London Airspace Modernisation Programme Deployment 1 (LAMP D1)

(Part of NATS West Airspace Modernisation Project - L6203)

Gateway documentation: Stage 2 Develop & Assess

2B Options Appraisal (Phase I – Initial)

Roles

Action	Role	Date
Produced	Manager Airspace Change Compliance & Delivery NATS Directorate of Airspace & Future Operations	29/03/2021
Reviewed Approved	Air Traffic Control Lead NATS Swanwick Development	29/03/2021
Reviewed Approved	Head of Operational Development (Airspace) NATS Directorate of Airspace & Future Operations	29/03/2021

Drafting and Publication History

Issue	Month/Year	Changes this issue
1.0	Jan 2021	Initial version submitted to CAA for Stage 2 (Feb 2021) gateway.
2.0	Mar 2021	Amended with initial options appraisal for Options 2 & 3 added, submitted to CAA for Stage 2 (Mar 2021) gateway.
2.1	Mar 2021	Post Gateway actions: added baseline option 0 to initial options appraisal; correction of minor typos/inconsistencies.

Contents

1. Introduction

This Airspace Change Proposal (ACP) is sponsored by NATS. Today's air traffic services (ATS) route network has evolved over time and does not exploit modern navigation technology. The objective of this project is to update the route network in accordance with the CAA's Airspace Modernisation Strategy (AMS) using Performance Based Navigation (PBN). This will provide benefits in capacity whilst minimising environmental impacts.

This document forms part of the document set required for the CAP1616 airspace change process:
Stage 2 Develop and Assess, Step 2B Options Appraisal (Phase 1 Initial) including Safety Considerations.
Its purpose is to consider the shortlist of airspace design options which have progressed through the Step 2A (ii) Design Principle Evaluation, to provide comparisons of each option via qualitative assessment or, if available and proportional, quantitative analysis. Under Stage 2 the designs are not yet fully developed so the granularity of the analysis may be broad.

There are four design options in this document which are compared to the baseline do-nothing scenario. The options to have progressed to this stage are:

- Option 2 – Systemised PBN Routes, 5nm radar separation
- Option 3 – Systemised PBN Routes with 3nm radar separation
- Option 4 – Systemised routes without Free Route Airspace (FRA)
- Option 6 – Systemised routes with FRA above (NATS' preferred option)

The other options considered have not progressed to this stage following design principle evaluation and feedback from subject matter experts (SMEs). This document should be read in conjunction with the Step 2A Design Options & Design Principle Evaluation document, which gives descriptions of each option and assesses each option against the Design principles agreed in Step 1B.

Where are we in the airspace change process?

We have completed Stage 1 Define, where we established the need for an airspace change and the design principles underpinning it. We are now in Stage 2; Develop and Assess and this document is Step 2B.

