



International Civil Aviation Organization

**AFI PLANNING AND IMPLEMENTATION REGIONAL GROUP
SIXTEENTH MEETING (APIRG/16)
(Kigali, Rwanda 19-23 November 2007)**

Agenda Item 3: Global and Inter-regional activities

3.3: Global Air Navigation Plan

Performance - Based Global ATM System: Performance Based Navigation (PBN)

(Presented by the Secretariat)

SUMMARY

This discussion paper provides details on the establishment of the Performance Based Navigation concept in the context of a performance-based Global ATM System, the benefits of PBN, recent actions taken by ICAO at the Global and Regional levels regarding PBN implementation and what role the APIRG and States in conjunction with their stakeholders must play in PBN implementation.

Action by the APIRG is in paragraph 4.

1. INTRODUCTION

1.1 ICAO efforts to continually improve the Air Traffic Management (ATM) system are focused on the Global Air Traffic Management Operational Concept. The Concept was endorsed by the Eleventh Air Navigation Conference in 2003 and is now an important part of all major ATM development programmes. The global ATM system envisaged in the concept, is one in which aircraft would operate as closely as possible to their preferred 4-dimensional trajectories. Performance Based Navigation (PBN) will play a central role in realizing this goal. This paper explains the benefits of PBN, recent actions taken by ICAO at the Global and Regional levels regarding PBN implementation, and what role the APIRG and States in conjunction with their stakeholders must play in PBN implementation.

2. ICAO EFFORTS TOWARD IMPLEMENTATION OF A GLOBAL ATM SYSTEM

2.1 Update of the Global Air Navigation Plan and development of an integrated programme to support implementation planning

2.1.1 On 30 November 2006 the Council accepted the second amendment of the *Global Air Navigation Plan* (GANP) (Doc 9750). This amendment originated from the Sixth Air Navigation Commission Consultation Meeting with Industry on Fostering the Implementation of the Recommendations of the Eleventh Air Navigation Conference (2004).

2.1.2 The GANP now contains a set of twenty-three Global Plan Initiatives (GPIs) which stem from the industry roadmap and the Eleventh Air Navigation Conference. The GPIs therefore support the transition to the ATM system envisioned in the operational concept and are a logical progression of the evolutionary work already accomplished by the Planning and Implementation Regional Groups (PIRGs) and will integrate into the present planning framework.

2.1.3 The GANP will be supported by planning tools (e.g. software applications, planning documentation, web-based reporting forms and project management tools). As States and PIRGs consider ATM operational improvements to the regional air navigation infrastructures, it is intended that they will use the GPIs and associated common programme templates as the basis for establishing performance objectives and implementation timelines, as well as to develop a comprehensive schedule and programme of planning activities to achieve the work.

2.2 Performance-based transition strategies

2.2.1 Assembly Resolution A35-15 urged the Council to ensure that ICAO develop transition strategies necessary to support the implementation of a global ATM system (Appendix B, Resolving Clause 2). In support of this aspect of global planning, the Commission developed Part I of the *Manual on Global Performance of the Air Navigation System* (Doc 9883), entitled *Performance-Based Transition Guidelines*. This document is posted to the ICAO-NET, pending editorial finalization and translation.

2.2.2 An important objective of this document is to raise general awareness of the need to change the way in which the evolution of ATM is planned at national, regional and global levels and to support the GANP as a transition planning document. Planning choices increasingly need to be justified in advance by a thorough analysis of anticipated performance needs, expected benefits and achievement timelines. Such explicit management and planning of ATM performance will be needed to ensure that throughout the transition process the expectations of the ATM community are met.

2.3 Performance objectives and ATM operational improvements

2.3.1 Each ICAO Region is in the process of determining which ATM operational improvements it should pursue based on clearly established performance objectives, followed by development of work programmes. This will then be used to support the ICAO Air Navigation Integrated Programme and Headquarters Technical Officers will be assigned to support the regions in their various work programmes. The work programmes with timelines will also be used to track progress and report to ICAO governing bodies.

