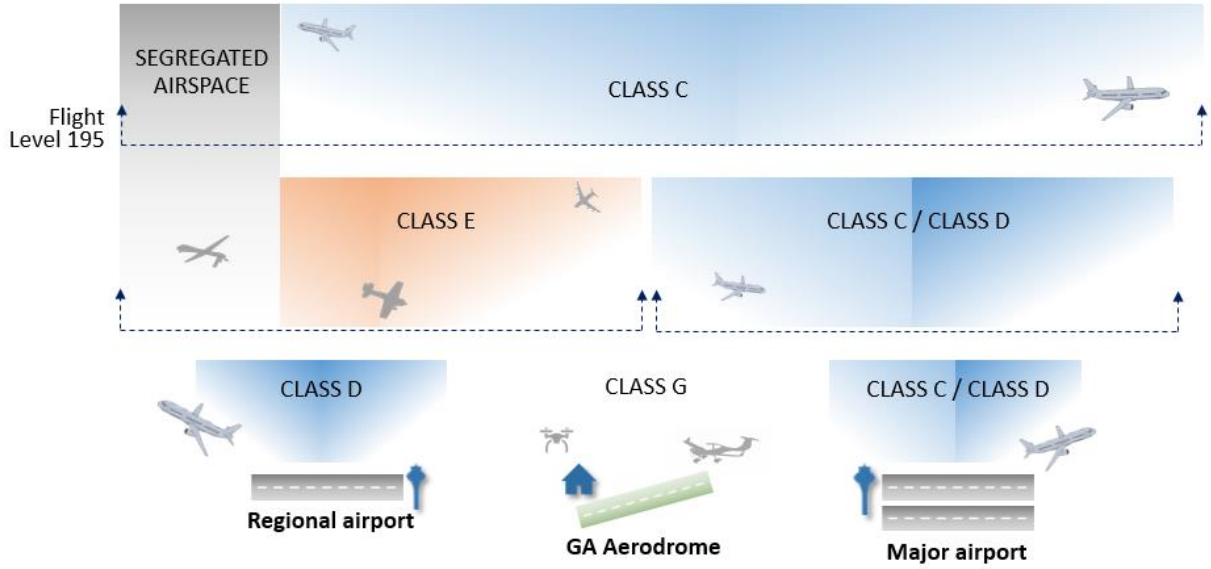
Modernisation outside controlled airspace

Ends

As General Aviation and commercial traffic expand operations outside controlled airspace:

- **safety**: improve the situational awareness of all aircraft and aerodromes operating outside controlled airspace
- **efficiency:** deliver greater integration rather than segregation of airspace, to satisfy the requirements of all classes of aircraft including future market entrants (such as drones or spaceplanes)

Figure 4.4 Illustration of airspace classifications



Ways

Airspace design	Operational procedures	Technology enablers
9. Review the provision of Flight Information Services in the UK to ensure alignment with international standards and interoperability across airspace boundaries		
9.1. A State-sponsored programme to define the Flight Information Service requirements in the UK FIS review.	9.2. FIS task descriptions, capabilities, licensing and funding.	9.3. not applicable
Timescale: by 2020		**Driver: EU Part-ATS**
10. Review airspace classifications and structures to optimise the integration of all classes of aircraft		
10.1. Optimised airspace classifications and structures in line with the requirements set out in EU law (especially EASA Part ATS) and ICAO Standards and Recommended Practices and Procedures for Air Navigation Services. Roadmap to be developed.	10.2. New operating procedures to accompany the introduction of a refined set of airspace classifications.	10.3. Electronic conspicuity devices and air traffic services surveillance capabilities at aerodromes.
Timescale: by 2020		**Driver: EU Part-ATS**
11. Deploy electronic surveillance solutions to aircraft and at airports without primary radar		
11.1. Development of new airspace structures such as surveillance mandatory zones that enable greater integration will be implemented and funded by the airports.	11.2. New procedures for air traffic services personnel to use electronic surveillance information displays to support the provision of flight information services will be developed and published by the CAA.	11.3. Interoperable electronic conspicuity devices and electronic surveillance information displays.
Timescale: by 2022		**Driver: EU surveillance implementing rule**

Dependencies

11.1 to 11.3 The widespread introduction of interoperable electronic conspicuity devices is dependent on the further development of a commercially viable and competitive market for both airborne and ground-based equipment. It is also dependent on the development of national standards for the core requirements that electronic surveillance equipment should meet.

Modernisation of the UK's CNS (communications, navigation and surveillance) infrastructure

Ends

As legacy ground-based capabilities are replaced:

- **safety**: enhanced situational awareness
- **efficiency:** flexible routeings not linked to fixed ground-based aids. Resilience improved through new technologies with less risk of technical failure

Figure 4.5 Illustration of remote air traffic control tower

Source: NATS

Ways

Airspace design	Operational procedures	Technology enablers
12. Cross-industry plan for the efficient use of radio-frequency spectrum to support growing demand from aviation		
12.1. Development of airspace structures that support the efficient used of radio-frequency spectrum.	12.2. Development of air traffic management operational procedures that support the efficient use of radio-frequency spectrum.	12.3. Development of national standards and specifications for new aviation technologies that optimise the use of radio-frequency spectrum.
Timescale: by 2020		**Driver: EU Part-ATS**
13. Cross-industry plan for the full adoption of datalink communications		
13.1. not applicable	13.2. New operational procedures that optimise the use of datalink capabilities.	13.3. Development of national standards that enable more technology solutions to rely on datalink.
Timescale: by 2019		**Driver: EU datalink implementing rule**
14. A satellite-navigation implementation plan to coordinate the upgrade of routes		
14.1. Continued development of the national standards for airspace structures and routes designed to satellite-based navigation specifications.	14.2. Continued development of national standards for the air traffic management operational procedures that optimise the use of satellite navigation.	14.3. Removal of legacy ground-based navigation technologies.
Timescale: by 2020		**Driver: EU PBN implementing rule**

Dependencies

12.1 to 12.3 The demand for radio-frequency spectrum from other sectors of the economy is a major dependency on the efficient use of the asset for aviation purposes.

