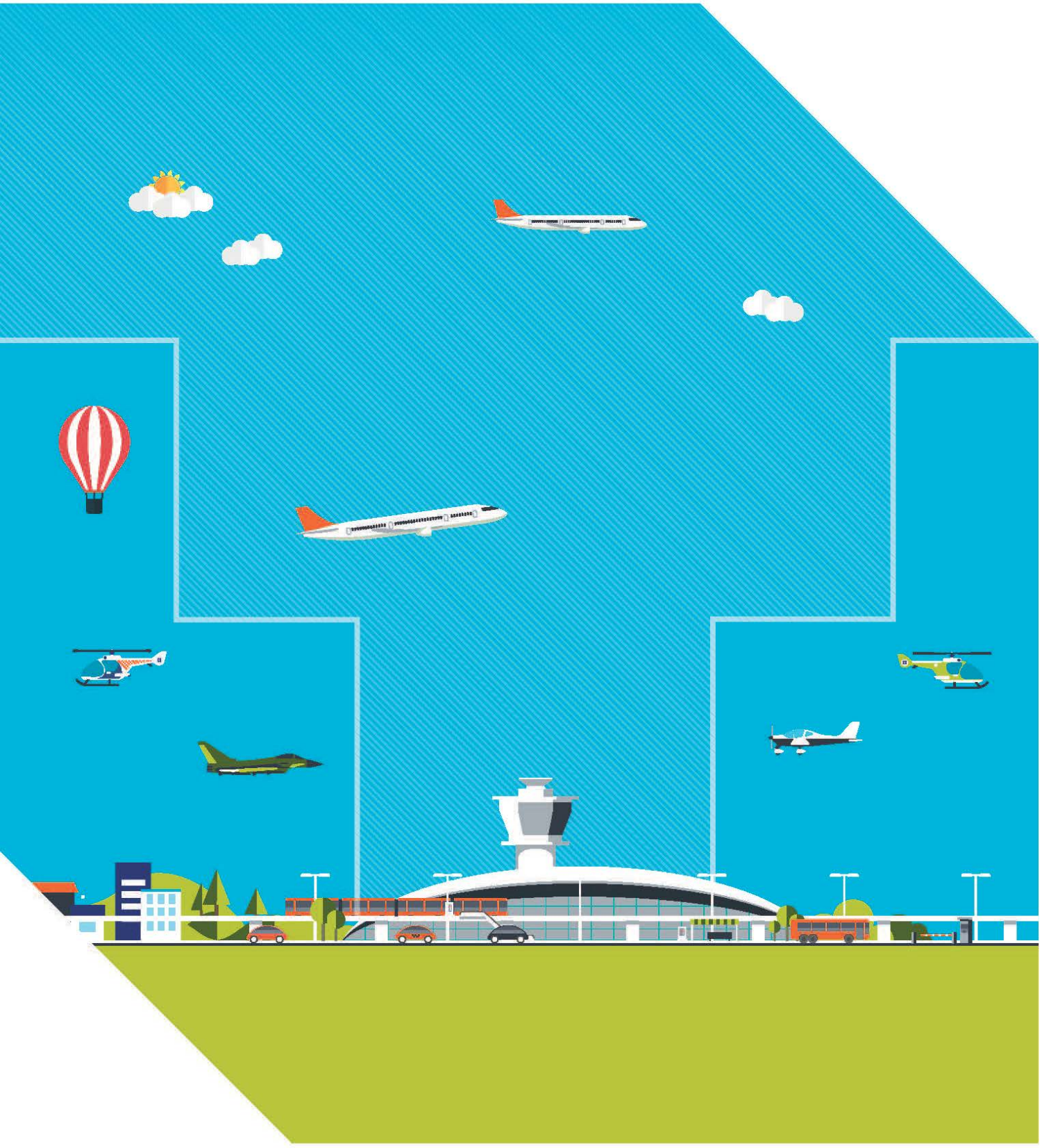
Airspace Modernisation Strategy

CAP 1711



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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. Unlocking the benefits of modernisation will make journeys faster and more environmentally friendly. Better airspace design can help with the management of noise impacts and improve access for other airspace users, including the Ministry of Defence, for whom airspace is a key resource.

2. UK airspace is some of the most complex in the world, yet its design dates back to the 1950s and 1960s. The Government has set out its support and objectives for the modernisation of UK airspace in its Green Paper[1] published in December 2018 in preparation for its forthcoming Aviation Strategy. Prior to this, in October 2017, the Government tasked the CAA with a key oversight role for airspace modernisation. Consistent with our role as specialist aviation regulator and our statutory responsibilities, we are required 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] The Green Paper also consults on some specific new government policies to support modernisation. https://www.gov.uk/government/consultations/a-new-aviation-strategy-for-the-uk-call-for-evidence

3. This Airspace Modernisation Strategy responds to that requirement, setting out the detailed initiatives that industry must deliver to achieve the objectives envisaged in current government policy. 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 by the CAA taking into account feedback from stakeholders.[2]

4. Working together, the Department for Transport and the CAA have developed a shared objective for modernising airspace. This is set out in full in Chapter 1, the Introduction. Airspace modernisation will need to be delivered and funded by a range of aviation organisations, and a wide range of stakeholders will need to be engaged throughout its delivery. The Department for Transport and the CAA are committed to working with relevant stakeholders and those tasked with delivery to ensure modernisation happens in a coherent and consistent way, giving rise to the benefits expected.

5. The strategy sets out the ends, ways and means of modernising airspace, initially focusing on the period until the end of 2024.[3] 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 industry-led working groups to draw up delivery plans, with delivery overseen by the CAA. One such plan will be a macro-level co-ordinated implementation plan (an airspace change masterplan) detailing which interdependent airspace changes are deemed necessary and when.

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2 The CAA published a draft for comments in July 2018. https://consultations.caa.co.uk/policy-development/draft-airspace-modernisation-strategy/

3 2024 corresponds to the end of the next Single European Sky Performance Scheme reference period (RP3). https://ec.europa.eu/transport/modes/air/single-european-sky/ses-performance-and-charging/performance-and-charging-schemes_en

6. We have also worked with the Department for Transport, NERL (the subsidiary of NATS that is 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 Board' chaired by the Aviation Minister. The Department for Transport 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 and a supporting Annex to this strategy document.

7. This new governance structure replaces the previous FAS groups, but many of them will remain as industry co-ordination groups that provide a useful focal 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. In presenting this first edition of an Airspace Modernisation Strategy to the Secretary of State, we begin this process. The CAA will review the strategy regularly in making our annual report in which we will measure progress against the delivery plans. The CAA will also take those opportunities to continue to update the strategy, bearing in mind the 2040 timescale specified by the Government, in order to accommodate new technologies or other developments. Where appropriate, the CAA may seek comments on these updates before implementing them, but will not do so in every case.

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

10. Chapter 2 sets out the roles and responsibilities of the Department for Transport, the CAA, NERL and other relevant stakeholders in the new governance structure.

11. 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.

12. In Chapter 4, 15 initiatives are identified focusing on the period until the end of 2024 as the primary ways of modernising airspace. They cover five areas of airspace infrastructure:

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

13. The 15 initiatives are summarised in Table 1 below showing the obligations[4] and timeframes.

14. Chapter 5 identifies that there are a number of current foreseeable 'unknowns' that could change and reshape the context for this strategy. While the current initiatives are enablers for further work to accommodate new airspace users such as drones, there are areas in which the

[4] Under the EU (Withdrawal) Act 2018 the Government is in the process of bringing EU aviation law into UK law, with certain responsibilities reassigned to the Secretary of State or the CAA.

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 deliver the services required by new types of airspace users. This could result in changes to current CAA or other charging mechanisms. We note what these gaps or emerging policies are, and note that they may shape future iterations of this strategy and associated delivery plans.

15. 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.

16. The need for these plans is addressed in Chapter 6. We explain that the CAA and Department for Transport, as co-sponsors of airspace modernisation, have tasked NERL with leading the FASI South programme to create, by June 2019, a single co-ordinated implementation plan for airspace changes in Southern England. This will be followed by further commissions for the creation of masterplans covering modernisation of the rest of UK airspace.

17. 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. Seven of the 15 initiatives are assessed as on track overall, with eight requiring attention.

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

Table 1 Summary of 15 initiatives

	Initiative		Obligation and timeframe*
Upper airspace	1	**Direct Route Airspace:** deployment of additional waypoints to the existing route network	EU legislation (by 2022)
	2	**Free Route Airspace:** removal of all fixed routes so aircraft can fly fully optimised routes	EU legislation (by 2022)
	3	**Advanced Flexible Use of Airspace:** new airspace designs, procedures and technology to increase options for airspace configurations, to support the efficient use of airspace and to best meet military requirements while being cognisant of civil airspace users.	EU legislation (by 2022) UK strategic ambition Known and emerging defence requirements (2018–2030)
Terminal airspace	4 5	**Terminal airspace redesign in Southern England** **Terminal airspace redesign in Northern England and Scotland** Fundamental redesign of the terminal route network using precise and flexible satellite navigation	EU legislation (by 2024) UK Government Airports NPS in the London terminal airspace (by 2024)
	6	**Queue management:** streaming traffic into and out of the terminal and absorbing delays in the upper airspace	EU 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 EU legislation (by 2024)
	8	**Satellite navigation route redesign:** redesign of new arrival and departure routes using satellite-based navigation standards	EU legislation (by 2024)
Uncontrolled airspace	9	**Review of Flight Information Service provision in the UK**	EU legislation (from 2022)
	10	**Airspace classification review:** including a review of air traffic services provision in uncontrolled airspace	EU legislation (from 2022) ICAO standards
	11	**Electronic surveillance solutions**	Fully interoperable electronic conspicuity solution (ongoing, likely CAA mandate in 2022–2024)
CNS and ATM infrastructure	12	**Cross-industry plan for the efficient use of radio-frequency spectrum**	Indirectly from EU legislation (ongoing)
	13	**Cross-industry plan for the full adoption of datalink communications**	EU legislation (from 2019)
	14	**A satellite-navigation implementation plan**	EU legislation (2020–2024)
	15	**Air traffic management**	EU legislation (by 2024)

* Under the EU (Withdrawal) Act 2018 the Government is in the process of bringing EU aviation law into UK law, with certain responsibilities reassigned to the Secretary of State or the CAA.

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 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.[5] 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 Department for Transport in 2017.[6] 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. Unlocking the benefits of modernisation will make journeys faster and more environmentally friendly. Better airspace design can manage noise impacts and improve access for other airspace users, including the

5 Beyond the horizon, the future of UK aviation, next steps towards an Aviation Strategy, HMG, April 2018.

6 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

Ministry of Defence, which requires more access to airspace to support a greater number of military aircraft.

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 positive monitoring and direction of air traffic control to maintain safe distances between them. **Uncontrolled** airspace typically incorporates areas where aircraft are not identified and managed by air traffic control, although they may request information or a more limited service from air traffic controllers. Airspace is further divided into classifications.[7]

1.3 The vast majority of commercial flights operate in controlled airspace. General Aviation and aerial sports operate largely in uncontrolled airspace below 6000 feet, alongside a few commercial flights. The military also has significant requirements to use both types of airspace and occasionally also operates within the confines of segregated training or danger areas.[8] 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, NERL (NATS En Route plc, the subsidiary of NATS which is air traffic control provider for upper airspace); at lower levels, airport operators and localised air traffic services providers; and the Ministry of Defence which has an interest in upper and lower airspace for diverse purposes.