2.3.2 States and regions, in determining which ATM operational improvements to pursue, should use the *Performance Based Transition Guidelines*, the Global Air Navigation Plan and the Airspace Concept contained in the *Performance Based Navigation Manual* (Doc 9613) in draft on the ICAO-NET. The Airspace Concept as described in the PBN Manual supports performance based transition planning by providing guidance that will assist in determining airspace requirements, leading to logical ATM operational improvements. Because of its integral part in planning, ICAO is in the process of incorporating the Airspace Concept in the Global Plan.

3. PERFORMANCE BASED NAVIGATION (PBN)

3.1 Of all of the possible GPIs contained in the Global Air Navigation Plan, and the ATM operational improvements that may result from a performance based transition planning process, PBN

offers the most immediate and tangible benefits. All regions are expected, if they have not already done so, to establish PBN implementation programmes with associated timelines

3.2 The recent 36th Session of the ICAO Assembly was advised of the worldwide growing importance of PBN in respect of aviation safety and efficiency and subsequently adopted Resolution A36-23, Performance based navigation global goals (see Attachment A). This resolution calls on States and Planning and Implementation Regional Groups (PIRGs) to develop PBN implementation plans by 2009. These plans are to ensure globally harmonized and coordinated implementation of PBN by 2016 for approach operations with vertical guidance (APV) and according to a set of established timelines and milestones, based on requirements, for terminal and enroute operations.

3.3 ICAO has already undertaken considerable activities in relation to PBN. The ICAO Required Navigation Performance Special Operational Requirements Study Group (RNPORSOG) addressed a divergence of implementation that resulted in a lack of harmonization between RNP applications and the significant confusion that had developed regarding concepts, terminology and definitions. As a result of the Study Group's work, ICAO developed the PBN concept. This concept includes two key "building block" elements: RNAV and RNP. PBN brings together, under one umbrella, a number of diverse RNAV and RNP applications encompassing all regimes of flight, from enroute to approach. PBN provides a framework of harmonized modern navigation operational approval requirements that make use of available navigation systems and aircraft capability. In addition to enhanced safety, PBN will provide significant benefits in terms of fuel savings, accessibility and flexibility in terminal areas and in addressing environmental problems (emissions and noise).

3.4 Out of the work of the RNPORSOG, the *Performance Based Navigation Manual* (Doc 9613) was developed and State letter AN 11/45-07/22, *Guidance material for the issuance of performance based navigation (PBN) operational approvals*, was issued, in order to assist States in implementation and avoid proliferation of operational approval requirements. The appendix to the State Letter, which reflects Volume II of the new ICAO PBN Manual, contains detailed technical "Navigation Specifications" with standardized, harmonized airworthiness and operator requirements for a number of RNAV and RNP operations. These standardized Navigation Specifications draw from the extensive experience in technical requirements definition of States that have implemented PBN and also contain detailed recommendations for pilot and controller training. The standardization of these navigation specifications brings significant benefits to operators and air navigation service providers (ANSPs).

3.5 A key prerequisite for PBN implementation is that the State must comply with its obligations with regard to implementation of WGS-84, as all RNAV and RNP operations are conducted solely with reference to WGS-84 coordinate data. It should be noted that only about 47% of the States in the AFI Region have reported WGS-84 implementation in their AIP, although it is recognized that some additional States have partially implemented WGS-84.

3.6 The importance of PBN is widely recognized and regions are in various stages of implementation. In August of this year, the 18th Meeting of the APANPIRG agreed on five conclusions in this regard. The most important and far-reaching of these was **Conclusion 18/52 – Establishment of a Regional Performance Based Navigation Task Force (PBN/TF)**. The meeting considered that implementation of PBN in the region would yield efficiency and safety benefits in the short term, but that for PBN to become widely implemented, considerable effort would need to be put into planning and identifying what airspace measures could be introduced and the level of air navigation service required. For these reasons a dedicated task force was established to develop a PBN implementation plan for the Asia/Pacific Region and to address related regional PBN implementation issues. GREPECAS has had such a task force for some time, and has already completed a PBN Roadmap for the CAR/SAM Region.

The Mideast (MID) Region is also presently in the process of establishing a PBN taskforce. For the reasons above, it is recommended that this meeting of the APIRG also establish a PBN Task Force with terms of reference as stated at Appendix A to this working paper.

