Free Route Airspace Deployment 2

Consultation

Version 1.2
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Prepared by NATS
Airspace Change Compliance & Delivery

Issue	Month/ Year	Changes in this issue
Issue 1.0	August 2021	Submission to CAA
Issue 1.1	September 2021	Stakeholder list updated
Issue 1.2	October 2021	Flight planning examples added to section 4.

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1 Executive Summary

Free Route Airspace (FRA) is well established across Europe and NATS has been involved in developing the FRA concept over the last 7 years. FRA is Initiative 2 of the UK CAA's Airspace Modernisation Strategy (AMS) (CAP 1711) (Ref 1), mandated for European Union (EU) members in European Law (EU Implementing Regulation EU716/2014, superseded by EU2021/116 (see para 2.2)). FRA implementation has been recommended as a part of the Eurocontrol Single European Sky ATM Research (SESAR) programme.

An initiative of the UK AMS, NATS is proposing to introduce FRA across UK airspace in four deployments. This second deployment (Deployment 2), across the majority of the Southwest of the UK UIR airspace, (see Figure 1 below) will allow aircraft in upper airspace to flight plan and fly between waypoints and not be constrained to follow the current network of routes. The concept will also enable the opportunity to flight plan across the airspace managed by Borealis Alliance[1] member air navigation service providers (ANSPs) unconstrained by the route network in each ANSP's airspace with free crossing at boundaries not limited to fixed entry/exit points.

The change from a network of routes to FRA represents a significant change for aircraft operators and Air Traffic Control (ATC); NATS welcomes your feedback to develop our proposed deployment. Future deployments will be consulted on through separate ACPs.

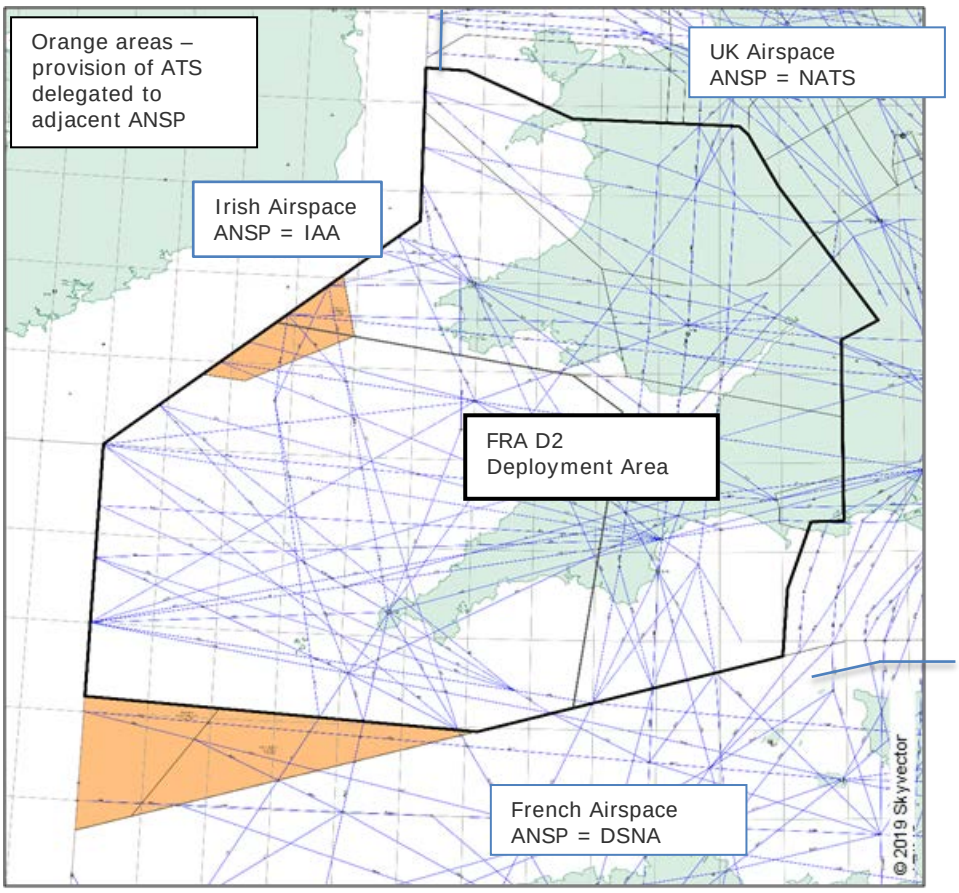


Figure 1 FRA D2 Deployment Area with extant airspace structures

[1] The Borealis Alliance includes the Air Navigation Service Providers (ANSPs) of Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Norway, Sweden and the UK.

Within the constraints of the European mandate as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018 (see para 2.2) and the AMS, three options for implementation of FRA are presented in this consultation document:

- FRA Option 1. In which all ATS routes are removed.
- FRA Option 2. In which the ATS route structure is partially maintained.
- FRA Option 3. In which the ATS route structure is maintained, but aircraft are not constrained to flight plan the routes within the FRA.

The changes proposed in this ACP will only affect flights above 24,500ft (FL245)

This ACP is dependent on the London Airspace Modernisation Programme 2 Deployment 1.1, which proposes to change the airspace below the FRA D2 region between 7,000ft and 24,500ft. There are significant design efficiencies and cost benefits for implementation at the same time.

The consultation for these two ACPs is being run simultaneously and stakeholders are recommended to read and respond to both documents to fully understand the interdependency. This document provides all detail for the proposed FRA deployment in this airspace. FRA D2 cannot be implemented independent of the LD1.1 ACP because the final design specifics are based on the LD1.1 ACP design options. The Divisional Flight Level (DFL) at which FRA is implemented is dependent on the LD1.1 consultation outcome, so some design specifics (ie precise location of FRA significant points) are indicative only at this stage.

It is NATS intent that this document provides stakeholders with sufficient information on the FRA proposals to be able to provide informed feedback to finalise the design, in conjunction with the LD1.1 proposal.

The consultation for both ACPs will run concurrently. Consultation opens on 6th September and ends on 29th November 2021, a period of 12 weeks and 1 day.

This consultation document and response questionnaire are available via the CAA airspace change consultation portal at:

https://consultations.airspacechange.co.uk/nats/nats-fra-d2

If the proposal is approved by the CAA, implementation of the airspace change will occur not before 23rd March 2023.

2 Introduction

This consultation relates to changes to airspace and the ATS route structure which will change aircraft flight profiles above FL245. We are seeking feedback from any stakeholders who may be affected by the proposal. Primarily this is likely to be users of the airspace and other aviation stakeholders. Nonetheless we welcome feedback from any interested parties.

Your feedback at this stage will help us explore the potential impacts of the proposed changes to the FRA Deployment 2 (D2) airspace. We invite considered responses supported by evidence where possible.

2.1 About this Airspace

The area covered by this ACP is shown in Figure 1 and covers the southwest of England and most of Wales. The ACP proposes changes to the airspace and route structure which will change aircraft flight profiles above FL245.

The airspace is used extensively by aircraft arriving at and departing from airports outside the area, including all London airports, Liverpool, Birmingham, Manchester and Dublin. These arriving and departing aircraft will be descending from or climbing into the upper airspace (FL245 and above).

The upper airspace also accommodates flights arriving to the London FIR from the adjacent FIRs: Scottish, Irish, French (Brest) and the Channel Islands Control Zone as well as traffic departing from adjacent UK airspace, and overflights such as transatlantic flights to/from continental Europe.

Due to the impact of the coronavirus pandemic on the aviation industry, the number of flights significantly reduced across the whole of the UK and Europe from the second quarter of 2020 to date. Previously, demand for air travel across the UK had been increasing faster than predicted.

2.2 Why must this change happen now?

This ACP aims to introduce FRA across a large swathe of UK airspace; this will facilitate flight efficiency benefits by enabling aircraft to flight-plan and fly user-preferred routes, where possible. FRA is being implemented throughout European airspace and is already in operation in several neighbouring States. The introduction of FRA in UK airspace will ensure that the UK upper airspace is consistent with that of neighbouring states, enabling cross-border free routing.

The introduction of FRA will enable environmental benefit by allowing airline operators to reduce CO_2 emissions per flight, which in turn generates economic benefit due to reduced operating costs. The implementation of FRA in the UK is a major initiative of the CAA's AMS (CAP 1711) (Ref 1).

The implementation of FRA by European Union (EU) member states was mandated in European law under the EU Implementing Regulation EU716/2014 (Pilot Common Project) (Ref 2). EU716/2014 has been superseded by EU2021/116 (Common Project 1) within the EU. This change to the regulation occurred post-UK withdrawal from the EU and the DfT have consulted on if and how to incorporate this into UK law, at the time of writing, a decision has not been published. EU716/2014 is retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018[2] (referred to as 'the mandate' throughout this document). Due to wider commitments (e.g. Borealis Alliance and the CAA AMS) and consistency of operation, NATS' intention is to introduce FRA throughout UK airspace regardless of the withdrawal of the United Kingdom from the European Union (EU). FRA implementation will align with the requirements[3] of EU716/2014 until such time that it is superseded in UK law.

NATS has committed to introducing FRA in UK upper airspace to complete the harmonised Borealis Alliance volume of FRA. Borealis member ANSPs have committed to put in place a seamless and integrated FRA (Cross-Border) volume extending across national airspace boundaries, from the eastern boundary of the North Atlantic to the western boundary of Russian airspace in the North of Europe; without the need for crossing boundaries at mandated Co-Ordination Points (COPs). See Page 16 for further details.

NATS is undertaking this ACP both to ensure the UK meets its the mandate, and that it delivers the aims of initiative 2 of the AMS, whilst enabling airline operators to optimise their flight profiles.

2.3 About this document

This consultation document explains the history, impacts and benefits of the proposal. There are two complementary documents available, providing more details on how the options were appraised and how this consultation will be conducted:

- Stage 3 Consultation Strategy, which provides details on how we will conduct the consultation. (Ref 3).
- Stage 3 Full Options Appraisal, which provides analysis of the evidence for each option in comparison to the baseline. (Ref 4).

2.4 Where are we in the airspace change process?

The airspace change process (CAP1616: Ref 5) is summarised in the flowchart below. We are at Stage 3.

Stage 1 Define has been completed, where the need for an airspace change was established. Representatives of stakeholder groups were engaged with, to develop and define the design principles underpinning this proposal.

Stage 2 Develop & Assess has also been completed, where initial design concepts were developed, refined with feedback from representatives of stakeholder groups, each option evaluated against the design principles and an initial appraisal performed to illustrate the benefits and impacts of each option. This crucial stage of the process removed the least suitable potential airspace designs from further development; for example, those that were not as safe, those that were sub-optimal for environmental impacts or those not technically viable.

Supporting documentation for this proposal (including Stage 1 and Stage 2) can be found on the CAA's airspace change portal by clicking on this link.

[2] The SESAR PCP ATM Functionality 3 (AF3) states that Free Route shall be provided and operated in the airspace for which the Member States are responsible at and above Flight Level 310 in the ICAO EUR region by 1st January 2022. FRA Deployment 1 (ACP-2018-11) will meet this requirement.
[3] Other than the requirement to implement FRA by 1 January 2022.

The three design options that have progressed to the current stage are all viable. Option 1 (where all ATS routes are removed) is NATS' preferred solution. This proposal is now at Stage 3 Consult, where stakeholders are asked for feedback on these options.

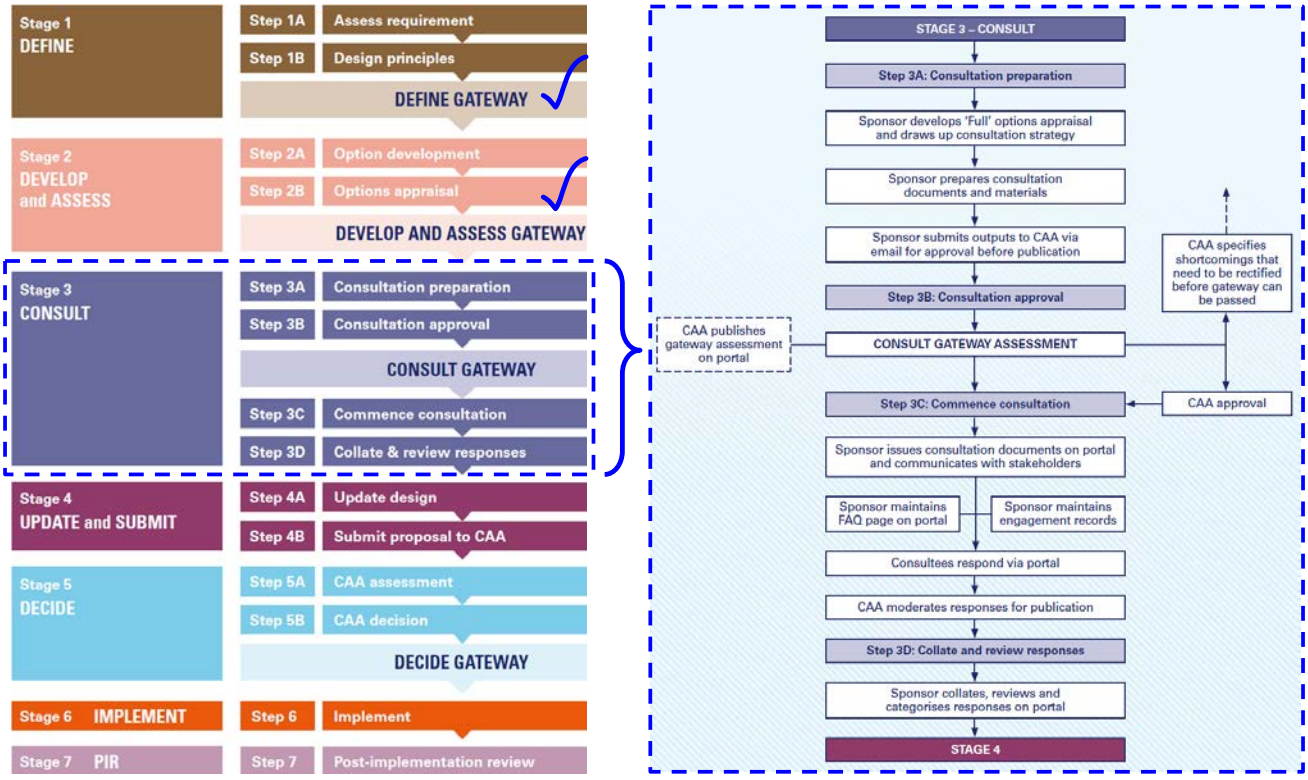


Figure 2 Airspace Change Process – Overview (left) and Stage 3 Consult (right)

Stakeholders

A stakeholder is an interested third party in an airspace change proposal. This ACP is proposing changes within controlled Class C airspace at FL245+. Due to the flight levels at and above which the changes are proposed, the primary focus of this consultation is aviation stakeholders and this document uses common aviation technical language.

