

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

<u>Comment No.</u>	<u>Organisation</u>	<u>Paragraph Reference</u>	<u>Comment</u>	<u>Comment Disposition</u>
1	BAA	Page 10, Section 2.2.1	BAA recommends that environmental considerations are included within the scope of the policy and that Airports are fully engaged. Airports are essential to the sponsorship of PBN, the benefits of which will not come about without the full commitment of Airports. Neither is it possible for decisions about new SIDS, STARS and holds to be made without considering the Airport and environmental implications.	<p>Comment partially accepted.</p> <p>The topic of environmental considerations is complex and goes beyond the concept of PBN which is concerned with aircraft navigation performance and navigation infrastructure. For this reason it is considered out-of-scope of the policy document.</p> <p>Concerning the second part of the comment, the role that the airports have to play in the decision making process is essential to the successful implementation of PBN. Recognising this role, text changes have been made to Section 5.1.2 to make clear the important role that airports have to play and the need for their commitment.</p>
2		Page 10, Section 2.2.1	This Section refers to CCO and CDOs and states that “where there is a conflict between the two, the priority should be given to achieving a CCO as this will offer the greatest environmental and airspace efficiency benefits”. To date, the full impact of CCO has not been fully assessed in terms of noise. Analysis indicates that there are likely to be localised dis-benefits for areas beneath departure routes. A greater understanding is therefore required as it is likely that there will be winners and losers. For that reason, BAA proposes further validation work is undertaken to quantify the benefits and any trade-offs between competing factors such as noise versus climate benefits. BAA also suggests that direction is needed from Government regarding policy surrounding trade-offs between emissions/climate change and noise.	<p>Comment accepted.</p> <p>We accept that work is ongoing to better understand the implications of CCO and that government policy in this area is awaited i.e., DfT Sustainable Framework for Aviation. The text in this Section has therefore been modified to reflect that status although a high-level statement remains, concerning the recommendation to introduce CCO and CDO where practicable.</p>
3		Page 14, Section 4.1.3, Para 4	This paragraph states that “ <i>PBN procedures will be optimised to deliver the inherent safety, capacity and environmental benefits</i> ”. BAA recommends further work is carried out to assess all potential impacts and trade offs in order to deliver the inherent safety, capacity and environmental benefits. Whilst fuel and emissions savings may be made, redesign of routes and concentration of aircraft as a result of PBN, will lead to different areas being over-flown or over-flown in a different manner to the current position. This needs to be taken account of and fully appreciated.	<p>Comment partially accepted.</p> <p>Policy Statement 3 highlights the availability of an option to mandate an airspace change and the priority given to PBN services over non-PBN services in a modernised airspace system.</p> <p>As with any airspace change we</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

				<p>recognise that the potential impacts and trade-offs will have to be worked-through before consultation is undertaken by the sponsor. We anticipate that in this respect, groups such as the PBN Implementation Working Group (PBNIWG) and the FAS Industry Implementation Group (FASIIG) will make a valuable contribution to the discussion, as part of the studies supporting large scale airspace projects where mandates might be applied.</p> <p>The Policy Statement is there as an enabler.</p>
4		Page 15, Sections 4.3.1, 4.3.2 and 4.3.3	<p>These Sections suggest that SIDS/STARS will be phased out and new holds designed. The re-design of routes and introduction of PBN routes will result in greater concentration of aircraft. As above, a full grasp needs to be reached of the impacts and trade-offs. Track keeping is already showing an increase in concentration of aircraft over the same ground which is resulting in an increase in complaints from those affected. The concentration v. dispersion debate needs to be addressed prior to opting for one over the other and the Government needs to take a view and have a defined policy surrounding this.</p>	<p>Comment noted.</p> <p>The only phasing out is that of conventional SIDs, STARS and holds, to be replaced by designs predicated on PBN principles. We still anticipate a highly systemised terminal airspace structure existing for many years.</p> <p>We agree that the concentration v. dispersion debate needs to be addressed and the impacts considered, although it should be noted that PBN offers benefits in the en-route and wider TMA, outside of the airport environment.</p>
5	Boeing	Page 13, Section 4.1.1, Para 2	Should be "predicated" instead of "utilise"? How will anyone know what it means to utilise?	Comment accepted.
6		Page 13, Section 4.1.2, Para 1	Comply or based on or developed consistent with? There is not much in the ICAO PBN Manual navigation specification associated with ATS routes other than some brief assumptions. An ANSP could get lost or confused easily by the navigation specification.	<p>Comment accepted.</p> <p>Paragraph changed to state that ATS routes and instrument approach procedures are required to be developed, consistent with the specifications contained in the ICAO</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