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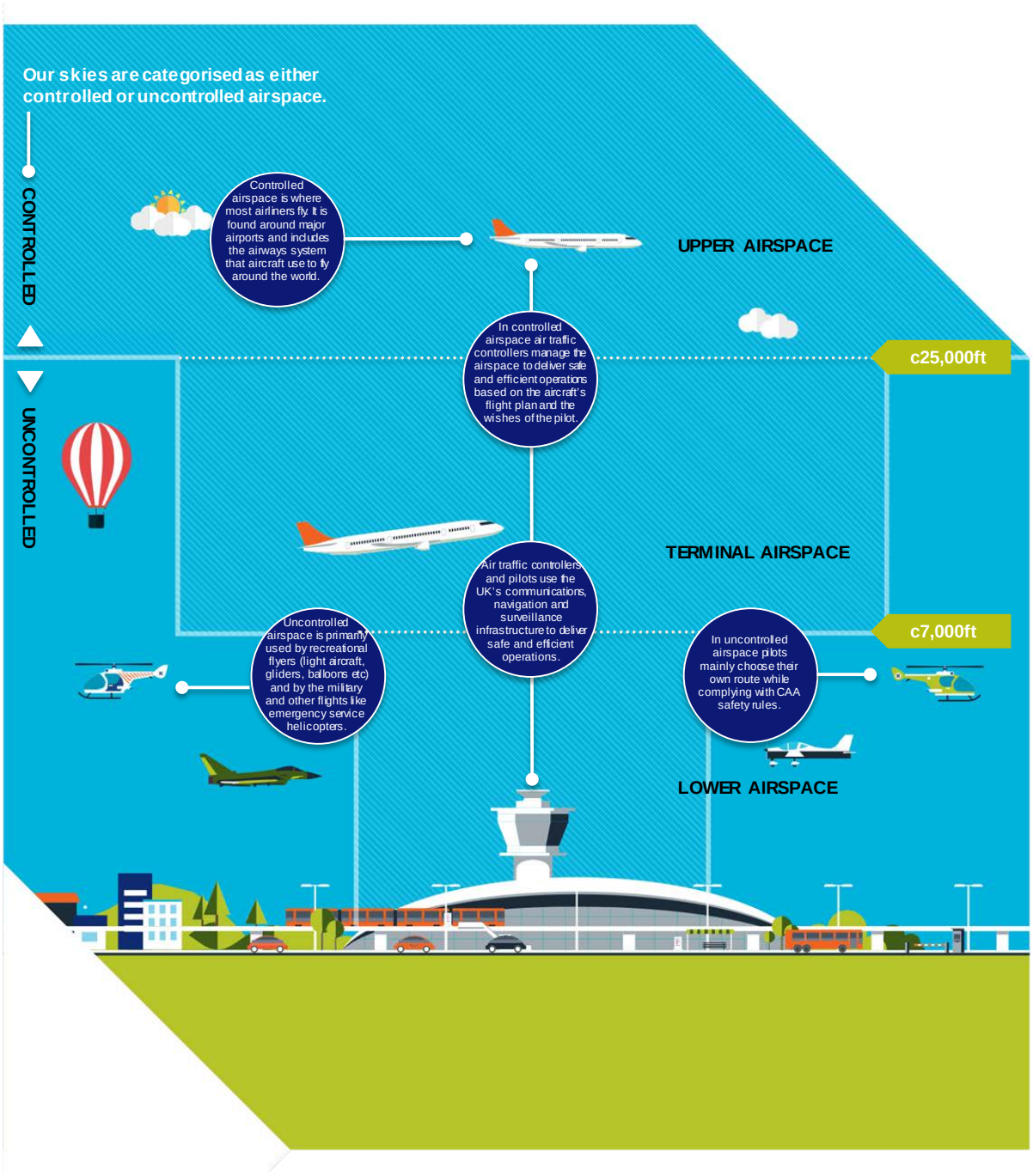
7 See https://www.caa.co.uk/Consumers/Guide-to-aviation/Airspace/How-is-UK-airspace-structured-/ and https://www.nats.aero/ae-home/introduction-to-airspace/.

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

Figure 1.1 Controlled and uncontrolled airspace



Note: this diagram is representational only and does not necessarily depict the specific areas in which airspace users operate.

1.5 UK airspace is also a key gateway between Europe and North America, the world's busiest intercontinental air corridor, and its efficient operation is crucial for international air traffic management.[9] 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.

1.6 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.

1.7 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 often constrain aircraft climb performance such that more time is taken for them to reach their optimum cruising altitude. This creates inefficiencies and results in greater fuel burn and more emissions. Flightpaths may not presently be optimised to reduce noise impacts or designed to offer relief from noise. This inefficient use of airspace causes unnecessary delays for passengers and significant air traffic control workload to manage bad weather or other forms of disruption. It also has 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.

1.8 In addition, military airspace requirements are constantly changing as a result of technological developments and Government direction. Military aircraft, land and maritime systems use the full range of upper, lower and

[9] 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).

terminal airspace, including all classifications of airspace. The UK and its allies are bringing into service more technologically advanced and capable fast jets together with other platforms such as Remotely Piloted Aircraft Systems (drones)[10] that have new airspace demands.

1.9 Drones can be remotely piloted or autonomous, and are used for civil or military aviation purposes. They may require changes to airspace structures and rules if they are to integrate seamlessly into UK airspace. They are an example of the different types of new technology airborne vehicles that the UK's skies are now hosting, in addition to accommodating increasing commercial flights, military activities and an active General Aviation sector. In the future, UK airspace will also need to accommodate commercial spaceflight, and other new technologies are constantly being developed. These technologies affect what flies, and also how vehicles are flown, meaning new concepts for operating aircraft are also emerging.

1.10 Such a high rate of change cannot be accommodated within the current airspace structure. Incorporating this ever more complex and growing mix of traffic requires advanced technological tools and air traffic solutions. For example, in 2019 the CAA will consult on proposals to mandate full electronic conspicuity – electronic or digital means for allowing airspace users to sense all others and be seen by all others – in order to unlock safety benefits, save lives and enable future airspace design to accommodate better sharing and access among different users of airspace, including commercial aviation, the military, General Aviation and drones. The economic and financial models that will be used to deliver the services required by new types of airspace users will also need to be developed.

10 Drones may be referred to by a variety of terms, including Unmanned Aerial Vehicles (UAV) and Remotely Piloted Aircraft Systems (RPAS). Further information is at www.caa.co.uk/Consumers/Unmanned-aircraft/Our-role/An-introduction-to-unmanned-aircraft-systems/.

1.11 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 already high safety standards. 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.

1.12 As noted above, modernisation is needed to meet future military requirements: access to larger portions of segregated airspace, weapons ranges and to meet other training requirements such as electronic warfare. To allow military aircraft to operate across the differing classifications of airspace, there is a need to standardise and ensure interoperability of airborne and ground systems, such as electronic conspicuity. This will help enable more flexible designs of airspace, improve safety and encourage integration rather than segregation.

1.13 Implementing new airspace design will affect overflown communities in different ways, for example in terms of facilitating an increased number of flights at some airports or changing the flightpaths that are used. Reducing noise impacts could itself be a driver for a new design. 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.

1.14 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. Military capability will be degraded and sub-optimal airspace solutions will have an impact on other users.

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

- 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, and
  - ensuring defence requirements are facilitated through access to appropriate airspace
- maximise the utilisation of available runway capacity, including the government's policy for a new runway at Heathrow airport
- enable government policies in respect of the reduction and mitigation of noise and how it should be distributed to manage the impact of aviation growth on local 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 safety and efficiency
- safely and efficiently accommodate new technologies that change the types of aerial craft and how they operate, for example drones and spacecraft
- 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.

1.16 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

1.17 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.

1.18 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.

1.19 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.

1.20 FAS addressed UK implementation of the EU's air traffic management Master Plan and deployment of SESAR (Single European Sky Air Traffic

Management Research, the technological pillar of the EU Single European Sky initiative).[11]

Developments in government policy

1.21 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.

1.22 The Department for Transport subsequently published new policies in October 2017, including new Air Navigation Guidance and new Air Navigation Directions to the CAA.[12] 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
- a greater emphasis on the aviation industry working with communities to manage noise impacts
- 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

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11 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.

12 Air Navigation Guidance 2017: Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management, Department for Transport, October 2017. 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.

- a commitment to give the CAA a new decision-making role over changes in air traffic control operational procedures that could result in a planned and permanent redistribution of air traffic, even though the airspace design itself is unchanged.

1.23 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.[13] The new process came into effect in January 2018.

1.24 The Government has most recently set out its support and objectives for the modernisation of UK airspace in its Green Paper[14] published in December 2018 in preparation for its forthcoming Aviation Strategy.

An updated airspace strategy to replace FAS

1.25 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:

- a new runway at Heathrow: outlined in the Airports National Policy Statement designated in June 2018[15], and any other runways used more intensively or due to be developed by 2040
- the need to co-ordinate multiple inter-related airspace changes across different airports

13 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.

14 The Green Paper also consults on some specific new government policies to support modernisation.

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

- potential policy changes arising from government reviews, such as more explicit policy on how noise must be considered, and relevant international policy changes
- the airspace requirements of the most advanced, known as 'fifth generation', military aircraft and other new military systems
- drones
- commercial spaceflight.

1.26 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**. This is consistent with the CAA's role as specialist aviation regulator and its statutory responsibilities.

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

1.28 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.

1.29 This Airspace Modernisation Strategy forms part of the Government's new arrangements to take forward the delivery of the airspace modernisation programme, which will be a cornerstone of its forthcoming Aviation Strategy. 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

1.30 Working together, the Department for Transport and the CAA have developed a shared objective for modernising airspace.

1.31 The Department for Transport 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 Department for Transport and the CAA are committed to working with relevant stakeholders and those tasked with delivery to ensure modernisation happens in a coherent and consistent way, delivering the benefits described above.

Department for Transport and CAA shared objective for modernising airspace

Objective

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

Parameters

- create sufficient airspace capacity to deliver safe and efficient growth of commercial aviation
- progressively reduce the noise of individual flights, through quieter operating procedures and, in situations where planning decisions have enabled growth which may adversely affect noise, require that noise impacts are considered through the airspace design process and clearly communicated
- use the minimum volume of controlled airspace consistent with safe and efficient air traffic operations
- in aiming for a shared and integrated airspace, facilitate safe and ready access to airspace for all legitimate classes of airspace users, including commercial traffic, General Aviation and the military, and new entrants such as drones and spacecraft
- not conflict with national security requirements (temporary or permanent) specified by the Secretary of State for Defence.

The Department for Transport and CAA will undertake further work to consider whether and how the impact of the objective can be assessed.

Later in this introductory chapter we explain the roles of the various parties involved in airspace modernisation. As context for the shared objective, the boxes below explain how airspace modernisation relates to:

- the CAA's decision-making role on individual airspace change proposals
- government policy on managing aviation noise.

How does this objective relate to the CAA's individual airspace decisions?

- Both the CAA's strategy and its individual airspace change decisions are governed by the factors set out in section 70 of the Transport Act 2000, and relevant Government policy and guidance.
- The objective for modernisation is drawn from section 70, and will guide the work the CAA does on the UK's national strategy.
- Separately from the objective, the way in which section 70 guides airspace change decisions is set out in detail in the CAA's guidance on airspace design (CAP 1616).
- The CAA's decisions will also be informed by decisions of relevant planning authorities, guidance and directions given to it by the Secretary of State and other relevant government policy.
- The CAA's airspace design guidance requires that evidence be developed to cover every factor in section 70, and shared with the CAA (and published on the airspace change portal).
- All airspace change proposals will be required to undertake a formal cost benefit analysis conducted in accordance with the Government's WebTAG methodology. This will enable the different costs and benefits of changes to be compared on a common basis and will be used to inform CAA's decisions.
- For each proposal, WebTAG is used to measure and compare the adverse health impacts of aviation noise, to help the sponsor design – and the CAA consider – the option that creates the best possible noise outcome alongside all other factors in section 70.

How does this objective relate to government noise policy?

- The objectives of the Airspace Modernisation Strategy (AMS) interact with wider government policies on noise. This section provides context about this interaction.
- The AMS objective and parameters set out above provide a set of deliverables that the AMS is responsible for. They do not aim to encapsulate the entire government policy on aviation noise. Instead, the noise objective aims to identify where airspace has a specific role relating to noise. For example, while the Government continues to expect the ICAO Balanced Approach to be followed, the objective focuses on the measures within the Balanced Approach where airspace is most relevant. The AMS aims to progressively reduce the noise of

individual flights, through quieter operating procedures. In situations where planning decisions have enabled growth which may adversely affect noise, noise impacts are considered through the airspace design process and clearly communicated.[16]

- The AMS can only be responsible for delivering noise reduction where it has an element of control. Where a decision has been taken through the planning process to increase airport capacity, this is outside the responsibility of the AMS. The objective therefore does not focus on the overall level of noise as this is contingent on planning decisions.
- When an airport is changing airspace (for a planned increase in capacity or any other reason) it must develop its design proposal in accordance with policy and law. This means adhering to the CAA's airspace change process, through which WebTAG is used to measure and compare the adverse health impacts of aviation noise, to help the sponsor design – and the CAA consider – options that manage noise impacts using health assessments and consultation responses, and consider noise alongside all other factors in section 70.
- The Government will articulate its overarching objective on aviation noise through the Aviation Strategy.
- The Aviation Strategy will consider whether, where there is new airport growth which requires approval through the planning process, this should be accompanied by a noise cap which balances noise and growth and gives communities future certainty around noise.
- It is therefore important to note that at some airports, where a planning authority has placed a condition which limits the number of aircraft or passenger movements, and where an airport has reached that limit, additional airspace capacity created to deliver safe and efficient growth of commercial aviation can only be used if and when planning approval is given for airports to grow.
- Through the Aviation Strategy, the Government will also consider proposals for the creation of a new national performance indicator (KPI) which can be used to track the long-term performance of the UK aviation industry in reducing noise at a national level. We also want to ensure that there are suitable mechanisms in place to deliver noise reduction at airport level which are measurable and enforceable and thereby contribute to the national noise KPI.

16 Aiming to reduce the noise of individual flights means aiming for an average reduction per flight. It does not mean that there will be a reduction in noise on every individual flight, or that there will necessarily be an overall reduction in noise, as this will be dependent on the overall number of flights.

Stakeholders affected

1.32 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. Timely access to appropriate airspace is essential for the maintenance of military capability. Airspace modernisation must enable this while minimising impact on other users. Airspace modernisation is also 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 spacecraft.
- **For airports,** the sharing of accurate flight information about traffic using our airspace is expected to improve runway throughput and resilience. Additional airspace capacity will provide airports with the scope to develop their operations in line with their business plans (subject to planning considerations). 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[17],** airspace modernisation offers environmental improvements because aircraft can 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. Airports should also consider whether they can develop airspace change proposals to reduce noise, i.e. to reduce the total adverse health effects of noise. Where aircraft are able to follow more fuel-efficient routes, wider society will also benefit because fewer CO_2 emissions will reduce greenhouse-gas impacts.