The primary stakeholder groups for this consultation are:

- Air Navigation Service Providers (ANSPs) who border the FRA D2 area
- Airlines
- Airports
- Ministry of Defence
- Computerised Flight-planning Service Providers (CFSP)
- National Air Traffic Management Advisory Committee (NATMAC) Members
- General Aviation/Sport aviation

The stakeholders proactively targeted by NATS for involvement in this consultation are listed in Appendix A. However, we welcome responses from any organisation or individual.

2.5 Scope of this consultation and link with LAMP 2, Deployment 1.1 ACP

This ACP proposes the introduction of FRA Deployment 2 across the area depicted in Figure 1. This implementation is dependent on the London Airspace Modernisation Programme 2 Deployment 1.1 (LD1.1), which proposes to change the airspace below the FRA D2 region between FL70 and FL245/FL305. The precise design and implementation of these two airspace changes are dependent on each other.

Prior to the COVID-19 pandemic the LD1.1 and FRA D2 projects were being progressed independently. As a result of the pandemic a thorough review was undertaken by NATS of these projects. This concluded that by implementing these two projects simultaneously significant costs could be saved whilst delivering the benefits to the aviation industry earlier. Information on the LD1.1 consultation is available here (Ref 6).

The ACPs, which have been ongoing for several years, remain distinct, and will be evaluated separately by the CAA. However, the timelines have been synchronised to facilitate simultaneous implementation. The first stage of this is coordinating the consultations, which will be run concurrently. This allows stakeholders to evaluate and give feedback on both changes, and better understand the impact/benefit of the combined changes.

Synchronising the implementation of systemised routes with the delivery of FRA means the options for LD1.1 can be developed to ensure the two deployments complement each other and maximise benefit.

While the mandate requires that FRA is implemented in airspace at and above FL310, in the D2 area the FRA concept of operations could extend down to FL245[4], which is the established division between upper and lower airspace and the base of the London Upper CTA.

Given the dependency between this ACP and the LD1.1 ACP, the exact level of the interface between LD1.1 and FRA will depend on the route structure below, the finalised design of which is subject to the LD1.1 consultation, which seeks feedback on two options:

- Option 4 proposes systemised routes with FRA above from FL305 (FL245 in Sector 9);
- Option 6 proposes systemised routes with FRA above from FL245

This ACP is consulting upon the options for implementing FRA, with a lowest possible level of FL245, and seeks feedback from stakeholders on the options for this implementation.

This area of airspace neighbours with Irish airspace (already FRA) on the west border, and with the French airspace (FRA planned to be implemented in December 2021) on the southern border. The south-west corner contains airspace known as the PEMAK Triangle and the TAKAS Box where Air Traffic Services (ATS) are delegated to the French and Irish Air Navigation Service Providers (ANSPs) respectively. This is subject to a separate ACP with an anticipated implementation date of December 2021, in order to align with the French deployment of FRA (Free Route Airspace Deployment 2.1)[5].

The FRA D2 ACP has been categorised under CAP1616 as a Level 2B change as it only proposes changes above FL245.

Subsequent FRA Deployments within UK airspace are planned, these will be progressed under separate ACPs.

It should be noted that the FRA area overlies the LD1.1 area, but the lateral boundaries are slightly different. This is necessary since the extent of the FRA D2 airspace is slightly different from that of the lower airspace subject to the LD1.1 proposal.

[4] Flight data processing system limitations prevent considering FRA implementation at lower levels.
[5] The UK FRA deployment plan initially sought to introduce FRA in the PEMAK Triangle and TAKAS Box as part of this second FRA deployment, FRA D2, which originally aligned with Brest ACCs' airspace change requirements and schedule. The UK's FRA timeline has changed but the Brest timeline cannot. For this reason, the PEMAK Triangle and TAKAS Box is now progressing separately, as FRA Deployment 2.1, in accordance with Brest ACC's timelines and requirements. This ACP will change the name of the PEMAK Triangle to the LARLA Triangle.

2.6 FRA D2 and LD1.1 dependency FAQs

There is a separate document of FAQs available on the consultation portal. Some key ones are included here. The FRA D2 and LD1.1 ACPs are dependent and co-ordinated, they are being run in parallel, with both consultations being run concurrently.

The outcome of the LD1.1 consultation will determine the Division Flight Level (DFL) between FRA D2 & LD1.1 (i.e. the level at which Free Route Airspace begins and aircraft can choose their preferred trajectory (subject to some limitations), so this is a key dependency.

- Do both ACPs have to be implemented at the same time? Yes, in practical terms the two ACPs cannot be implemented independently. There are significant design efficiencies and cost benefits to implementing at the same time. Implementing separately would incur very significant additional costs resulting from transitional states requiring additional design, consultation, validation, safety assurance training etc. From the airspace users' perspective, the impact of trying to introduce the two changes separately could potentially result in confusion & stakeholder fatigue.

  - LD1.1 cannot be implemented independent of FRA because there are no routes proposed above FL245/305 and no routes in sector 9 (see Figure 7 for location of Sector 9). Existing routes in sector 9 do not align to the route structure proposed in the LD1.1 ACP.

  - FRA D2 cannot be implemented independently of the LD1.1 ACP because the structural limitation, FRA significant points etc are based on the LD1.1 ACP design options.

- What if there is a delay to either ACP, for example the need to re-consult as a result of the outcome of the other ACP consultation? If there is a delay to either ACP that will result in delay to the other. This risk is recognised and accepted.

- Will the cumulative impacts of both ACPs be shared with stakeholders? Yes, cumulative impacts & benefits are considered (in section 17). To consider ACP one option in isolation can give apparently contradictory results, hence the combined benefits/impacts should be considered by the reader. This is essential in order to understand the "bigger picture".

2.7 Proposed UK FRA Deployment Plan

The scope of the first FRA Statement of Need submitted to the CAA, which initiated the ACP process, was to introduce FRA throughout the UK. Following the assessment meeting and initial work on design principles and options development, it became apparent that the scale of the ACP (in particular the length of time required to implement FRA in phased geographical deployments) did not easily align with the engagement and consultation requirements of the ACP process. The implementation of FRA was assessed against influencing factors, such as system requirements, simultaneous airspace modernisation projects (LAMP, ScTMA, FASI etc.), traffic flow complexity, Borealis Alliance commitments and the requirements of neighbouring ANSPs. The results of which necessitated a geographically phased implementation to enable the introduction of FRA throughout UK airspace. Therefore, in consultation with the CAA, the decision was taken to submit individual ACPs for each planned deployment of FRA.

2.8 Options for Consultation

Since this change is an agreed strategic aim of the European Commission Single European Sky initiative and the CAA's AMS, the options development for FRA has been limited to the following:

1. Baseline: FRA Option 0. Do nothing – maintain the current high level ATS route structure.
2. Implement FRA in accordance with Implementing Regulation EU716/2014 (see para 2.2).

   FRA Option 1. In which all ATS routes are removed.
   FRA Option 2. In which the ATS route structure is partially maintained.
   FRA Option 3. In which the ATS route structure is maintained, but aircraft are not constrained to flight plan the routes within the FRA.

For each of Options 1-3 Route Availability Document (RAD) restrictions would be introduced in order to manage the flow of traffic transitioning into and out of FRA (more details of these options are given in section 5).

3 Current Airspace (Baseline)

Before looking at the proposed options for this ACP, it is important to understand the current day airspace operation in the area. It should be noted that "Doing nothing" is useful as a baseline for comparison, but due to the mandate it is not considered a viable option.

The area covered by this ACP is shown in Figure 1, which covers the airspace over the Southwest of England and most of Wales. The geographical scope of FRA Deployment 2 is predicated on ATC sector boundaries within the region.

The airspace is used extensively by aircraft arriving at and departing from airports within and outside the area. These arriving and departing aircraft will be descending from or climbing into the upper airspace (FL245 and above).

The airspace up to FL245 is part of the London Flight Information Region (FIR). Above FL245 this airspace is part of the London Upper Flight Information Region (UIR). This airspace also interfaces with the Scottish, Irish, and the French (Brest) UIRs. The traffic is comprised of aircraft arriving/departing UK airports whether originating from airports within the lateral boundary of the FRA D2 area, or airports outside the area, and overflights such as transatlantic flights to/from continental Europe.

Within the BANBA CTA and TAKAS box, the provision of ATS is delegated to the IAA. Within the PEMAK triangle the provision of ATS is delegated to DSNA.

Figure 3 overleaf shows the ATS routes and the density distribution of flights within this upper airspace for a typical summer week (11-18th August 2019):

Currently all aircraft flight plan to fly along the published ATS route structure or on published Directs (DCTs) which are trajectories between specified waypoints. Modern satellite navigation now makes navigation between any points possible. Air traffic control (ATC) routinely instruct aircraft to route direct to a point (termed a tactical direct), to improve efficiency as aircraft transit through UK airspace. The use of the designated entry/exit points (termed co-ordination points (COPs)) at the UIR boundary, and the influence on flightpaths of some navigation beacons and the ATS route structure can be seen clearly in Figure 3. However, the regular use of tactical direct shortcuts to/from the COPs can also be discerned.

For reference, the extant UK route structure is defined in detail in the following sections of the UK Aeronautical Information Publication (AIP) (Ref 7):