				PBN Manual.
7		Page 14, Section 4.1.2, Para 3	Shouldn't it state "regulatory guidance material based upon the navigation specification"? Aircraft manufacturers have no way to certify to an ICAO PBN Manual navigation specification. This could lead to confusion.	Comment accepted and text modified.
8		Page 14, Section 4.1.3, Para 2	Insert "regulatory" before "standards" so as not to confuse with technical standards or other kinds.	Comment accepted and text modified.
9		Page 15, Section 4.2.1, Para 1	"Should require aircraft compliance to the RNAV 5 navigation specification and ensure infrastructure and ATM operations consistent with the RNAV 5 navigation specification." "Should apply" seems a little vague versus saying what really should be done.	Comment accepted and text modified in-line with the suggested wording.
10	CAA	Page 16, Figure 3	<p>With regard to Basic GNSS, the term "Basic" is not in common use to describe GNSS. LNAV is supported by GNSS, in this case it is GPS Signal in Space (SiS) augmented by an Aircraft Based Augmentation System (ABAS). Note: RAIM (Receiver Autonomous Integrity Monitoring) is a form of ABAS.</p> <p>With regard to Augmented GNSS, ICAO defines GNSS as:</p> <p><i>Global navigation satellite system (GNSS). A worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation.</i></p> <p>As can be seen from the definition, GNSS already includes the Augmentation. LPV and LP are better described as GPS SiS augmented by a Spaced Based Augmentation System.</p>	<p>Comment accepted.</p> <p>Key underneath Figure 3 revised to reflect the ICAO definitions.</p>
11		Page 39, Annex 3, Para A3.2	The table for Advanced-RNP Functionality includes the term "Selectable RNP". However, it is not apparent in which flight phases the discrete navigation accuracy values are designed to be used.	<p>Comment accepted.</p> <p>This has caused much discussion within the ICAO PBN Study Group and whilst the group did not wish to be constrained by specific application of navigation accuracy values, in practice it is felt that the selections available are going to be restricted. To assist the</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

				reader, the term "Selectable" is dropped and a further table is included to expand upon the envisaged application of the capability.
12	EUROCONTROL	Page 7, Section 1.2, Para 3	With reference to the paragraph commencing " <i>Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity, availability and functionality...</i> ", as Availability is related only to GNSS SiS do you need to make this point explicit?	<p>Comment accepted.</p> <p>The inclusion of Availability in this definition (from the ICAO PBN Manual) is misleading, so the issue is slightly more than one of just making the term explicit. The definition in Para 3 has been re-written to make it clear that the availability requirement is linked to the supporting navigation infrastructure. Text is now:</p> <p>Airborne performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity and functionality needed for the proposed operation in the context of a particular airspace concept. Within the airspace concept, the availability of GNSS SIS or that of some other applicable navigation infrastructure has to be considered in order to enable the navigation application.</p> <p>The comment has also been passed back to the ICAO PBN Study Group.</p>
13		Page 8, Section 1.3, Para 2	With reference to this paragraph where it is stated that The ICAO PBN Manual captures a number of existing navigation specifications e.g., " <i>RNP Approach (final approach)...</i> " there could be misunderstanding in some ECAC States that RNP APCH can only be used from the FAF. Does the bracket imply that the policy will only be considering it in this flight segment?	<p>Comment accepted.</p> <p>The ICAO PBN navigation specification and associated IFP design criteria allows RNP APCH to be used in all approach segments e.g., Initial, Intermediate, Final Approach and Missed Approach, but also in limited Final Approach / Missed Approach segment applications e.g., London Gatwick APV-Baro. Brackets after RNP APCH in the text have been deleted. UK policy is in-line with ICAO.</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