13.2 & 13.3 The optimisation of datalink capabilities is dependent on the development of technologies and procedures that are interoperable across Europe and globally.

14.1 The widespread adoption of satellite-based navigation routes is dependent on the ability of airspace change sponsors (mainly airports and air navigation service providers) to redesign long-established routes to be more precise and flexible.

14.2 Air traffic management operational procedures that optimise the use of satellite navigation are dependent on the development and deployment of air traffic control support tools that introduce greater automation and predict aircraft trajectories.

14.3 The removal of ground-based navigation technologies is dependent on the implementation of satellite-based procedures and investment from aircraft operators in the avionics and flight crew approvals to use them.

Chapter 5

Unknowns: gaps in the current policy and regulatory architecture

Chapter summary

This chapter explains:

- policy areas and emerging innovation in which development is still ongoing, which may affect future iterations of the strategy and plan
- how the CAA will identify and respond to future gaps that emerge, including blockers to delivery.

Taking account of future developments

5.1 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 sit still. There are innovations and disruptions that continually shift.

5.2 That the Air Navigation Directions task the CAA with an annual delivery report on the strategy and plan means we can regularly take stock of the context of the strategy and plan, including changes and innovations that are forthcoming, or gaps in the policy or regulatory framework that are affecting delivery. When it is within the CAA's remit to suggest a solution or enabler to better respond to a change or gap, we will do so. Often, this will require working with others, such as the Government, which owns all relevant UK policy and law.

5.3 In this chapter we set out the current foreseeable 'unknowns' that could change and reshape the context for this strategy. These include areas in which the Government has signalled it may develop new or amended

policy positions, or new technologies that we think are becoming ubiquitous and may impact on how airspace is designed or used. There will also be 'unknowns' that are not foreseeable, and by definition, this means we cannot predict or discuss them in advance.

5.4 This chapter is included so that the CAA can give stakeholders sight of, and potentially advise the Government on:

- any known gaps that are being managed or changes that are being considered either by government or another relevant organisation, that our strategy must work around now and respond to in the future, and
- any further gaps that we have identified that are not yet being managed, that our strategy must work around, that may affect airspace modernisation and that potentially require management in the future.

5.5 The areas of change noted in this chapter, to be developed in future iterations of the strategy and plan, are grouped as follows:[45]

- emerging policy in the UK
- emerging international policy
- emerging innovations or disruptions in airspace.

Emerging policy in the UK

5.6 The Department for Transport announced in 2017 that it would be developing a new Aviation Strategy to address the development of aviation up to 2050. In April 2018 the Government published its response to its earlier call for evidence on the Aviation Strategy. The Government is now developing the Aviation Strategy Green Paper for publication in

[45] The strategy will be updated regularly, but the pace of change may mean that some of the topics raised in this chapter move on before the CAA is able to review and republish the full document. Please refer to the dates of any publications discussed in this section and be aware that there may be newer versions of those documents available.

Autumn 2018 before a final strategy in the first half of 2019. The Aviation Strategy contains several areas of policy development that could impact on the Airspace Modernisation Strategy.

Noise

5.7 Limits on noise already exist at some airports in the form of air transport movement or passenger caps, or noise contour limits set through the planning process. The Government expects that future limits will be discussed and agreed in the context of proposals for new airport capacity, including planning applications[46], and the Airspace Modernisation Strategy would need to have regard to these.

5.8 The CAA's obligations under section 70 of the Transport Act 2000 means that opportunities for noise improvements should be explored through the Airspace Modernisation Strategy and deployment plans where these are not in conflict with growth. Therefore, the Government expects the CAA's strategy and any plans developed to deploy it to identify opportunities for airspace changes which have noise benefits, and to promote and facilitate such changes where these are not in conflict with growth and do not have disproportionate disbenefits for efficiency or carbon.

5.9 Once airports have received permission to expand, they will expect to make full use of their capacity within planning conditions, and that airspace will support this. However, this can lead to growth which some may find unsustainable.

5.10 In its Aviation Strategy the Government intends to explore the relationship between growth and noise reduction, the possibility of noise reduction targets and the potential for these to be enforceable. These might be set at a national level, airport level or even at a route level. The Airspace Modernisation Strategy needs to have regard to any such binding targets

46 See Para 1.24 of 'The future of UK aviation: making best use of existing runways June 2018'. https://www.gov.uk/government/publications/aviation-strategy-making-best-use-of-existing-runways

which would complement limits set through the planning process at individual airports, and the CAA will look to the Government to set a clear policy on this. This development on noise policy will not be finalised until after the Government's Aviation Strategy has been prepared, consulted on and published. This will be in 2019, at which point an update to the Airspace Modernisation Strategy and related delivery plan may be required.

5.11 The CAA has welcomed the clarity in the Government's Air Navigation Guidance on noise and adverse effects, but this concerns the CAA's decisions on airspace change proposals and does not constitute a national strategic policy. Therefore in the meantime, where the CAA's work in preparing this strategy and reporting on it annually reveals the need for trade-offs and there is no policy guidance, we will seek guidance from the Government.

Compelling airspace to be changed

5.12 Neither the Government nor the CAA currently has powers to compel an airport or air navigation services provider to develop and put forward an airspace change proposal. The CAA can refuse an airspace change if it does not meet the requirements set out in Section 70, but cannot compel:

- initiation: bringing about an airspace change proposal that has been identified as necessary
- quality: failure to progress/complete a necessary airspace change proposal to the required standard, either because of inadequate resourcing or not taking the necessary actions
- timeline: failure to adhere to the proposed timeline for a necessary airspace change proposal.

5.13 This means that when airspace modernisation is needed across a number of airports to restructure and rationalise the airspace they use, there is no way of ensuring that they will each sponsor the airspace changes identified as necessary. Where there are interdependencies between changes, this can hold up modernisation.