ENR 3.3 AREA NAVIGATION ROUTES

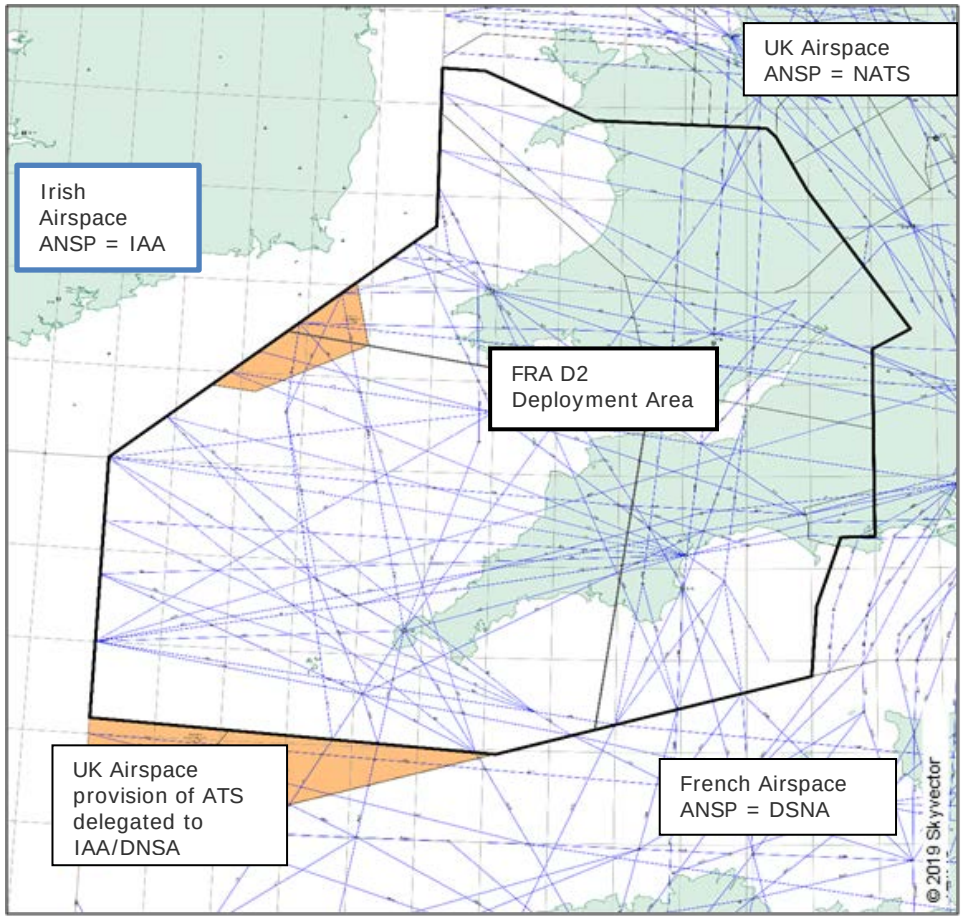
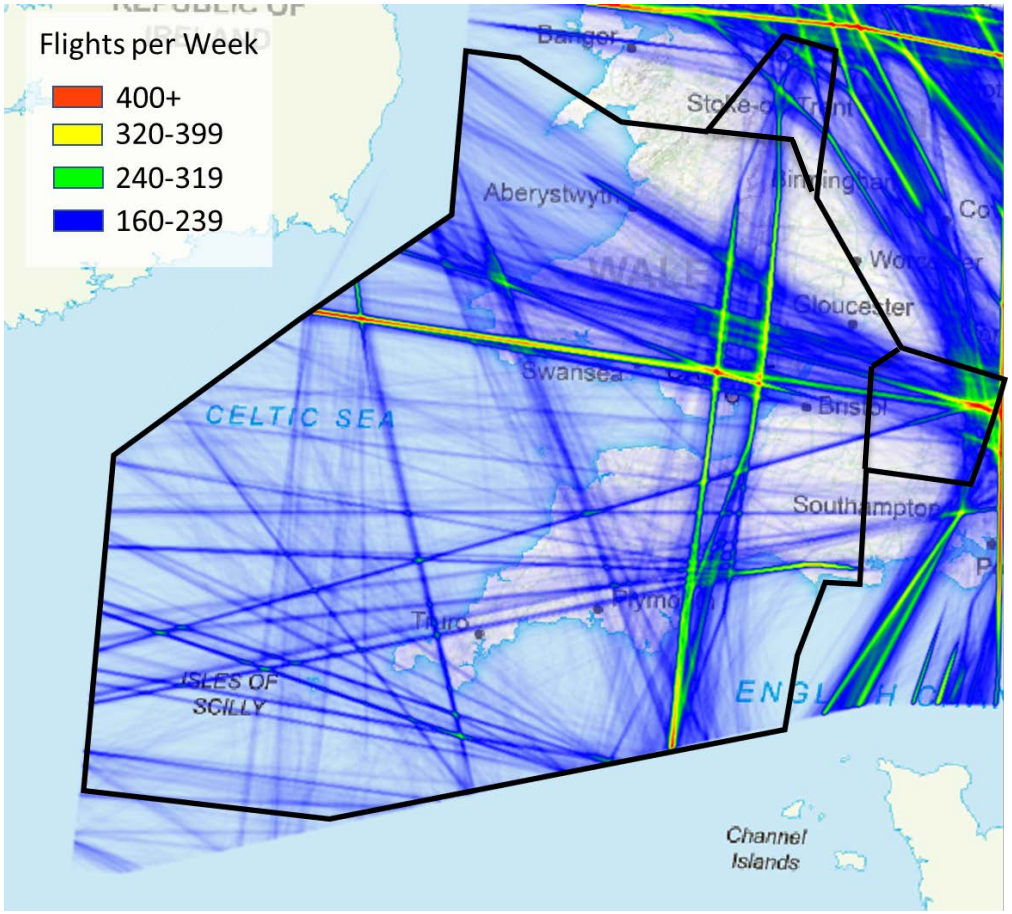


Figure 3 Upper ATS routes (FL245 and above) within the FRA Area....



and the density of flights (Aug 11-18 2019)

4 FRA Concept Overview

FRA is defined as "A specified airspace within which users may freely plan a route between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished[6]) waypoints, without reference to the ATS route network, subject to airspace availability." Within this airspace, flights remain subject to air traffic control.

Waypoints can be assigned as one or more FRA significant points depending on their intended use as follows:

- FRA Entry Point (E) A published Significant Point on the horizontal boundary of the FRA from which FRA operations are allowed.
- FRA Exit Point (X) A published Significant Point on the horizontal boundary of the FRA to which FRA operations are allowed.
- FRA Point (I) A published Significant Point via which FRA operations are allowed.
- FRA Arrival Point (A) A published Significant Point to which FRA operations are allowed for arriving traffic to specific aerodromes.
- FRA Departure Point (D) A published Significant Point from which FRA operations are allowed for departing traffic from specific aerodromes.

The precise location of these FRA significant points is dependent on the base flight level at which FRA is implemented, which is dependent on the LD1.1 ACP. This will be determined by the outcome of the LD1.1 consultation. To calculate the position of FRA Arrival points, a po gradient of c.5% (c.80 nautical miles from the airport) will be assumed. For FRA Departure points, a climb gradient of c.7% (c.60 nautical miles from the airport) will be assumed[7]. FRA Entry and Exit points will situated on or close the lateral boundary of FRA[8]. FRA Intermediate points will be assigned where appropriate within the FRA volume.

Within FRA, air traffic will be able to flight plan user-preferred trajectories without reference to a route structure; therefore flows of traffic are able to change hour by hour, month by month and year by year in a manner which is not constrained by airspace design and is therefore less predictable. Short- and long-term factors which can have an influence on the routings chosen by aircraft operators include:

Short Term Factors

- weather/winds (jet stream position),
- industrial action,
- events such as large sporting events (e.g. football matches, Olympics etc),
- military activity,
- ATC traffic regulations (used to manage flows).

Long Term Factors

- relative route charges between neighbouring countries,
- fuel prices,
- company business models/ fleet mix,
- seasonal route preferences,
- changing destinations and emerging markets,
- political factors,
- tourism preferences/marketing/fashion.

[6] FRA D2 will initially be deployed on legacy Flight Data Processing system which is unable to accommodate FRA flight plans which include unpublished waypoints.
[7] Subject to ATC procedures and structural limitations
[8] Taking into account the ERNIP and EUROCONTROL guidance.

4.1 Overflights.

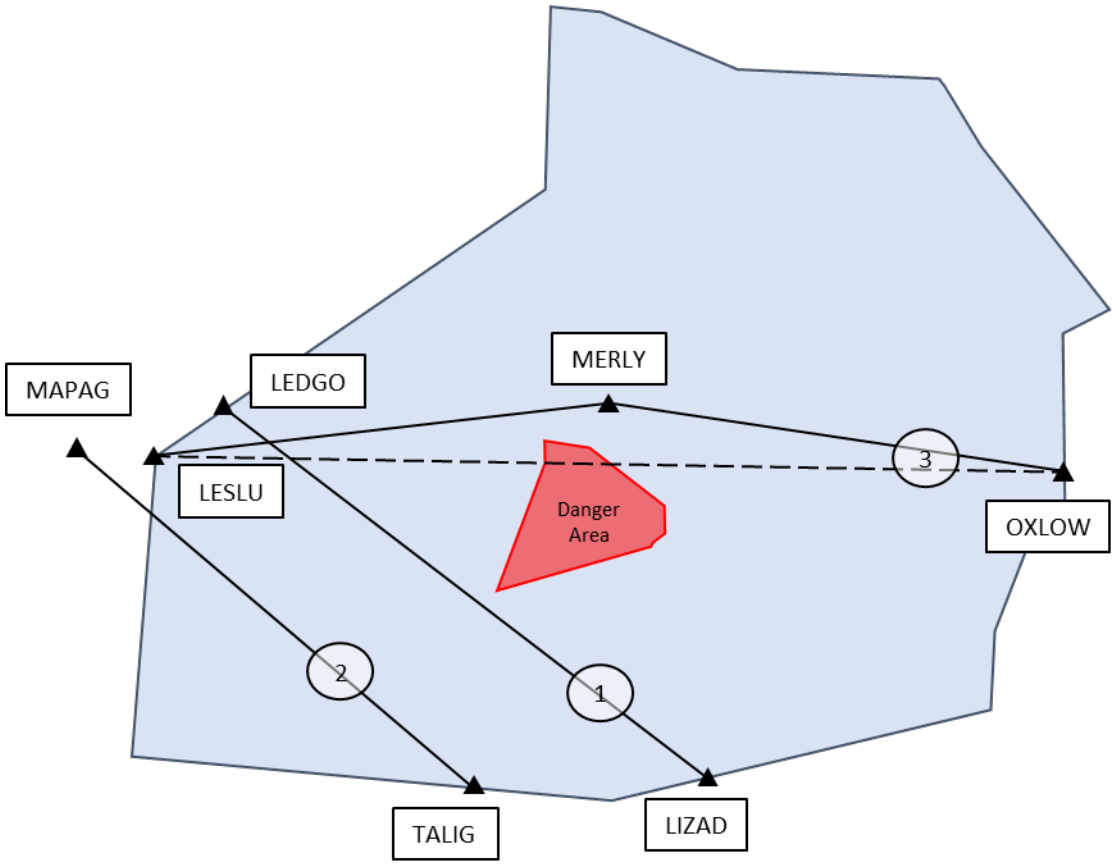


Figure 4 Examples of transiting flight plans.

Figure 4 shows examples of flight plans transiting the blue FRA area. These range from:

1. Transit between a FRA E point and a FRA X point on the UIR boundary (e.g. LIZAD-LEDGO) with no intermediate points in between.

2. Transit between a FRA E point on the UIR boundary (TALIG) to a point outside UK airspace (MAPAG) (Cross border FRA).

3. Example of a flight plan which would not be permitted would be OXLOW–LESLU since it would transit a volume of active segregated Special Use Airspace (SUA). For this to be accepted it would have to route via a FRA I point to take it around the SUA (e.g. an existing waypoint MERLY).

4.2 Arrivals

Each airport will have a defined set of arrival points (FRA Arrival points) for descending out of FRA to arrive at an airport[9]. These may then link to Standard Terminal Arrival Routes (STARs) (where available) for the destination airport. The inclusion of FRA Arrival points simply defines the point at which aircraft transition from FRA to the route structure below, where this exists, to arrive at a specific airport.

The design changes proposed in LD1.1 maintains connectivity between the proposed new routes and existing STARs, and this is described in the LD1.1 interface sections.

As the baseline airspace beneath the FRA D2 deployment area is subject to the LD1.1 consultation, Figure 5 shows an *indicative* example of the proposed arrival structure using Cardiff Airport as the example assuming a FRA DFL of FL245. Actual points will be determined after the FRA D2 and LD1.1 consultations.

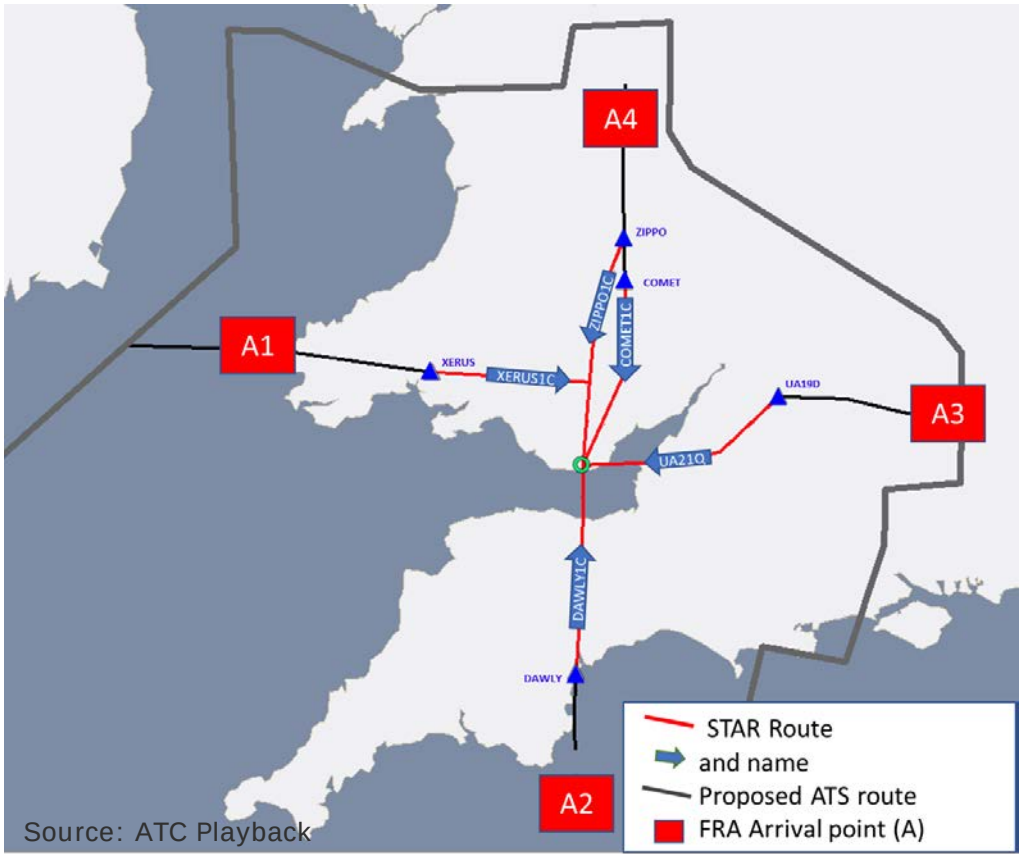


Figure 5 Indicative examples of arrival to Cardiff

The FRA D2 deployment area affects arrivals for several airports. Cardiff, Bristol and Exeter are the primary airports within the FRA D2 footprint (only Cardiff and Bristol have STARs).

The arrival points for all airports under the FRA D2 area will be published in the AIP in accordance with ERNIP guidance.