14		Page 14, Section 4.1.3, Para 2	Mention is made in this paragraph of <i>"in advance of any European directive...."</i> The EC has indicated that they wish to use 'regulations' rather than directives to stop States interpreting the rules differently.	Comment accepted. The European legislation inferred in this paragraph i.e., PBN Implementing Rule, is being developed under an EU Regulation. Text corrected.
15		Page 16, Figure 3	For clarity, it would help the reader if there is delineation between with/without vertical guidance? I see you've put in 2D and 3D but visually will that be picked up?	Comment accepted. Figure 3 has been re-drawn along the lines of the suggested.
16		Page 17, Footnote 10	Mention is again made of Availability, this not limited to GNSS SiS.	Comment accepted. See disposition of comment No.12. Footnote modified to indicate PBN airborne performance requirements.
19		Page 22, Section 5.1.3.3	There is some text that might (and has in house) been misread: Large air transport aircraft are typically equipped with dual redundant navigation sensors e.g., VOR, DME, ADF. With future reliance on RNAV equipment e.g., Flight Management Systems (FMS), there will be a regulatory requirement for dual systems. To avoid that someone gets to the end of this sentence and thinks that you are asking for Dual RNAV in the short term I wonder if there could be some re-phrasing along the lines below to lead to the thoughts in the last part of the paragraph. Large air transport aircraft are typically equipped with dual redundant navigation sensors e.g., VOR, DME, ADF. With operations become more dependent upon RNAV equipment e.g., Flight Management Systems (FMS), there will be a need to identify the degree of dependence upon RNAV and the back-up navigation capability that conventional aids can continue to apply. In the long term it would be expected that there will be a need for a regulatory requirement for dual systems.	Comment accepted. Text modified.

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

20	IAA	Page 9, Section 1.5, Para 3	When discussing (UK and Irish) terminal airspace procedures it is incorrect to say that no permanent procedures have been implemented. Suggest making clear that the statement applies only to the UK.	Comment accepted. Statement clarified.
21	MOD / AIDU		<p>From a procedure design perspective with particular reference to procedures in and out of UK Military airfields, any effects will only be felt if and when a decision is made to upgrade military aircraft with the appropriate equipment. If such a decision is to be made, consideration must be given as to the extent of RNAV procedure usage. If an equipment upgrade is initiated with the intention of enabling UK Military aircraft to operate in areas and airfields designated as RNAV whilst utilising existing procedures at UK Military airfields, there may not be any significant impact on the UK Military Instrument Approach Procedures programme. However, if a decision is made to convert all UK Military airfields to RNAV procedures entirely, obviously a new program would have to be implemented. Sufficient lead-in time is essential to ensure compliance within defined time-scales; the PANS-OPS conversion program is a 3-year, £multimillion conversion program. Design criteria would have to defined, contractual arrangements negotiated and not least funding lines identified.</p> <p>If civilian airfields convert to RNAV ahead of the military, AIDU will merely reproduce the procedures from AIP entries as they do now. This becomes an operator problem if conventional procedures are withdrawn and aircraft are not equipped to fly RNAV procedures.</p> <p>If RNAV procedures are required <i>to any extent</i> at UK Military airfields, funding will have to be provided as the current PANSOPS conversion and maintenance programs do not included these procedures.</p>	<p>Comment noted.</p> <p>Regarding the situation at larger civilian airfields, the introduction of RNAV instrument approach procedures is seen as a back-up to ILS i.e., to improve airfield resilience. Therefore a non-RNAV instrument approach procedure will still be available.</p> <p>With the potential rationalisation of conventional navigation aids supporting ATS routes and instrument approach procedures at smaller airfields, MOD may see limitations, both in terms of access and for training purposes.</p>
22	NATS	Page 7, Section 1.2, Para 3	The ICAO definition of Performance-based Navigation references 'ATS route' and this encompasses departure and arrival routes i.e., SIDs and STARs. In the UK, ATS routes are generally understood to exist in the en-route phase of flight only and so it would be beneficial to add a footnote to clarify its meaning within the context of the policy.	<p>Comment accepted.</p> <p>The use of the term ATS route in the PBN definition is consistent with the former's definition in Annex 11, i.e., ATS route is used to mean variously, airway, advisory route, controlled or uncontrolled route, arrival or departure. However, the author agrees that in the UK we generally refer to ATS route as</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