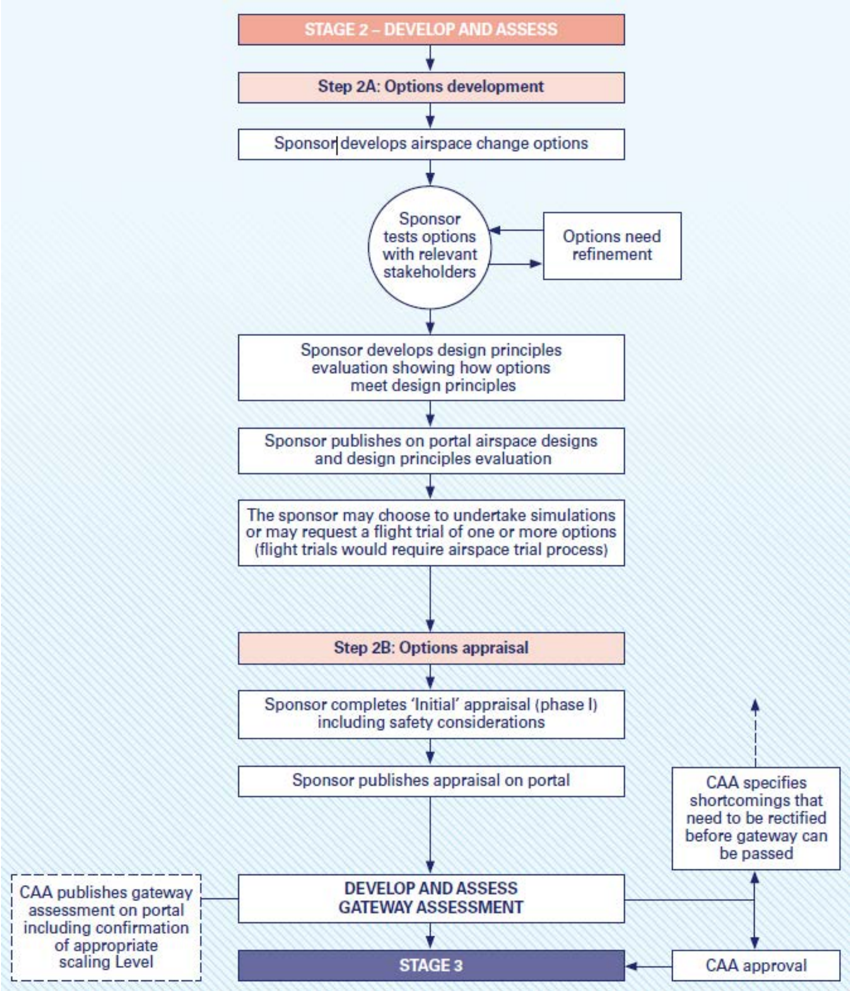

Figure 1: CAP1616 Airspace Change Process Stage 2

2. How to read this document – illustrations of current and potential impacts

The following tables are based on CAP1616 4th edition, Table E2, pages 201-203.

From Stage 2A four options have been short-listed. These are Option 2, 3, 4 and 6. A separate analysis is presented for each option. For each option the table lists stakeholder groups alongside types of impact the option would have.

The changes described within this ACP will only affect the enroute network in airspace above 7,000ft. However, the ACP will progress on the assumption of a scaled Level 1. This will continue to allow any airport led changes to be progressed in parallel if this is appropriate.

In this document we provide tables for the four candidate design options. Note that these are compared against the baseline, do-nothing scenario.

We describe broadly what we expect the scale of impact might be, for each option.
Owing to the broad nature of the design options, it is not possible to provide an accurate quantitative assessment of each option. This document will therefore provide a qualitative assessment and provide some indicative quantitative assessments of potential savings which might be achieved if the design option was implemented. This initial numerical analysis is based on the broad design concepts and will be subject to

refinement before the next stage, so the numbers may change as the design is refined. This is proportionate and in line with the expectations of CAP1616 Stage 2[1].
It is expected that with more detailed modelling of the designs as they develop in Stage 3, some of the as-yet unquantified benefits (e.g. due to synergies enabled by linking with FRA) will be better quantified.

There is a fixed correlation between fuel burnt and greenhouse gases emitted. For every 1kg of fuel that is burnt 3.18kg of CO_2 equivalent (CO_2e) is emitted.

[1] CAP1616, 4th edition, page 41 paragraph 133 and page 197 paragraph E12

3. Design Options

3.1. Option 0 Do Nothing (Baseline)

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	No change – no impact.
Communities	Air quality	Qualitative	No change – no impact.
Wider society	Greenhouse gas impact	Qualitative	No change – no impact. In the long term, lack of systemisation would have a negative impact on greenhouse gas emissions.
Wider society	Capacity/ resilience	Qualitative	No change to extant. In the long term the impact of constrained effective capacity would have a negative impact on resilience & capacity.
General Aviation (GA)	Access	Qualitative	No change – no impact.
General Aviation / commercial airlines	Economic impact from increased effective capacity	Qualitative	No change to extant. In the long term the economic impact of constrained effective capacity would have a negative economic impact.
General Aviation / commercial airlines	Fuel burn	Qualitative	No change – no impact. In the long term, lack of systemisation would have a negative impact on fuel burn.
Commercial airlines	Training cost	Qualitative	No change – no impact.
Commercial airlines	Other costs	Qualitative	No change – no impact.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	No change – no impact.
Airport/ Air navigation service provider	Operational costs	Qualitative	No change – no impact.
Airport/ Air navigation service provider	Deployment costs	Qualitative	No change – no impact.

Table 1: Options Appraisal (CAP1616), Systemisation – PBN Routes, 5nm radar separation

Conclusion

The baseline "Do Nothing" Option 0 does not meet the following Design Principles:

- DP2 Economic Fuel Burn
- DP3 Environmental CO_2 emissions
- DP9 Technical (PBN)
- DP10 Technical (AMS)

For further information please see the DP evaluation matrix in the Stage 2a Design Options and Evaluation document.