Indicative FRA Arrival Point	Route below	STAR
A1	E/bound	XERUS 1C
A2	N/bound	DAWLY1C
A3	W/bound	UA21Q
A4	S/bound	COMET1C /ZIPPO1C

Table 1 Indicative examples of FRA Exit (Arrival) points (Cardiff)

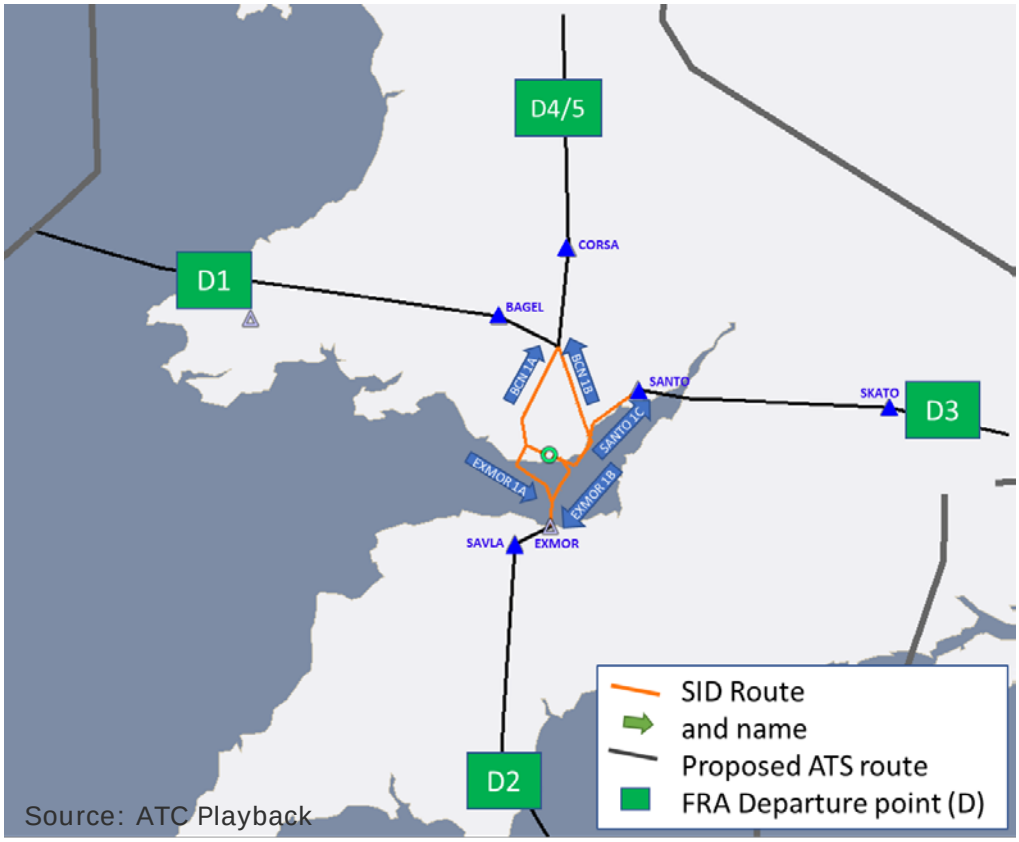
[9] This is in accordance with EUROCONTROL FRA Guidance in ERNIP Part 1 Section 10 (Ref 11) which describes FRA arrival connectivity.

4.3 Departures

Each airport will have a defined set of points for departures (FRA Departure points) to transition (climb) from the lower ATS route structure into FRA. Where Standard Instrument Departures (SIDs) are available at the departure airport the transition from the SID to the lower ATS route network will be unchanged from today (or as proposed within LD1.1 ACP).

The design changes proposed in LD1.1 maintains connectivity between the proposed new routes and existing SIDs, and this is described in the LD1.1 interface section.

As the baseline airspace beneath the FRA D2 deployment area is subject to the LD1.1 consultation, Figure 6 shows an *indicative* example of the proposed departure structure[10] using Cardiff Airport as the example assuming a FRA DFL of FL245. Actual points will be determined after the FRA D2 and LD1.1 consultations.



The FRA D2 deployment area affects departures for several airports. Cardiff, Bristol and Exeter are the primary airports within the FRA D2 footprint (only Cardiff and Bristol have SIDs).

The departure points for all airports under the FRA D2 area will be published in the AIP in accordance with ERNIP guidance.

Figure 6 Indicative examples of departure points (Cardiff)

Indicative FRA Departure Point	Route direction	SID (end point)
D1	W bound	BCN1A/BCN1B (BCN)
D2	S bound	EXMOR1A/EXMOR1B (EXMOR)
D3	E bound	UA16M (SANTO)
D4	N bound	BCN1A/BCN1B (BCN)
D5	NW bound	BCN1A/BCN1B (BCN)

Table 2 Indicative Examples of departure points (Cardiff)

[10] As outlined in EUROCONTROL FRA Guidance in ERNIP Part 1 (Ref 11)

Cross Border FRA & Borealis Alliance

In addition to the introduction of Arrival and Departure Points for airfields, FRA also allows for the introduction of Cross Border operations i.e. the ability to flight plan to cross existing international airspace boundaries without the need to do so via a published Co-ordination Point (COP)[11].

The Borealis Alliance members have worked cooperatively since 2012 to develop a common FRA concept of operations as outlined in the Borealis Free Route Airspace Concept of Operations v1.0 (Ref 8). Many of the design options discussed in the Stage 2 document set (Refs9 & 10) are related to and have been influenced by the engagement between Borealis Alliance members as well as other Stakeholders and Air Navigation Service Providers (ANSPs).

The intention of the cross-border FRA concept is to secure unconstrained cross-border FRA operations at the ANSP interfaces, in accordance with the Eurocontrol European Route Network Implementation Plan (ERNIP Part 1) (Ref 11) and North Atlantic Documents e.g. ICAO Doc 7030 (Ref 12). This concept will enable airspace users to flight plan a preferred trajectory, regardless of national FIR boundaries, and portions of airspace within which the provision of ATS is delegated to the participating states. This will allow flight plannable free routing from the North Atlantic to the Russian Border.

Figures 7-8 show the development of the Borealis FRA Airspace (source Borealis Alliance 2019).

Figure 7 Current State of Borealis FRA (2019)

[11] Subject to structural limitations that may be required to manage traffic flows or system limitations.

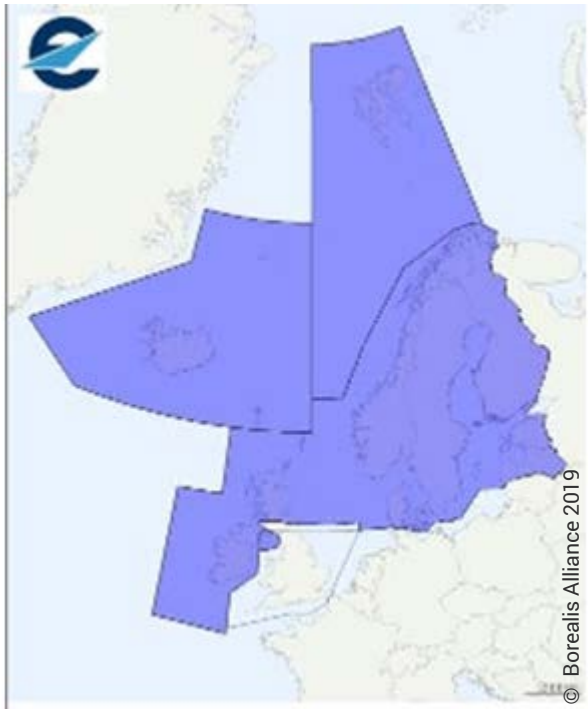


Figure 8 Borealis FRA, Post UK FRA D1 (Dec 2021)

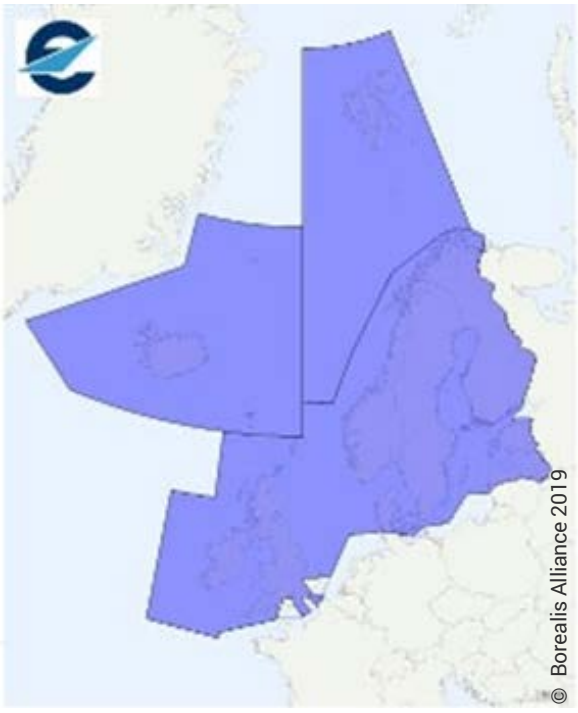


Figure 9 Borealis FRA Post 2024

4.4 FRA- Concept Options

Figure 10 shows the FRA area which is under consideration for Deployment 2. The sections of the border where cross-border transit is proposed to be unconstrained are indicated by the red lines. For the other parts of the border, crossing will have to be flight planned via one of the established coordination points, or a new coordination point included within this proposal.

The following options are proposed for consultation.

FRA Option 1. In which all ATS routes are removed.

FRA Option 2. In which the ATS route structure is partially maintained.

FRA Option 3. In which the ATS route structure is maintained, but aircraft are not constrained to flight plan the routes within the FRA.

These design options proposed are discussed in Section 5 in detail.

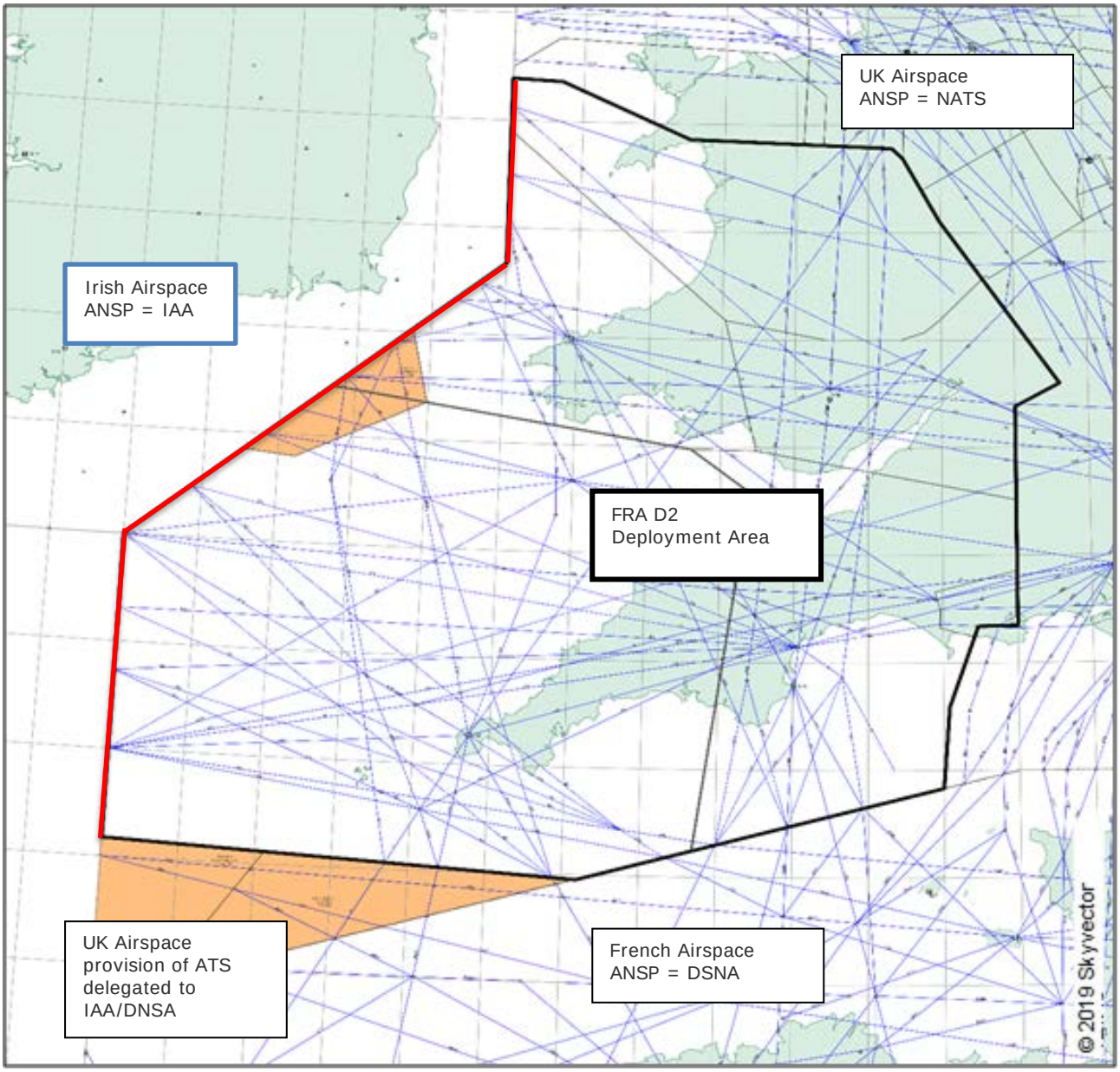


Figure 10 FRA Deployment 2 Area with extant ATS routes shown

Flight plan Buffer Zones

To support the safe introduction of proposed FRA changes, NATS has reviewed the application of Flight-Plan Buffer Zones (FBZs) as part of the introduction of FRA to ensure flight plans remain compliant and consistent with policy across the Deployment 2 Area.