				being in the en-route and refer separately to SIDs and STARs. A footnote is added.
23		Page 16, Section 4.4.2	Policy Statement 9 does not reflect the precise wording used in PANS-OPS Vol II, Part III Section 3 Chapters 4 and 5 concerning runway classification. Should say, CAT I precision approach runway.	Comment accepted. Text corrected.
24		Page 19/20, Section 5.1.2	When addressing implementation considerations the two options given suggest that the vehicles for change are ANSP or regulator led and that simplistically viewed, the associated costs are largely borne by either the ANSP or by the airborne user. The successful migration towards PBN supported airspace will require a much closer collaboration between the ground and air side and a greater integration of ground and air capabilities than has been the case up till now. Therefore the policy should not suggest an expectation that one or the other stakeholder may bear the brunt of an implementation as this would give a false impression of the level of commitment that each might want to make. Further, as frameworks for change, each option is too narrowly scoped to enable a stakeholder to be confident that a chosen option will deliver the required service improvements. In reality, depending on the airspace/procedure change and the supporting navigation application required, it will be necessary for any successful implementation to encompass elements of both options i.e. ANSP investment in system change, user investment in certification and approvals, and regulatory measures to drive equipage. This section could be revised to reflect the necessarily integrated nature of any PBN implementation process, regardless of the type, size and scope of the proposed introduction.	Comment accepted. The use of Options was felt to illustrate the dilemma of implementation i.e., mixed operations versus mandate or notified airspace change. This may be a somewhat idealised situation and the comment is fully accepted. Rather than lose the theme of Options completely, the text has been modified to introduce additional text reflecting perhaps a more pragmatic framework of scenarios for change as suggested in the comment.
25	PPL/IR and AOPA UK	General	<p>The GNSS technology that enables an aviation navigation infrastructure based on PBN is not new. European aviation has been slow to adopt GNSS applications, and, since broadly the same equipment has been available in Europe as elsewhere, the glacial pace of adoption has its roots in the difficulty of creating a coherent and interoperable system of standards and procedures in an environment where a single ATS route may pass through the airspace of a dozen or more states.</p> <p>Against that backdrop, the UK's proposal of a PBN policy is an important enabler, and we welcome such an initiative in the hope and expectation that the new navigation infrastructure is fit for purpose, is tailored to the target levels of safety of its users, and provides a mechanism for significant increases in capacity for all airspace users.</p>	Comment noted.

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

			<p>Such a PBN policy will deliver a positive cost-benefit for commercial air transport, which operates almost exclusively under IFR to meet its target level of safety, and is able to do so because of IFR infrastructure that serves its operation needs. And the PBN policy will have little if any impact on the section of aviation that flies exclusively under VFR.</p> <p>However, the diverse user-base that we represent often operates at the interface between the two regimes: there is a real choice for any given flight between VFR and IFR, a choice to be made by the operator and/or the flight crew. Access to the IFR system, which is generally a safer operational environment, comes at a cost, in equipment, crew training and (lamentably more significantly in recent years) certification burden. It is fundamental to overall system safety that such costs are proportionate to the real benefits that they deliver. Regulation and policy can have a significant influence on every aspect of those costs.</p> <p>With that in mind, the acceptability of the proposed PBN policy to our GA community depends very strongly on the cost of participation. If that participation involves:</p> <ul style="list-style-type: none">• equipment, such as GNSS/SBAS, that is widely available at a cost commensurate with light aircraft equipage;• airworthiness certification that takes into account the practicalities and commonalities of the GA cockpit;• generic procedures that have been developed to meet GA needs with generic operational approval and;• training that is either included in the instrument rating or widely available without unnecessary regulatory formality; <p>then it is reasonable for PBN to become the mainstay of navigation for all airspace users.</p> <p>If, by contrast, participation involves:</p> <ul style="list-style-type: none">• equipment, such as Baro-VNAV or DME/DME that is not available at reasonable cost for light aircraft;• airworthiness certification that treats a Cessna 172 like a Boeing 737;• the development of specific procedures for each operator in a way that assumes an 'ops manual' approach to safe operation, with individual certification and;• training programs that are tailored for commercial aviation needs in a	
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Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

