Free Route Airspace Deployment 2.1
PEMAK Triangle, TAKAS Box

Gateway documentation:
Stage 2 Develop and Assess

Step 2A (i)
Airspace Change Design Options
and engagement summary

Roles

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References

1. Borealis Alliance Free Route Airspace Concept of Operations v1.0
2. EUROCONTROL European Route Network Improvement Plan (ERNIP)
   (Relevant sections: Section 6 Enroute Design Methodology, Sub-section 6.5: Free Route Airspace (FRA) Design)
3. CAA Airspace Modernisation Strategy (CAP 1711)
   (Relevant Sections: Upper Airspace Section 4)
4. ICAO Doc 7030, North Atlantic (NAT) Regional Supplementary Procedures
5. Commission Implementing Regulation (EU) No 716/2014 (Pilot Common Project (PCP))

1. Introduction

1.1 This document forms part of the document set required in accordance with the requirements of the CAP1616 airspace change process.

1.2 This document aims to provide adequate evidence to satisfy Stage 2 Develop and Assess Gateway, Step 2A Airspace Change Design Options.

1.3 Free Route Airspace (FRA) is defined[1] 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between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished) way points, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.*"

1.4 The concept of FRA, where aircraft can fly between points and are not constrained to follow a network of routes, is well established and has been recommended as a part of the EUROCONTROL Single European Sky ATM Research (SESAR) programme and is a major initiative of the CAA's Airspace Modernisation Strategy (AMS). The implementation of FRA by European Union (EU) member states was mandated in European Law under the EU Implementing Regulation EU716/2014.

2. Options development

2.1 NATS is in the process of proposing airspace changes to implement Free Route Airspace (FRA) within high altitude airspace across the UK, as mandated by European Law. UK FRA is planned to be introduced in a phased manner, split into four main deployments within the UK airspace. This plan was developed in alliance with neighbouring Air Navigation Service Providers (ANSPs). Each phased deployment of FRA is being progressed as an individual ACP under CAP1616, and each is therefore following similar (parallel) workstream.

2.2 This ACP is a subset of the second main UK FRA deployment and seeks to introduce FRA in airspace where the provision of ATS has been delegated to Brest and Shannon ACCs.

2.3 These two volumes are known as the PEMAK triangle (provision of Air Traffic Service (ATS) delegated to Brest Area Control Centre (ACC)) and TAKAS box (provision of ATS delegated to Shannon ACC), and collectively are referred to as 'the region' in this document. The region is illustrated in Figure 1 overleaf.

2.4 NATS does not provide an air traffic service to aircraft in the region.

2.5 NATS sponsors this ACP on behalf of Brest ACC and Shannon ACC, the ATS providers in the region.

2.6 The UK FRA deployment plan initially sought to introduce FRA in this region as part of the second FRA deployment, known as FRA D2, which originally aligned with Brest and Shannon ACCs' airspace change requirements and schedule.

2.7 The UK's FRA timeline has changed but the Brest/Shannon timeline cannot.

2.8 For this reason, the PEMAK triangle and TAKAS box – 'the region' – has been removed from the original scope of UK FRA D2 and is now progressing separately, as FRA D2.1, in accordance with Brest ACC's[2] timelines and requirements.

[1] http://www.EUROCONTROL.int/articles/free-route-airspace

[2] Shannon ACC already operate FRA and have stated that they are content to progress in accordance with Brest ACC airspace design requirements and timeframe.