A Flight-Plan Buffer Zone (FBZ) is an area (always associated with Special Use Airspace (SUA)) promulgated to ensure adequate flight plan trajectory separation from active Danger Areas or other SUA.

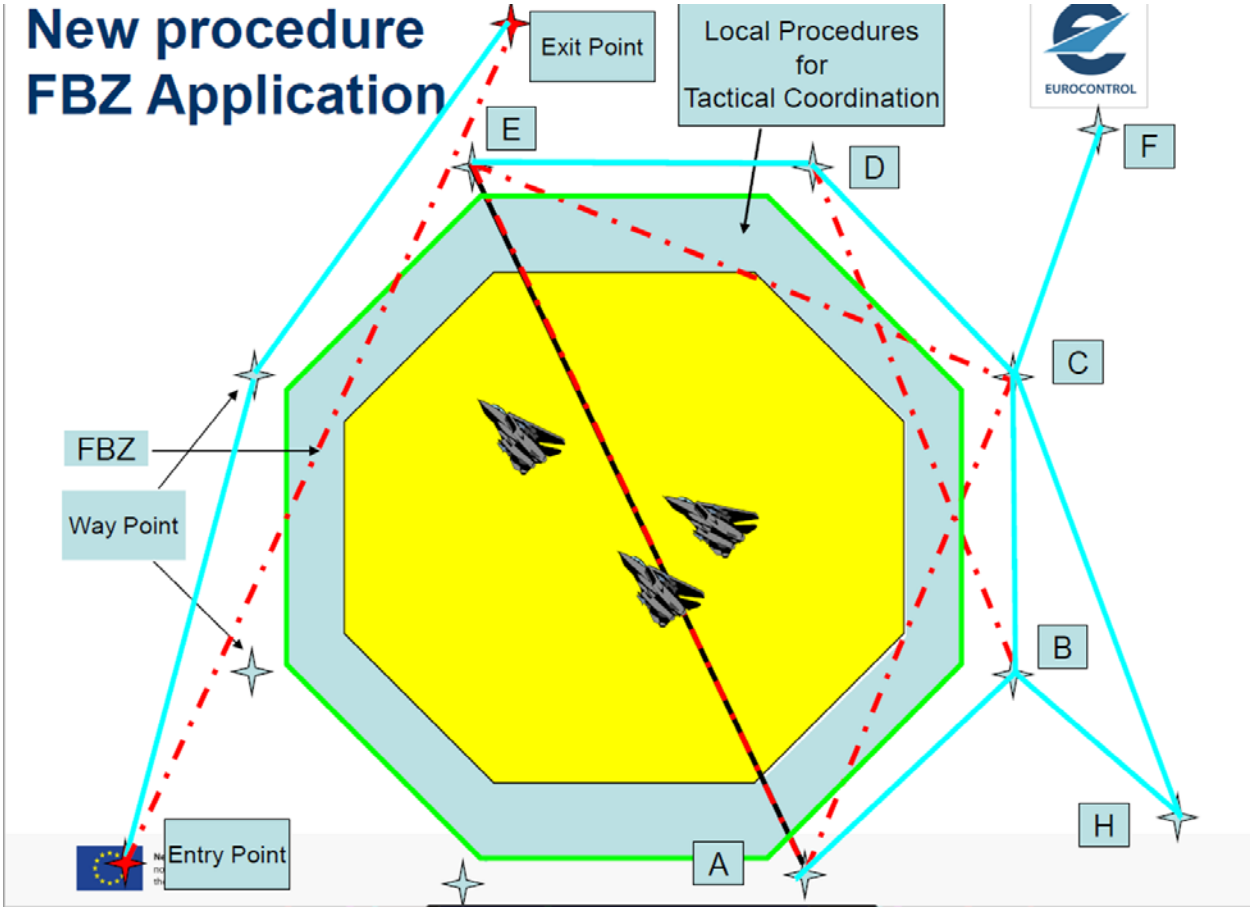


Figure 11 Flight plan Buffer Zone

In the example shown in Figure 11 the yellow area is the SUA/Danger area, the blue zone surrounding it is the FBZ. This extends around the boundary of the SUA, the distance of which will be determined by the level of risk of excursion determined by the activity being conducted within the SUA. Flight plans will be rejected[12] by the IFPS if the planned trajectory of the flight would enter the FBZ. In Figure 11 any of the red dotted flight planned trajectories would be rejected. The blue flight planned trajectories would be accepted.

[12] FBZ would be applicable to General Air Traffic (GAT) Flight Plans submitted to the European Network Manager. They would not affect Military Operational Air Traffic (OAT) flight plans.

The requirement for a buffer between ATS Routes and SUA is contingent on the 2014 CAA's SUA - Safety Buffer Policy for Airspace Design Purposes. The policy states that a buffer is only required for specific activity within SUA[13]. Therefore, for those volumes of SUA which cater for multiple activity types as listed in AIP ENR 5.1, NATS intends to activate an FBZ in IFPS only when the activity being conducted requires a buffer. This will be achieved through existing Airspace Management processes. The SUA volumes that may require a buffer and therefore need to be considered within the proposed FRA D2 region, are listed in Table 3 and illustrated in Figure 12.

Special Use Airspace	Designators				
FOST Danger Areas	EG D006A	EG D007A	EG D007B	EG D008A	EG D008B
	EG D008C	EG D009A	EG D009B	EG D012	EG D013
Oakhampton	EG D011A	EG D011B	EG D011C		
Castlemartin	EG D113A	EG D113B			
Manorbier	EG D115A	EG D115B			
Salisbury Plain Training Area	EG D123	EG D124	EG D125	EG D128	
Pendine	EG D117				
Pembrey	EG D118				
Aberporth Ranges	EG D201A	EG D201B	EG D201C	EG D201D	EG D201F
	EG D201G	EG D201H	EG D201J		
West Wales	EG D202A	EG D202B	EG D202C	EG D202D	
Sennybridge	EG D203				
South West Managed Danger Areas	EG D064A	EG D064B	EG D064C		
North Wales Military Training Areas	South Low	South High	North Low	North High	

Table 3 List of Special Use Airspace which may require a buffer within the FRA D2 Region

In support of the design of LD1.1 and FRA D2, NATS intends to seek dispensation from the buffer policy. This has been deemed necessary to enable NATS to deliver specific initiatives of the CAA's AMS (Ref 1), which are:

- 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
- facilitating defence and security objectives

The policy requires that upper ATS and conditional routes are separated from SUA by a minimum of 10nm. No specific separation criteria is specified for FRA trajectories[14]. CTAs should be 5nm from SUA[15] and a vertical buffer of 2000ft should be applied. Applying the criteria specified would have a significant impact to route/trajectory flight plan availability, which is likely to result in one of the following outcomes:

- Negatively impact efficiency and environmental benefits
- Negatively impact defence and security objectives. Assuming either a buffer were to be applied inside the SUA or SUA booking protocols established to limit SUA activation. For example, when the South West Manged Danger Areas are active, the FOST Danger Areas, Castle Martin and Manorbier Danger Areas could only be activated to a maximum altitude of c.22,00ft (refer to Table 3).

[13] The North Wales Military Training Areas do not have any activity descriptors listed in the AIP.
[14] In relation to FRA the policy states 'Route Free Operations Airspace requires, as necessary, means other than airspace design to ensure sufficient separation is applied between controlled flights and SUA. The arrangements for the employment of Flight Plan Buffer Zones are detailed in the European Route Network Improvement Plan Section 3.'
[15] Notwithstanding the Upper Airspace CTA which mirrors the UK UIR. See UK AIP ENR 2.1 FIR, UIR, TMA AND CTA.

To illustrate this the diagrams at Figure 12 show the airspace as it is today (where the airspace has evolved prior to the publication of the 2014 buffer policy (except for EG D064 A,B &C) and the airspace inclusive of a 10nm external buffer to the SUA volumes within the FRA D2 area.

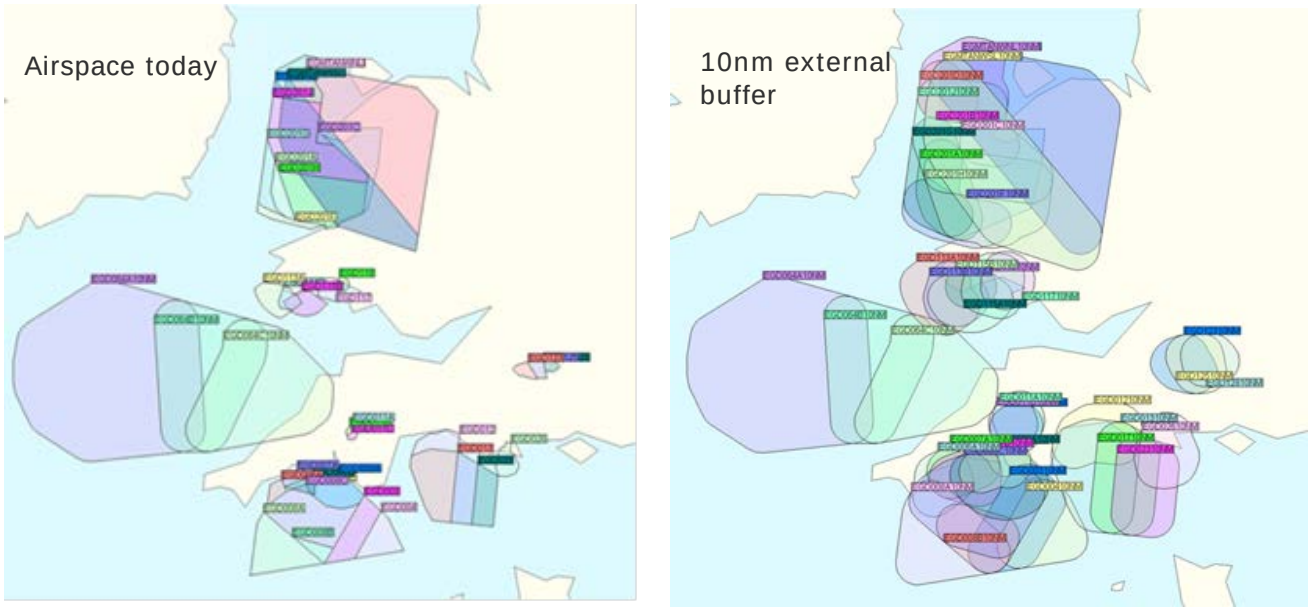


Figure 12 Illustrative example of the buffer policy

To make the case for policy dispensation it is necessary to determine a minimum safe distance that an aircraft can flight plan from each SUA. To achieve this, it is necessary to conduct a hazard identification, risk analysis and assess the mitigations that can be considered (in accordance with the CAP760[16] guidance). CAP1616 recognises that it would be disproportionate to conduct detailed safety assessments while an ACP is at a formative stage with more than one option. Only a qualitative assessment is required until submission of the Final Options Appraisal (stage 4 of the ACP process). This work will be conducted post consultation, once stakeholder feedback has been considered, an option selected and, if necessary, the design modified. Therefore, it is not possible to consult upon the size and shape of SUA buffers.

The request for dispensation will be based on the maintenance or enhancement of existing airspace arrangements that have been proved safe through established operational practice. It will also consider the outcome of route conformance data contained within the High Level High Speed trial report and analytical data on DCT conformance[17].

In addition, NATS has engaged extensively with the MoD to fully understand the following:

- The nature of the activity that occurs within SUA
- The applicability of the AIP activity descriptors for each SUA
- The safety barriers applied by the MoD to ensure containment for each SUA

NATS has sought specialist advice from the CAA as advised in the policy. The CAA advised that they cannot make a decision on specific elements of the proposal prior to Stage 5 of the ACP process. The airspace design options are contingent on the safety case achieving dispensation from this policy. NATS will present the case for policy dispensation to the CAA in the ACP submission (Stage 4 of the ACP process).

[16] CAP760 - Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases
[17] Internal analytics reports completed by NATS. This information will be shared with the CAA as part of the ACP submission

4.5 No Planning Zones

A No Planning Zone (NPZ) is a defined airspace volume which may be used to restrict flight plans and thus prevent undesirable traffic flows in a particular area. They can also be used where gaps in ATM capability exist i.e. Geographical Radio Communication or Radar Surveillance Coverage Gaps.

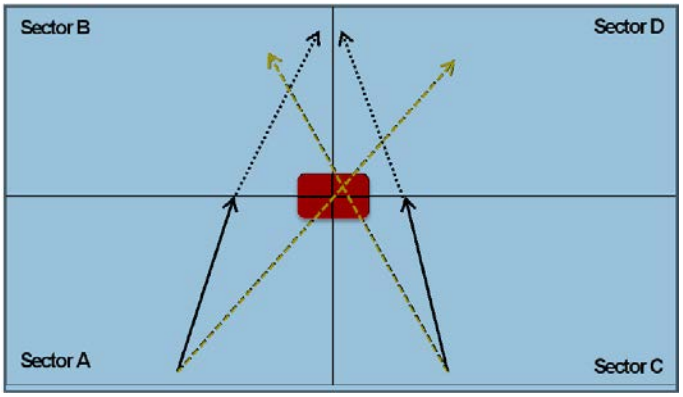
The process to determine the requirement for NPZs is primarily based on the outcome of flight plan validation simulation conducted by the EUROCONTROL Network Manager (NM). To complete a flight plan simulation, it is necessary for the NM to replicate the proposed airspace design within their test systems. Due to the cost, time and effort required to achieve this activity it would be disproportionate to conduct this simulation on each of the options presented within this consultation. Furthermore, the final option may be amended depending on the consultation responses which would potentially require further simulation. Therefore, it is not possible to consult on where and how NPZs may be used within the design.