As such this option was rejected. It is included here for comparison purposes,

3.2. Option 2. Systemisation – PBN Routes, 5nm radar separation

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	This airspace change only affects airspace above 7,000 ft and will therefore have no significant impact on the noise metrics (contours etc) associated with airspace change. This proposal covers a large portion of the South West of England and Wales. This area encompasses the following Areas of Outstanding Natural Beauty (AONBs) and National Parks; Llŷn, Shropshire Hills, Cannock Chase, Gower, Wye Valley, Cotswolds, North Wessex Downs, Chilterns, Mendip Hills, Quantock Hills, Cranborne Chase and West Wiltshire Downs, Dorset, East Devon, Blackdown Hills, North Devon, South Devon, Cornwall, Tamar Valley, Isles of Scilly, Snowdonia, Pembrokeshire Coast, Brecon Beacons, Exmoor, Dartmoor, New Forest. This area also encompasses the following designated quiet areas: Swansea and Neath Port Talbot; Cardiff and Penarth; Newport. No flight trajectories below 7,000 ft will be altered over these AONBs, quiet areas & National Parks.
Communities	Air quality	Qualitative	Government guidance states that aircraft flying higher than 1,000 ft are unlikely to have significant impact on local air quality[2]. This airspace change only affects airspace above 7,000 ft and is therefore unlikely to have a significant impact on local air quality.
Wider society	Greenhouse gas impact	Quantitative	The average calculated network CO_2e emissions for Option 2 is a disbenefit of 79.5kg per flight. Note that improvements in predictability leading to improved flight planning and reduced delay and holding could counter this disbenefit.
Wider society	Capacity/ resilience	Qualitative	The changes contained within this design option introduce numerous new systemised routes. These routes will provide an efficient deconflicted network with added connectivity to UK Flight Information Region (FIR) exit areas yielding capacity benefits and a reduction in air traffic control (ATC) complexity. This would increase the resilience of the ATC network.
General Aviation (GA)	Access	Qualitative	There will be no change to GA access to the extant Controlled Airspace (CAS). This ACP may require an increase in CAS in some areas and a reduction in others. The proposed airspace classification is not yet set but it is not anticipated to be Class A (which would preclude Visual Flight Rules (VFR) flights). All other classes allow for VFR access subject to appropriate ATC clearance. Other areas of new CAS may be required if Danger Areas (DAs) are realigned (with portions of DAs being replaced with Class C airspace). (see Step 2A doc). The LD1 project will undertake a comprehensive review of airspace bases with a view to releasing airspace that is no longer required. This will help to offset the additional new airspace required.
General Aviation / commercial airlines	Economic impact from increased effective capacity	Qualitative	The proposed changes will increase the effective capacity of the airspace. The economic impact of this would be positive, however it has not been quantified.

[2] See Air Navigation Guidance 2017 para 3.28

General Aviation / commercial airlines	Fuel burn	Quantitative	The average calculated network fuel burn for Option 2 is 20,031kg per flight, compared to the baseline of 20,006 kg. (a disbenefit of 25kg per flight). Note that improvements in predictability leading to improved flight planning and reduced delay and holding could counter this disbenefit.
Commercial airlines	Training cost	Qualitative	Flight procedures worldwide are updated with each aeronautical information regulation and control (AIRAC) cycle and airlines update their procedures accordingly, training as required. This proposal is not anticipated to require additional training costs for airlines.
Commercial airlines	Other costs	Qualitative	No other airline costs are foreseen.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	This proposal is not expected to change Airport or air navigation service provider (ANSP) infrastructure, beyond the initial deployment phase which will require some systems engineering amendments.
Airport/ Air navigation service provider	Operational costs	Qualitative	This proposal is not expected to change Airport or ANSP operational costs.
Airport/ Air navigation service provider	Deployment costs	Qualitative	This proposal is expected to require air traffic controller familiarisation training, in the order of 120-150 controllers and c.50 assistants at NATS Swanwick, including extensive use of the NATS simulator facility. Support staff are required to run the simulator – planning, training staff, data preparation and testing, pseudo pilots, safety analysts, outputs to be recorded and reported etc. Some staff may only require briefings. There may be occasions where the reduced availability of operational controllers during their conversion training could mean operational rostering becomes a factor when considering continuous service delivery. The Military ANSP may also require briefing prior to deployment. This requirement will be clarified as designs mature through on-going engagement.

Table 2: Options Appraisal (CAP1616 E2), Systemisation – PBN Routes, 5nm radar separation

Conclusion

Compared to the baseline the performance of Option 2 is worse in terms of CO_2 emissions and fuel burn. The performance of Option 2 is also worse than that of Option 4 or 6, in terms of CO_2 emissions and fuel burn. The capacity & resilience benefits would also be lesser than Option 4 or Option 6. For these reasons Option 2 is **rejected** at this stage.