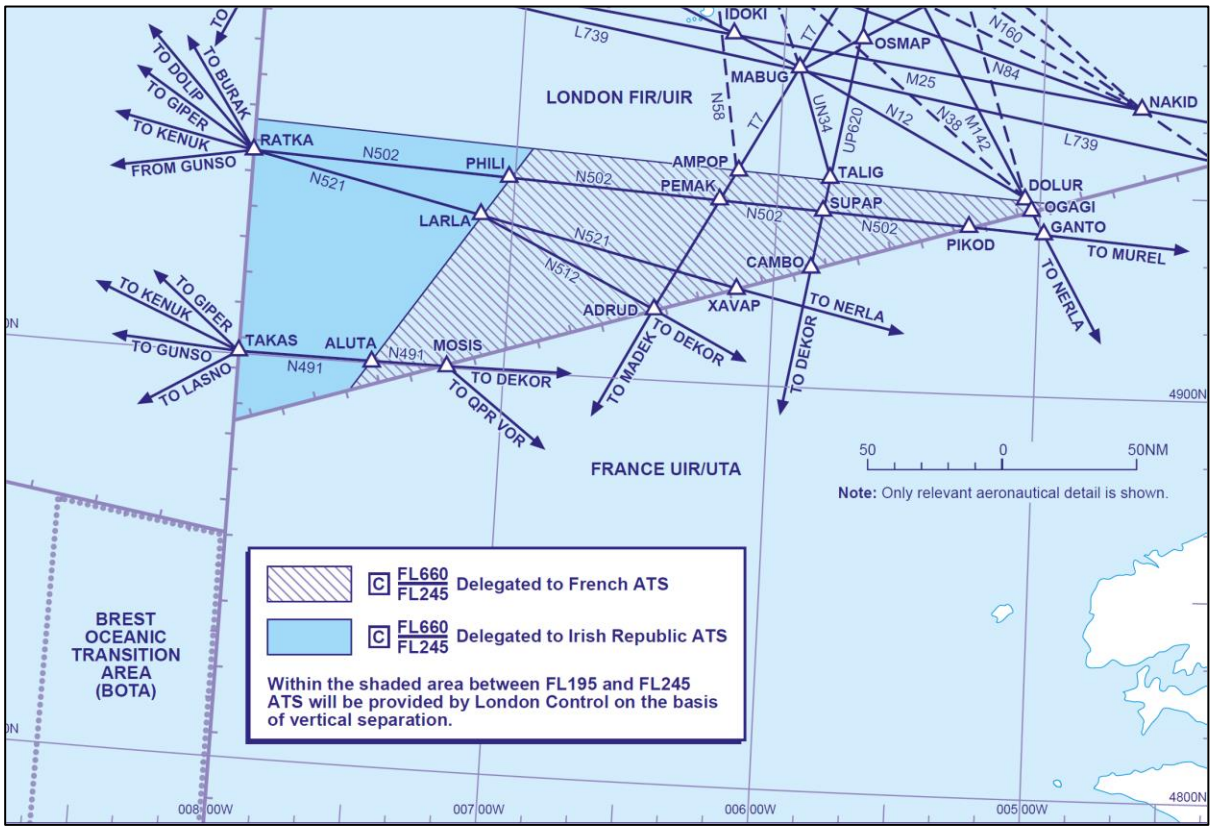

Figure 1 Extract from UK AIP ENR 6-48 illustrating the region

2.9 Early engagement with Brest and Shannon ACCs highlighted the constraints associated with this proposal as follows:

- Brest ACC **must** deploy FRA to meet the extant PCP mandate:
  Flexible Airspace Management and Free Route shall be provided and operated in the airspace for which the Member States are responsible at and above FL310 in the ICAO EUR region…from 1 January 2022.
- Brest ACC's Flight Data Processing system (FDP) **cannot** operate in a mixed mode, i.e. where one volume of airspace is FRA and another part consists of a 'conventional' ATS route structure. Therefore they have to remove the route structure to be able to implement a consistent FRA design throughout the Brest Area of Responsibility (AoR).
- NATS sponsors this airspace change but does **not** provide an air traffic service to aircraft in the region. ATS in the region has been delegated to Brest and Shannon for decades. The flows in the region essentially join Brest's Area of Responsibility (AOR) with the AOR of Shannon, crossing a small corner of southwestern UK airspace FL245+. UK (NATS) controllers have no knowledge of, or involvement in managing these traffic flows.
- The French and Irish primary radar cover in this region at FL245 is **better** than that available to NATS controllers (see UK AIP ENR 6-10).
- Brest ACC has a **fully mature airspace design** for the entire Brest ACC AoR, including this region, suitable for their FDP system.
- Brest ACC has followed **French airspace change process** regulatory requirements to develop their design – NATS has no influence on that process.
- The IAA introduced FRA in 2009 (fulfilling the PCP mandate). The IAA have stated that they are content to change the airspace within the TAKAS box in accordance with Brest ACC's airspace requirements and timeline.