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

1.33 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, initially focusing on the period until the end of 2024.[18] To establish the **means** of delivering modernised airspace, such as the resources needed, this strategy requires industry-led working groups to draw up delivery plans, with delivery overseen by the CAA. One

17 When referring to 'communities' this strategy document generally means those on the ground affected by aviation's environmental impacts in the vicinity of an airport, usually by noise but also sometimes local air quality (where there is an impact on the distribution or volume of emissions below 1000 feet). Communities may in turn be represented in different ways: by local authorities and elected representatives in national or local government; community leaders or representative groups/forums, airport consultative committees, and bodies with an interest in aviation's environmental impacts.

18 2024 corresponds to the end of the next Single European Sky Performance Scheme reference period (RP3). https://ec.europa.eu/transport/modes/air/single-european-sky/ses-performance-and-charging/performance-and-charging-schemes_en

such plan will be a macro-level co-ordinated implementation plan (an airspace change masterplan) detailing which interdependent airspace changes are deemed necessary and when. This itself will require a timeline of airspace change proposals needed as part of a modernisation effort, and a critical path outlining the deadlines for individual airspace change proposals within it.

1.34 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. An airspace change masterplan will therefore be a crucial element in airspace modernisation. This is discussed in Chapter 6 in the context of the coordination role that NERL will carry out.

1.35 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.

1.36 The main **ways** in which these **ends** should be delivered, namely by updating airspace designs, operational procedures and enabling technologies through 15 initiatives, are described in Chapter 4.

1.37 This strategy does not pre-empt specific solutions and allows space for innovation. There are other ends which airspace modernisation may need to deliver that are still being developed in detail – for example, the approach to integrating drones with aircraft that have a pilot on board. The initiatives set out in Chapter 4 also act as enablers for further work on accommodating drones and other new airspace users, and as we develop the strategy in the future, we will add more detail on how to integrate these new users. Current gaps such as these are considered in Chapter 5.

Reviewing the strategy

1.38 The CAA will review the Airspace Modernisation Strategy regularly in order to report to the Secretary of State annually on its delivery and to measure progress against the delivery plans. The CAA will also use those opportunities to continue to update the strategy, bearing in mind the 2040 timescale specified by the Government, in order to accommodate new technologies or other developments. This will include the need to consider developments in neighbouring air traffic management areas, especially our European neighbours, given the need to manage traffic effectively end to end. Where appropriate, the CAA may seek comments on these updates before implementing them, but will not necessarily do so in every case.

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[19] (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[20] 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 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.

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19 The Civil Aviation Authority (Air Navigation) Directions 2017 as amended by The Civil Aviation Authority (Air Navigation) (Amendment) Directions 2018. https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Commercial_industry/Airspace/Airspace_change/2017%20Directions%20as%20amended%20by%202018%20Directions.pdf

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

2.6 The Directions give the CAA responsibility for deciding whether to approve a proposal for a change to the published design of airspace, administering the airspace change process and providing guidance on the process to stakeholders (Direction 4).[21] 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).[22] The Directions were amended to give the CAA a new decision-making role over changes in air traffic control operational procedures that could result in a planned and permanent redistribution of air traffic.

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 or reduce 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.[23]

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 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

21 The CAA's process and guidance is set out in CAP 1616 and associated documents, as referenced in Chapter 1. www.caa.co.uk/cap1616

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

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

stakeholders. While some changes to the UK's airspace design can be contentious with aviation stakeholders and local communities, it is a key 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.[24]

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 Department for Transport. 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 (known as terminal air navigation services), while NERL (the air navigation service provider for en-route airspace, as discussed below) will typically sponsor changes to upper airspace, where traffic is in the cruise phase of the flight away from the airport environment.

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

[24] https://airspacechange.caa.co.uk

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

2.15 There are two elements to these terminal air navigation services:

- the 'radar approach and departure' (approach control) service, and
- the aerodrome control service.

2.16 These two elements of terminal air navigation services are provided by the airport (acting as an air navigation service provider) itself, or by a third-party air navigation services provider (for example, NATS (Services) Ltd, see below). Thus an airspace change that affects a number of airports may involve or affect multiple air navigation services providers.

NATS

2.17 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 commercial basis. This strategy document concerns NERL only, and not the commercial work of NSL. NERL is the sole provider of air traffic control services for aircraft flying 'en route' in UK airspace[25] 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 efficiency of air navigation services, through setting targets to drive performance in four key performance areas (safety, environment, capacity, and cost-efficiency)

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

- 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 co-ordinated 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.
- a performance plan proposed by the CAA, including targets and incentives, that covers NERL's monopoly en-route and London Approach air navigation service activities, for adoption by the Government. The performance plan has to be approved by the European Commission. NERL is required to report on its performance and delivery against targets.[26]

Airspace users

2.18 Airspace users include airlines and other commercial operators, General Aviation, the Ministry of Defence, and new entrants such as drones and spacecraft. The definition of General Aviation can vary, but essentially it means all civil flying other than commercial airline operations. It 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. Airspace users are required to have the necessary aircraft equipage to use the modernised airspace design, and to ensure that the associated operational procedures are introduced and that pilots are appropriately trained.

Stakeholders impacted by airspace change

2.19 There are stakeholders who may be impacted by individual airspace changes, and who may also be interested in the national policy and

[26] 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.

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

2.20 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

2.21 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.

The Civil Aviation Authority (Air Navigation) Directions 2017

2.22 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

2.23 In October 2017 the Direction to "prepare and maintain a co-ordinated 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

2.24 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, as amended by The Civil Aviation Authority (Air Navigation) (Amendment) Directions 2018. 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. As noted in paragraph 2.6, the 2018 amendment gave the CAA a new decision-making role over the way airspace is used within an existing design.

Section 70 of the Transport Act 2000

2.25 Section 70 of the Transport Act 2000[27] 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

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

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[28] consistent with the safe operation of aircraft and the expeditious flow of air traffic[29]
- it satisfies the requirements of operators and owners of all classes of aircraft
- it takes account of the interests of any person[30] (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
- it takes account of any international obligations of the UK notified to the CAA by the Secretary of State.

2.26 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

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28 As set out in CAP 1616, the CAA interprets "the most efficient use of airspace" as: *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.* In addition, the CAA may consider multiple factors in assessing a proposal against the duty of making the most efficient use of airspace. Those factors may also be relevant to the CAA's other section 70(2) duties.

29 As set out in CAP 1616, the CAA interprets "expeditious flow" as: *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.*

30 As set out in CAP 1616, the CAA interprets 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.

minimum restrictions which are consistent with the exercise of those functions.

2.27 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. The objective for airspace modernisation also reflects section 70. The way in which we apply section 70 in our airspace change decision-making role is set out in detail in our CAP 1616 guidance (Appendix G).

Air Navigation Guidance 2017

2.28 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.[31]

2.29 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.[32] 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 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

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

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

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

2.30 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 including SESAR (SES ATM Research), 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.[33]

EU law

2.31 The Single European Sky (SES) initiative[34], through its regulatory framework and the SESAR air traffic management Master Plan[35], sets out a range of airspace and air traffic management modernisation. SES aims to increase the efficiency of air navigation services to cope with traffic growth. It sets requirements for EU States and those that have agreed to follow EU law through basic and implementing legislation. The extent to which the UK will continue to be bound by EU law is uncertain at the time of writing, but will become clearer as the UK's exit from the UK approaches.[36]

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

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

35 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 Master Plan 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 Master Plan 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.

36 Under the EU (Withdrawal) Act 2018 the Government is in the process of bringing EU aviation law into UK law, with certain responsibilities reassigned to the Secretary of State or the CAA.

2.32 Under the SES initiative, a number of implementing regulations covering technical interoperability, safety, airspace and performance have been adopted and implemented. Two key regulations that directly impact on airspace are Common Requirements and Standardised European Rules of the Air.

2.33 EU Regulation 2017/373[37], 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).

2.34 EU Regulation 923/2012[38] 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.

2.35 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 the rest of Europe. Irrespective of the outcome of the UK's exit from the EU, the UK will remain part of the pan-European air traffic management system and have co-operative arrangements with other European States, principally through its membership of the EUROCONTROL intergovernmental organisation, industrial partnerships such as Borealis and, currently, the

37 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.

38 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].

UK-Ireland Functional Airspace Block.[39] Subject to the terms of the UK's exit from the EU, the UK consequently remains fully committed to continuing to contribute the necessary technical resources to SESAR and EASA initiatives in air traffic management in order to remain aligned with European air traffic modernisation.

New governance structure for airspace modernisation

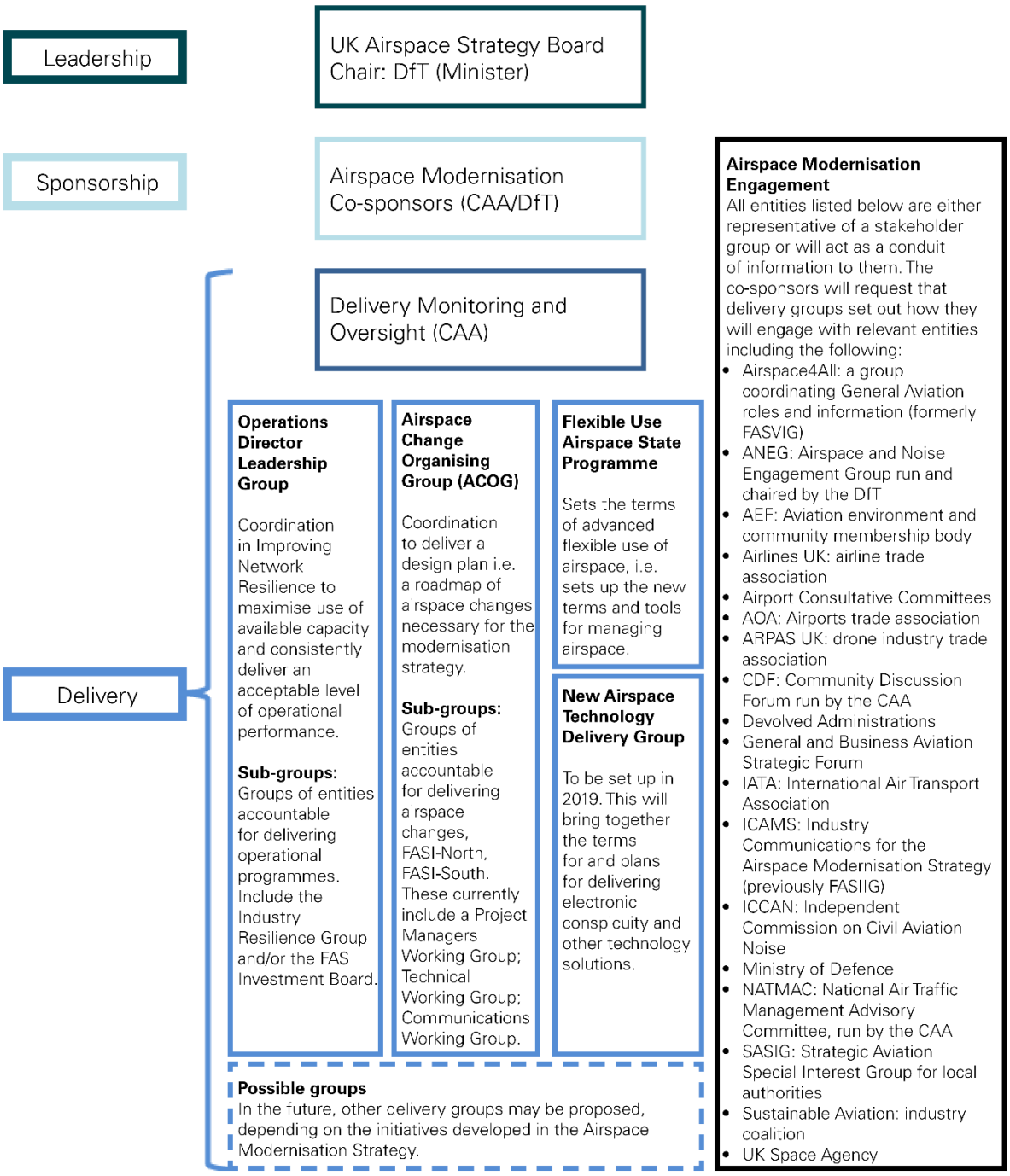
2.36 The Department for Transport and the CAA worked with NERL and the Infrastructure and Projects Authority to develop a new governance structure for airspace modernisation.

2.37 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. Accompanying this strategy document is the Governance Annex co-authored with the Department for Transport, which names all the different groups in the structure and their role.

2.38 At the delivery level there will be a series of industry organisations, brought together into co-ordinated 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 Chapter 4 of this strategy to deliver modernised design, operations and technology. The Governance Annex gives a list of groups that exist at the time of writing this strategy. Two of these groups, FASI-S and FASI-N, are being supported by a project management function that is being set up by NERL. The Governance Annex provides further detail.

39 See https://www.nats.aero/about-us/ses/alliances/ for more on Borealis and https://www.nats.aero/about-us/ses/uk-ireland-fab/ for more on the UK/Ireland Functional Airspace Block.