Should they be required, the proposed deployment of FRA will comply with guidelines for NPZs as set out within Para 4.5.5 of the EUROCONTROL Network Management Flight Planning Requirements - Guidelines issued Dec 2018 (Ref 14):

- *When and where required to prevent inappropriate flight trajectory airspace crossings or to properly manage ATC operationally, sensitive areas inside or across relevant FRA area/s establishment of No Planning Zone/s (NPZ) might be considered in accordance with provisions in ERNIP Part 1, 9.5.5.*
- *Within the airspace volume representing such zone the planning of flight trajectory is either not permitted or allowed under certain specified conditions. In order to assist the airspace users in the presentation of the intended flight operation, the flight planning limitation/s shall be defined in the Route Availability Document (RAD).*
- *Airspace users can avoid such zone by flight planning via appropriate significant points around it or in accordance with allowed conditions.*
- *Such a zone is named "No Planning Zone" (NPZ) and shall be published in accordance with provisions in ERNIP Part 1 .*

An example of how an NPZ could be used is an occasion where two flights are transferred by two different upstream control sectors to two different downstream control sectors, causing sector clipping which makes management of the flights more difficult. As such, alignment of sector boundaries has to be avoided by coordinated airspace design.

If a coordinated airspace design approach is difficult or not practical, and in order to manage such ATC operationally sensitive areas, limiting flight planning through a small critical part of the airspace around the sector boundaries (red shaded zone) can be considered.



An NPZ is the airspace of defined dimensions within which the planning of flight trajectory is either not permitted or only allowed under certain specified conditions.

Airspace users can avoid such zone/s by planning via appropriate significant points around the zone/s or in accordance with allowed conditions.

4.6 Route Availability Document (RAD)

The RAD is a common reference document containing the description for route and traffic orientation. It includes route network and free route airspace utilisation rules and availability. The RAD is also an Air Traffic Flow and Capacity Management (ATFCM) tool that is designed as a sole-source flight-planning document, which integrates both structural and ATFCM requirements, geographically and vertically.

The content of the RAD shall be agreed between the EUROCONTROL Network Manager and the Operational Stakeholders through an appropriate cooperative decision making (CDM) process. The RAD is a dynamic tool managed by ANSPs and EUROCONTROL and therefore changes to it are outside of the scope of the CAP1616 process.

A key process to determine the requirement for RAD restrictions associated with an airspace design is the outcome of flight plan validation simulation conducted by the EUROCONTROL Network Manager (NM). To complete a flight plan simulation, it is necessary for the NM to replicate the proposed airspace design within their test systems. Due to the cost, time and effort required to achieve this activity it would be disproportionate to conduct this simulation on each of the options presented within this consultation. Furthermore, the final option may be amended depending on the consultation responses which would potentially require further simulation. Therefore, it is not possible to consult on where and how RAD restrictions may be used.

4.7 Simulations

Two real time ATC simulations of FRA concepts and design options have been undertaken by NATS over a total of four days.

- 23 & 24 May 2018
- 23 & 31 March 2019

These simulations have served to inform opinions of the different options and provide hands-on experience for air traffic controllers such that different options can be evaluated.

4.8 What will happen to the Standard Route Document (SRD) when FRA is introduced?

We will continue to publish the SRD updates each AIRAC and it will look very similar to today. The difference will be for entries which contain a FRA portion, we will be inserting a new indicator <FRA> to indicate that this portion of routeing is FRA airspace and that the operator may file DCT or via any FRA relevant waypoint in that portion.

Where waypoints are mandated to be used in certain situations, this will also be reflected in the SRD. There are likely to be a high number of mandated waypoints within the West FRA volume. Consequently, there may be less opportunity to insert the <FRA> indicator and a greater number of routes promulgated as waypoint DCT waypoint within the West airspace.

The map in Figure 17 below shows some example FRA routings. Table 11 shows how these routings could be described in the SRD.

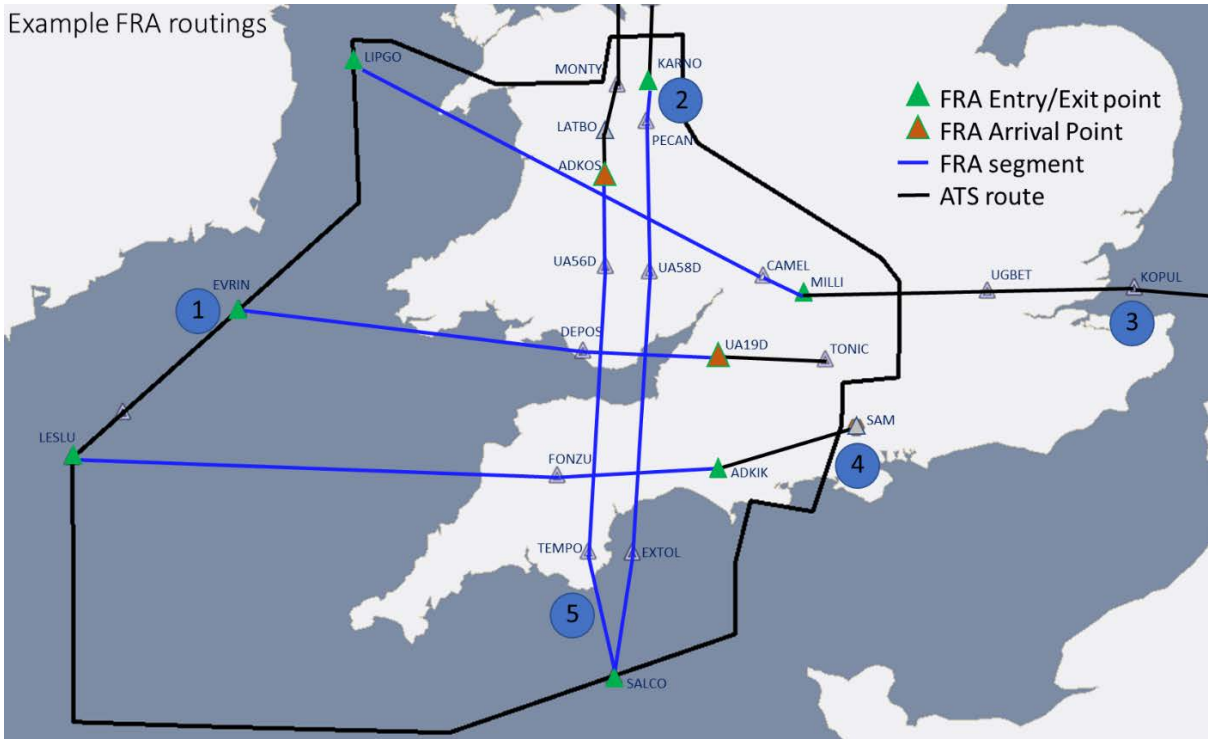


Figure 13 Example FRA routings

Ref	Route	Example FRA routing	Example SRD routing with mandated waypoints
1	Eastbound EVRIN – EGLL	EVRIN <FRA> UA19D P2 TONIC TONIC1H EGLL	EVRIN DCT DEPOS DCT UA19D P2 TONIC TONIC1H EGLL
2	Southbound EGNT – SALCO	KARNO <FRA> SALCO	KARNO DCT PECAN DCT UA58D DCT EXTOL DCT SALCO
3	Westbound KOPUL – LIPGO	RAPIX L610 KOPUL Q60 UGBET UA50E (ROUTE B) MILLI <FRA> LIPGO	RAPIX L610 KOPUL Q60 UGBET UA50E (ROUTE B) MILLI DCT CAMEL DCT LIPGO
4	Westbound EGKK – LESLU	SAM N19 ADKIK <FRA> LESLU	SAM N19 ADKIK DCT FONZU DCT LESLU
5	Northbound SA LCO – EGGP	SALCO <FRA> ADKOS P16 MONTY	SALCO TEMPO UA56D ADKOS P16 MONTY

KEY: FRA ENTRY POINT FRA ARRIVAL POINT FRA EXIT

Table 4 FRA Flight plan examples

Where traffic is joining/leaving FRA to/from an airfield for which there are mandated FRA arrival/departure connecting routes promulgated in the RAD Pan Europe, then this mandated portion will be displayed in the SRD entry, from the FRA Arrival/Departure Points as shown in Example 1 & 5.

For LD1.1 & FRA D2, it may be that there are specific RAD mandated DCTs to avoid danger areas when active. If this is the case, then it is likely that we will publish these as full route strings (waypoint DCT waypoint) in the SRD.

5 Proposed FRA Options

The purpose of this consultation is to allow you to give your feedback on our proposals for FRA D2. This section presents the options for possible implementations of FRA.

5.1 Options

Given the mandate and the CAA AMS requirement to introduce FRA, NATS' options on how to implement delivery are limited. Equally, the methods required by the European Network Manager to ensure consistency across all States, as well as agreements reached as part of the Borealis Alliance in respect of Cross Border Operations, further constrain viable options. The following three options are provided in order of descending preference:

- FRA Option 1. In which all ATS routes are removed (preferred option).
- FRA Option 2. In which the ATS route structure is partially maintained.
- FRA Option 3. In which the ATS route structure is maintained, but aircraft are not constrained to flight plan the routes within the FRA.

For each of Options 1-3, RAD restrictions are likely to be required to manage the flow of traffic transitioning into and out of FRA and to enforce the ATC operational procedures at the flight planning stage. See para 0 on page 24.

The mandate stipulates FRA be implemented at and above FL310 as the minimum requirement. Within the D2 airspace, it is NATS' preference to implement FRA from FL245, which is in line with the preferred option of the LD1 ACP consultation. Due to the interdependency with the LD1 design, the actual implementation level(s) will be determined post consultation during Stage 4 of both ACPs. Due to this interdependency we have assessed the benefits for FRA D2 against a DFL of FL305 (FL245 in Swanwick AC Sector 9) (LD1 Option 4) and a DFL of FL245 throughout the region (LD1 Option 6). See Full Options Appraisal (Ref 4)

For the FRA ACP, it is important to note that the design options and FRA design remain the same – the specific location of FRA entry/exit points and FRA vertical boundaries will be determined once the route structure below FRA is finalised (LD1). This consultation is seeking views on the FRA deployment, and considers the options described below:

5.2 FRA Option 1

Option 1 represents the purest implementation of FRA where all routes are removed above a defined level. This is NATS' preferred option (it is also the EUROCONTROL preference). Removing the route structure encourages more efficient flight planning behaviour, thus increasing the likelihood of benefit realisation. It creates a consistent environment for air traffic controllers, whereby all confliction points are determined by aircraft trajectory.

Where flow management is regularly required in a specific volume of airspace (for example between Danger Areas), then structural limitations may be used to manage traffic flows and capacity.

5.3 FRA Option 2

Option 2 represents a compromised implementation of FRA where some routes are retained primarily to manage flows and transitions into and out of FRA. For example, rather than using mandated waypoints for aircraft leaving FRA inbound to an airport, routes would be extended into FRA to connect to STARs or lower Route Structures.

Where flow management is regularly required in a specific volume of airspace (for example between Danger Areas), then routes may be retained and mandated to provide a systemised ATS route structure for SUA avoidance.

If FRA Option 2 were implemented it would allow certain flows to be systemised, consistent with the LD1 ACP. This concept could add complexity to the air traffic operation by introducing a mixed mode of operation. It would also constrain the ability for airlines to file user preferred flight plans.

The retention or partial retention of routes would require controllers to react to different systems of conflict generation, adding complexity to the operation by introducing a mixed mode of controller procedures and system requirements. Furthermore, the retention of routes would require the use of parallel but not necessarily complimentary RADs, introducing a risk of inconsistency between the airspace systems.

5.4 FRA Option 3

Option 3 represents a compromise implementation of FRA where all ATS routes are retained, but aircraft operators are not required to flight plan along the routes. This represents a significant compromise to the implementation of FRA and is not NATS' preferred solution.

Conceptually Option 3 has the potential to minimize the initial impact on airline operators. By retaining a route structure within FRA, airlines and flight planning service providers could choose to what degree they wish to embrace FRA and either route direct or continue to flight plan and fly the existing ATS route structure.

This option could be used as a transitional arrangement to minimize the initial impact on airline operations, with routes being withdrawn at a later date. However, this option may not encourage the most efficient flight plans to be filed and therefore may not realise the full benefits that FRA facilitates.

In addition, it exacerbates the mixed mode of operation issue explained in option 2.

5.5 Requirements

The requirements for FRA as defined in the mandate are listed in the Stage 2 documentation (Refs 9 & 10).

How each of these requirements could be best met was evaluated in Stage 2. This resulted in the use of combinations of the tools available to construct the options which are now being progressed for consultation (as outlined in this section).

5.6 Design Principles

The proposed FRA options have been designed in accordance with the design principles as detailed in the Stage 1B Design Principles document.

5.7 PBN equipage

The FRA volume will not be designated as having an associated minimum RNAV equipage specification (as is required for ATS routes). However, all aircraft, other than State Aircraft, operating in en-route controlled airspace within the London UIRs must be equipped with, as a minimum, RNAV equipment meeting RNAV 5 in accordance with the requirements set out in ICAO Doc 7030 Regional Supplementary Procedures (EUR)[18]. The majority (94.1%) of aircraft that operate from UK airports are RNAV1 equipped.