5.14 In its response to its Aviation Strategy call for evidence, the Government stated that it would explore policy mechanisms to deliver airspace change should airports or NERL not bring about the airspace changes that are necessary for modernisation. Several options were considered. These could be combined into one legislative clause that would:

- give the Secretary of State new legislative powers to direct airports to take forward airspace changes within the plan, and
- create a policy framework that enabled NERL to take forward some necessary changes.

5.15 The Government intends to consider this policy further through the Aviation Strategy Green Paper in Autumn 2018.

5.16 The CAA would support the reintroduction of legislative provisions that modernise the air traffic services regulatory and licensing framework, which also support the delivery of airspace modernisation.

5.17 Any policy developed will be reflected in the final Airspace Modernisation Strategy and any associated governance to modernise airspace.

Feasibility assessment

5.18 NATS is developing a feasibility assessment for airspace in the South East at the request of the Secretary of State. We understand the assessment will:

- establish whether there is sufficient airspace capacity to meet airports' potential demands
- establish where there are interdependencies between different airports' demands for airspace
- propose a roadmap or deployment plan for the delivery of airspace changes including the order in which they will be developed.

5.19 The feasibility assessment outlines the concept of 'letterboxes in the sky' at 7,000–9,000 feet, i.e. entry points to the upper route airspace. NATS will develop this concept further and propose an airspace change to the CAA for the upper route airspace, including the letterbox concept.

Airports, in cooperation with NATS, will design flightpaths into and out of these letterboxes, proposing these airspace changes to the CAA. While NATS will not be required to consult on the feasibility plan they develop, both NATS and the individual airports will have to follow the CAA's airspace change process, including engagement and consultation requirements, when they design the changes the plan has deemed necessary.

5.20 While the feasibility assessment looks at the capacity demands of airports across the South East, one of its key requirements will be to establish whether the airspace design necessary to accommodate a new runway at Heathrow is possible. It is also expected to set out the interdependencies between Heathrow's airspace needs and other airspace changes that will need to happen, i.e. a critical pathway for the airspace redesign needed to enable the third runway. An airspace change proposed by one airport could conflict with changes required by other airports in the future. Currently, there is no strategic sequencing or prioritisation of airspace changes. Although co-ordination through a working group enables mutual understanding, there remains no way of requiring them to be progressed in harmony and in the necessary timescales.

5.21 The Department for Transport have asked the CAA to provide technical advice to assure the feasibility assessment that NATS has developed. Once the assessment is completed during August 2018, and subsequently considered by the Government, it will need to be included in this Airspace Modernisation Strategy and plan. In particular, the deployment plans associated with south east airspace improvement,[47] it will have to be built into the deployment plans discussed in Chapter 6 of this document. The CAA expects to task the industry with the

[47] Initiative 4 as described in Chapter 4.

development of a long-term and UK-wide airspace modernisation roadmap as part of the next financial settlement.[48]

Further policy considerations

5.22 There are additional policy areas which may or may not be clarified though the new Aviation Strategy. These include:

5.23 **Access for General Aviation:** What policies should guide the future design and how that growth and General Aviation access are traded off against one another?

5.24 **Carbon:** The airspace strategy would need to have regard to any future policy which limits aviation's carbon emissions. Should opportunities for carbon savings be explored through the airspace strategy? If so, should they be prioritised or only considered where they are not in conflict with growth and do not have noise disbenefits?

Emerging international policy

5.25 At the time of writing this document, the UK is a member of the European Union but is in the process of leaving it following a national referendum. EU policy and regulation is currently being developed on several airspace issues. What those policies look like, whether they will affect the UK, and if so how, are all open questions at the time of writing this strategy. It may be the case that the UK decides to follow EU air traffic management related Implementing Rules in order to ensure its airspace system remains interoperable with EU airspace, enabling traffic to move easily across the skies without impediment. If that is the case, all the policies currently being developed and noted here will eventually need to be enshrined in the Airspace Modernisation Strategy. Were the UK to decide not to adopt EU air traffic management related Implementing Rules, this

48 The fixed reference period around which the CAA's economic regulation of NERL is based. RP3 runs from 2020 until 2024. NERL may not be the only body carrying out this work, but will be involved in some way even if the task is given to another industry body.

would no doubt raise issues for this strategy to address, such as determining alternate means of achieving interoperability.

- The EU Implementing Rule Part-ATS provides the UK the opportunity to review some elements of our airspace arrangements, classifications and air traffic service delivery to better align with ICAO Standards and Recommended Practices. It is not yet clear what timeline will be defined to deliver and deploy this review, or indeed what the future elements will look like. The opportunity to review the UK airspace arrangements to meet international obligations will be a major programme of change sponsored by the State and will have a significant bearing on the Airspace Modernisation Strategy.
- The continued deployment of Single European Sky mature air traffic management technologies and tools will continue through the second Common Project Implementing Regulation. This Common Project is currently being defined and is likely to focus on the key airport operations with significant European network capacity implications. It will be adopted in 2019 but we do not yet know the detail or timeline and how the UK would comply. Any commitment to comply with deployment deadlines will feed into the Airspace Modernisation Strategy deployment plan.
- The European Commission has tasked the SESAR Joint Undertaking and EUROCONTROL to develop a European airspace architecture study and associated high-level modernisation goals. The UK will continue to engage with this exercise to ensure that there is continued alignment of our strategic ambitions.
- The Commission's preparations for Reference Period 3 of the Single European Sky performance scheme are currently under development, both in terms of changes to the regulatory framework and requirements, expected to be agreed in autumn 2018, but also the EU-level targets, which are expected to be adopted by May 2019. It is expected that target setting for the existing horizontal flight efficiency indicators for en-route airspace will continue to apply. The objectives of the Airspace Modernisation Strategy are consistent with

EU objectives in this area, with a view to minimising excess track miles flown. The Commission is also considering the establishment of performance monitoring indicators – without targets – for the share of arrivals using Continuous Descent Operations at key airports.