Figure 2.1 Governance structure for the Airspace Modernisation Strategy



Note: The Governance Annex provides further detail about the groups shown.

2.39 More groups, or amendments to the membership or roles of existing groups, may become necessary in the future, as the work to deliver the initatives changes or matures.

2.40 Between the delivery groups and the co-sponsors is a new Delivery Monitoring and Oversight function to be undertaken by the CAA. It will:

- monitor progress across all initiatives in the Airspace Modernisation Strategy
- act as the point of escalation for delivery groups and as a gateway between them and the co-sponsors (which may in turn escalate to the Minister)
- engage directly with delivery groups
- monitor risks and oversee delivery so that outputs accord with policy and legislation.

2.41 The Delivery Monitoring and Oversight function will not have decision-making powers nor influence the quality of airspace design (which must happen through the airspace change process).

2.42 The Department for Transport and CAA have a shared role as co-sponsors. They will ask the Chair of each delivery group to write Terms of Reference for how the group will operate, how stakeholders listed in the governance structure will be engaged, and that commit to producing and publishing minutes of working group meetings.

2.43 The Aviation Minister-chaired UK Airspace Strategy 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 devolved administrations and local government, the CAA and Ministry of Defence; NERL; commercial aviation including airports and airlines; General Aviation; and community and environmental groups.

This group sits at the top of the governance structure. Information about this group will be available on the Department for Transport's website.[40]

2.44 Alongside the groups that have strategy and delivery roles is an engagement plan, with stated commitments to consider the views of several industry and community groups, as noted above.

2.45 This governance structure replaces the previous FAS groups, but many of them will remain as industry co-ordination groups that provide a useful focal point and mechanism for including representation of particular stakeholder interests. For example, organisations such as Airspace4All Ltd (formerly FASVIG, the Future Airspace Strategy VFR Implementation Group Ltd) exist as a way of ensuring General Aviation organisations are involved in airspace modernisation and have representation and a focused point of engagement.

2.46 The structure is designed to support our airspace modernisation objective. The sponsors may recommend different or more radical options later on if progress is not sufficient and governance is a cause.

2.47 In the Governance Annex there is further information about all the roles set out in this governance structure, including the role of the co-sponsors; how the Delivery Monitoring and Oversight function will be set up in the CAA; the membership of the working groups, which initiatives they are delivering and how they will be expected to engage with stakeholders.

Potential tensions between roles in airspace modernisation

2.48 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

40 https://www.gov.uk/government/organisations/department-for-transport

to make such conflicts transparent and, where possible, better manage them.

Decision-making

2.49 Later in this document we describe Government-led work to consider, through the Aviation Strategy, new policies to compel the development of an airspace change proposal that is necessary, but for which no sponsor is forthcoming. If these policies are adopted, the 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 an airspace change masterplan that the co-sponsors (CAA and Department for Transport) are commissioning from NERL, which the CAA will need to technically assure. To understand whether to trigger the use of a power or policy to require that an airspace change proposal is developed, the CAA's new Delivery Monitoring and Oversight team will track delivery of the masterplan and monitor any potential delays or risks.

2.50 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) commissioning a masterplan of airspace changes, tracking its delivery, and advising on whether powers to force an airspace change to be developed should be triggered; and

b) deciding whether the masterplan is technically robust and deciding whether the final proposal produced for any individual airspace change should be approved.

2.51 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.

NERL

2.52 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 as well as being a stakeholder where changes are proposed in lower airspace.

2.53 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 airspace change masterplan required the change. Tensions could arise where there is an actual or perceived conflict from NERL taking on or initiating an airspace change proposal in such circumstances.

Challenges with delivery

2.54 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.

2.55 Chapter 5 explores how to address the issue of an airport or NERL 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 airspace change masterplan 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 known 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.

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.[41]

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.[42] The UK's transition to a route structure designed using satellite-based navigation is recognised by the Government in recent guidance.[43] The widespread

41 Commission Implementing Regulation (EU) Regulation 2018/1048 laying down airspace usage requirements and operating procedures concerning performance-based navigation.
Commission Implementing Regulation (EU) Regulation 2017/373 laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight.
Commission Implementing Regulation (EU) Regulation 2017/386 laying down requirements for the performance and the interoperability of surveillance for the Single European Sky.

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

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

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.[44]

3.4 Another example of a vital programme to aid airspace modernisation is the electronic conspicuity of users of UK airspace, whereby using electronic or digital means users can sense all others and be seen by all others. This will unlock safety benefits, save lives and enable future airspace design to accommodate better sharing and access among different users of airspace.

The ends that modernised airspace must deliver

3.5 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, the Air Navigation Guidance 2017, which

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

sets out how carbon emissions, air quality and noise should be considered

- **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
- **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.

3.6 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.

3.7 Across all of these – and related to efficiency in particular – is the need to enable growth. In December 2018, the Government published a Green Paper consulting on how it sees sustainable growth being delivered, in preparation for its forthcoming Aviation Strategy. This followed its 'Beyond the Horizon' document (a response to the Aviation Strategy call for evidence) published in April 2018, in which the Government said that there is a need to increase aviation capacity in the South East and that it wants to ensure that this growth is sustainable.[45] The Government has also published a policy on making the best use of existing runways.[46] The sustainable growth of aviation is therefore also a clear end that airspace modernisation must deliver.

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45 Beyond the horizon, the future of UK aviation, next steps towards an Aviation Strategy, paragraphs 6.2 and 6.4, HM Government, April 2018. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698247/next-steps-towards-an-aviation-strategy.pdf

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

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

3.9 In circumstances where the CAA believes the policy framework or evidence base does not provide a clear solution to any trade-offs that arise between the delivery of airspace modernisation initiatives or the different airspace design changes identified in the forthcoming airspace change masterplan, we will request guidance from the Government. Public policy ultimately rests with our democratically elected Government, and the regulator should act in accordance with policy and legislation.

Maintaining and enhancing high aviation safety standards

3.10 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.

3.11 The pace of change across the aviation industry is set to quicken. Traffic levels across the commercial, General Aviation and military sectors are forecast to rise, coincident with new innovations such as drones, which are already proliferating. There is a consensus that airspace modernisation is required to enable innovation while at the same time maintaining high standards of aviation safety. This includes reducing the complexity of airspace structures 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.[47]

3.12 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

[47] State Safety Programme for the United Kingdom. https://www.caa.co.uk/Safety-initiatives-and-resources/How-we-regulate/UK-State-Safety-Programme/

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.

3.13 One of the areas of greatest concern in uncontrolled airspace is the risk of mid-air collision where military, General Aviation and some 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 conspicuity 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.

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

3.15 As a vital aid to the Airspace Modernisation Strategy the CAA therefore wishes to ensure that there is full electronic conspicuity of UK airspace users, in order to unlock safety benefits, save lives and enable future airspace design to accommodate better sharing and access among different airspace users, including commercial aviation, military, General Aviation and future users such as drones.

Securing the efficient use of airspace and enabling integration

3.16 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.

3.17 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.[48] Modernisation must accommodate growing traffic levels to secure the most efficient use of airspace and the expeditious flow of traffic.

3.18 In today's airspace, to assure the safety of commercial air transport flights using the UK's controlled airspace and route network, General Aviation is constrained to an extent by the segregation between controlled and uncontrolled airspace. However, the forecast growth in traffic and technological advancements will require access to, and management within, the finite volume of UK airspace. To facilitate access by all airspace users to the greatest extent possible, there must be a transition towards greater integration of air traffic, where it is safe to do so.

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

Achieving this will require a consideration of new airspace designs, operating procedures, technologies and equipment.

Avoiding flight delays by better managing the airspace network

3.19 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.

3.20 In April 2017, a group of airports and airlines based in the congested South East, together with NATS, the airport slot-coordinator Airport Coordination Ltd and the CAA, formed the Industry Resilience Group. The purpose of this group is to pool expertise and recommend actions (for industry itself, or for the Government as part of its expected review of Aviation Strategy) to address shorter term resilience issues.

3.21 The output will support a systemised approach to the way in which the UK's aviation network is planned and operated to enhance its day-to-day operating resilience, reduce delays and the associated costs to both industry and passengers.[49]

3.22 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. By 2017, this had risen to 160,075 minutes and would have risen further had mitigating capacity improvements not been implemented.[50] These delays, while not substantial, were forecast to grow

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49 https://www.caa.co.uk/Consumers/Guide-to-aviation/Improving-resilience-for-UK-airports-and-airspace/

50 Data provided by NATS.

to 5.6m minutes by 2030 if airspace modernisation is not delivered successfully. This is equivalent to an average of 26.5 minutes of delay per delayed flight, with more than 1 in 3 flights from all UK airports expected to depart over half an hour late due to airspace capacity shortfalls.[51]

3.23 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 air traffic control 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, reduce the effective capacity of the airspace network and create delays.

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

3.25 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 often have

51 www.gov.uk/government/publications/upgrading-uk-airspace-strategic-rationale. Note that this analysis deals solely with NATS-attributable delay caused by a shortfall in airspace capacity. It does not include weather related delay, nor delay due to NATS' staffing or technical issues.

to fly sub-optimal routes, at less efficient altitudes and speeds, to avoid bottlenecks in the airspace network.

3.26 Flights in lower airspace that are transitioning between the take-off or landing phase and the cruise in upper airspace would 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.

3.27 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. Growing 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

3.28 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. Reducing noise impacts could itself be a driver for a new design. 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.

3.29 In 2017 the Government issued revised environmental guidance to the CAA to clarify that in assessing the number of people 'significantly

affected by aircraft noise', the total adverse effects must be considered.[52] This clarification of existing policy builds in an assessment of health impacts into airspace change proposals so that, for example, the creation of a respite route could reduce the total adverse health effects while increasing the absolute number of people affected. As a result, the aviation industry is required to consider options when designing airspace to find ways to manage the distribution of noise that best reflects this policy objective.

3.30 The CAA will review every initiative in the strategy in 2020, once the Government's Aviation Strategy is finalised, to determine whether the initiatives are compatible with noise policy. We may, at that point, strengthen the requirements or detail as to how initiatives should be delivered to comply with such noise policy.

Facilitating defence and security objectives

3.31 The military relies on access to 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. Over the next few years the number and capability of fast jets will increase, requiring larger portions of airspace for training; a new maritime patrol aircraft will be introduced; and Remotely Piloted Air Systems (drones) will be based in the UK.

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52 Air Navigation Guidance 2017: Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management, Department for Transport, October 2017. https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017
Section 70(2) of the Transport Act 2000 requires the CAA to take account of any guidance on environmental objectives given to the CAA by the Secretary of State in exercising its air navigation functions.

3.32 Airspace for military training should provide aircrew with the ability to simulate realistic ingress/egress distances and weapons employment while defending against enemy tactics in a contested environment. Much of the current special-use airspace was developed to support the training needs of aircraft that are now retired, and it is neither optimal for current missions nor emerging requirements. With the transition to the latest generation of military fast jets, the need for specialised training airspace will continue to evolve. Although tactical training for this latest generation does include the use of ground-based simulators and training systems, it is anticipated that it will also drive greater airspace requirements over the next 10 years. To exercise the full capability of 'fifth generation' systems and present a sufficient training challenge, airspace must provide the size, structure and manoeuvring area to exercise tactics and employ weapons.

3.33 Some areas of the UK's airspace are therefore segregated for military use, 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, systems and processes can help to secure the most efficient use of airspace consistent with safety, defence and security objectives by creating greater opportunities and options for segregated airspace use, while allowing traffic to use potential segregated areas more effectively when they are not in use.

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. Fifteen initiatives are identified, focusing on the period until the end of 2024, 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 and air traffic management.

Each initiative is described in terms of the main airspace design, operational concepts and technologies. Key dependencies are also highlighted.

Introduction

4.1 A comprehensive modernisation programme across UK airspace is needed to achieve the ends described in Chapter 3. 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 and procedures for segregated airspace that accommodate defence requirements and ensure efficiency.
- **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:
  - modernise airport arrival and departure routes to increase the throughput of traffic and better manage aircraft noise impacts; and
  - reconfigure 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 drones. 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 and air traffic management,** focusing respectively on:
  - the transition from primary radars, radios and ground beacons to satellite-based and datalink technologies
  - the modernisation of air traffic management systems and tools that gather and share operational and planning information with air traffic controllers, pilots and other stakeholders.

4.2 Defence airspace modernisation requirements cut across all airspace types. They will therefore be met by several initiatives in this strategy, but also by other changes in airspace design which may be proposed outside these initiatives, including at lower altitudes and outside controlled airspace.

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

Upper airspace

4.4 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.

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

1. optimising Direct Route Airspace
2. the introduction of Free Route Airspace
3. Advanced Flexible Use of Airspace.

4.6 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. Direct Route Airspace was introduced to key parts of the UK's upper airspace in March 2016, and its use is being optimised through close collaboration with the airline community.

4.7 Free Route Airspace is a further improvement of the Direct Route Airspace concept that sees the removal of all established routes from the upper airspace, allowing aircraft to follow the most efficient flightpath to

their destination using intermediate points only where necessary. 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 flightpaths taking into account flight time, fuel burn, network delays and the weather.