3.3. Option 3. Systemised routes with 3nm radar separation

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	This airspace change only affects airspace above 7,000 ft and will therefore have no significant impact on the noise metrics (contours etc) associated with airspace change. This proposal covers a large portion of the South West of England and Wales. This area encompasses the following Areas of Outstanding Natural Beauty (AONBs) and National Parks; Llŷn, Shropshire Hills, Cannock Chase, Gower, Wye Valley, Cotswolds, North Wessex Downs, Chilterns, Mendip Hills, Quantock Hills, Cranborne Chase and West Wiltshire Downs, Dorset, East Devon, Blackdown Hills, North Devon, South Devon, Cornwall, Tamar Valley, Isles of Scilly, Snowdonia, Pembrokeshire Coast, Brecon Beacons, Exmoor, Dartmoor, New Forest. This area also encompasses the following designated quiet areas: Swansea and Neath Port Talbot; Cardiff and Penarth; Newport. No flight trajectories below 7,000 ft will be altered over these AONBs, quiet areas & National Parks.
Communities	Air quality	Qualitative	Government guidance states that aircraft flying higher than 1,000 ft are unlikely to have significant impact on local air quality[3]. This airspace change only affects airspace above 7,000 ft and is therefore unlikely to have a significant impact on local air quality.
Wider society	Greenhouse gas impact	Qualitative	The average calculated network CO_2e emissions for Option 3 will be almost the same as for option 2. (i.e. ~79.5kg per flight). Note that improvements in predictability leading to improved flight planning and reduced delay and holding could counter this disbenefit.
Wider society	Capacity/ resilience	Qualitative	The changes contained within this design option introduce numerous new systemised routes. These routes will provide an efficient deconflicted network with added connectivity to UK Flight Information Region (FIR) exit areas yielding capacity benefits and a reduction in air traffic control (ATC) complexity. This would increase the resilience of the ATC network.
General Aviation (GA)	Access	Qualitative	There will be no change to GA access to the extant Controlled Airspace (CAS). This ACP may require an increase in CAS in some areas and a reduction in others. The proposed airspace classification is not yet set but it is not anticipated to be Class A (which would preclude Visual Flight Rules (VFR) flights). All other classes allow for VFR access subject to appropriate ATC clearance. Other areas of new CAS may be required if Danger Areas (DAs) are realigned (with portions of DAs being replaced with Class C airspace). (see Step 2A doc). The LD1 project will undertake a comprehensive review of airspace bases with a view to releasing airspace that is no longer required. This will help to offset the additional new airspace required.
General Aviation / commercial airlines	Economic impact from increased effective capacity	Qualitative	The proposed changes will increase the effective capacity of the airspace. The economic impact of this would be positive, however it has not been quantified.

[3] See Air Navigation Guidance 2017 para 3.28

General Aviation / commercial airlines	Fuel burn	Qualitative	The average calculated network fuel burn for Option 3 will be almost the same as for option 2. (i.e. a disbenefit of ~25kg per flight). Note that improvements in predictability leading to improved flight planning and reduced delay and holding could counter this disbenefit.
Commercial airlines	Training cost	Qualitative	Flight procedures worldwide are updated with each aeronautical information regulation and control (AIRAC) cycle and airlines update their procedures accordingly, training as required. This proposal is not anticipated to require additional training costs for airlines.
Commercial airlines	Other costs	Qualitative	No other airline costs are foreseen.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	Air navigation service provider (ANSP) infrastructure would require significant change in order to enable 3nm radar separation. Significant changes would be required to the legacy iFACTs controller tool suite. This would be nugatory since this tool will be replaced (by DP Enroute). Waiting for the tools support required for 3nm radar separation in Area Control would impact the overall delivery timescale of the ACPs required to meet the aims of the AMS
Airport/ Air navigation service provider	Operational costs	Qualitative	This proposal is not expected to change Airport or ANSP operational running costs.
Airport/ Air navigation service provider	Deployment costs	Qualitative	This option requires significant investment in systems infrastructure including multi million pound investment in current systems which are due for replacement. This proposal is expected to require air traffic controller familiarisation training, in the order of 120-150 controllers and c.50 assistants at NATS Swanwick, including extensive use of the NATS simulator facility. There's also additional complexity requiring training, due to ATCOs potentially operating on multiple sectors, some with 3nm separation and some not. Support staff are required to run the simulator – planning, training staff, data preparation and testing, pseudo pilots, safety analysts, outputs to be recorded and reported etc. Some staff may only require briefings. There may be occasions where the reduced availability of operational controllers during their conversion training could mean operational rostering becomes a factor when considering continuous service delivery. The Military ANSP may also require briefing prior to deployment. This requirement will be clarified as designs mature through on-going engagement.