2.10 Due to these constraints, the mandate under EU law and that the introduction of FRA is an agreed strategic aim of the European Commission Single European Sky initiative, the options development has been limited to the following:

- Baseline: do nothing – maintain the current high level ATS route structure.
- Implement FRA in accordance with Implementing Regulation EU716/2014, remove all ATS routes and rationalise waypoints in accordance with the DSNA Brest ACC FRA design in both the PEMAK triangle and TAKAS box.
- Implement FRA in accordance with Implementing Regulation EU716/2014, remove all ATS routes and rationalise waypoints in accordance with the DSNA Brest ACC FRA design in the PEMAK triangle but retain ATS routes in the TAKAS box.

2.11 To minimise stakeholder engagement fatigue (particularly for those already engaged through other UK FRA deployments), NATS considers it proportional to limit stakeholder engagement regarding the design options to targeted stakeholders only.

2.12 Some of the legal requirements to implement FRA originate in EU law. It is NATS' position that due to wider commitments (e.g. Borealis Alliance) and the CAA Airspace Modernisation Strategy, it is the intention to introduce FRA regardless of the withdrawal of the United Kingdom from the EU.

2.13 Independent Commission on Civil Aviation Noise (ICCAN) guidance related to noise impacts on stakeholders on the ground has been considered during options development. The changes proposed in all options are at FL245 and above, therefore the ICCAN guidance is not considered relevant for this ACP.

3. Stakeholder Engagement

3.1 NATS has been actively involved in meetings and stakeholder engagement regarding how best to implement FRA for several years. Table 1 presents the stakeholder engagement meetings which have taken place.

Table 1 Stakeholder meetings

Date	**Subject/*outcome***	**Meeting with**
19-20 August 2015	Borealis Alliance FRA Project Group, London	All Borealis Alliance members (Avinor, EANS, ANS Finland, IAA, ISAVIA, Latvijas Gaisa Satiksme (LGS), LFV, NATS, Naviair) for more information please click this link.
23-24 September 2015	Borealis Alliance FRA Project Group, Dublin	
27-28 October 2015	Borealis Alliance FRA Project Group, Oslo	
18-19 November 2015	Borealis Alliance FRA Project Group, Stockholm. The above 4 meetings culminated in the agreement of the Borealis Alliance FRA CONOPS. (Ref 1) signed by the CEOs of all member ANSPs.	
2015 – Present	Ongoing series of Borealis Alliance meetings. Initially 10 per year, now 4 per year.	
15th July 2016	Initial FRA briefings	RAF(U) Swanwick
13th February 2017	Initial FRA briefings	MoD DAATM
1st Mar 2017	Initial FRA briefings	RAF Air Command
23rd March 2017	Initial FRA briefings	RAF ASACS
19th December 2017	FRA CONOPS Review This meeting influenced the EUROCONTROL European Route Network Improvement Plan (ERNIP) – Part 1: European Airspace Design Methodology – Guidelines, which have in turn influenced the design option selection listed herein.	EUROCONTROL
10th January 2018	Flight Plan Buffer Zones (FBZs) in FRA Agreed the high level concept of FBZs and their application within FRA.	CAA/EUROCONTROL
13TH February 2018	FRA Update. LIDO confirmed that NATS plans for FRA deployment were acceptable and presented no technical issues. This	Lufthansa Systems (LIDO)