5.8 ATC Traffic Management

The proposed FRA will be managed by NATS Swanwick Centre ATC. Flights will be monitored by ATC with the assistance of medium and short term conflict detection tools. These will alert ATC if aircraft trajectories are in conflict and hence ATC intervention is required. Optimisation of traffic flows will be achieved in areas of high traffic density and complexity through the use of RAD restrictions which may require that flight plans pass through designated waypoints depending on origin/destination e.g. requirements for entering or exiting designated FRA Airspace

5.9 Other Design Options Considered (but not progressed)

Full assessment of design options which were considered but not progressed is given in the Design Principle Evaluation and Options Appraisal (Ref 9 & 10).

The requirements for FRA as set out in the mandate are listed in Ref 9. The design options that were considered in Stage 2 in order to meet each of these mandated requirements are detailed in Ref 9. Combinations of these were then used to construct the options progressed for consultation (i.e. the Options as outlined in Section 6).

5.10 Full options assessment

The Options Appraisal (Phase II – Full) including safety assessment (Ref 4) as required by CAP1616 (Ref 5), accompanies this document and is published on the CAA portal for this airspace change.

5.11 Implementation Timetable

The *earliest* implementation of any of the changes proposed herein would be March 23rd 2023 (AIRAC 3/2023), subject to CAA approval. Implementation would be coincident with the LD1.1 Airspace Change subject to that ACP obtaining CAA approval.

[18] As set out in UK AIP GEN 1.5 3.2.1

6 Impacts of this proposal

This section describes the impacts and/or benefits of the proposed FRA options. CAP1616 requires that the environmental impacts (e.g. CO_2 emissions) of the proposed airspace changes are assessed for the ACP in question in isolation. However, this ACP (ACP-2019-12) is being implemented concurrently with the LD1.1 ACP (ACP-2017-70) and they are dependent upon each other. One of the reasons for doing this is that there are synergies which result in the combined system being more efficient. Hence the combined/cumulative results for both ACPs are also presented here.

6.1 Noise, visual intrusion, the general public, stakeholders on the ground

The changes proposed impact flights above 24,500ft. This is well above the 7,000ft threshold stipulated by the DfT, below which overflights are deemed to have significant impact on stakeholders on the ground. As such, we assess that there would be no significant change to noise or visual intrusion and no change in impact to stakeholders on the ground due to any of the proposed FRA change options.

6.2 CO_2 emissions

CO2 emissions analysis has been performed using computer simulations which modelled the operation of the FRA D2 airspace.

The flight level at which FRA is implemented influences the enabled benefits. Due to the interdependency with the LD1.1 design, the actual implementation level(s) will be determined post consultation during Stage 4 of both ACPs.

Due to this interdependency we have assessed the benefits for FRA D2 against a DFL of FL305 (FL245 in Swanwick AC Sector 9) (LD1.1 Option 4) and a DFL of FL245 throughout the region (LD1.1 Option 6) Table 4 shows the enabled CO_2e reductions:

	FRA implemented at FL305 / FL245 in Sector 9 (LD1.1 Op4)		FRA implemented at FL245 (LD1.1 Op6)	
FRA Option	2023 CO_2e (T) saving	2033 CO_2e (T) saving	2023 CO_2e (T) saving	2033 CO_2e (T) saving
Option 1 – All routes removed	1,208	1,680	1,530	2,128
Option 2 - Partial Routes	906	1,260	1,148	1,596
Option 3 - All routes retained	483	672	612	851

Table 5 CO_2e emissions (reduction) for each FRA Option at deployment levels FL305 (LD1.1 Op4) and FL245 (LD1.1 Op6)

The results of the modelling forecast an enabled reduction in CO_2e emissions for all FRA Options.

Table 4 demonstrates the effect of the FRA deployment level on the potential enabled benefits, which will be determined post-consultation.

To recognise the cumulative impact of both ACPs when considering the potential benefits. the benefits across the whole airspace, for FRA D2 Options with LD1.1 Option 4 (FRA DFL of FL305 (FL245 in Swanwick AC Sector 9) and FRA D2 Options with LD1.1 Option 6 (FRA DFL of FL245 throughout the region) are presented, with the total overall impacts for each option summarised in Table 5 and Table 6 below:

	Combined Benefits: FRA / LD1.1 Option 4	2023 CO_2e (T) saving	2033 CO_2e (T) saving	CO_2e total saving 2023-2033 £(traded)	CO_2e total saving 2023-2033 £(nontraded)
FRA Option 1	Option 1 – All routes removed	1,208	1,680	258,945	323,512
	LD1.1 Option 4	1,500	2,089	321,731	401,907
	Combined Benefits	**2,708**	**3,769**	**564,524**	**731,664**
FRA Option 2	Option 2 - Partial Routes	906	1,260	194,209	242,634
	LD1.1 Option 4	1,500	2,089	321,731	401,907
	Combined Benefits	**2,406**	**3,349**	**501,589**	**650,090**
FRA Option 3	Option 3 - All routes retained	483	672	103,578	129,405
	LD1.1 Option 4	1,500	2,089	321,731	401,907
	Combined Benefits	**1,983**	**2,761**	**413,480**	**535,886**

Table 6 Combined CO2e emissions reductions for each FRA Option and LD1.1 Option 4

	Combined Benefits: FRA / LD1.1 Option 6	2023 CO_2e (T) saving	2033 CO_2e (T) saving	CO_2e total saving 2023-2033 £(traded)	CO_2e total saving 2023-2033 £(nontraded)
FRA Option 1	Option 1 - All routes removed	1,530	2,128	327,978	409,863
	LD1.1 Option 6	1,198	1,669	256,892	320,999
	Combined Benefits	**2,728**	**3,797**	**580,676**	**725,419**
FRA Option 2	Option 2 - Partial Routes	1,148	1,596	245,983	307,397
	LD1.1 Option 6	1,198	1,669	256,892	320,999
	Combined Benefits	**2,346**	**3,265**	**515,940**	**644,541**
FRA Option 3	Option 3 - All routes retained	612	851	131,191	163,945
	LD1.1 Option 6	1,198	1,669	256,892	320,999
	Combined Benefits	**1,810**	**2,520**	**425,309**	**531,312**

Table 7 Combined CO2e emissions reductions for each FRA Option and LD1.1 Option 6

Column 3 & 4 in the tables above give the annual CO_2e emissions savings estimated for each option in 2023 and 2033. Columns 5 & 6 give the figures for monetised value of traded and non-traded CO_2e emissions savings, totalled across the years 2023-33.

Tables 5 & 6 show that FRA Option 1 enables a greater CO_2e benefit than either Option 2 or 3, whatever the implementation level. When combined with the implementation of the proposed LD1.1 change to the airspace below, FRA Option 1 implemented with LD1.1 Option 6 provides the greatest overall benefit (as highlighted by the red outline). Therefore, to optimise the largest environmental benefit from both ACPs, NATS preferred option is FRA Option 1 with LD1.1 Option 6.

Results from WebTAG are given in full in Appendix A of the Full Options Appraisal (ref 4).

6.3 Fuel Burn

CO2 emissions analysis has been performed using computer simulations which modelled the operation of the FRA D2 airspace.

As for CO_2e emissions, enabled benefits for FRA D2 implemented with a DFL of FL305 (FL245 in Swanwick AC Sector 9) (LD1.1 Option 4), and a DFL of FL245 throughout the region (LD1.1 Option 6) are presented in Table 7 below: :

	FRA implemented at FL305 / FL245 in Sector 9 (LD1.1 Op4)		FRA implemented at FL245 (LD1.1 Op6)	
FRA Option	2023 Fuel burn saving (T)	2033 Fuel burn saving (T)	2023 Fuel burn saving (T)	2033 Fuel burn saving (T)
Option 1 - Full FRA	380	528	481	669
Option 2 - Partial Routes	285	396	361	502
Option 3 - All routes retained	152	211	192	268

Table 8 Fuel burn savings for each FRA Option at deployment levels FL305 (LD1.1 Op4) and FL245 (LD1.1 Op6)

The results of the modelling indicate that the proposed changes will enable a reduction in average fuel burn per flight. The best-case forecast average reduction (Option 1 implemented at FL245) is 1.1kg per flight. This gives a total reduction of 481 tonnes of fuel p/a (2019 traffic level).

The summed overall fuel burn impacts for each option are presented in Table 8 and Table 9 below:

	Combined Impacts: FRA / LD1.1 Option 4	2023 Fuel Burn (T)	2033 Fuel Burn (T)	2023 Fuel cost saving (£)	2033 Fuel cost saving (£)
FRA Option 1	Option 1 - Full FRA	380	528	173,877	241,598
	LD1.1 Option 4	472	657	215,974	300,803
	Combined Impacts	**852**	**1,185**	**389,851**	**542,401**
FRA Option 2	Option 2 - Partial Routes	285	396	130,408	181,198
	LD1.1 Option 4	472	657	215,974	300,803
	Combined Impacts	**757**	**1,053**	**346,381**	**482,001**
FRA Option 3	Option 3 - All routes retained	152	211	69,551	96,639
	LD1.1 Option 4	472	657	215,974	300,803
	Combined Impacts	**624**	**869**	**285,524**	**397,442**

Table 9 Combined fuel burn benefits for each FRA Option and LD1.1 Option 4

	Combined Impacts: FRA / LD1.1 Option 6	2023 Fuel Burn (T)	2033 Fuel Burn (T)	2023 Fuel cost saving (£)	2033 Fuel cost saving (£)
FRA Option 1	Option 1 - Full FRA	481	669	220,092	306,115
	LD1.1 Option 6	377	525	172,504	240,260
	Combined Impacts	**858**	**1,194**	**392,596**	**546,375**
FRA Option 2	Option 2 - Partial Routes	361	502	165,069	229,586
	LD1.1 Option 6	377	525	172,504	240,260
	Combined Impacts	**738**	**1,027**	**337,573**	**469,846**
FRA Option 3	Option 3 - All routes retained	192	268	88,037	122,446
	LD1.1 Option 6	377	525	172,504	240,260
	Combined Impacts	**569**	**793**	**260,541**	**362,706**

Table 10 Combined fuel burn benefits for each FRA Option and LD1.1 Option 6

Column 3 & 4 in the tables above give the fuel burn savings estimated for each option in 2023 and 2033. Columns 5 & 6 give the figures for monetised fuel cost savings, for the years 2023-33.

Tables 8 & 9 show that FRA Option 1 enables a greater fuel burn saving than either Option 2 or 3, whatever the implementation level. When combined with the implementation of the proposed LD1.1 change to the airspace below, FRA Option 1 implemented with LD1.1 Option 6 provides the greatest overall benefit (as highlighted by the red outline). Therefore, to optimise the largest environmental benefit from both ACPs, NATS preferred option is FRA Option 1 with LD1.1 Option 6.

6.4 Airspace capacity

The flight-plan options this proposal would enable airlines to avoid capacity constrained areas within the proposed FRA volume and avoid consequential delay and cost. However, this is not quantifiable and no specific change in capacity is assumed or claimed by this proposal.

FRA implemented with no restrictions could result in a reduction in the airspace capacity. Hence RAD restrictions are likely to be used to manage the flow of traffic transitioning into and out of FRA, and to provide some optimisation in areas of high traffic complexity.

6.5 MoD

The proposed FRA is expected to have a minimal impact on MoD operations. Operational Air Traffic (OAT) flight plans will not be affected by NPZ & FBZ, which form part of the (International Flight Plan System) IFPS.

Where large scale military exercises occur, temporary flight plan restrictions would be managed by the CAA, Airspace Regulation (Utilisation) (notified by NOTAM).

Standing Coordination Procedures (SCP) apply between Swanwick (Mil) and London Area Control (LAC) which allow Military Area Controllers to apply a minimum vertical separation of 1000ft (2000ft if relevant aircraft are either non Reduced Vertical Separation Minimum (RVSM) approved in RVSM airspace or above FL410) without the need for coordination, up to and including FL450. SCP is predicated on GAT being established on the route structure. Within FRA, it is proposed that this agreement is modified such that GAT is considered established on route when they are flying within 5nm of their flight planned trajectory, which is visible to Military Area Controllers. When GAT is not on its flight planned trajectory (or within 5nm), the initiation of coordination is a joint responsibility of both Military Area Controllers and LAC.

Additionally, an amendment is proposed to the on-route status for GAT agreement west of 5°W, whereby GAT flying off-route tracks west of 5°W is considered to be continuously on route at or above FL290. NATS would like to lower the agreement to above FL245 so it is consistent with the base level of FRA.

NATS seek feedback from the MoD as to whether the proposed changes would be acceptable.

6.6 General Aviation (GA) airspace users

There is not expected to be any impact on general aviation or sport aviation airspace users. Arrangements for the activation of Upper Gliding Areas within the deployment area will be unaffected by the introduction of FRA.

6.7 Commercial Airlines

There is expected to be a positive impact on the operations of commercial airlines. FRA will enable increased flexibility in flight planning. Flight plans will more closely reflect the tactical directs provided today. As such there may be benefits in reduced distances flown and reduced fuel uplift requirement. Because of the flexibility of flight planning which FRA will facilitate, and how the airlines will choose to use this flexibility, it is difficult to predict and quantify the benefits to airlines with certainty.

6.8 Impact on Aviation Safety

Project activities so far have included Real Time Development Simulations and associated Safety and Human Factors workshops. The initial work[19] that has been done has indicated that the Air Traffic Controllers regard the FRA mode of operation as being similar to that experienced today.