- We expect that the UK will seek to keep pace with EU airspace developments until 2024, even after Brexit. This is one of the assumptions built into the next financial settlement.[49] We also expect that we will want to remain interoperable with the EU's air traffic management systems in the future.

Emerging innovations or disrupters in airspace

5.26 Technology is developing new ways of flying, new things that fly and new ways of controlling and managing our airspace.

5.27 Drones are just one example of an emerging technology that is fast becoming ubiquitous. A CAA survey in 2017 found that 4% of UK citizens had purchased a drone within the last two years, a further 6% were considering purchasing one in the future, and a further 10% said they had no plans but hadn't ruled out buying one.[50] There is also increasing commercial use of drones. If more people and businesses are are buying and flying drones, their integration into airspace needs to be managed so that they are flown safely and securely. This could require changes to airspace design to segregate drones from other traffic, or it could require development of operational concepts to integrate drones into airspace. This could include technologies such as new systems that enable aircraft, including drones, to detect and avoid one another, and systems that render all aircraft electronically visible (conspicuous) to one another.

---

49 The fixed reference period around which the CAA's economic regulation of NERL is based. RP3 runs from 2020 until 2024.

50 CAA Consumer Tracker Survey Wave 4, published December 2017. https://www.caa.co.uk/News/Civil-Aviation-Authority-Consumer-Tracker/

Government policies on drones will guide how their management into airspace will work.

5.28 Development of Urban Air Mobility solutions in global cities is being explored as a solution to ease congestion and unlock capacity for public transport, perhaps as early as 2025. In order to facilitate and manage emerging technologies, the long-term plan will include how to fully integrate new users alongside existing manned aviation, not just in terms of airspace but by having interoperable platforms and appropriate mechanisms of sending and receiving data.

5.29 Before these new sytems are developed, there will need to be decisions about the market model for drones services, such as whether this will be an extension of NERL's existing monopoly activity or whether it can and should be provided on a competitive basis. The CAA has not reached any conclusions on this activity yet, or who should pay for it, or how they should pay.

5.30 The first UK commercial space launch is expected in the early 2020s. Commercial space operations will place additional new demands on airspace and supporting technological systems. These operations extend beyond our current upper airspace structures into a space traffic environment, and as such will require new approaches to safely manage these operations. The scope of the international rules and regulations relating to airspace may change and the UK's airspace management strategy will have to respond accordingly.

Spotting and responding to other emerging changes

5.31 Other policy developments, or new innovations and disruptions, will also impact on this strategy and plan in the future. The CAA intends to spot and plan for these by:

- Continuing to work closely with the Government in developing this strategy regularly, to ensure we remain aware of new policies or

laws that are being developed that will influence or change the strategy and plan.

- Maintaining contact with relevant policy and research officials internationally, whether in ICAO, EASA, EUROCONTROL or other EU groups (although the nature of this contact will depend in part on how the UK exits the EU).
- Using horizon scanning to become aware of new technologies or other changes that could affect how airspace is designed and used. The CAA does this through an engagement plan so that we regularly interact with stakeholders aware of innovations and disruptions; an internal horizon-scanning process to capture insights and new intelligence as it emerges; an external portal to allow innovators to tell us about opportunities and challenges; and an in-house think tank called Aviation Futures, which looks ahead and undertakes scenario-building to consider how regulation can best respond to change.

Chapter 6

Means: timelines and delivery plans

Chapter summary

This chapter explains that:

- the resources or **means** of delivering airspace modernisation rests with industry organisations and not the CAA.
- the CAA is considering whether to task an industry group or other organisation with developing a nationwide strategic roadmap
- the CAA will continue working with the Department for Transport and other organisations identified in the airspace governance plan to consider how best to commission the development of a nationwide roadmap of airspace changes that will be necessary in the future.

Delivery plans

6.2 The means of delivering airspace modernisation – such as the resources needed to bring in changes – must rest with the industry organisations that will use airspace. For example, the CAA can set out, within this strategy, why airspace redesign is needed and the policy ends it must achieve, but we cannot do that airspace change ourselves. Timelines and delivery plans must be set out by the organisations that will undertake this design, and integrate the concepts and technologies.

6.3 Many of the operational concepts and technologies set out in this strategy have deployment plans associated with them, which were drawn up by relevant industry bodies working together with the CAA and government

under the previous Future Airspace Strategy.[51] A summary timeline is provided in Figure 6.1 below.

6.4 It is proposed that the CAA will commission further design, operational and technology studies required to support the development and deployment of this strategy.

6.5 The CAA believes that any new studies needed should be based on the factors set out in Section 70 of the Transport Act 2000. The factors set out how the CAA must exercise its air navigation functions, including giving priority to maintaining a high standard of safety.

6.6 The CAA will bring together industry-led deployment plans to deliver the Direction that there is a single strategy and plan.

6.7 At present, there is no deployment plan for the design changes needed for modernisation, as the new Directions and this new strategy have introduced the need for clearer requirements around airspace design. The CAA is therefore considering whether to task an industry group or other organisation with developing a nationwide strategic roadmap that would set out where airspace design changes are needed having considered the points below, which broadly relate to the factors in Section 70.

6.8 A design roadmap would consider:

- where airspace changes are needed to deliver a safety benefit, for example, changes that keep routes far enough apart from one another
- where airspace changes are needed to deliver capacity, for example:
  - airspace bottlenecks where delays to consumers could be alleviated by capacity
  - areas where planned development on the ground such as new runways will require new airspace designs

[51] Details of relevant industry deployment plans can be found at http://futureairspace.aero/ and http://fasvig.org/

    - areas where more direct routes are possible that could, for example, reduce controlled airspace
  - where airspace changes can deliver noise benefits that are not in conflict with growth and do not have disproportionate disbenefits for efficiency or carbon
  - where airspace changes are needed to introduce new technology, for example the introduction of performance-based navigation

6.9 Any potential strategic roadmap that is developed would have to take current coordination work into account. For example, it might build on any roadmap that is developed out of the feasibility assessment NATS has undertaken for the South East – although further development would be necessary, as that assessment itself does not deal with the same horizon (of 2040) or range of factors as the CAA's strategy.