Table 3: Options Appraisal (CAP1616 E2) – Systemised routes with 3nm radar separation

Conclusion

Compared to the baseline, the performance of Option 3 is worse in terms of CO_2 emissions and fuel burn. It would however bring benefit in terms of capacity & resilience.

The performance of Option 3 is also worse than that of Option 4 or 6, in terms of CO_2 emissions and fuel burn. The capacity & resilience benefits would also be lesser than Option 4 or Option 6.

Further there would be significant costs and or timescale impact to the AMS associated with upgrading ATC systems infrastructure in order to enable 3nm radar separation.

For these reasons Option 3 is rejected at this stage.

3.4. Option 4. Systemised routes without FRA

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	This airspace change only affects airspace above 7,000 ft and will therefore have no significant impact on the noise metrics (contours etc) associated with airspace change. This proposal covers a large portion of the South West of England and Wales. This area encompasses the following Areas of Outstanding Natural Beauty (AONBs) and National Parks; Llŷn, Shropshire Hills, Cannock Chase, Gower, Wye Valley, Cotswolds, North Wessex Downs, Chilterns, Mendip Hills, Quantock Hills, Cranborne Chase and West Wiltshire Downs, Dorset, East Devon, Blackdown Hills, North Devon, South Devon, Cornwall, Tamar Valley, Isles of Scilly, Snowdonia, Pembrokeshire Coast, Brecon Beacons, Exmoor, Dartmoor, New Forest. This area also encompasses the following designated quiet areas: Swansea and Neath Port Talbot; Cardiff and Penarth; Newport. No flight trajectories below 7,000 ft will be altered over these AONBs, quiet areas & National Parks.
Communities	Air quality	Qualitative	Government guidance states that aircraft flying higher than 1,000 ft are unlikely to have significant impact on local air quality[4]. This airspace change only affects airspace above 7,000 ft and is therefore unlikely to have a significant impact on local air quality.
Wider society	Greenhouse gas impact	Quantitative	The average calculated network CO_2e emissions for Option 4 is a disbenefit of 30kg per flight. Note that improvements in predictability leading to improved flight planning and reduced delay and holding could counter this disbenefit. This analysis is indicative and more detailed quantitative analysis of CO_2e emissions will be presented in Stage 3.
Wider society	Capacity/ resilience	Qualitative	The changes contained within this design option introduce numerous new systemised routes. These routes will provide an efficient deconflicted network with added connectivity to UK Flight Information Region (FIR) exit areas yielding capacity benefits and a reduction in air traffic control (ATC) complexity. This would increase the resilience of the ATC network.
General Aviation (GA)	Access	Qualitative	There will be no change to GA access to the extant Controlled Airspace (CAS). This ACP may require an increase in CAS in some areas and a reduction in others. The proposed airspace classification is not yet set but it is not anticipated to be Class A (which would preclude Visual Flight Rules (VFR) flights). All other classes allow for VFR access subject to appropriate ATC clearance. Other areas of new CAS may be required if Danger Areas (DAs) are realigned (with portions of DAs being replaced with Class C airspace). (see Step 2A doc). The LD1 project will undertake a comprehensive review of airspace bases with a view to releasing airspace that is no longer required. This will help to offset the additional new airspace required.
General Aviation /	Economic impact from increased effective capacity	Qualitative	The proposed changes will increase the effective capacity of the airspace. The economic impact of this would be positive, however it has not been quantified.