Draft Conclusion 16/xx – Establishment of a Regional Performance Based Navigation Task Force (PBN/TF):

That, an Africa PBN Task Force, with terms of reference as outlined in Appendix A to the APIRG/16 Report on Agenda Item x.x, be established to develop a PBN implementation plan for the Africa Region and address related regional PBN implementation issues.

3.7 In order to familiarize States and stakeholders with the PBN concept and explain how to implement PBN, ICAO has organized “Introduction to PBN” seminars in all ICAO regions. Two of these seminars have already been conducted in the Asia and Pacific Region this past September. . These seminars each had attendance in excess of 120. As of the drafting of this working paper a seminar was scheduled for the MID Region in November 2007. The next two PBN seminars are scheduled in the AFI Region, 15-18 January 2008 in Abuja, Nigeria and 22-25 January 2008 in Nairobi, Kenya. The target audience for these seminars is airspace planners, ANSPs, air operators, aerodrome operators, regulators, air traffic controllers and procedure designers, among others.

3.8 Assembly Resolution A36-23 calls for the States to develop a PBN implementation plan by 2009, geared towards achieving the global PBN implementation performance objectives. It is essential that the PBN implementation plan be developed in full cooperation and coordination with all stakeholders, including regulators, ANSPs, aerodrome operators, air operators and others, as appropriate.

3.9 Recognizing that the PBN concept is now established, that guidance material has been developed and distributed, that strong action on PBN implementation has been taken at the regional level with establishment of the PBN Task Force and that the States have had the opportunity to learn about PBN at the recent seminars, it is important that the States now act in accordance with Assembly Resolution A36-23 to ensure a globally harmonized and coordinated transition to PBN for international and domestic operations. The AFI Region is experiencing the highest aviation accident rate in the world. PBN, as part of the planned Performance-based Global ATM System, is the essential initial step in addressing this safety issue, as well as air traffic growth, by leveraging the navigation capabilities that exist in aircraft today to reap substantial benefits in terms of safety, capacity, access and the environment in the near-term. To this end, the 16th Meeting of the Africa Planning and Implementation Regional Group is urged to adopt the following Conclusions in support of accelerated PBN implementation:

Draft Conclusion 16/xx – Development of State PBN Implementation Plans:

That, the Regional Offices encourage States to begin development of their State PBN implementation plans in harmony with the development of the Africa Regional PBN implementation plan being coordinated by the AFI PBN Task Force for submission to APIRG/17 (2008).

Draft Conclusion 16/xx – Designation of Contact Person for PBN Implementation:

That, by 28 February 2008, States designate a focal contact person responsible for performance based navigation implementation and provide details of the contact

person to either the Eastern and Southern African (ESAF) or the Western and Central African (WACAF) ICAO Regional Office, as appropriate.

4. ACTION BY APIRG:

The Meeting is invited to:

- a) note the information in this paper; and
- b) agree to the draft Conclusion 16/xx in paragraph 3.6 and draft Conclusions 16/xx and 16/xx in paragraph 3.9.

Appendix A

Africa Planning and Implementation Regional Group Performance Based Navigation (PBN) Task Force

Proposed Terms of Reference

1) Develop as part of the goal of moving towards a performance-based Global ATM System, an African Regional PBN implementation plan, based on a gap analysis, in line with the ICAO PBN goals and milestones. This PBN implementation plan must be based on the following strategic objectives and guiding principles.

Strategic objectives:

- a) To ensure that the implementation of the navigation item of the CNS/ATM system is based on clearly established operational requirements;
- b) to avoid undue multiple equipment on the aircraft and/or multiple systems on ground;
- c) to avoid the need for multiple airworthiness and operational approvals for intra- and inter-regional operations;
- d) to explain in detail the contents of the Regional Air Navigation Plan and of the Regional CNS/ATM Plan, describing potential navigation applications.

