



**WORKING PAPER**

**ASSEMBLY — 39TH SESSION**

**EXECUTIVE COMMITTEE**

**Agenda Item 20: Environmental Protection – Aircraft Noise – Policy, Standardization and Implementation Support**

**Agenda Item 22: Environmental Protection – International Aviation and Climate Change – Policy, Standardization and Implementation Support**

**PERFORMANCE BASED NAVIGATION (PBN) AND ENVIRONMENTAL OPPORTUNITIES**

(Presented by Canada)

**EXECUTIVE SUMMARY**

Advances in defined performance and functionality of navigation systems have enabled changes in airspace design, separation minima, route spacing, airport access, procedure design and air traffic management. These advances enable more efficient aircraft operations resulting in opportunities to both reduce Greenhouse Gas (GHG) emissions and options for reducing the aggregate production of aircraft noise. However, in the terminal environment near aerodromes, these improvements usually result in a perceived concentration of noise, due to more aircraft following the same efficient approach profile.

Global data and pragmatic guidance is needed to assist all stakeholders to make informed and conscious decisions about how best to implement PBN in the vicinity of aerodromes so as to appropriately balance the environmental benefits from the perspective of reducing GHG emissions and reducing negative noise impacts.

**Action:** The Assembly is invited to:

- a) Call upon States to contribute data concerning noise impacts in the vicinity of aerodromes; and
- b) Direct the Council to develop a pragmatic approach to balancing GHG and noise impacts in the vicinity of aerodromes when implementing PBN procedures.

<i>Strategic Objectives:</i>	This working paper relates to Air Navigation Capacity and Efficiency Strategic Objectives.
<i>Financial implications:</i>	No additional resources requested
<i>References:</i>	Assembly Resolutions in Force (as of 4 October 2013) (Doc 10022); Performance-based Navigation (PBN) Manual (Doc 9613); and Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829).

## 1. INTRODUCTION

1.1 The Performance-Based Navigation (PBN) concept is an ICAO initiative. The first resolution related to PBN originated at the 36<sup>th</sup> ICAO Assembly, requiring States to complete PBN implementation plans by 2009. Resolution A36-23 was reviewed and superseded at the 37<sup>th</sup> ICAO Assembly by resolution A37-11: Performance-based navigation global goals. This resolution stands as global guidance for air navigation service providers (ANSP) for the priorities for implementing PBN.

1.2 Resolution A37-11 recognizes many considerations for safety and efficiency and ultimately urges all States to implement area navigation (RNAV) and required navigation performance (RNP) air traffic services (ATS) routes and approach procedures in accordance with the ICAO PBN concept laid down in the *Performance-based Navigation (PBN) Manual* (Doc 9613).

1.3 Additional guidance is now required as to how States can achieve a balance between all opportunities for environmental advantage that the implementation of PBN presents, with particular attention required in the vicinity of aerodromes.

## 2. BACKGROUND

2.1 Doc 9613 provides the means to support PBN applications, in terms of required performance, equipment functionality and enabling infrastructure, including navigation specifications (nav specs). It has practical guidance for the development of documents related to standards, regulations, certification, advisories, guidance and operational approvals.

2.2 Along with Doc 9613 existing State Advisory Circulars (ACs) and other regulatory enablers are also beneficial as guidance to enable application of PBN capabilities. For example, the United States of America's Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) ACs supporting various RNAV and RNP operations were used to enable Canadian operations and expedite the development of Canada's PBN regulatory infrastructure.

2.3 PBN is an enabler for direct and indirect environmental benefits as outlined in the table below:

FUEL SAVINGS	ENVIRONMENT
<ul style="list-style-type: none"> <li>• Shorter flight tracks</li> <li>• Optimum profile descent (OPD) capability, continuous climb operations (CCO) and continuous descent operations (CDO)</li> <li>• Reduced flight variance for more predictable operations</li> <li>• Lower landing minima reducing weather cancellations and diversions</li> <li>• Reduced probability of missed approaches or diversions</li> <li>• Reduced probability of airborne holding from airspace and airport capacity gains</li> <li>• Separation standards enabling more aircraft operating on optimum trajectories</li> <li>• Reduced contingency fuel requirements owing to system predictability and reliability</li> </ul>	<ul style="list-style-type: none"> <li>• Significant reductions of CO<sub>2</sub> emissions and fuel consumption</li> <li>• Significant reduction in other pollutants (mono-nitrogen oxides, carbon monoxide)</li> <li>• Specification of shorter flight paths and vertical profiles that lower thrust levels allow for lower noise operations</li> <li>• Increased opportunity for placement of flight paths over non-noise sensitive areas</li> <li>• Reduced aerodynamic noise from optimum drag profiles</li> </ul>

2.4 Terminal environments are expected to become more dependent on RNP navigation specifications in order to take advantage of the tighter aircraft containment and narrower obstacle clearance areas that the associated designs offer. In addition, the more predictable lateral path definitions will enable more precise vertical path construction. Unfortunately, these predictable paths are often perceived as a negative noise impact by residents in affected communities in the vicinity of aerodromes.

### 3. PBN AND THE ENVIRONMENT IN TERMINAL OPERATIONS

3.1 Noting the planned progression of PBN in Canada, it is apparent that there are many opportunities to leverage efficiencies that will reduce aviation’s GHG contribution. However, in the terminal environment below approximately 10,000 feet above ground, optimal flight paths producing a minimum emissions footprint often need to be balanced with the environmental impact of noise on underlying residential communities.

3.2 Reducing the aggregate production of noise concurrently with reductions in GHG emissions through the use of PBN flight paths is not a significant challenge. What is a challenge is

reducing GHG emissions through optimal flight paths while addressing the potential concentration of this new, albeit lower, noise profile. The guidance provided in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829) is generally applicable to planning airport expansions or developments, but not easily applicable to the operational changes that PBN enables.

3.3 Variability in flight paths to allow noise dispersion means variability away from the optimal flight path resulting in higher GHG emissions from aircraft. Similarly, keeping aircraft at higher altitudes for longer than optimal to reduce noise impact on the ground results in additional track miles to permit the required descent angle for landing, again, resulting in additional GHGs. Both of these approaches have been used to mitigate complaints about the repetitious noise impacts of PBN implementations that were originally optimized for GHG reduction, even in cases where those implementations also reduced the individual noise profile for an approach to the runway concerned.

3.4 In this era of focusing on the environment, the aviation industry and those affected by it must make conscious choices with respect to flight paths with regard to their net effect on both GHG production and noise impact. The consultations to reach these decisions would be more easily facilitated if there were global data, guidance and principles around the effects of repeated exposures to the types of noise profiles resulting from fuel-optimal PBN approaches.

3.5 Canada, along with other States and industry, has gathered data and developed expertise in the area of understanding noise impacts in the vicinity of aerodromes. This data and expertise could be used within the existing Panel structure to develop the necessary global policies and guidance, based on practical experience and lessons learned during recent PBN implementation programmes.

#### 4. **RECOMMENDATION**

4.1 The Assembly is invited to direct the Council to develop data and practical guidance material to assist airspace planners and other stakeholders, including residents of affected communities, to determine a pragmatic approach to achieving a balance between all opportunities for the environmental benefit from the implementation of PBN, paying particular attention to flight paths in the vicinity of aerodromes.

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