			<p style="text-align: center;">way that practically excludes GA pilots;</p> <p>then the progression to PBN as a de facto requirement for IFR flight is likely to create significant safety dis-benefits in the GA sector of aviation where safety is a key issue, in order to deliver capacity and cost benefits to the commercial air transport sector where safety is already consistent with target.</p> <p>We welcome the informal commitments by the CAA and other stakeholders to work with GA to ensure that all such requirements are proportionate and appropriate. The attitude of GA to PBN policy and the safety of GA pilots over the timescales of FAS will depend on a successful outcome to such initiatives.</p>	
26		Page 13, Section 4.1.1	We support the endorsement of the endorsement of the ICAO PBN Concept, and the uptake of PBN as soon as is reasonably practicable, subject to the reservations in our general comments.	Comment noted.
27		Page 13, Section 4.1.2	We support the application of ICAO PBN Specifications, subject to the reservations in our general comments.	Comment noted.
28		Page 14, Section 4.1.3	<p>We do not support PBN mandates for airspace under any circumstances. With the reservations expressed in our general comments, PBN mandates should only be used for ATS routes (including SIDs/STARs) to and from specific airports where the availability of airborne equipment for PBN to the vast majority of affected operators is achievable at proportionate cost, and even then as a last resort where equipage cannot be assured through delivering direct benefit to the user.</p> <p>Mandates are the favoured tool of aviation regulators to solve the so-called chicken-and-egg problem in deploying new technology in ATM. Without the availability of corresponding ground systems and procedures, aircraft operators are reluctant to equip with the technology as it provides no operational advantage and comes at considerable cost. But unless a significant proportion of operators are equipped with the technology, ANSPs feel unable to invest in ground systems and develop procedures, as legacy procedures remain necessary to deal with the majority of operators. Since regulation is understandably the regulator's tool of choice, mandatory equipage seems like a natural way to address the chicken-and-egg problem, by setting a level playing field and ensuring that commercial competitors do not obtain a competitive advantage by delaying adoption. On observing a lack of progress in equipment adoption as a nail, the temptation to use the hammer of a mandate is strong. And mandate-compliance costs may be borne equitably and simultaneously between competitors as they are passed on to end users in equal measure in the short term, while in the long term the measures reduce the costs for end-users.</p>	<p>Comment rejected.</p> <p>Notification of airspace (otherwise described as a mandate) is an important mechanism by which change can be introduced, bringing with it, certainty of equipment capability, guaranteed interoperability and therefore maximum derived benefits. However, the use of a mandate will only be authorised where the applicant has demonstrated the need for such a change and with it, equipment levels to support the change and cost benefits where retrofit is required. The Airspace Change Process (ACP) ensures that all stakeholder views have been canvassed (through consultation) and then fairly considered. The purpose of providing this Policy Statement is to provide the major ANSPs with a mechanism for making the scale of changes envisaged by the Future Airspace Strategy. But justification will be required.</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

			<p>Aviation users, however, span a complex spectrum of commercial and non-commercial. For non-commercial users, equipage to meet a mandate is not a business investment with a view to long term profits. Many non-commercial users operate on a limited budget where such investment is simply not an option, thus leading to exclusion. Where the activity from which they are excluded brings not just a utility benefit but also a safety benefit, such as IFR-capability, such a mandate can clearly be dangerous. The ultimate price of an excessive cost of entry to the IFR system for non-commercial users can be measure in the lives of pilots and their passengers lost attempting to fly VFR in marginal (but legal) conditions, for example in CFIT accidents.</p> <p>Aviation is by no means the only industry in which the chicken-and-egg problem arises. In any circumstance in which technologies are paired (batteries/chargers, video-tapes/video-tape-players, operating-systems/applications), similar chicken-and-egg interoperability issues crop up. Most such industries have no regulators, at least not with such power of mandate. Yet technology adoption in such industries is not stifled: on the contrary, it is considerably faster than in aviation. Such progress occurs by ensuring an advantage for the adopter of the new technology, even in a mixed environment. SESAR calls this “best equipped best served”.</p> <p>An analogous situation in aviation is the adoption of GPS equipment in the USA. The widespread availability of GPS approaches since the early 1990s has led to widespread use of TSO-C129 A1 equipment to deliver IFR capability to previously un-served runways and airports, or easier and more reliable operations into existing instrument runways. As a consequence, the US fleet is more capable than the European equivalent.</p>	
29		Page 15, Section 4.2.1	We support the use of RNAV5 for ATS routes.	Comment noted.
30		Page 15, Section 4.3.1	<p>We support the use of RNAV5 for Arrivals. The “opportunity basis” on which RNAV 1 is used should take into account the following factors:</p> <ul style="list-style-type: none"> • the accessibility of RNAV 1 (discussed in the general comments above) to the entire fleet using the airport under IFR • the use of STARs designed for one airport by aircraft inbound to another (e.g., EGSS for EGSC, EGLC for EGMC) • the availability of alternative methods of operation for aircraft not equipped with RNAV 1, for example the use of RNAV 5 combined with radar monitoring, or radar vectoring. 	Comment noted.