6.10 The development of a roadmap would need to involve a range of aviation stakeholders, that might be expected to sponsor airspace changes the roadmap identifies. It would also need to be led and coordinated.

6.11 The draft governance plan in Chapter 2 noted the potential need for a level of delivery coordination.

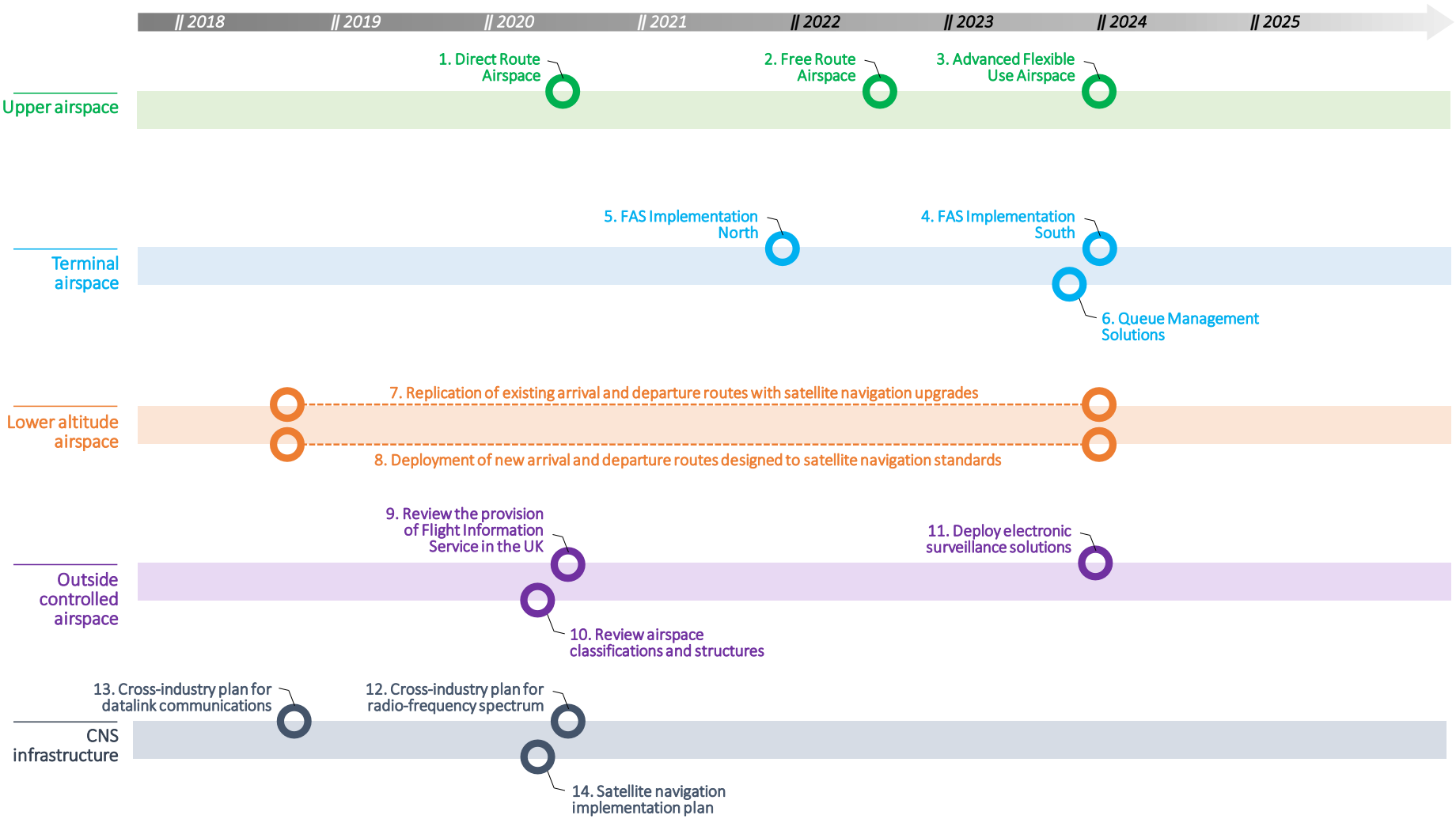
6.12 In our business plan guidance to NERL[52] we said that, given NERL's role as the UK's monopoly en-route and London Approach service provider, airspace modernisation is a fundamental requirement of its current licensed activities and that it is the largest single source of relevant airspace design expertise. We also said that we expected NERL to set out how it would develop a coordinated and sequenced masterplan of UK airspace changes between 2020 and 2040. NERL has indicated in its initial RP3 Business Plan that it is willing to take on a wider role to support airspace modernisation in the South East, including planning, implementation and monitoring.

---

52 www.caa.co.uk/cap1625

6.13 The CAA will continue working with the Department for Transport and other organisations identified in the airspace governance plan to consider how best to commission the development of a nationwide roadmap of airspace changes that will be necessary in the future.

Figure 6.1 Timeline of airspace-related developments



Chapter 7

Summary of progress with industry delivery

7.1 In table 7.1 overleaf the progress towards completion of each major initiative and the supporting airspace designs, operational procedures and technology enablers is indicated by a green, amber or red status:

- green status indicates that the initiative is on track to be completed in the timescales expected
- amber status indicates that the initiative needs attention from key stakeholders to ensure completion in the timescales expected
- red status indicates there are major issues with the initiative and a significant risk that completion will not be achieved in the timescales expected.

Several key risks to the delivery of the airspace modernisation initiatives outlined in the AMS have been identified during the production of the strategy and are also summarised in table 7.1. The risks are assessed on a 1 (low) to 5 (high) scale against likelihood (L), and severity (S).