4.8 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 that defence and security needs are met and that the limited resource is otherwise used as efficiently as possible. Advanced Flexible Use of Airspace (AFUA) concepts will upgrade the airspace structures, procedures and technologies used to manage segregated areas. This will improve military mission effectiveness by providing suitably sized and located training airspace, while enabling increases in capacity and flight efficiency by allowing civil traffic to route directly more frequently when hazardous activities are not taking place.

4.9 In catering for military requirements in upper airspace, the AFUA initiative may also include terminal airspace and may need to be coordinated with changes in uncontrolled airspace.

4.10 The implementation of Free Route Airspace and the upgrades to implement AFUA are required by EU 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 routes in the upper airspace before 1 January 2022. The implementation of Direct Route Airspace in the UK in 2016 is a stepping stone towards Free Route Airspace. Improving the management of Flexible Use Airspace is also a UK strategic ambition to accommodate the next generation of military aircraft that require greater volumes of airspace for testing and training.

4.11 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.	EU legislation SESAR Pilot Common Project AF3 (by 2022, compliance achieved in 2016)	**Safety:** Additional airspace capacity reduces the risk factors associated with traffic congestion and peaks in controller workload. **Efficiency:** Increasing the number of route options available to airspace users 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:** The military has efficient and effective access to suitably sized and sited volumes of airspace to complete its missions. 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 routes so aircraft can fly fully optimised routes.	EU legislation SESAR Pilot Common Project AF3 (by 2022)	
3) Advanced Flexible Use of Airspace New airspace designs, procedures and technology to increase options for airspace configurations, to support the efficient use of airspace and to best meet military requirements while being cognisant of civil airspace users.	EU legislation SESAR Pilot Common Project AF3 (by 2022) UK state requirements	

Terminal airspace

4.12 The terminal airspace from c.25,000 feet to c.7000 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.

4.13 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
6. the introduction of better queue management capabilities into terminal airspace.

4.14 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.

4.15 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.

4.16 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 co-ordinate 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 one to two minutes rather than the eight 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. NERL will be undertaking further work to identify where there are other interdependencies between different airports' demands for airspace, such as the impact of holding stacks on departure flows from neighbouring airports (see Chapter 6).

4.17 The queue management initiative is supported by the introduction of Airport Collaborative Decision Making (A-CDM) systems at larger airports, enabling better-informed, more consistent decision-making. A-CDM introduces new systems and processes to create, refine and exchange up-to-date runway and airspace data between the airport, air traffic control, airlines and ground handlers, including:

- the progress of each flight turnaround
- times for each flight to push back from stand and take off
- optimal departure sequencing to maximise runway and airspace performance.

4.18 A-CDM gathers the latest estimated landing times for inbound flights from arrival management tools to improve the management of ground operations that are often the cause of air traffic delays.

4.19 A-CDM also allows air traffic controllers to construct an optimised sequence of departures. A-CDM co-ordinates the process by which departing aircraft are granted permission to push back from the stand, using a key tool which calculates an optimal time for each flight to begin its start-up and departure sequence. The calculation is based on the

departure plans of other aircraft, the performance of the runways and the capacity of the airspace.

4.20 A-CDM also provides network management organisations and air traffic controllers with departure planning information about each flight allowing them to optimise traffic flows across UK and European airspace. Electronic messages are submitted from the airport to the European Network Manager Operations Centre at the exact time that each aircraft pushes back from the stand, and also give target take-off time, taxi time to the runway, actual take-off time and route through the airspace. This information is then relayed to local air traffic control centres across the UK and Europe.

4.21 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 1 January 2024. The performance of queue management solutions is enhanced if they are integrated across neighbouring states. The SESAR European air traffic management Master Plan sets out the ambition for cross-border queue management that allows air traffic controllers from multiple states to work together to use the solutions to optimise the flow of traffic and avoid delays.

4.22 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 and any more intensive use of other runways as laid out in the Governments Airports National Policy Statement.

4.23 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.	EU legislation SESAR Pilot Common Project 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.
6) Queue management Streaming traffic into and out of the terminal and absorbing delays in the upper airspace.	EU legislation SESAR Pilot Common Project AF1 (by 2024) SES air traffic management Master Plan ambition (regarding departure management and cross-border queue management)	**Environment:** Greater precision and flexibility offers opportunities to manage the distribution or impact of noise by avoiding population centres and deploying multiple routes for noise relief.

Lower altitudes around airports

4.24 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 drones.

4.25 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.

4.26 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.

4.27 At lower altitudes, the noise impact of aviation on those on the ground takes greater precedence than the management of aircraft emissions. 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.

4.28 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.[53]

4.29 When redesigning arrival and departure routes at lower altitudes, there are a number of techniques that may be deployed by airspace change sponsors to better manage the impacts of aircraft noise, for example:

53 www.caa.co.uk/cap1616

- **noise respite:** greater planning and predictability of noise impacts, such as:
  - the planned use of different runways at different times of day, providing communities with predictable relief from the noise impacts of movements on either runway
  - alternating between multiple departure routes to a pre-planned schedule

  Respite can be designed into airspace structures more easily once arrival and departure routes are upgraded, because they can be designed with greater accuracy and flexibility
- **noise redistribution:** the redesign of airport arrival and departure routes at lower altitudes that allows for noise impacts to be redistributed away from more sensitive areas. This is dependent on there being adjacent areas that are less sensitive to noise to which the flightpaths can be moved; the relative noise sensitivity of areas is difficult to estimate and must be carefully considered where redistribution is the aim.

4.30 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 in the UK). The introduction of satellite navigation has been declared a top priority by ICAO for its programme to upgrade airspace[54] and is the subject of EU Regulation 2018/1048 on performance-based navigation published in July 2018, the requirements of which go wider than the airports defined by the Pilot Common Project in that they will apply to all EASA airports and air traffic services routes. Table 4.3 summarises the main lower altitude airspace initiatives and how they relate to the strategic framework.

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

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 EU legislation (by 2024)	**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, reduces the reliance on ground navigation beacons (contingency still required) 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.	EU legislation (by 2024) SESAR Pilot Common Project AF1	

Operations outside controlled airspace

4.31 Outside controlled airspace, General Aviation, predominantly recreational flying, operates alongside 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. This was discussed in Chapter 3 under the heading ‘maintaining and enhancing high aviation safety standards’.

4.32 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.

4.33 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 EU Part-ATS
10. review the use of all airspace classifications, both controlled and uncontrolled, the associated airspace structures and related air traffic management requirements to ensure the arrangements are optimised for all classes of aircraft
11. electronic conspicuity: 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 such that the airspace user can sense all others and be seen by all others

The CAA will need to take the lead on these initiatives and will establish programmes of work with stakeholders in the near future.

4.34 The CAA's high-level strategy in respect of the electronic conspicuity initiative is not to require a particular technology or supplier of technology. Given global market, commercial and regulatory developments, we see ADS-B-enabled and interoperable platforms[55] as the most likely commonly adopted technology in the UK. While we do not rule out alternatives, we would expect them to be interoperable with ADS-B standards. The key point is that any technology used must be fully interoperable for the purpose of achieving the required outcome of 'sense

[55] ADS-B, 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.

all others and be seen by all others' by electronic or digital means. The existing UK standard for these devices[56] will be kept up to date as a performance-based regulation to enable rapid advances where appropriate.

4.35 The CAA is not proposing an immediate general mandate to require all users to be fully electronically conspicuous. We will, however, use a rolling programme of highly focused mandates over the next few years to target particularly challenging volumes of airspace and choke points when making decisions on airspace change proposals by industry sponsors.

4.36 The CAA is minded to move to a general UK mandate requiring all users to be fully electronically conspicuous at a future date. This date will be influenced by the pace of adoption, the availability and cost of equipment, the development of ground-based infrastructure and other technological developments. We are currently minded that the earliest date for such a general mandate would be in three to five years' time (i.e. 2022–2024).

4.37 The CAA will consult interested parties early in 2019 on this high-level strategy, including the mechanisms for achieving it, before making a decision later in 2019 on its formal adoption.

56 Electronic Conspicuity Devices, CAP 1391. www.caa.co.uk/cap1391

4.38 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 UK	EU legislation (Part-ATS) (from 2022[57])	**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	EU legislation (Part-ATS) (from 2022) A review of air traffic services provision in uncontrolled airspace to align with international standards	
11) Electronic surveillance solutions	Fully interoperable electronic conspicuity solution for all airborne craft (ongoing, and likely to be mandated by the CAA in a 2022–2024 timeframe)	

Communications, navigation and surveillance (CNS) infrastructure and air traffic management

Communications, navigation and surveillance (CNS) infrastructure

4.39 Modernising air traffic management systems, tools and procedures used by air traffic controllers, network managers, flight crews and other operational stakeholders will enhance their decision-making. In addition, the transition from predominantly ground-based CNS infrastructure to a mix of ground and satellite-based capabilities providing greater resilience is a key result expected to be delivered by airspace modernisation. In the near term to 2024, some ground-based infrastructure will need to be retained for defence, security and resilience purposes. Such infrastructure

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

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.

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

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 reduces reliance on ground-based assets
15. the modernisation of air traffic management systems, tools and procedures

Communications

4.41 Radio-frequency spectrum is an asset in high demand, mainly due to the increased usage from the telecoms industry. The growing volume of data required to be transferred between aircraft (including drones and spacecraft) and air traffic services in order to facilitate the evolution of airspace management will in the coming years place greater pressure on the radio-frequency spectrum currently allocated to aeronautical services. A cross-industry plan for the efficient use of radio-frequency spectrum is therefore required to ensure aviation needs are understood, justified and reflect a real-time requirement for safe air operations that can contribute to the ambition of an integrated airspace.

4.42 The management and protection of spectrum for aviation use is an ongoing task within the CAA, working with external bodies to ensure that access to sufficient suitable and appropriately protected spectrum is maintained. The rationalisation of the current ground infrastructure will enable the deployment of additional spectrally efficient systems that can support the expected increase in data traffic.

4.43 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 co-ordinated and managed.

Navigation

4.44 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.

4.45 ICAO Assembly Resolution A37-11 requires member States to submit a national implementation plan concerning the introduction of satellite navigation routes. This resolution encourages States to deploy satellite navigation in the upper, terminal and lower altitude airspace (as described in the sections above). As a conseqence of the greater reliance on satellite navigation, there is a subsequent opportunity to review the requirements for ground-based infrastructure based on resilience and contingency requirements. The rationalisation of ground-based assets is enabled by the transition to a satellite-based navigation infrastructure and 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

4.46 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 and the associated ground use of the data to support air traffic services.

Air traffic management systems, tools and procedures

4.47 The modernisation of air traffic management systems, tools and procedures will provide stakeholders with more accurate and joined-up information about when flights plan to depart, when they do depart, the routes that they are expected to follow and when they are expected to arrive in particular sectors of airspace. The sharing of accurate and up-to-date flight information between air traffic controllers, network planners, flight crews and other operational stakeholders allows traffic flows to be sequenced and deconflicted earlier. Crossing traffic can be identified and

resolved before the tactical interactions that characterise air traffic management today occur. This increases the options available to operational stakeholders and improves the management of network performance – increasing airspace capacity, safety, efficiency and resilience.

4.48 This modernisation is consequently a key enabler for:

- the successful implementation of initiatives described in the upper airspace and terminal airspace sections of this strategy
- the effective integration of UK airspace with the wider European and global air transport network, following a standard set of requirements laid out in the SESAR Deployment Pilot Common Project

by allowing air traffic controllers to manage a larger number of flights through the same volumes of airspace with greater efficiency, resilience and flexibility.

4.49 One of the main components of air traffic management modernisation is the deployment of a SESAR-compliant flight data processing system and associated toolset for air traffic controllers. NATS is part of the iTEC (Interoperability Through European Collaboration) consortium that also brings together air navigation service providers of Spain, Germany, Lithuania, the Netherlands, Norway and Poland. The system aims to enable widespread improvements in safety, capacity, flight efficiency and environmental performance across European airspace by enhancing interoperability between control centres and allowing aircraft operators to optimise their flightpaths. iTEC will feature advanced trajectory management functions and new conflict-management tools. It will also allow volumes of airspace to be managed in a more flexible and dynamic way, responding to changes in traffic demand, weather conditions or adapting to reservations of segregated airspace.

4.50 Advanced data exchange and sharing services are required to communicate aeronautical information (flight, weather, aerodrome, obstacles, etc) to operational stakeholders using new air traffic

management systems and tools on the ground and in the air. The Aeronautical Information Exchange Model (AIXM) is a specification that enables the encoding and distribution in digital format of the aeronautical information. The aeronautical information management (AIM) concept is being delivered via the SESAR programme to provide more accurate and efficient digital aeronautical information to airspace users, air navigation service providers and airport operators.

4.51 System Wide Information Management (SWIM) supports these information exchanges through an internet-protocol-based network. The synchronisation of data involves civil and military air navigation service providers, airspace users, airport operators, meteorological service providers and the European network manager. SWIM services will enable new air traffic management systems and tools like iTEC to connect and share flight information.