Date	Subject/*outcome*	Meeting with
	provided confidence that the proposed airspace design was operable. *Confirmed LIDO's acceptance of proposed FRA options*	
14th February 2018	FRA Update. Sabre confirmed that NATS plans for FRA deployment were acceptable and presented no technical issues. This provided confidence that the proposed airspace design was operable. *Confirmed Sabre Data Services' acceptance of proposed FRA options*	Sabre Data Services
28th March 2018	FRA Update. British Airways confirmed that NATS plans for FRA deployment were acceptable and presented no technical issues. This provided confidence that the proposed airspace design was operable. *Confirmed BA's acceptance of proposed FRA options*	British Airways
2nd May 2018	FRA Update. Jeppesen confirmed that NATS plans for FRA deployment were acceptable and presented no technical issues. This provided confidence that the proposed airspace design was operable. *Confirmed Jeppesen's acceptance of proposed FRA options.*	Jeppesen
25th September 2018	FRA update and Design principle engagement.	DSNA Reims
5th October 2018	FRA update and Design principle engagement	EUROCONTROL network management
5th October 2018	FRA update and Design principle engagement	Jeppesen
16th October 2018	FRA update and Design principle engagement	IAA Shannon
4th December 2018	FRA update	CAA
10th December 2018	General FRA progress update	RAF(U) Swanwick
15th January 2019	FRA update and options engagement (interface specifics)	Avinor
4th February 2019	FRA update and options engagement (interface specifics)	Maastricht UAC
15th May 2019	FRA update and options engagement (interface specifics)	IAA
10th June 2019	FRA update and confirmation of agreement of options	Borealis Alliance Reykjavík
13th August 2019	General FRA progress update	DSNA Brest ACC
1st October 2019	FRA update and confirmation of agreement of options	Borealis Alliance Oslo
7th October 2019	General FRA progress update	DSNA Brest ACC
23rd October 2019	General FRA progress update	FABEC FRA Project
26th November 2019	FRA update and confirmation of agreement of options	Borealis Alliance Copenhagen
5th January 2020	General FRA progress update	RAF(U) Swanwick
18th March 2020	FRA update and confirmation of agreement of options	Borealis Alliance WebEx
29th September 2020	FRA update and confirmation of agreement of options	Borealis Alliance WebEx

3.2 The first four meetings (listed in Table 1 above) developed and agreed the Borealis Alliance FRA Concept of Operations (Ref 1). This outlines the agreed common concept of operations for FRA across the Borealis Alliance area. Agreement of this CONOPS required extensive multi-way engagement between all nine Borealis Alliance member ANSPs (which includes the IAA). The resulting CONOPS influenced the design options listed herein (and in the Stage 2Aii design principle

evaluation document). All stakeholders were polled by email in October 2020 as to whether they agreed with the design options or had comments. The response from DSNA favoured option 1. All other responses received agreed the design options. Additionally, MUAC stated that they do not need to provide further input into FRA D2.1 and have requested to be removed from the stakeholder list.

3.3 Table 2 below summarises the two-way stakeholder engagement on the FRA D2.1 design options. Email evidence of this Stage 2 engagement will be provided separately to the CAA.

Table 2 Evidence of two-way stakeholder engagement

Stakeholder	Engagement date	Feedback	Relevant to options…
Maastricht Upper Area Control Centre (MUAC)	06/10/2020	Thanks for your message and that you involve Maastricht UAC in the project. Similar to the feedback which Maastricht UAC provided to earlier consultations on Deployment 2, we respond that the design principles seem reasonable to us but since MUAC is not directly adjacent to this airspace change, we do not want to formally approve or disapprove the principles. (MUAC have stated that they do not need to provide further input into FRA D2.1 and have requested to be removed from the stakeholder list.)	All
Eurocontrol	08/07/2020	FRA update and discussion on publication of FRA in delegated ATS airspace	All
	10/09/2020	Joint FRA update and discussion on FRA deployment in delegated ATS airspace with the IAA and NM	All
IAA	10/03/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	05/05/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	20/07/2020	Joint FRA update and discussion on FRA deployment in delegated ATS airspace with DSNA	All
	10/09/2020	Joint FRA update and discussion on FRA deployment in delegated ATS airspace with DSNA and NM	All
	06/10/2020	Yes, we have been involved and agree the design options	All
Sabre	06/10/2020	No response	
BAE Systems	06/10/2020	Yes, we have been involved and agree the design options	All
Airlines UK	06/10/2020	No response	
BBGA	06/10/2020	No response	
Low Fares Airlines	06/10/2020	No response	
MoD	06/10/2020	Yes, we have been involved and agree the design options	All
Jeppesen	06/10/2020	Yes, we have been involved and agree the design options	All
Lufthansa Systems	06/10/2020	No response (out of office autoresponse until after this engagement closes)	
NavBlue	06/10/2020	No response	
DSNA	22/01/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	19/03/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	22/04/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	30/04/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	07/07/2020	FRA update and discussion on FRA deployment in delegated ATS airspace	All
	20/07/2020	Joint FRA update and discussion on FRA deployment in delegated ATS airspace with the IAA	All
	10/09/2020	Joint FRA update and discussion on FRA deployment in delegated ATS airspace with the IAA and NM	All

Stakeholder	Engagement date	Feedback	Relevant to options…
	06/10/2020	Yes, we agree with Option 1. Thank you all for your involvement in the project,	Option 1

3.4 This section demonstrates two-way engagement with appropriate stakeholders. Tables 1 and 2 indicate where option decisions were influenced by engagement with stakeholders.