Table 7.1 Progress status and key risks

Airspace design	Operational procedures	Technology enablers

1. Direct Route Airspace: deployment of additional waypoints to the existing en-route network			**On track**
1.1. New waypoints	1.2. Established procedures	1.3. Airline flt-planning systems	
Timescale: by 2020		**Driver: Single European Sky legislation**	
Risk: that aircraft operators do not invest in the flight planning system upgrades required to use Direct Route options effectively and maximise the benefits			Score: 6 (L2*S3)

2. Free Route Airspace: removal of all fixed waypoints so aircraft can fly optimised routes			**Needs attention**
2.1. Remove fixed route network	2.2. New procedures	2.3. Airline flt-planning systems	
Timescale: by 2022		**Driver: Single European Sky legislation**	
Risk: that aircraft operators do not invest in the flight planning system upgrades required so that they can access portions of Free Route airspace effectively			Score: 12 (L3*S4)

3. Advanced Flexible Use Airspace: new booking and release capabilities for segregated airspace			**Needs attention**
3.1. New airspace structures	3.2. New procedures	3.3. Airspace management tools	
Timescale: by 2024		**Drivers: Single European Sky legislation and UK state priority**	
Risk: that the implementation of new airspace structures to enable AFUA, restrict the access of civil traffic to key routes and volumes of airspace, generating inefficiencies and capacity constraints on certain areas of the UK.			Score: 9 (L3*S3)

4. FAS Implementation South: redesign of the terminal network in southern England			**Needs attention**
4.1. Terminal airspace redesign	4.2. New procedures	4.3. New tools for controllers	
Timescale: by 2024		**Drivers: Airports NPS, industry priority**	
Risk: that the large number of co-dependent airspace changes required to modernise the terminal airspace in the south of England (involving 16+ different sponsors) are not coordinated effectively, leading to sub-optimal airspace designs, poor engagement with affected stakeholders, inefficient network integration and delays to implementation.			Score: 20 (L4*S5)

5. FAS Implementation North: redesign of the terminal network in northern England			**Needs attention**
5.1. Terminal airspace redesign	5.2. New procedures	5.3. New tools for controllers	
Timescale: by 2021		**Drivers: NERL RP2 plan, industry priority**	
Risk: that the large number of co-dependent airspace changes required to modernise the terminal airspace in the north of England are not coordinated effectively, leading to sub-optimal airspace designs, poor engagement with affected stakeholders, inefficient network integration and delays to implementation.			Score: 12 (L3*S4)

Airspace design	Operational procedures	Technology enablers

6. Arrival Management Solutions: new capabilities to stream the flow of arrival traffic			On track
6.1. Linear holding structures	6.2. New procedures	6.3. Arrival management tools	
Timescale: by 2024		**Driver: Single European Sky legislation**	
Risk: that the implementation of multiple arrival and departure management systems focused on different airports are not integrated effectively at a network level, leading to pinch points & inefficiencies.			Score: 6 (L2*S3)

7. Replication of existing arrival and departure routes with satellite navigation upgrades			On track
7.1. Route replications	7.2. New procedures	7.3. Aircraft avionics upgrades	
Timescale: by 2024		**Drivers: ICAO GANP, EU PBN implementing rule**	
Risk: that many conventional arrival and departure routes at airports cannot be accurately replicated using satellite navigation capabilities (especially in the turn), creating new, or more concentrated noise impacts at lower altitudes and deterring sustainable improvements.			Score: 9 (L3*S3)

8. Deployment of new arrival and departure routes designed to satellite navigation standards			Needs attention
8.1. Route upgrades	8.2. New procedures	8.3. Aircraft avionics upgrades	
Timescale: by 2024		**Driver: SES legislation for larger airports**	
Risk: that the redesign of arrival and departure routes at low altitudes create new, more frequent or more concentrated noise impacts that deter implementation of sustainable improvements.			Score: 12 (L4*S3)

9. Review provision of UK Flight Information Services to ensure alignment with international standards and interoperability across airspace boundaries			On track
9.1. Define FIS requirements	9.2. FIS framework	9.3. not applicable	
Timescale: by 2020		**Driver: EU Part-ATS**	
Risk: There is a risk that the funding model required to deliver a Flight Information Service that serves the needs of users will not be possible.			Score: 8 (L2*S4)

10. Review airspace classifications and structures to optimise the integration of all classes of aircraft			On track
10.1. Optimised classifications	10.2. New procedures	10.3. Electronic conspicuity	
Timescale: by 2020		**Driver: EU Part-ATS**	
Risk: - that industry cannot support the level of service provision aspired to within a revised airspace structure.			Score:12 (L3*S4)
Risk: there is potential perceived conflict for the CAA between its regulatory function and the modernisation ambition			Score: 9 (L3*S4)

Airspace design	Operational procedures	Technology enablers

11. Deploy electronic surveillance solutions to aircraft and at airports without primary radar			Needs attention
11.1. New airspace structures	11.2. New procedures	11.3. Electronic conspicuity	
Timescale: by 2022		**Driver: EU surveillance implementing rule**	
Risk: that the adoption of electronic surveillance solutions onboard aircraft and on the ground at airports does not reach the critical mass levels required for the information derived to be used effectively in the air traffic management operation.			Score: 9 (L3*S3)

12. Cross-industry plan for the efficient use of radio-frequency spectrum to support growing demand from aviation			On track
12.1. Airspace structures	12.2. New procedures	12.3. Develop standards	
Timescale: by 2020		**Driver: EU Part-ATS**	
Risk: that a lack of available spectrum for the aviation sector constrains the widespread adoption of new technologies and procedures that can improve airspace safety, efficiency and capacity.			Score: 9 (L3*S3)

13. Cross-industry plan for the full adoption of datalink communications			Needs attention
13.1. Not applicable	13.2. New procedures	13.3. Development standards	
Timescale: by 2019		**Driver: EU datalink implementing rule**	
Risk: that a lack of coordination in the adoption of datalink solutions across airports, aircraft operators and air traffic control reduces the benefits of the technology.			Score: 9 (L3*S3)

14. A satellite-navigation implementation plan to coordinate the upgrade of routes			Needs attention
14.1. National standards	14.2. National standards	14.3. Remove ground technol.	
Timescale: by 2020		**Driver: EU PBN implementing rule**	
Risk: that the ongoing reliance on legacy ground navigation infrastructure by a minority of aircraft operators deters their removal and the transition to a fully satellite-based infrastructure.			Score: 12 (L4*S3)

Chapter 8

Glossary

Although we have avoided the use of abbreviations where possible in this guidance, in the interests of completeness we have included below some common abbreviations – as well as other terms – that relate to airspace modernisation.