[4] See Air Navigation Guidance 2017 para 3.28

commercial airlines			
General Aviation / commercial airlines	Fuel burn	Quantitative	The average calculated network fuel burn for Option 4 is 20,016 kg per flight, compared to the baseline of 20,006 kg. (a disbenefit of 10kg per flight). Note that improvements in predictability leading to improved flight planning and reduced delay and holding could counter this disbenefit. This analysis is indicative and more detailed quantitative analysis of fuel burn will be presented in Stage 3.
Commercial airlines	Training cost	Qualitative	Flight procedures worldwide are updated with each aeronautical information regulation and control (AIRAC) cycle and airlines update their procedures accordingly, training as required. This proposal is not anticipated to require additional training costs for airlines.
Commercial airlines	Other costs	Qualitative	No other airline costs are foreseen.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	This proposal is not expected to change Airport or air navigation service provider (ANSP) infrastructure, beyond the initial deployment phase which will require some systems engineering amendments.
Airport/ Air navigation service provider	Operational costs	Qualitative	This proposal is not expected to change Airport or ANSP operational costs.
Airport/ Air navigation service provider	Deployment costs	Qualitative	This proposal is expected to require air traffic controller familiarisation training, in the order of 120-150 controllers and c.50 assistants at NATS Swanwick, including extensive use of the NATS simulator facility. Support staff are required to run the simulator – planning, training staff, data preparation and testing, pseudo pilots, safety analysts, outputs to be recorded and reported etc. Some staff may only require briefings. There may be occasions where the reduced availability of operational controllers during their conversion training could mean operational rostering becomes a factor when considering continuous service delivery. The Military ANSP may also require briefing prior to deployment. This requirement will be clarified as designs mature through on-going engagement.

Table 4: Options Appraisal (CAP1616 E2) – Systemised routes without FRA

Conclusion

Compared to the baseline, the performance of Option 4 is worse in terms of CO_2 emissions and fuel burn. It would however bring benefit in terms of capacity & resilience.

The Systemised PBN routes offer a highly efficient network design which would keep aircraft safe with minimal ATC intervention. The use of a 5nm separation radar environment requires no upgrade to existing radar or associated systems. The introduction of direct routings enables further environmental benefits not present in Option 3.

The performance of Option 4 is better than all other options except Option 6 in terms of CO_2 emissions and fuel burn. The capacity & resilience benefits are also judged to be the second best.

As such Option 4 is accepted and progressed to Stage 3.

3.5. Option 6. Systemised routes with FRA above

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	This Airspace change only affects airspace above 7,000 ft and will therefore have no significant impact on noise. This proposal covers a large portion of the South West of England and Wales. This area encompasses the following AONBs and National Parks; Llŷn, Shropshire Hills, Cannock Chase, Gower, Wye Valley, Cotswolds, North Wessex Downs, Chilterns, Mendip Hills, Quantock Hills, Cranborne Chase and West Wiltshire Downs, Dorset, East Devon, Blackdown Hills, North Devon, South Devon, Cornwall, Tamar Valley, Isles of Scilly, Snowdonia, Pembrokeshire Coast, Brecon Beacons, Exmoor, Dartmoor, New Forest. This area also encompasses the following designated quiet areas: Swansea and Neath Port Talbot; Cardiff and Penarth; Newport. No flight trajectories below 7,000 ft will be altered over these AONBs, quiet areas & National Parks.
Communities	Air quality	Qualitative	Government guidance states that aircraft flying higher that 1,000 ft are unlikely to have significant impact on local air quality.[5] This Airspace change only affects airspace above 7,000 ft and will therefore have no significant impact on air quality.
Wider society	Greenhouse gas impact	Quantitative	It is anticipated that Option 6 would result in 9kg increase to CO_2e emissions per flight. This option is anticipated to enable greater benefits in the FRA above such that the combined airspace will yield greater benefit in reduction of CO_2e emissions for the whole flight. Note that improvements in predictability leading to improved flight planning and reduced delay and holding could further add to this benefit. Detailed quantitative analysis of CO_2e emissions will be presented in Stage 3.
Wider society	Capacity/ resilience	Qualitative	The changes contained within this design option introduce new systemised routes. These routes will provide an efficient deconflicted network with added connectivity to UK FIR exit areas yielding capacity benefits and a reduction in ATC complexity. This increases the resilience of the ATC network. The connectivity to FRA at higher levels enables increased flight planning flexibility which would allow aircraft operators to flight plan more efficiently and give them the option of avoiding capacity constrained areas. This ability to avoid restrictions by utilising alternative flight plan trajectories would reduce the likelihood of delay and improve the resilience of the wider network.