Initiatives

4.52 Table 4.5 summarises the main CNS and air traffic management 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	Indirectly from EU legislation (Part-ATS and surveillance implementing rule) (ongoing)[58]	**Safety:** Significant potential safety enhancements from the increase in airspace capacity, traffic flow predictability, situational awareness, aircraft navigational capabilities and resilience. **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. **Efficiency**: Satellite navigation offers resilience for established instrument landing systems and ground navigation beacons, and also allows access to airports that may otherwise be closed in poor weather.
13) Cross-industry plan for the full adoption of datalink communications	EU datalink implementing rule (2019)	
14) An implementation plan for the introduction of satellite-based navigation routes Includes the retention of sufficient ground navigation aids, communications and surveillance capability to ensure the continued provision of air services in the event of loss of the global navigation satellite system.	EU legislation (2020–2024)	
15) Air traffic management To modernise systems, tools and procedures.	SESAR Pilot Common Project (AF4, AF5 and AF6) (by 2024)	

Further detail on the ways of modernising airspace

4.53 The main ways of delivering airspace modernisation are:

- changes to the established **airspace design**, meaning its structure and route network

58 Commission Implementing Regulation (EU) 2017/386 Requirements for the Performance and the Interoperability of Surveillance for the SES.

- **new operational concepts** including procedures to manage the flow of traffic, and
- the introduction of **new enabling equipment and technologies**.

4.54 This section provides further detail on the main ways of modernising airspace for the period until the end of 2024 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 and air traffic management.

4.55 Under each heading the 15 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.

4.56 Progress with the 15 initiatives, in the form of a RAG status, is set out in in Chapter 7.

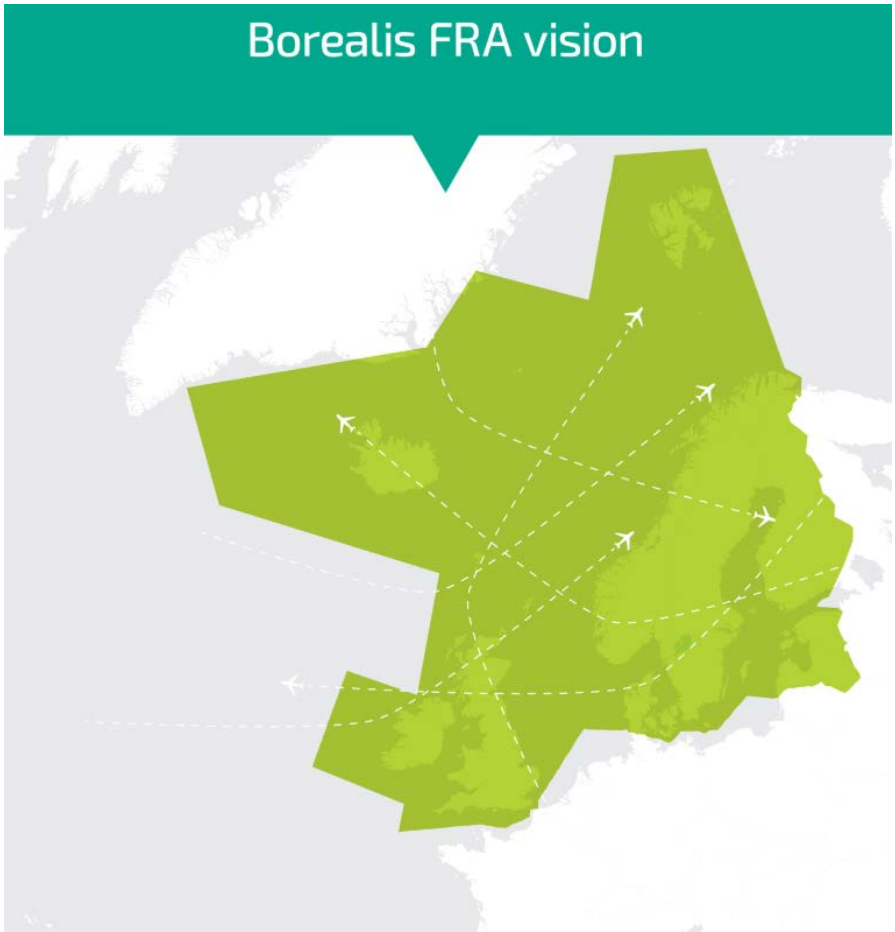
Modernisation in upper airspace

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 (FRA) 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 route network		
1.1. New waypoints to enable Direct Route Airspace have been implemented by NERL as part of its Service and Investment Plan and funded by the unit rate.*	1.2. Flight crews and air traffic controllers 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 co-ordinated and funded by the airline community.
Timescale: by 2022		**Driver: Single European Sky legislation**
2. Free Route Airspace: removal of all fixed routes so aircraft can fly fully 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 co-ordinated and funded by the airline community.
Timescale: by 2022		**Driver: Single European Sky legislation**
3. Advanced Flexible Use of Airspace: new booking and release capabilities for segregated airspace		
3.1. New airspace structures to enable Advanced Flexible Use of Airspace 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 Advanced Flexible Use of Airspace will be developed collaboratively by the CAA, NERL 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.
Timescale: by 2022		**Drivers: SES legislation and UK state requirements**

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 co-ordinated 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 For the operation of Advanced Flexible Use of Airspace and Free Route Airspace, there is a key dependency on the implementation of new airspace management tools by military outstations to book and release segregated 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.

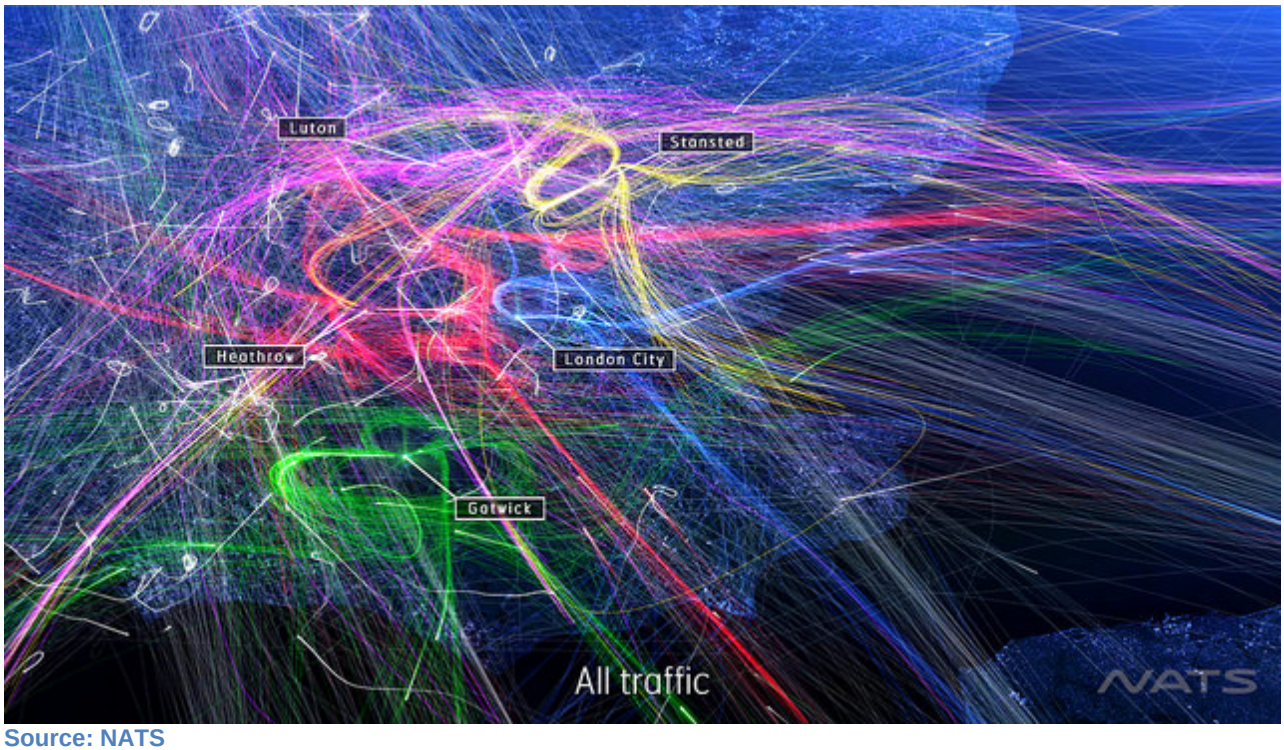
Modernisation in terminal airspace

Ends

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

- **safety**: capacity gains achieved while 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: Single European Sky legislation and Airports NPS**	

5. FAS Implementation North: redesign of the terminal network in northern England and Scotland		
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: Single European Sky legislation and NERL RP2 plan**	

6. Queue management: new capabilities to stream the flow of 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. Co-ordination on airspace design with neighbouring States' air navigation service providers.	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. Co-ordination on new procedures with neighbouring States' air navigation service providers.	6.3. Arrival and departure management tools that calculate the speed controls needed to stream inbound and outbound traffic flows are being deployed by NERL (through the Service and Investment Plan, funded by the unit rate) and by some larger airports. Co-ordination on technology implementation with neighbouring States' ANSPs.
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 ATC 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 ATC 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 co-ordinated with the introduction of new airspace designs and operating procedures in order to be effective.

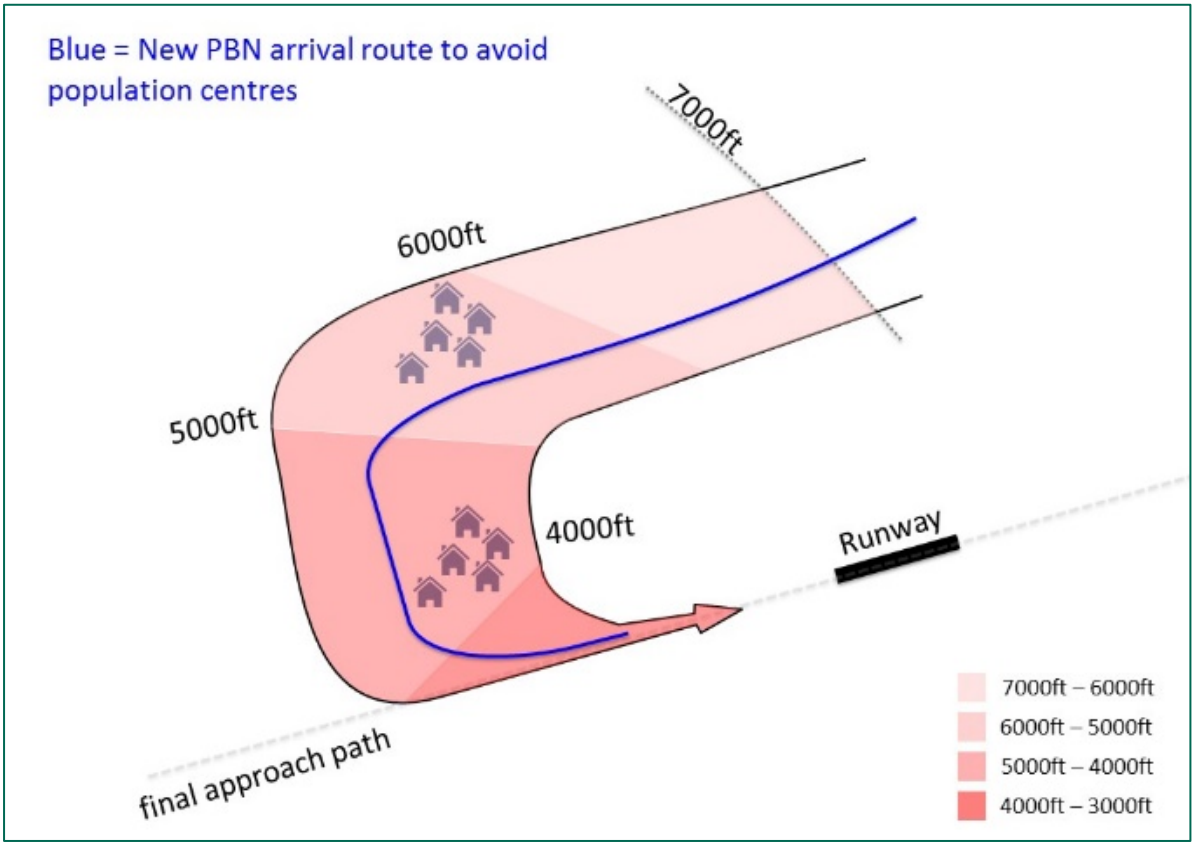
Modernisation in airspace at lower altitudes

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 manage 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 being 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 being implemented and funded by aircraft operators.
Timescale: by 2024		**Driver: Single European Sky legislation**

Dependencies

7.1 & 8.1 There is a major dependency on airspace design to effectively manage the trade-offs between different stakeholders that are impacted by aircraft noise, for example by deploying multiple alternating routes.