Term	Abbreviation	Description
Advisory route	ADR	A designated route along which air traffic advisory service is available.
Aerodrome traffic zone	ATZ	Aerodrome traffic zone – normally, circular zones around an aerodrome where pilots and ATS providers must follow specific requirements.
Aeronautical Information Publication	AIP	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. Publication is the responsibility of the CAA, but is carried out under licence by NATS. www.ais.org.uk
Air navigation directions		The Civil Aviation Authority (Air Navigation) Directions 2017. These Directions set out the CAA's air navigation duties and were jointly issued by the Secretary of State for Transport and the Secretary of State for Defence.
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, October 2017, Department for Transport Guidance from the Secretary of State which the CAA is required to take account of when considering airspace change proposals. https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017
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 safety report		A report raised internally within an airline/operator whereby flight crew can report safety-related concerns.

Air traffic control	ATC	Service from an air navigation service provider providing guidance to aircraft through controlled airspace.
Air traffic control surveillance minimum altitude chart	ATSMAC	The lowest altitude that a radar controller can allocate to an inbound or outbound aircraft.
Air traffic management	ATM	The combined processes of air traffic control, air traffic flow management, and aeronautical information services. ATM can also mean air transport movement.
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.
Air traffic services airspace	ATS Airspace	Airspace in which control by air traffic services and specific rules of operations are required.
Air transport movement	ATM	Air transport movements are landings or take-offs of aircraft used for the transport of passengers, cargo or mail on commercial terms. ATM can also mean air traffic management.
Airline customers		Those airlines which operate from an airport or use the services of an air navigation service provider.
Airspace change process		The staged process an airspace change sponsor follows to submit an airspace change to the CAA for a decision. The process includes actions associated with implementation and post-implementation review, after the CAA or, where applicable Secretary of State, decision.
Airspace change proposal		A request (usually from an airport or air navigation service provider) for a permanent change to the design of UK airspace.
Airspace design		Together, the airspace structure and flight procedures.
Airspace infringement	Infringement	When an aircraft enters controlled airspace without having previously obtained permission to do so from air traffic services.

Airspace structure		Designated volumes of airspace within identified characteristics, including the equipment aircraft wanting to enter that airspace must carry and actions pilots must carry out before entering that airspace. The volumes of airspace are designed to ensure the safe and optimal operation of aircraft. Airspace structures consist of: (a) controlled airspace, namely control zones, control areas, terminal control areas and airways (b) airspace restrictions, namely danger, restricted and prohibited areas (c) radio mandatory zones, transponder mandatory zones (d) other airspaces specified by the CAA when defining the airspace change process, such as, for example, flight information zones, aerodrome traffic zones, temporary segregated areas, temporary reserved areas or free-route airspace.
Airway		A corridor of controlled airspace of defined width with a defined lower base, extending to Flight Level 245 (a nominal altitude of 24,500 feet) unless otherwise denoted.
Area navigation	RNAV	A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the capability of self-contained aids, or a combination of these. (ICAO Doc 9613) https://www.icao.int
Area navigation routes		An air traffic service route created for aircraft capable of employing performance based navigation technology.
Call-in (by Secretary of State)		For certain types of airspace change, the Secretary of State may decide to call-in a particular airspace change proposal and make a decision instead of the CAA, a decision which the CAA will then be required to implement.
Carbon dioxide	CO2	Naturally occurring atmospheric gas, which causes greenhouse effects leading to global warming, and ocean acidification in increased concentrations.
Classes of airspace		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 (Classes B and F are currently unused in the UK).

Communications, navigation and surveillance infrastructure	CNS infrastructure	Technological infrastructure supporting air traffic service provision.
Conditional route		An airspace route that is only available under certain circumstances.
Continuous climb (or descent) operations	CCO or CDO	Allow arriving or departing aircraft to descend or climb continuously, to the greatest extent possible.
Control area	CTA	Area of controlled airspace, usually surrounding an aerodrome, extending from ground level to a specified altitude.
Control zone	CTR	Area of controlled airspace, usually surrounding an aerodrome, extending between two specified altitudes.
Controlled airspace	CAS	Airspace in which air traffic control must have control over aircraft to maintain safe separation between them.
Danger Area		Airspace within which activities dangerous to the flight of aircraft may exist at notified times.
Direct	DCT	A term used in relation to flightplan clearances and type of approach.
En-route holding		Pattern adopted by aircraft on the instruction of air traffic services to manage delay and sequencing, and hold them in the air until onward clearance (usually to land) is provided.
En-route phase		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.
European Aviation Safety Agency	EASA	The European Union authority for aviation safety.
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.
Flight information region	FIR	Specified region of airspace, coordinated through the International Civil Aviation Organization.
Flight procedures		Part of the airspace design. A set of predetermined segments intended to be followed by a pilot when arriving to or departing from an aerodrome.
Flight rules		Aircraft can operate under Visual Flight Rules (VFR) or Instrument Flight Rules (IFR). There is also an intermediate form, Special Visual Flight Rules (SVFR).