[5] See Air Navigation Guidance 2017

General Aviation	Access	Qualitative	There will be no change to GA access to the extant CAS. This ACP may require an increase in CAS in some areas and a reduction in others. The proposed airspace classification is not yet set but it is *not* anticipated to be Class A which would preclude VFR flights. All other classes allow for VFR access subject to appropriate ATC clearance. Other areas of new CAS may be required if Danger Areas are realigned (with portions of DAs being replaced with Class C airspace). (see Stage 2A doc) The LD1 project will undertake a comprehensive review of airspace bases with a view to releasing airspace that is no longer required. This will off-set the additional new airspace required.
General Aviation / commercial airlines	Economic impact from increased effective capacity	Qualitative	The proposed changes will increase the effective capacity of the airspace. The economic impact of this would be positive, however it has not been quantified.
General Aviation / commercial airlines	Fuel burn	Quantitative	The average calculated network fuel burn per flight for Option 6 is 20,009kg compared to the baseline of 20,006 kg, (an increase of 3kg per flight). Note that improvements in predictability leading to improved flight planning and reduced delay + holding could bring benefit which would eclipse this dis-benefit. More detailed quantitative analysis of fuel burn will be presented in Stage 3.
Commercial airlines	Training cost	Qualitative	Flight procedures worldwide are updated with each AIRAC cycle and airlines would update their procedures accordingly, training if required. This proposal is not anticipated to require additional training costs for airlines.
Commercial airlines	Other costs	Qualitative	No other airline costs are foreseen
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	This proposal is not expected to change Airport or ANSP infrastructure, beyond the initial deployment phase which would require some systems engineering amendments.
Airport/ Air navigation service provider	Operational costs	Qualitative	This proposal is not expected to change Airport or ANSP operational costs.
Airport/ Air navigation service provider	Deployment costs	Qualitative	This proposal is expected to require air traffic controller familiarisation training, in the order of 120-150 controllers and c.50 assistants at NATS Swanwick, the extensive use of the NATS simulator facility. Support staff are required to run the simulator – planning, training staff, data preparation and testing, pseudo pilots, safety analysts, outputs to be recorded and reported etc. Some staff may only require briefings. There may be occasions where the reduced availability of operational controllers during their conversion training could mean operational rostering becomes a factor when considering continuous service delivery.

Table 5: Options Appraisal (CAP1616 E2) – Systemised routes with FRA above

Conclusion

Compared to the baseline, the performance of Option 6 is worse in terms of CO_2 emissions and fuel burn. It would however bring benefit in terms of capacity & resilience.

Option 6 has the best performance of the viable options in terms of CO_2 emissions and fuel burn. The capacity & resilience benefits are also judged to be the best.

As such Option 6 is accepted and progressed to Stage 3.

4. Options Appraisal Overview

Four options: 2, 3, 4, & 6 were carried forward from the DP evaluation to the Initial Options Appraisal.
As a result of the Initial Options Appraisal, quantitative and qualitative analyses it was concluded that Option 2 and Option 3 were sub-optimal and were discounted.

Option 4 and Option 6 demonstrated the best environmental performance, have been accepted and will be developed further and progressed to Stage 3.

5. Safety Assessment

This section provides a brief, qualitative overview of the impact of each option on aviation safety.
It should be noted that only options 4 and 6 are proposed to be progressed, nonetheless their progression was not on the basis that these two options were the only ones on the grounds of safety. The other options, not covered in this section, also met the design principles on safety but were considered sub-optimal with regards to the other success criteria.

5.1 Options Appraisal Safety Assessment - Baseline

The current operation uses a published route structure and airline operators flight-plan to follow available ATS routes or flight plannable Directs (DCT) as published in the Route Availability Document (RAD). The published routes are supportive of strategic de-confliction between flights against active Special Use Airspace volumes (such as Danger Areas) and airspace with constrained radiotelephony or surveillance coverage. The routes also provide an operational framework that is conducive to Air Traffic Controllers' familiarity with traffic patterns, potential conflict points and practices for conflict avoidance/resolution. Flights into and out of the airspace volume (i.e. across boundaries with other Sectors and Air Traffic Control Units) are managed via published waypoints and agreed co-ordination points (COPs).

In addition to flights following routes, some may be instructed to take a more direct path through the airspace. This is done in a tactical manner by Air Traffic Controllers based on their judgement that a different path can be followed safely.

Air Traffic Controllers are supported in their task by equipment functionality (tools) that includes prediction of the trajectories that aircraft will follow. Predicted trajectories can be viewed by Controllers, and the tools use the former to identify potential areas of conflict between aircraft for Controllers' attention. The tools also monitor the conformance of aircraft to their expected trajectories and highlight deviations. The tools support the Controllers in ensuring that the aircraft pass through the airspace safely separated from other aircraft, and other airspace such as Danger Areas.