4. Baseline (do nothing) description

4.1 The following pages describe the baseline (do nothing) scenario.

4.2 Current airspace diagrams

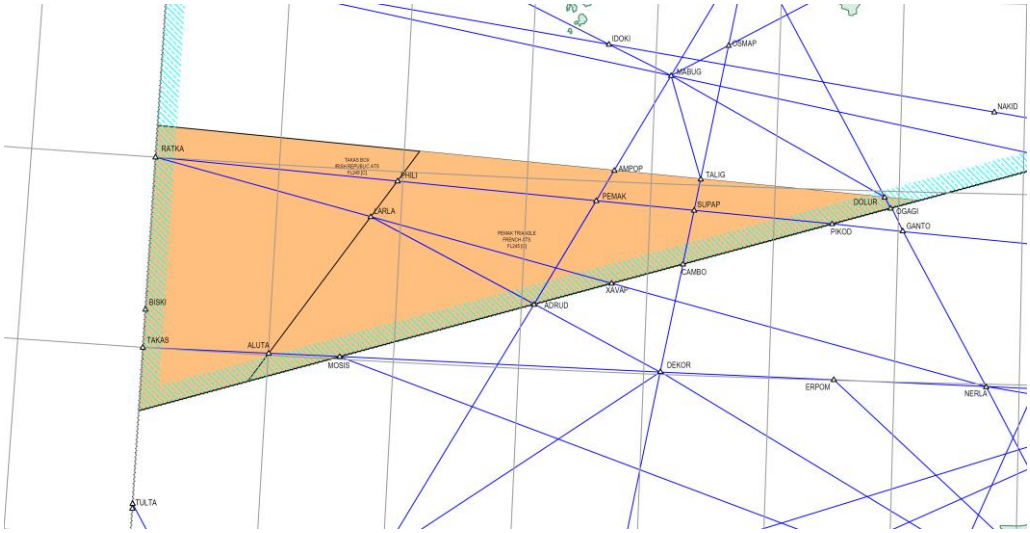

Figure 2 Current UIR airspace/routes within FRA Deployment 2.1 area

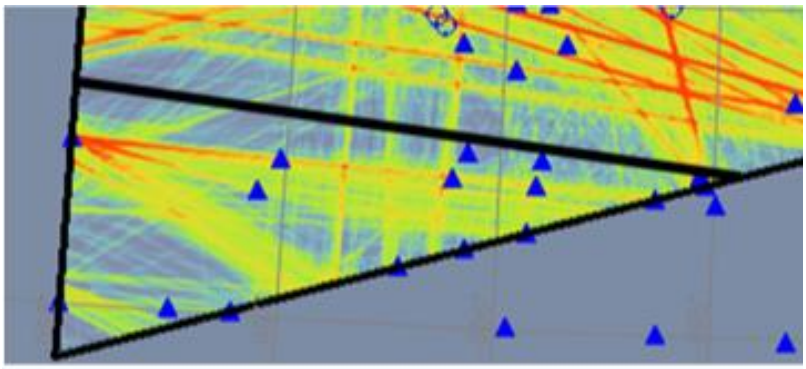

Figure 3 Typical current day traffic flows in FRA D2 region (above FL245)

4.3 Figure 2 shows the current UIR airspace in the region and Upper ATS route network.

4.4 Figure 3 shows current flight-path density plots (2018 data). This shows the typical busy flows of traffic in the upper airspace.

4.5 Currently all aircraft flight plan the published ATS route structure. Satellite navigation technology 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 coordination points (COPs)) at the UIR boundary, and the influence on flight-paths of some navigation beacons and the ATS route structure can be seen clearly in Figure 2. However, the regular use of tactical direct shortcuts to/from the COPs can also be discerned.