Future Airspace Strategy	FAS	A collaborative initiative between a range of stakeholders for modernising the UK's airspace (which sets the direction, but does not include details or recommendations about specific structures or flightpaths). www.caa.co.uk/fas
Future Airspace Strategy Industry Implementation Group	FASIIG	Implementation group representing largely commercial aviation industry interests in FAS.
Future Airspace Strategy Visual Flight Rules Implementation Group	FASVIG	Implementation group representing VFR (Visual Flight Rules) community interests (including General Aviation) in FAS.
General Aviation	GA	Essentially all civil flying other than commercial airline operations, which therefore encompasses a wide range of aviation activity from powered parachutes, gliding and ballooning to corporate business jets, and includes all sport and recreational flying.
General Aviation traffic	GAT	See General Aviation.
Helicopter routes		Nominated airspace routes designed for use by helicopter traffic.
Holding patterns		Flight patterns adopted by aircraft to hold until cleared to land by air traffic control.
Holding stack		Airspace used to 'hold' aircraft until they are able to land at an airport. Heathrow airport has four stacks set by government.
Instrument approach procedure	IAP	A set series of aircraft manoeuvres from the initial approach to landing.
Instrument flight procedures	IFP	Procedures designed to international/ national criteria, published in the UK AIP, flown by aircraft with reference to ground-based or satellite-based navigation aids and most usually associated with arrival at or departure from an airport.
Instrument flight rules	IFR	The rules under which a pilot can fly and navigate an aircraft, in certain weather conditions, primarily through use of on-board instruments.
International Civil Aviation Organization	ICAO	The agency of the United Nations responsible for international standards for civil aviation which the UK is bound by international treaty to implement.
International Civil Aviation Organization standards and recommended practices	ICAO SARPs	Technical specifications set by the International Civil Aviation Organization for aviation, implemented and regulated national by states globally to manage safety risks.

Judicial review		A type of court proceeding in which a judge reviews the lawfulness of a decision or action made by a public body. A judicial review is a challenge to the way in which a decision has been made, rather than the rights and wrongs of the conclusion reached. The court will not substitute what it thinks is the 'correct' decision.
Lower air traffic services route	Lower ATS Route	An air traffic route notified in the UK aeronautical information publication in lower airspace.
Lower airspace		Controlled airspace below Flight Level 245 (a nominal altitude of 24,500 feet).
Magnetic variation		Magnetic variation is the angle on the horizontal plane between magnetic north (the direction the north end of a compass needle points, corresponding to the direction of the Earth's magnetic field lines) and true north (the direction along a meridian towards the geographic North Pole). Variation changes as the position of the magnetic North Pole drifts, affecting compass bearings.
Manual of Air Traffic Services Part II	MATS Pt II	A locally specific manual used by each air navigation service provider which underpins how its air traffic controllers manage aircraft, and in turn influences their decisions.
Military operations		Operations undertaken by military aircraft, or military aerodromes.
Name-code designators		Short standardised names for geographical coordinates.
National Air Traffic Management Advisory Committee	NATMAC	National Air Traffic Management Advisory Committee – an advisory body chaired by the CAA with representation across the UK aviation community, consulted for advice and views on airspace management and strategy matters.
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). www.nats.co.uk
Noise preferential route	NPR	Aircraft departing from certain airports follow set departure routes agreed by Government or the Local Authority, with the aim of providing certainty in respect of, and, where possible, minimising noise impacts on the ground. Noise Preferential Routes are not decided by the CAA nor covered by the processes described in this guidance.

Non-directional beacon	NDB	Radio transmitter at a specified location used by aircraft as a navigational aid.
Notified airspace design		Details of airspace structure and procedures published in the UK 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. (ICAO Doc 9613) https://www.icao.int
Prohibited area		An area of airspace of defined dimensions within which the flight of aircraft is prohibited.
Radio mandatory zone	RMZ	Defined airspace structure in which the carriage and operation of radio equipment is mandatory unless previously agreed.
Radio telephony coverage	R/T coverage	The volume of airspace that a radio frequency emanating from a particular transmitter/receiver site can operationally cover.
Required navigation performance	RNP	Type of performance-based navigation. See Performance Based Navigation.
Respite		Planned and notified periods where overflight or noise impact are reduced or halted to allow communities undisturbed time.
Restricted area		An area of airspace of defined dimensions within which the flight of aircraft is restricted in accordance with certain conditions.
Safety buffer requirement		CAA policy setting out requirements for a safety buffer between classes of airspace.
Secondary surveillance radar	SSR	Type of radar which both detects and sets position of aircraft in the air, and also receives information from the aircraft.
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	European project which concerns the roll-out of new technology across the European Union.
Single European sky regulations		Regulations which underpin the SES process.
Special visual flight rules	SVFR	A special case of operating under visual flight rules.
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.
Stakeholder		An interested third party in an airspace change proposal – neither the change sponsor nor the CAA or DfT.
Standard arrival route	STAR	Published flight procedures followed by aircraft on an Instrument Flight Rules (IFR) flightplan 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 (IAP) can be commenced.
Standard instrument departure	SID	Published flight procedures followed by aircraft on an Instrument Flight Rules (IFR) flightplan 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.
Terminal control area		Area of controlled airspace surrounding an airport.
Terminal manoeuvring area	TMA	A designated area of controlled airspace surrounding a major airport where there is a high volume of traffic.
Transponder mandatory zone	TMZ	Defined airspace structure in which the carriage and operation of transponder equipment is mandatory unless previously agreed.
Transport Analysis Guidance	WebTAG	DfT transport options analysis and modelling tool and associated guidance. https://www.gov.uk/guidance/transport-analysis- guidance-webtag
Uncontrolled airspace		Airspace in which aircraft are able to fly freely through the airspace without being constrained by instructions in routeing or by air traffic control, unless they require an air traffic control service.
Upper air traffic services route	Upper ATS route	An air traffic route notified in the UK aeronautical information publication in upper airspace.

Upper airspace		Controlled airspace above Flight Level 245 (a nominal altitude of 24,500 feet).
Upper information region	UIR	Flight information region in upper airspace.
VHF Omni Range and Distance Measuring Equipment	VOR/DME	Combination of two types of radio beacon placed together and used in the UK to provide an en-route navigation service.
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.
Visual reference point	VRP	Fixed point on land or sea used by pilots to fix position of their aircraft in relation to their route.
World geodetic system coordinates	WGS84 coordinates	Standardised global coordinate system used in navigation and Global Positioning Systems (GPS).