5.2 Safety Assessment – Option 4 Systemised routes without FRA.

Project activities so far have included multiple iterations of fast-time simulation computer modelling, Real Time Development Simulation. Safety and Human Performance (HP) experts have attended a significant part of these workshops.
The feedback from the simulations and from the early design activities has been assessed during a Preliminary Safety Issues Identification workshop that will form the basis for the planning and the execution of the safety and HP activities throughout the project lifecycle.
The initial findings from workshops at the time of this Safety Statement are as follows:

- Airspace Safety Review –the Airspace Safety Review concluded that the proposed designs could be implemented safely, and initial work has indicated that overall, the proposed changes would result in a small improvement in safety.
- Tempest Assessment – The LD1 design is predicted to result in a small safety benefit (<1%) in terms of NATS En Route RAT ATM Ground points at the NATS En Route Level.

The concept of operations for the systemised airspace is "File it, Fly it", so aircraft will fly the filed flight plan. As such, the level of tactical intervention required will be reduced from that of today. Initial work that has been done has indicated that the Air Traffic Controllers regard the systemised airspace mode of operation as being similar to the flows of traffic experienced today, achieved with substantial tactical traffic intervention but with more emphasis on monitoring traffic flows and less active intervention being required. Key factors underlying this are that routings that are provided (tactically) today are expected to be reflected in flight plans and that the tools will continue to support Controllers in foreseeing and resolving potential conflicts.
The proposed ATS route structure will consist of formally defined PBN routes, meaning that route spacing rules and route containment will be considered in accordance with current CAA policies. During the simulations the participants did not identify any significant safety related issues. Following the Airspace Safety Activities (including the Airspace Safety Review) and the liaison meetings with the different stakeholders the design team will identify, if necessary, any updates required to the proposed design and this will be assessed during the further development simulations.

The changes introduced are aiming at reducing ATC workload - the concept underlying the proposed design is looking at the introduction and or the update of straight routes and this proposed solution is seen as beneficial from an ATC perspective.
Appropriate safety cases will be written, as will an analysis of CAP1385 route separation criteria of each route segment against adjacent proposed routes.

5.3 Safety Assessment – Option 6 Systemised airspace with FRA above.

The concept of operations for Option 6 is the same as for Option 4, but with the overlying airspace comprising Free Route Airspace (FRA).

The same project activities have been undertaken as for Option 4.

A qualitative high-level safety appraisal for the two proposed options for the LD1 systemised airspace network indicates that the existing level of safety performance undertaken within the current operation would be at least maintained. Work is ongoing to provide detailed quantitative safety assessments for subsequent CAP1616 stages, and we are confident that either of these two options could be implemented safely.

6. Conclusions and next steps

The Statement of Need for this proposal can be summarised:

Current Situation – Today's network does not exploit modern navigation technology or provide capacity for long-term growth in aviation.

Many UK airports plan to change their low-level airspace to better suit their needs. Modern aircraft have navigation performance far exceeding that of the types which the network was originally designed.

There is the opportunity to enable significant environmental and capacity benefits by changing the network to suit the navigation performance of modern aircraft.

Desired outcome – The Optimal alignment and connectivity of the ATS route network with each airport's airspace structures, such that network capacity should not be a significant constraint on airport capacity and environmental impacts are minimised.

Seven Design options were developed in Step 2A of the CAP1616 Airspace change process to deliver the desired outcome. These options were shared with our stakeholders. Stakeholder feedback as well as input from SMEs was incorporated into the design options and the resulting options, along with a Do-nothing option were evaluated against the design principles developed during Step 1B. This evaluation is detailed in Step 2A and used to determine which design options were suitable for progression.

We thank all stakeholders who were able to participate in the Stage 2 engagement and look forward to their continued involvement with the development of this proposal.

From this initial options appraisal Step 2B, we conclude that following options are suitable for further development and can be progressed to the next stage:

- Option 4 – Systemised routes without FRA.
- Option 6 – Systemised routes interfacing with FRA above

These options will be developed in greater detail in stage 3 and presented for consultation. It is also anticipated that further synergies can be realised by the introduction of FRA simultaneously, and these could result in greater environmental benefit across the whole airspace.
Subject to CAA approval at Stage 2, the ACP will progress to Stage 3 during which detailed consultation is undertaken on those options progressed.

At Stage 3 we will further develop our remaining design options into feasible design solutions. This will enable more quantitative as opposed to qualitative analysis including fuel burn, and WebTAG CO_2e emissions analysis. All benefits and impacts will be monetised at this stage such that the overall benefit/impacts can be assessed. This information will be included in the consultation material we prepare for our formal consultation process.

End of document