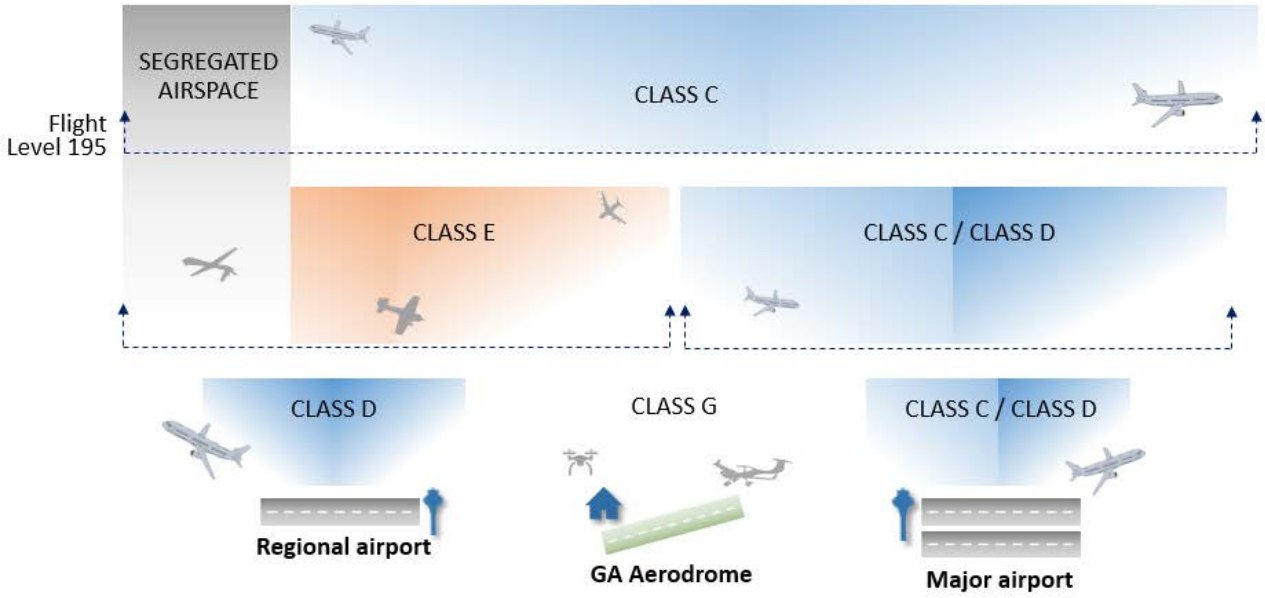
Modernisation outside controlled airspace

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 spacecraft)

Figure 4.4 Illustration of airspace classifications



Ways

Airspace design	Operational procedures	Technology enablers
9. Review of Flight Information Service provision 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. Flight Information Service task descriptions, capabilities, licensing and funding.	9.3. Not applicable.
Timescale: by 2022		**Driver: EU Part-ATS**
10. Airspace classification review 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 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 2022		**Driver: EU Part-ATS**
11. Deployment of electronic surveillance solutions to aircraft and at airports to aid integration of traffic		
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. The CAA will consult on a strategy for mandating adoption by airspace users.
Timescale: ongoing, mandate likely 2022–2024		**Driver: safe and efficient airspace**

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 communications, navigation and surveillance (CNS) infrastructure and air traffic management

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 should be supportable by CNS systems that make efficient use of the 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: ongoing	**Drivers: EU Part-ATS and EU surveillance implementing rule**	
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 that includes the retention of sufficient ground navigation aids, communications and surveillance capability to ensure the continued provision of air services in the event of Global Navigation Satellite System (GNSS) loss		
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. Rationalisation of legacy ground-based navigation technologies.
Timescale: 2020–2024	**Driver: EU PBN implementing rule**	
15. Air traffic management to modernise systems, tools and procedures		
15.1. Not applicable.	15.2. Continued development of operational procedures to maximise the benefits of new air traffic management systems and tools.	15.3. iTEC deployment, SWIM implementation and deployment of aeronautical information management.
Timescale: by 2024	**Driver: SESAR Pilot Common Project**	

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.

15.2 & 15.3 The modernisation of air traffic management systems, tools and procedures is dependent on close cooperation across the main European air navigation service providers on the functionality of the new air traffic control technologies, timelines for deployment, interoperability arrangements and the approach to managing traffic flows collaboratively across State boundaries.

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. The initiatives described in Chapter 4 are also enablers for further work on accommodating new airspace users such as drones, and as we develop the strategy in the future, we will add more detail on how to integrate these new users. 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:[59]

- emerging policy in the UK
- emerging international policy
- emerging innovations or disruptions in airspace
- spotting and responding to other emerging changes.

[59] 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.

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, and followed this in December 2018 with the Aviation Strategy Green Paper with the aim of publishing a final strategy in 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[60], 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 delivery plans where these are not in conflict with growth. Therefore, the Government expects the CAA's strategy and any plans developed to deliver 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

60 See paragraph 1.24 of The future of UK aviation: making best use of existing runways, HM Government, June 2018. https://www.gov.uk/government/publications/aviation-strategy-making-best-use-of-existing-runways

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 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 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 has developed this policy further in its Aviation Strategy Green Paper published in December 2018.

5.16 The CAA would support the reintroduction of legislative provisions – assuming there is sufficient space in the legislative programme – to modernise the air traffic services regulatory and licensing framework that also support the delivery of airspace modernisation. As this legislation is developed, any potential conflicts of interest would have to be managed, for example to differentiate between the decision to use the power to compel an airspace change to be developed, and the decision on whether the change eventually proposed should go ahead. This conflict would be particularly apparent where the change involves the sponsor making a significant financial investment.

5.17 Any policy developed would be incorporated into the Airspace Modernisation Strategy and any associated governance to modernise airspace.

Feasibility assessment

5.18 NATS developed a feasibility assessment for airspace in the South East at the request of the Secretary of State. The CAA reviewed this report to offer technical advice to the Secretary of State. These two reports have been published by the Government.

5.19 The feasibility assessment outlines the concept of 'letterboxes in the sky' at 7000–9000 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 co-operation 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 it develops, 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 The Department for Transport and CAA, as co-sponsors of airspace modernisation, have asked NERL to a) undertake further technical work on the design concept outlined in its report and b) to create a single coordinated implementation plan for airspace changes in Southern England (a south-east airspace change masterplan, or masterplan for short). Further detail on this masterplan is outlined in Chapter 6.

Further policy considerations

5.21 We may need to take account of any other new policies introduced as a result of the Aviation Strategy work, such as General Aviation access, carbon emissions, or other relevant policies.

Emerging international policy

5.22 At the time of writing this document, the UK is a member of the EU 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. Under the EU (Withdrawal) Act 2018 the Government is in the process of bringing EU aviation law into UK law, with certain responsibilities reassigned to the Secretary of State or the CAA. It may be the case that the UK decides to continue 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 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 services 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 delivery 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 imminently, 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 the UK has exited the EU. This is one of the assumptions built into the next financial settlement.[61] We also expect that we will want to remain interoperable with the EU's air traffic management systems in the future, including operational arrangements with neighbouring EU States. Subject to the terms of the UK's exit from the EU, the UK consequently remains fully committed to continuing to contribute the necessary technical resources to SESAR and EASA initiatives in air traffic management.

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

Emerging innovations or disrupters in airspace

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

5.24 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.[62] There is also increasing commercial use of drones. If more people and businesses 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. Government policies on drones will guide how their management into airspace will work.

5.25 Global developments are being monitored and their applicability across the UK explored as a potential solution to ease congestion, unlock capacity and enable new use cases for public transport, perhaps as early as 2025. In order to facilitate and manage emerging technologies, the long-term plan will need to include how to fully and safely integrate new users alongside existing aviation participants. Consideration will need to be given for all airspace environments. A key part of this work will be addressing the interoperability of air platforms and traffic management systems and establishing appropriate mechanisms for sending and receiving data. The interaction between traditional air traffic management systems and the evolving counterpart systems being developed for

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

drones (known as unmanned traffic management or UTM) are being explored to solve safety-related issues affecting all users of airspace.

5.26 Before these new systems 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. This could lead to changes in CAA or other charging mechanisms.

5.27 The CAA intends to engage with industry and across government as soon as practicable to develop the principles to enable detailed deployment plans to be developed.

5.28 The first UK commercial space launch is expected in the early 2020s. Beyond that, new engine designs will facilitate hypersonic flight, allowing new high-speed international commercial operations in the upper atmosphere. 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

5.29 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, changing weather trends 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 rest with industry organisations and not the CAA
- the CAA and Department for Transport, as co-sponsors of airspace modernisation, have tasked NERL with leading the FASI South programme to create, by June 2019, a single co-ordinated implementation plan for airspace changes in Southern England
- this will be followed by further commissions for the creation of masterplans covering modernisation of the rest of UK airspace.

Delivery plans

6.1 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.

6.2 Many of the operational concepts and technologies set out in this strategy have delivery 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.[63] A summary timeline is provided in Figure 6.1 at the end of this chapter.

Next steps

6.3 The CAA and Department for Transport, as co-sponsors of airspace modernisation, are commissioning design, operational and technology studies required to support the development and delivery of this strategy.

6.4 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.

6.5 The CAA, through its new Delivery Monitoring and Oversight role, will track the progress of industry-led delivery plans.

6.6 At present, there is no delivery 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 and Department for Transport, as co-sponsors of airspace modernisation, have therefore tasked NERL with leading the FASI South programme to create a single coordinated implementation plan for airspace changes in Southern England (a South East airspace change masterplan, or masterplan for short).

6.7 The commission requires that through leadership and programme management, NERL prepares a South East masterplan that meets the following criteria:

63 Details of relevant industry deployment plans can be found at http://futureairspace.aero/ and https://airspace4all.org/.

- identifies where airspace changes could be developed in Southern England in light of:
  - forecast growth in demand for aviation across all sectors and the required airspace capacity to accommodate that growth
  - 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
  - areas where more direct routes are possible that could, for example, reduce controlled airspace

- identifies other changes that may be required to deliver one or more of the following benefits:
  - where airspace changes are needed to deliver a safety benefit, for example, changes that ensure route separation
  - where airspace changes can reduce noise (more specifically, reduce the total adverse effects of noise, as set out in the Air Navigation Guidance 2017)
  - where airspace changes can deliver air quality or fuel efficiency benefits
  - where airspace changes are needed to allow improved access to airspace for all users, for example where the existence of controlled airspace is no longer justified
  - where airspace changes are needed to enable the military to fulfil their training requirements and national security functions
  - where airspace changes are needed to introduce new technology, for example the introduction of performance-based navigation

- identifies:
  - the operational concepts required to deliver these changes and their level of maturity
  - the set of assumptions on which the proposed changes are based and are dependent

- the key risks associated with delivering the plan and how they could be mitigated
- the recommended coherent sequence of individual or modules of changes against the evaluated alternatives
- the preferred timescale for their adherence against each step of the CAA's CAP 1616 process and subsequent implementation
- the party responsible for taking each individual airspace change forward
- the interdependencies between individual changes
- the degree of commitment offered by each individual party.

6.8 NERL was also asked the minimum number of changes that are necessary to ensure that major airspace projects (for example, to accommodate new runway capacity) are viable.

6.9 We have asked NERL to deliver the Southern England masterplan by the end of June 2019, and it will be published once complete.

6.10 This commission concerns Southern England only, but it will be followed by further commissions in the future to apply this rationale to the rest of the UK's airspace. We expect a similar list of factors to be considered in future commissions, including improved access to all airspace users and military user requirements.

6.11 In addition, the sponsors will ask every delivery group in the Governance Annex to prepare a delivery plan.

CAA resourcing

6.12 A new, more rigorous process for making decisions on proposed changes in airspace design was introduced in January 2018, supported by new guidance (CAP 1616). This requires the CAA to be more visibly 'hands-on' during the process and to dedicate more resources to managing it covering:

- new skills: including running an online airspace change portal, and elements new to the process such as gateway sign-offs, options