4.6 For reference the extant UK route structure is defined in detail in the UK AIP ENR 3.3 AREA NAVIGATION ROUTES

5. FRA Concept Overview

5.1 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) waypoints, without reference to the ATS route network, subject to airspace availability.” Within this airspace, flights remain subject to air traffic control.

5.2 Deployment of FRA is a legislative requirement of the SESAR Pilot Common Project (PCP) ATM Functionality 3 (AF3) Implementing Rule.

5.3 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 unpredictable. 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.

5.4 FRA is also expected to enable flight planning and fuel benefits which will contribute to the UK Ireland FAB Performance Plan & UK Airspace Modernisation Strategy (AMS). NATS and the IAA have committed to the Borealis Alliance area of FRA. Borealis Alliance members (see Table 1) have committed to put in place a seamless and integrated FRA 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.

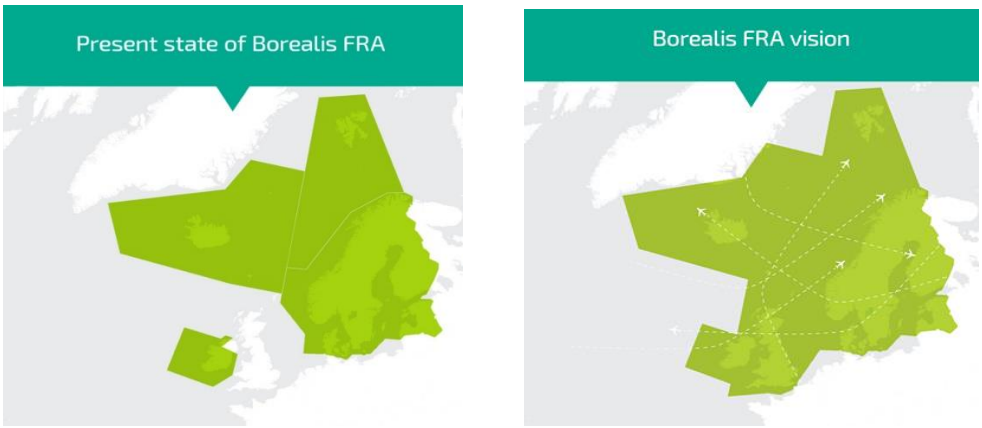

Figure 4 Proposed Borealis FRA area

5.5 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 2) and North Atlantic Documents e.g. ICAO Doc 7030.

5.6 This concept will enable airspace users to flight plan a preferred trajectory, regardless of national FIR boundaries, and portions of airspace within which ATS is delegated to the participating states.

5.7 The Borealis Alliance membership have worked cooperatively over many years to develop a common FRA concept of operations as outlined in the Borealis Alliance Free Route Airspace Concept of Operations v1.0 (Ref 1). The design options discussed in the Stage 2 document set are related to, and have been influenced by, the engagement between Borealis Alliance members and other ANSPs and stakeholders.

5.8 Note: DSNA are not part of the Borealis Alliance, however the IAA are and therefore the Borealis Concept of Operations needs to be considered for FRA deployment in the TAKAS box. Furthermore, the delegation of ATS provision is technically managed on a temporary basis by Letter of Agreement. NATS needs to ensure that the airspace design is consistent with the UK FRA system should the delegation of ATS be rescinded in the future.

6. Option 1 description - Implement FRA in accordance with Implementing Regulation EU716/2014, remove all ATS routes and rationalise waypoints in accordance with the DSNA Brest ACC FRA design in both the PEMAK triangle and TAKAS box