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

31		Page 15, Section 4.3.2	<p>We support the use of RNAV fixes as holding waypoints. Advanced holding capability in airborne equipment should not be assumed.</p>	<p>Comment noted.</p> <p>The Policy Statement contains the condition that the use of more advanced holding capability will only be applied where the fleet equipage can support the necessary functionality.</p>
32		Page 15, Section 4.3.3	<p>The “opportunity basis” on which RNAV 1 is used should take into account the following factors:</p> <ul style="list-style-type: none"> • the accessibility of RNAV 1 (discussed in the general comments above) to the entire fleet using the airport under IFR • the use of departures designed for one airport by aircraft outbound from another • the availability of alternative methods of operation for aircraft not equipped with RNAV 1, for example the use of RNAV 5 combined with radar monitoring, or radar vectoring. 	<p>Comment noted.</p> <p>RNAV 5 is not designed to support SIDs and therefore is not an appropriate alternative to the options provided in the Policy Statement.</p>
33		Page 15, Section 4.4.1	<p>We support the implementation of RNP APCH instrument flight procedures at all instrument runway ends. The CAA should facilitate a coordinated adoption with associated economies of scale, rather than waiting for individual airport operators to replace conventional non-precision approach procedures. Lessons may be learnt from the FAA’s GPS approach overlay program of the mid-1990s.</p> <p>We note that SBAS equipment (as an alternative to Baro-VNAV) can also be used to fly LNAV/VNAV procedures, and the policy should take this into account.</p>	<p>Comment noted.</p> <p>The CAA is promoting and facilitating the introduction of RNP APCH procedures, although the decision to implement rests with the individual airport operators.</p> <p>Comment accepted.</p> <p>Note added recognising LNAV/VNAV capability of certain SBAS equipment.</p>
34		Page 16, Section 4.4.2	<p>We support the proposed policy on runway infrastructure requirements. The policy should also provide for the use of APV procedures to airports without instrument runways with the use of circling (VM(C)) minima.</p>	<p>Comment noted.</p> <p>Policy is under development within the CAA regarding Instrument Approach Procedures To Aerodromes Without an Instrument Runway and/or Approach Control.</p>

Comment Response Document (Final) - Policy for the Application of Performance Based Navigation in UK_Irish Airspace.

35		Page 17, Section 4.5.1	We support such rationalisation of the navigation infrastructure.	Comment noted.
36		Page 17, Section 4.5.2	We note that many aircraft, including almost all general aviation aircraft, have no possibility of reversion to other sensors to provide continuity in the event of a GNSS failure. Reversion principles must take into account GNSS losses in a way that is compatible with aircraft using a single GNSS navigation system.	Comment noted. Although this Policy Statement is speaking to the reversion from an RNP to RNAV state, the loss of GNSS and the inability of certain classes of aircraft to continue even in a degraded mode, will have to be considered by the applicant as part of their safety case. It is envisaged that under those circumstances, radar will remain the back-up together with an optimised conventional navigation infrastructure.
37		Page 17, Section 4.6.1	We support the use of route spacing appropriate for the airspace and ATS operation being undertaken.	Comment noted.