Guiding principles:

- a) pre- and post-implementation safety assessments will be conducted to ensure the application and maintenance of the established target levels of safety;
- b) continued application of conventional air navigation procedures during the transition period, to guarantee the operations by users that are not RNAV- and/or RNP-equipped;
- c) the first regional PBN implementation plan should address the short term (2008-2012) and medium term (2013-2017); and
- d) target date for completion of the first regional PBN implementation plan is December 2008.
- e) input will be considered from all stakeholders in the PBN implementation process

2) Carry out specific studies, develop guidance material and facilitate training to assist States with RNAV/RNP implementation in the en-route, terminal, and approach flight phases, taking into account the performance based navigation (PBN) concept, according to the ICAO Strategic Objectives and Global Plan Initiatives (GPI) on this matter (GPI 5, 7, 10, 11, 12, 20, 21)

3) Identify other issues/action items arising from the work of the RNP SORSG or for consideration by the RNP SORSG in order to facilitate regional and global harmonization of existing applications as well as future implementation of Performance Based Navigation operations;

4) Review the States' PBN implementation documentation to ensure regional harmonization and for possible inclusion in ICAO-developed model documentation.

5) Address other regional PBN implementation issues as needed.

6) The task force should report to the APIRG, through the ATS/AIS/SAR Sub-group and briefing to the CNS Sub-group.

— END —

ATTACHMENT A

Assembly Resolution A36-23: Performance based navigation global goals

Whereas a primary objective of ICAO is that of ensuring the safe and efficient performance of the global Air Navigation System;

Whereas the improvement of the performance of the Air Navigation System on a harmonized, worldwide basis requires the active collaboration of all stakeholders;

Whereas the Eleventh Air Navigation Conference recommended that ICAO, as a matter of urgency, address and progress the issues associated with the introduction of area navigation (RNAV) and required navigation performance (RNP);

Whereas the Eleventh Air Navigation Conference recommended that ICAO develop RNAV procedures supported by global navigation satellite system (GNSS) for fixed wing aircraft, providing high track and velocity-keeping accuracy to maintain separation through curves and enable flexible approach line-ups;

Whereas the Eleventh Air Navigation Conference recommended that ICAO develop RNAV procedures supported by GNSS for both fixed and rotary wing aircraft, enabling lower operating minima in obstacle rich or otherwise constrained environments;

Whereas Resolution A33-16 requested the Council to develop a programme to encourage States to implement approach procedures with vertical guidance (APV) utilizing such inputs as GNSS or distance measuring equipment (DME)/DME, in accordance with ICAO provisions;

Recognizing that implementation of approach with vertical guidance (APV) is still not widespread;

Recognizing that the Global Aviation Safety Plan has identified Global Safety Initiatives (GSIs) to concentrate on developing a safety strategy for the future that includes the effective use of technology to enhance safety, consistent adoption of industry best practices, alignment of global industry safety strategies and consistent regulatory oversight;

Recognizing that the Global Air Navigation Plan has identified Global Plan Initiatives (GPIs) to concentrate on the incorporation of advanced aircraft navigation capabilities into the air navigation system infrastructure, the optimization of the terminal control area through improved design and management techniques, the optimization of the terminal control area through implementation of RNP and RNAV SIDs and STARs and the optimization of terminal control area to provide for more fuel efficient aircraft operations through FMS-based arrival procedures; and

Recognizing that the continuing development of diverging navigation specifications would result in safety and efficiency impacts and penalties to States and industry;

The Assembly:

1. *Urges* all States to implement RNAV and RNP air traffic services (ATS) routes and approach procedures in accordance with the ICAO PBN concept laid down in the *Performance Based Navigation Manual* (Doc 9613);

2. *Resolves* that:
 - a) States and planning and implementation regional groups (PIRGs) complete a PBN implementation plan by 2009 to achieve:
 - i) implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones; and
 - ii) implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014; and
 - b) ICAO develop a coordinated action plan to assist States in the implementation of PBN and to ensure development and/or maintenance of globally harmonized SARPs, Procedures for Air Navigation Services (PANS) and guidance material including a global harmonized safety assessment methodology to keep pace with operational demands;
3. *Urges* that States include in their PBN implementation plan provisions for implementation of approach procedures with vertical guidance (APV) to all runway ends serving aircraft with a maximum certificated take-off mass of 5700 kg or more, according to established timelines and intermediate milestones.
4. *Instructs* the Council to provide a progress report on PBN implementation to the next ordinary session of the Assembly; and
5. *Requests* the Planning and Implementation Regional Groups (PIRG) to include in their work programme the review of status of implementation of PBN by States according to the defined implementation plans and report to ICAO any deficiencies that may occur.