6.1 Airspace diagram

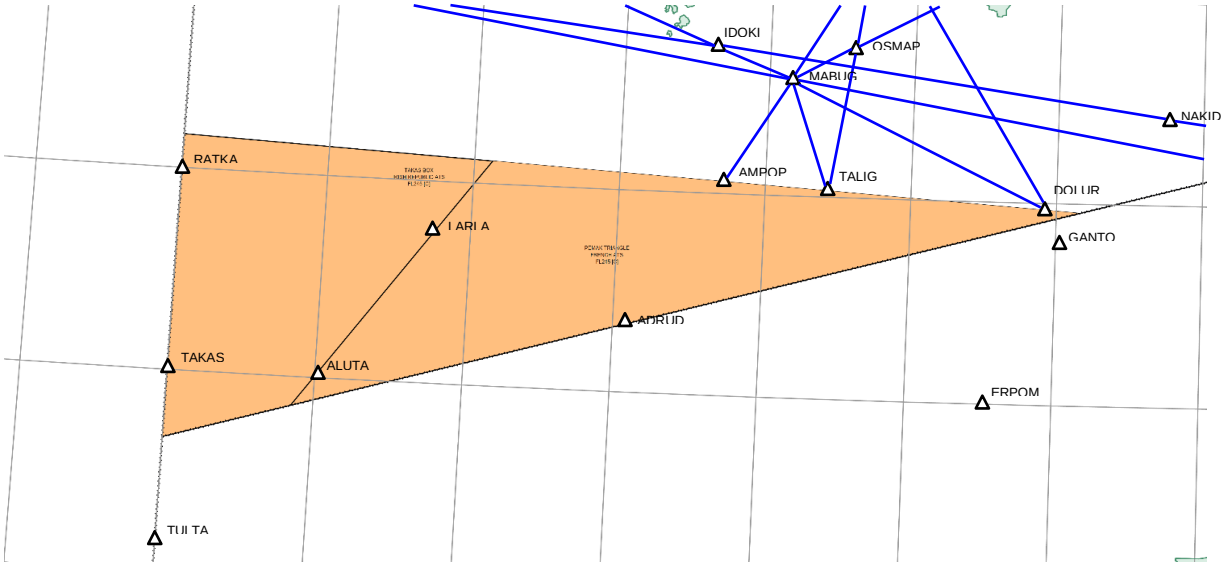

Figure 5 Option 1

6.2 Figure 5 shows the UIR FRA in the PEMAK triangle and TAKAS box with the Upper ATS route network removed and the number of waypoints rationalised to meet DSNA Brest ACC design requirements.

6.3 Aircraft would flight plan free route trajectories between waypoints subject to restrictions in the Irish and French RADs.

6.4 There are no SUA volumes within the region and therefore flight plan buffers do not need to be considered.

6.5 Stakeholder feedback from DSNA and alignment to EUROCONTROL guidance, which encourages the removal of the ATS route structure with FRA, makes Option 1 the preferred option at this stage of the ACP process.

7. Option 2 description - Implement FRA in accordance with Implementing Regulation EU716/2014, remove all ATS routes and rationalise waypoints in accordance with the DSNA Brest ACC FRA design in the PEMAK triangle but retain ATS routes in the TAKAS box