Key factors underlying this are that direct routings that are (tactically) provided today are expected to be reflected in flight plans and that tools will continue to support Controllers in foreseeing and resolving potential conflicts. Although reduced familiarity as to where conflicts may occur is a possibility (due to the ability to flight plan user-preferred trajectories) the tools are designed to provide adequate support in discerning and managing changes in this aspect.

A qualitative high-level safety appraisal for the three proposed options for FRA indicates that the existing level of safety performance undertaken within the current operation would be maintained.

6.9 Reversion Statement

Should the proposal be approved and implemented, depending on the Option implemented, reversion to the pre-implementation state would be:

- FRA Option 1. (In which all ATS routes are removed) –very difficult
- FRA Option 2. (In which the ATS route structure is partially maintained) –very difficult
- FRA Option 3. (In which the entire ATS route structure is maintained) – very difficult, subject to the LD1 ACP

Due to the removal of ATS Routes the changes proposed by Options 1 and 2 would permanently and significantly change the airspace structure, hence making reversion complex and very difficult. Option 3 would be equally difficult due to the dependency with the LD1.1 ACP and changing route structure below FRA.

In the unlikely event that there are unexpected issues caused by this proposal, then short notice changes could be made via NOTAM or by adding Route Availability Document (RAD) restrictions. For a permanent reversion, the changes would have to be reversed by incorporating this into an appropriate future AIRAC date. Due to the limitations of NATS Area System (NAS - flight and radar data processing) large scale airspace changes are only implemented four times a year.

[19] It has not yet been possible to fully involve all ATC parties (such as the Military) or to exercise the final form of equipment functionality.

7 How to respond to this consultation

The consultation begins on 6 September 2021 and ends on 29 November 2021, a period of 12 weeks and 1 day.

Consultation material is available on the CAA's airspace change consultation portal at:

https://consultations.airspacechange.co.uk/nats/fra-d2

The list of stakeholders targeted for this consultation is given in Appendix A. These stakeholders have been directly informed of this consultation.

The consultation is not limited to these stakeholders - anyone may respond.

A feedback questionnaire is provided on the consultation portal.

It is recommended (and preferred by the CAA) that responses are made via the portal.

Submissions via the portal are sent direct to the CAA. Supporting documents may also be submitted via the portal.

Please note that when submitting feedback, you will be asked to provide the following information:

- Your name, and your role if you are responding on behalf of an organisation.
- Your contact details (email)
- How you feel about the proposed changes to the airspace overall: Support, Object, No Comment, Ambivalent
- Your reaction to each of the 3 options: Strongly Support, Support, Neutral, Object, Strongly Object
- Your reasons for supporting or objecting to the proposal (for example: the impacts and benefits it may have on your flights or organisation, and how often you would be affected.)

If this proposal does not affect your operation, please respond as that fact itself is useful data.

Note that all responses go direct to the CAA who will moderate submissions. Responses will be publicly visible by being published on the CAA airspace change portal subsequent to submission.

8 Compliance with process, and what happens next

8.1 Compliance

If you have questions or comments regarding the conduct of the airspace change process (e.g. adherence to CAP1616 (Ref 7)), please contact the CAA:

Airspace Regulation
Ref: NATS FRA-D2 ACP 2019 –12
Safety and Airspace Regulation Group
Aviation House
Beehive Ring Road
Crawley
West Sussex
RH6 0YR

Form FCS 1521 can be used for this purpose

Note: These contact details must not be used for your response to this consultation. If you do so, your response may be delayed or missed out.

8.2 What happens next?

When the consultation period closes, a consultation feedback document will summarise the themes and NATS' response to issues raised – this may involve making changes to the design. The feedback document will be available for download via the CAA portal.

We will then submit an Airspace Change Proposal to the CAA based on this consultation document and the feedback report.

The CAA will then study the proposal to decide if it has merit and will publish a decision on its website.

If the CAA approves this proposal, we plan to implement the changes not before March 2023.

Dependency with LD1.1

The LD1.1 and FRA D2 ACPs are dependent. The dependencies are described in detail in Section 2.5. If there is a delay to the proposed implementation of either ACP, (for example requirements for design modification and re-consultation for one ACP but not the other) this will delay both. Similarly issues with one ACP may necessitate redesign and re-consultation of the other.

See the FAQs in 2.6 for further detail on the requirement to implement at the same time, and implications if there is a delay to either ACP.

9 References

1. CAA Airspace Modernisation Strategy (CAP 1711) (Relevant Sections: Upper Airspace Section 4)
2. Commission Implementing Regulation (EU) No 716/2014 of 27 June 2014 on the establishment of the Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan Text with EEA relevance: EU Publications Office
3. FRA D2 Stage 3 Consultation Strategy (link to CAA Portal)
4. FRA D2 Stage 3 Full Options Appraisal (link to CAA Portal)
5. CAP1616 Airspace Design: CAA Guidance on regulatory process for changing airspace design.
6. London Airspace Modernisation Programme 2 Deployment 1.1 Airspace Change Portal page
7. Aeronautical Information Publication (AIP)
8. Borealis Free Route Airspace Concept of Operations v1.0
9. FRA Deployment 2 - Design Principle Evaluation and Options Appraisal (link to CAA Portal)
10. FRA Deployment 2 - Options Appraisal (Phase II – Initial) (link to CAA Portal)
11. EUROCONTROL European Route Network Improvement Plan (ERNIP) – Part 1: European Airspace Design Methodology - Guidelines - Edition 2.4 24 June 2021 (Relevant section: Section 10 Free Route Airspace)
12. ICAO Doc 7030, North Atlantic (NAT) Regional Supplementary Procedures
13. Eurocontrol Network Management Flight Planning Requirements - Guidelines issued Dec 2018
14. Department for Transport 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.)

10 Glossary of Terms

ACC	Area Control Centre (there are two ACCs in the UK, Swanwick and Prestwick)
ACP	Airspace Change Proposal
AIP	Aeronautical Information Publication (where airspace and route definitions are published)
ANSP	Airspace Navigation Service Provider
AOR	Area of responsibility
ATC	Air Traffic Control
ATS	Air Traffic Services
Baseline	'As is' situation against which proposed changes are measured
Borealis Alliance	Alliance amongst north-west European Air Navigation Service Providers to drive better performance for stakeholders through business collaboration. The Alliance includes the ANSPs of Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Norway, Sweden and the UK.
CAA	the UK Civil Aviation Authority
CAP	Civil Aviation Publication (publications produced by the CAA)
CONOPS	Concept of operations
COP	Co-ordination Point
D2	Deployment Two, the second deployment of FRA across the area shown in Figure 1.
DCT	(Direct) Waypoint to waypoint routing, which does not use an airway.
DSNA	Direction des Services de la Navigation Aérienne - French ANSP
Eurocontrol	European Organisation for the Safety of Air Navigation; with 41 members it seeks to achieve safe and seamless air traffic management across Europe.
FAB	Functional Airspace Block. (e.g. the UK + Ireland airspace is agreed as a FAB)
FBZ	Flight Plan Buffer Zones – areas for flight planners to avoid to provide separation from Special Use Airspace.
FIR	Flight Information Region (Airspace below FL255)
FL:	Flight level, the altitude reference which aircraft use at higher altitudes using standard pressure setting, essentially units of 100ft, i.e. FL255 equates approximately to 25,500ft
FMC/FMS	Flight Management Computer/Flight Management System
FRA	Free Route Airspace
GAT	General Air Traffic
IAA	Irish Aviation Authority
ICAO	International Civil Aviation Organisation – an agency of the United Nations.
IFPS	Integrated Flight-plan Processing System
LAMP	London Airspace Modernisation Programme; established to redesign the airspace in and around the London TMA region, providing a more efficient airspace design, modernising the route structure and making better use of aircraft and ATC technologies.
MTCD	medium term conflict detection. Generic term for any ATC tool which looks ahead and predicts when aircraft are likely to be in conflict
NATMAC	National Air Traffic Management Advisory Committee
NDB	Non-Directional Beacon (radio navigation beacon)
NM	Network Management
NPZ	No Planning Zone – area where a flight plan is not permitted to enter at all or only when meeting prescribed criteria.
PCP	SESAR Pilot Common Project.
PBN	Performance Based Navigation – international requirements which standardise accuracy, safety and integrity for satellite navigation systems.
RAD	Route Availability Document: contains the policies, procedures and descriptions for route and traffic orientation. Includes route network and free route airspace utilisation rules and availability.
SESAR	Single European Sky ATM Research A collaborative project to completely overhaul European airspace and its air traffic management
SID	Standard Instrument Departure.
SRD	Standard Routing Document
STAR	Standard Terminal Arrival Route
SUA	Special Use Airspace – areas designated for operations of a nature that limitations may be imposed on aircraft not participating in those operations (i.e. military training areas)
TMA	Terminal Manoeuvring Area
UIR	Upper Information Region (Airspace above FL255)
VOR	VHF Omnidirectional Range (radio navigation beacon)
WebTAG	Department of Transport's web-based Transport Analysis Guidance; provides information on the role of transport modelling and appraisal, and templates for analysis (e.g. for Greenhouse gas emissions, and noise).

Appendix A List of Stakeholders

Airlines

Aer Lingus
Air Canada
Air France
Air New Zealand
Air Transat
American Airlines
Aurigny Airlines
Austrian Airlines
BA Cityflyer
Blue Islands
British Airways
Cathay Pacific
Cityjet
Delta Airways
DHL
Eastern Airways
EasyJet
Emirates
Etihad
Eurowings
FedEx
FinnAir
Fly Dubai
Gamma Aviation
German Wings
Gulf Air
Iberia
Iceland Air
Jet2
KLM
Logan Air
Lufthansa
Malaysia Airlines
Middle East Airlines
NetJets
Norwegian Air
Novair
Qantas
Qatar Airways
Ryanair
SAS
Saudia
Singapore Air
South Africa Airways
Tag Aviation
TAP Air Portugal
Thomson/ TUI
Turkish Airlines
United Airlines
UPS Europe
Virgin Airlines
West Jet
WizzAir

Air Navigation Service Providers (ANSPs)

ANS Finland (Finland)
Avinor (Norway)
Direction des Services de la Navigation Aérienne (DSNA) (France)
DSNA ACC Brest (France)
DSNA ACC Reims (France)
DSNA ACC Paris (France)
EANS (Estonia)
Eurocontrol Maastricht Upper Area Control Centre (MUAC)
Eurocontrol Central Flow Management Unit (CFMU)
Irish Aviation Authority (IAA) (Ireland)
Isavia (Iceland)
Latvijas Gaisa Satiksme (LGS) (Latvia)
LFV (Sweden)
NAVIAIR (Denmark)
RAF 78 Sqn

Data Houses/ Flight-planning providers

Air Support
Aviation Cloud
Flight Keys
Lido
Jeppesen
Lufthansa Systems
NavBlue
Sabre

National Air Traffic Management Advisory Committee (NATMAC) Members

Airlines UK
Airspace4All (formerly FASVIG)
Aviation Environment Federation (AEF)
Airport Operators Association (AOA)
Aircraft Owners & Pilots Association (AOPA UK)
Association of Remotely Piloted Aircraft Systems (ARPAS UK)
British Aerospace Systems (BAE Systems)
British Airline Pilots Association (BALPA)
British Air Transport Association (BATA)
British Balloon & Airship Club (BBAC)
British Business & General Aviation Assoc (BBGA)
British Gliding Association (BGA)
British Hang Gliding & Paragliding Assoc (BHPA)
British Microlight Aircraft Association (BMAA)
British Helicopter Association (BHA)
European UAV Systems Centre Ltd
General Aviation Safety Council (GASCo)
General Aviation Alliance (GAA)
Guild of Air Traffic Control Officers (GATCO)
Helicopter Club of Great Britain (HCGB)
Heavy Airlines
Honourable Company of Air Pilots
Light Aircraft Association (LAA)
Light Airlines
Low Fares Airlines (LFA)
Ministry of Defence (MoD) via the Defence Airspace and Air Traffic Management (DAATM)
PPL/IR

British Model Flying Association (BMFA)
British Parachute Association (BPA)

Airports[20]

EGGD Bristol
EGFF Cardiff
EGTE Exeter
EGHI Southampton
EGHH Bournemouth
EGGW Luton
EGSS Stansted
EGKK Gatwick
EGLL Heathrow
EGLC London City
EGWU Northolt
EGBB Birmingham
EGCC Manchester
EGLF Farnborough
EGMC Southend
EGKB Biggin Hill
EGNH Blackpool
EGFH Swansea
EGBJ Gloucester
EGBP Kemble (Cotswold)
EGTK Oxford
EGHQ Newquay
EGTP Perranporth
EGTU Dunkeswell
EGGP Liverpool
EIDW Dublin

Other

Airlines for America
AIRE (Airlines International Representation in Europe)
Airline Operators Committee Heathrow (AOC Heathrow)
Borealis Alliance Executive
Board of Airline Representatives (BAR)
Bristow Helicopters (HM Coastguard)
Direction de la Securities de l'Aviation Civilie (DSAC)
Direction du Transport Aerien (DTA)
French Air and Space Force
IATA
IATA- Heathrow AOC
Irish Aviation Authority Regulator
Irish Air Corps
Ports of Jersey SATCO
QinetiQ
United Kingdom Space Agency (UKSA)

[20] MoD Airfields are not included since consideration of these is incorporated in the DAATM joint response.