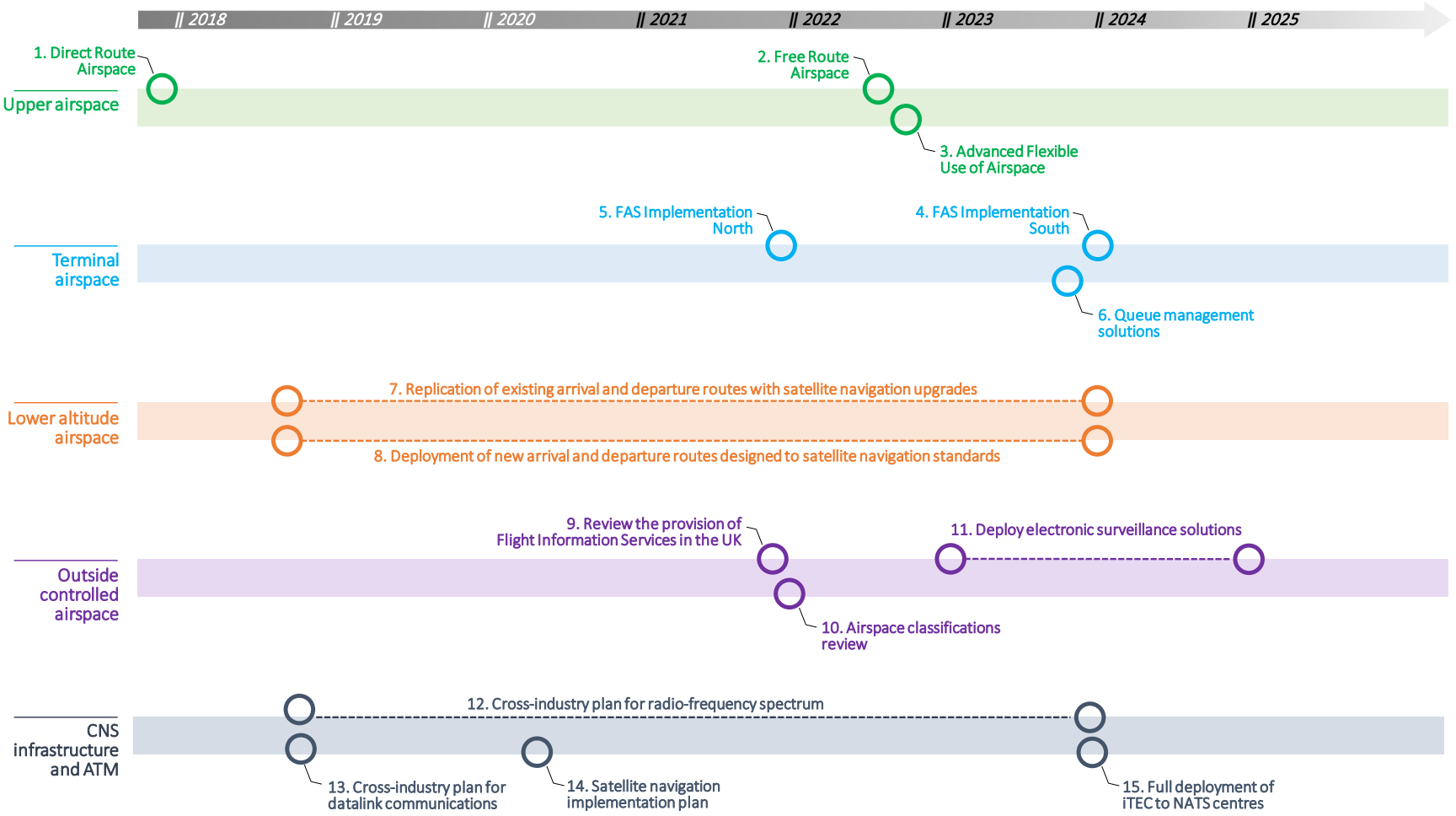
appraisal, Public Evidence Session and draft decision; these airspace regulation requirements cover a broader range of economics, community engagement and web skills than the CAA previously employed in this area

- increased rigour: we have had to expand our existing airspace regulator, environmental and legal teams to handle the increased rigour of the assessment stages and related outputs
- increased workload: the demands of airspace modernisation mean more staff resources are anticipated to be needed as major airspace changes, such as those required through the Southern England masterplan, materialise.

6.13 In the immediate future CAA has plans to build its staff skillset and resources in its airspace regulation function accordingly, but currently they are still below optimum strength. The CAA has identified the posts that are required and aims to address its resourcing issues by 2021.

6.14 Completely separate from the resourcing issues for the CAA's airspace regulation function, we are also increasing our staff resource to deliver the new roles of co-sponsorship and Delivery Monitoring and Oversight that underpin the Airspace Modernisation Strategy. The CAA seeks views on proposals to increase resource as part of its regular scheme of charges consultation.

Figure 6.1 Timeline of airspace-related developments up to 2024



Chapter 7

Summary of progress with industry delivery 2018

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 as at December 2018 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 Airspace Modernisation Strategy 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 as at December 2018

Airspace design	Operational procedures	Technology enablers

1. Direct Route Airspace: deployment of additional waypoints to the existing route network			**On track**
1.1. New waypoints	1.2. Established procedures	1.3. 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 to use Direct Route options effectively and maximise the benefits			Score: 6 (L2*S3)

2. Free Route Airspace: removal of all fixed routes so aircraft can fly fully 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 to use Free Route options effectively and maximise the benefits			Score: 12 (L3*S4)

3. Advanced Flexible Use of Airspace: to increase airspace configuration options supporting more efficient use			**Needs attention**
3.1. New airspace structures	3.2. New procedures	3.3. Airspace management tools	
Timescale: by 2022	**Drivers: SES legislation and UK state requirements**		
Risk: that the implementation of new airspace structures restricts the access of civil and/or military traffic to key routes or volumes of airspace, generating inefficiencies and capacity constraints in certain areas of the UK; and that AFUA will not deliver sufficient airspace to facilitate military activity.			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: Single European Sky legislation and Airports NPS**		
Risk: that the large number of co-dependent airspace changes required to modernise terminal airspace in the south of England (involving 16+ different sponsors) are not co-ordinated effectively, leading to sub-optimal airspace designs, poor engagement with affected stakeholders, inefficient network integration and implementation delays.			Score: 20 (L4*S5)

5. FAS Implementation North: redesign of the terminal network in northern England and Scotland			**Needs attention**
5.1. Terminal airspace redesign	5.2. New procedures	5.3. New tools for controllers	
Timescale: by 2021	**Drivers: Single European Sky legislation and NERL RP2 plan**		
Risk: that the large number of co-dependent airspace changes required to modernise the terminal airspace in the north of England are not co-ordinated 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. Queue management: new capabilities to stream the flow of traffic			→ On track
6.1. Linear holding structures	6.2. New procedures	6.3. Queue 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: Single European Sky legislation**	
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 of Flight Information Service provision in the UK 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 2022		**Driver: EU Part-ATS**	
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. Airspace classification review 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 2022		**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. Deployment of electronic surveillance solutions to aircraft and at airports to aid integration of traffic			→ Needs attention
11.1. New airspace structures	11.2. New procedures	11.3. Electronic conspicuity	
Timescale: ongoing, mandate likely 2022–2024		**Driver: safe and efficient airspace**	
Risk: that the adoption of electronic surveillance solutions on board 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: ongoing		**Drivers: EU Part-ATS and EU surveillance implementing rule**	
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 co-ordination 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 that includes the retention of sufficient ground navigation aids, communications and surveillance capability to ensure the continued provision of air services in the event of GNSS loss			→ Needs attention
14.1. National standards	14.2. National standards	14.3. Rationalise ground infrastr.	
Timescale: 2020–2024		**Driver: EU PBN implementing rule**	
Risk: that ongoing reliance on legacy ground navigation infrastructure by minority of aircraft operators deters transition to a fully satellite-based infrastructure.			Score: 12 (L4*S3)

15. Air traffic management to modernise systems, tools and procedures			→ On track
15.1. Not applicable	15.2. New procedures	15.3. New systems and tools	
Timescale: by 2024		**Driver: SESAR Pilot Common Project**	
Risk: that the requirements to change the airspace and upgrade air traffic management systems, tools and procedures in the same timeframe creates complex interdependencies that require significant resources, funding and additional development time to resolve.			Score: 12 (L4*S3)

Chapter 8

Glossary

Although we have only used abbreviations in this document where unavoidable, 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 air traffic services 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, as amended by The Civil Aviation Authority (Air Navigation) (Amendment) Directions 2018. 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

Term	Abbreviation	Description
Air navigation service provider	ANSP	An organisation which operates the technical system, infrastructure, procedures and rules of an air navigation service system, which may include air traffic control.
Air 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.
Airport Collaborative Decision Making	A-CDM	Systems and processes to enable the creation, refinement and exchange of up-to-date runway and airspace data between the airport, air traffic control, airlines and ground handlers about the status of inbound and outbound flights, enabling better-informed, more consistent decision making.

Term	Abbreviation	Description
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.
Airspace4All Ltd	A4A	Implementation group representing VFR (Visual Flight Rules) community interests (including General Aviation) in airspace matters, including modernisation strategy. Formerly known as the Future Airspace Strategy VFR Implementation Group Ltd (FASVIG). https://airspace4all.org/
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: ▪ controlled airspace, namely control zones, control areas, terminal control areas and airways ▪ airspace restrictions, namely danger, restricted and prohibited areas ▪ radio mandatory zones, transponder mandatory zones ▪ 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.

Term	Abbreviation	Description
Area navigation	RNAV	A method of navigation which permits aircraft operation on any desired flightpath 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 services route created for aircraft capable of employing performance-based navigation technology.
Association of Remotely Piloted Air Systems UK	ARPAS-UK	The professional body and trade association for the RPAS industry/
Automatic dependent surveillance – broadcast	ADS-B	A surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked
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	CO_2	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 services 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.

Term	Abbreviation	Description
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.
Drone		Commonly used term for an unmanned aerial system or vehicle (UAS or UAV), a powered aircraft without a human pilot on board. Drones may be remotely piloted (also known as a remotely piloted air system or RPAS) or autonomous. Drones range from relatively large aircraft similar in size and complexity to an aircraft with a pilot on board, to much smaller hand-held types with minimal payload, such as those for recreational use. https://www.caa.co.uk/Consumers/Unmanned-aircraft/Our-role/An-introduction-to-unmanned-aircraft-systems/
Electronic conspicuity	EC	Electronic or digital means whereby airspace users can sense all others and be seen by all others.
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.
EUROCONTROL		An intergovernmental organisation with 41 Member States acting as the central organisation for coordination and planning of air traffic control for all of Europe.
European Aviation Safety Agency	EASA	The European Union authority for aviation safety.

Term	Abbreviation	Description
Flexible use of airspace	FUA	Concept promoted by Eurocontrol wherein airspace is no longer designated as purely 'civil' or 'military' airspace, but considered as one continuum and allocated according to user requirements.
Flight information region	FIR	Specified region of airspace, co-ordinated 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	Replaced by the Airspace Modernisation Strategy, FAS was a collaborative initiative between a range of stakeholders for modernising the UK's airspace (which set the direction, but did not include details or recommendations about specific structures or flightpaths). www.caa.co.uk/cap 1711 www.caa.co.uk/fas
General Aviation	GA	Essentially all civil flying other than commercial airline operations, which therefore encompasses a wide range of aviation activity from drones, 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.
Independent Commission on Civil Aviation Noise	ICCAN	The independent UK body responsible for creating, compiling and disseminating best practice to the aviation industry on the management of civil aviation noise and advising government in this area.

Term	Abbreviation	Description
Instrument approach procedure	IAP	A set series of aircraft manoeuvres from the initial approach to landing.
Industry Communications for the Airspace Modernisation Strategy	ICAMS	Implementation group representing largely commercial aviation industry interests in FAS. Formerly known as the Future Airspace Strategy Industry Implementation Group (FASIIG).
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.
Interoperability Through European Collaboration	ITEC	A new Flight Data Processing System and associated toolset developed by a consortium of air navigation service providers of Spain, Germany, Lithuania, the Netherlands, Norway, Poland and the UK that aims to enhance interoperability between European control centres and allow aircraft operators to optimise their flightpaths.
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.

Term	Abbreviation	Description
London Approach		(See also terminal air navigation services.) The approach service for a number of airports can be combined and, in the case of the airports within the London terminal manoeuvring area, these have been centralised for safety and efficiency reasons. The unified approach service, the so-called 'London Approach' service, is provided by NERL.
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 co-ordinates.
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

Term	Abbreviation	Description
NATS En Route plc	NERL	Subsidiary of NATS Holdings Ltd and the sole provider of air traffic control services for aircraft flying 'en route' in UK airspace. NERL also provides some air traffic control services in the eastern part of the North Atlantic, as well as providing a combined approach function (London Approach) for five London airports.
NATS Services Ltd	NSL	Subsidiary of NATS Holdings Ltd providing air traffic services on a commercial basis.
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.

Term	Abbreviation	Description
Remotely piloted air system	RPAS	A powered aircraft without a human pilot on board which is piloted remotely, also known as an unmanned aerial system or vehicle (UAS or UAV). See 'drone', which is the term we use in this document for UAS, UAVs and RPAS.
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 Department for Transport.

Term	Abbreviation	Description
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.
System-wide Information Management	SWIM	A new set of internet-based information sharing standards and protocols that support aeronautical data. Supports exchanges between European civil and military air navigation service providers, airspace users, airport operators, meteorological service providers and the European network manager.
Terminal air navigation services	TANS	Terminal air navigation services comprise two elements: the 'radar approach and departure' (approach control) service, and the aerodrome control service. The approach service typically takes control of the aircraft from the en-route service within 40–50 nautical miles of the airport, and sequences aircraft for landing before handing over to aerodrome control. It also takes control of aircraft on departure from aerodrome control. Aerodrome control manages (visually from the airport's control tower) aircraft taking off and landing, and ground movement control of aircraft taxiing between the runway and the stands These two elements of terminal air navigation services are provided by the airport (acting as an air navigation service provider) itself, or by a third-party air navigation services provider.
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.

Term	Abbreviation	Description
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
UK Space Agency		An executive agency of the UK Government sponsored by the Department for Business, Energy and Industrial Strategy. It is responsible for all strategic decisions on the UK civil space programme and provides a clear, single voice for UK space ambitions.
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.
Unmanned aerial system Unmanned aerial vehicle	UAS UAV	A powered aircraft without a human pilot on board, which may be remotely piloted (also known as a remotely piloted air system or RPAS) or autonomous. See ‘drone’, which is the term we use in this document for UAS, UAVs and RPAS.
Unmanned traffic management	UTM	The interaction between traditional air traffic management systems and the evolving counterpart systems being developed for drones.
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.
Urban air mobility	UAM	An aerial solution to alleviate transport congestion in built-up areas, such as autonomous flying vehicles including air taxis.
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.

Term	Abbreviation	Description
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.