7.1 Airspace diagram

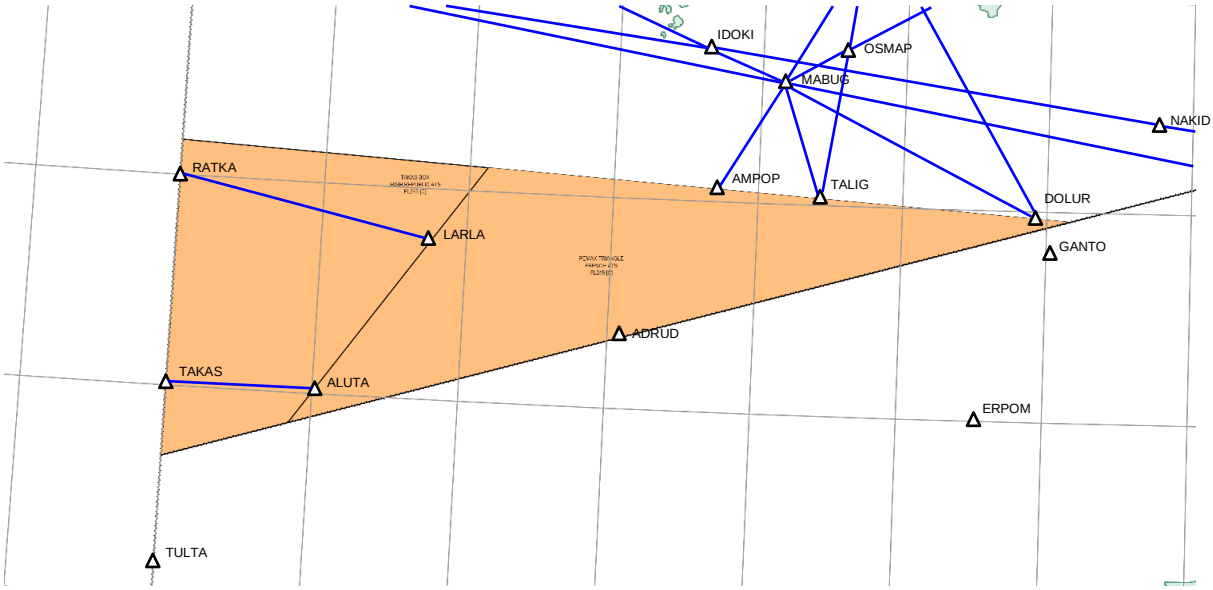

Figure 6 Option 2

7.1 Figure 6 shows the UIR FRA in the PEMAK triangle and TAKAS box but with an ATS route structure retained within the TAKAS box which aligns with the DSNA Brest ACC FRA design requirements. The number of waypoints is rationalised to meet DSNA Brest ACC design requirements.

7.2 Aircraft would flight plan free route trajectories between waypoints subject to restrictions in the Irish and French RADs.

7.3 There are no SUA volumes within the region and therefore flight plan buffers do not need to be considered.

8. Conclusion and Next Steps

8.1 NATS have conducted comprehensive two-way engagement with relevant ANSPs, CFSPs, airlines and MoD stakeholders[3]. The outcome of this engagement has influenced the selection of the preferred option to meet the requirements of the PCP within the constraints articulated by DSNA Brest ACC.

8.2 The constraints of the DSNA Brest ACC FDP system, the PCP mandate and the Single European Skies initiative have limited the number of design options to deploy FRA within the region.

8.3 In this document we have described these options, which have been developed with our stakeholders.

8.4 The next document, Step 2A(ii), will evaluate the design options listed in this document against the design principles from Stage 1, reducing the longlist to a shortlist for appraisal.

[3] General Aviation has not been identified as a stakeholder group because the proposed changes are wholly in Class C airspace FL245 and above.

9. Glossary of Terms

ACP: Airspace Change Proposal

ANSP: Airspace Navigation Service Providers

ATC: Air Traffic Control

ATS: Air Traffic Services

Baseline: The current "Do Nothing" 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: Civil Aviation Authority

CAP: Civil Aviation Publication (publications produced by the CAA)

CFSP: Computer Flight Plan Service Provider

CONOPS: Concept of operations

COP: Coordination Point. Points on the UIR boundary, traditionally used for flight plans where a flight transitions between the ANSP of the UK to/from that of the bordering country.

DCT (Direct): Waypoint to waypoint routing, which does not use an airway.

ERNIP: European Route Network Implementation Plan

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: The establishment of Functional Airspace Blocks (FABs) is a key mechanism of the Single European Sky (SES) and represents the framework established by Member States to enable increased cooperation and integration leading to a more rational organisation of airspace and service provision.

FBZ: Flight Plan Buffer Zones – areas for flight planners to avoid, to provide separation of FRA flight planned trajectories from Special Use Airspace.

FDP: Flight Data Processing

FIR: Flight Information Region (Airspace below FL245)

FL: Flight level, the altitude reference which aircraft use at higher altitudes using standard pressure setting, essentially units of 100ft, i.e. FL245 equates approximately to 24,500ft

FRA: Free Route Airspace

ICAO: International Civil Aviation Organisation – an agency of the United Nations.

ICCAN: Independent Commission on Civil Aviation Noise.

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.

NATMAC: National Air Traffic Management Advisory Committee

NM: Network Manager

NPZ: No Planning Zones – areas where a flight plan is not permitted to enter at all or only when meeting prescribed criteria.

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.

PCP: Pilot Common Project

SESAR: Single European Sky ATM Research. A collaborative project to modernise airspace and air traffic management across Europe to common standards

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)

Systemised airspace: Use of procedure based methods used to manage aircraft rather than tactical control.

TMA: Terminal Manoeuvring Area

UIR: Upper Information Region (Airspace above FL245)

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).

End of document