Agenda Item 2: SAM airspace optimization
a) PBN en route
b) PBN in terminal areas
c) PBN procedures

Results of the PBN/3 Workshop

(Presented by the Secretariat)

SUMMARY

The purpose of this working paper is to present the results of the PBN/3 Workshop (Lima, 9 to 13 March 2015) and assess the next steps in the process of full PBN design of TMAs and airspaces selected by SAM States.

REFERENCES:

- Summaries of PBN/1 and 2 workshops.
- SAM/IG meetings.

ICAO strategic objectives:	*A - Safety* *B - Air navigation capacity and efficiency* *E - Environmental protection*

1. **Background**

1.1 The Third Workshop on PBN airspace design in the SAM Region was held successfully at the Regional Office on 9-13 March 2015, with the participation of experts of the aeronautical administrations, air navigation service providers, and airline operators of the South American Region. The summary of the PBN/3 workshop appears in the Regional Office website at: http://www.icao.int/SAM/Pages/ES/MeetingsDocumentation_ES.aspx?m=2015-PBN3.

1.2 At the Third Workshop on PBN airspace design, the participants took note of some progress made in the PBN Project, although the required full validation had not been attained yet.

2. **Discussion**

2.1 The Third Workshop on PBN airspace design was held in Lima, Peru, on 9-13 March 2015, under the auspices of the ICAO South American Office and the support of Regional Project RLA/06/901 - "*Assistance in the implementation of an ATM regional system according to the ATM operational concept and the corresponding technological CNS support*", pursuant to ICAO Assembly Resolution A37-11, in which the global implementation of performance-based navigation (PBN) was approved.

2.2 In accordance with Conclusion SAM/IG/11-1 (*Support to SAM States for the redesign of their TMAs*), it was deemed advisable to plan the activities of Project RLA/06/901 for 2014 and 2015, in order to identify training requirements and provide enhanced training to ATM experts of the SAM Region, so as to support and expedite the regional PBN implementation plan, raising awareness of PBN implementation among participants.

2.3 Furthermore, taking into account the need to advance PBN implementation in the SAM Region, the SAM/IG/14 meeting (November 2014) concluded that Regional Project RLA/06/901 should be requested to increase the number/duration of activities related to the aforementioned implementation in 2015 and 2016, with a view to ensuring compliance with the goals established in the Bogota Declaration.

2.4 In view of the above, the SAM/IG/14 meeting reviewed the South American Airspace Optimisation Action Plan, and approved the proposals to incorporate new activities, including the PBN/3 and 4 workshops, in accordance with Conclusion SAM/IG/14-2 (*Meetings and resources required for conducting the activities of the South American Airspace Optimisation Action Plan*).

2.5 The Third SAM PBN Airspace Design Workshop was attended by 26 experts of 10 States, 8 IATA experts and 1 ALTA expert. The participating States were: Argentina, Bolivia, Brazil, Chile, Ecuador, Guyana, Panama, Paraguay, Peru, and Uruguay. The participants were representatives of aeronautical authorities, air navigation service providers and airline operators of the South American Region, with expertise in areas such as air traffic control, airspace planning, instrument approach procedure design, airline pilots/operation engineers.

2.6 **Results of the PBN/3 Workshop**

2.6.1 *Positive aspects*:

2.6.1.1 In general, although some progress was noted in the implementation of the PBN Project in the States attending the event, as described below, the level of maturity that was expected for the validation stage was not attained.

2.6.1.2 The workshop recognised that the participation of one or more leading operators in the various PBN implementation phases could significantly help advance the planning, design and validation processes. This was observed more clearly in the projects submitted by Chile, Panama and Peru.

2.6.1.3 Other positive aspects are: the investment in personnel training, mainly in PANS-OPS (for example, the Basic PANS-OPS and PBN course conducted in Ecuador), the process underway for conducting PANS-OPS PBN and RNP AR courses in Argentina, as well as the strategy of Peru to send experts to courses at ENAC in France. Also noteworthy was the strategy of Guyana to send an expert for training in airspace planning at the Singapore Academy. The structuring of procedure design sectors, including the acquisition of procedure design software in Argentina and Peru, as well as the existing structure in Brazil, were also highlighted during the workshop.

2.6.1.4 The feasibility of the PBN implementation methodology proposed by PBN workshops, starting with the initial workshop held in Miami in March 2013, has already been confirmed by successful implementations in the Lima and Santiago TMAs under the PROESA and PAMPA Projects, respectively.

2.6.1.5 Note was taken of proper implementation by several States of SMS for safety validation of the proposed PBN designs.

2.6.1.6 It has also been noted that the use of *Flight Operations Quality Assurance* (FOQA) data is one of the best tools for design, and especially, for post-implementation assessment of a PBN airspace concept, because it offers real data on the benefits derived from implementation.

2.6.1.7 The evolution of the flexible use of airspace (FUA) concept was applied in Ecuador, with the use of SER-4 starting at FL180, which will permit the creation of a direct route between Guayaquil and Galápagos, applying CDO and CCO criteria, resulting in significant operational gains in terms of fuel savings and thus CO_2 emissions.

2.6.1.8 The delegations of Paraguay and Uruguay established preliminary contact for the exchange of experts, whereby Paraguay would send PANS-OPS experts to Uruguay to conduct a PANS-OPS course, while Uruguay would offer its ATC simulator and the corresponding experts to Paraguay to conduct a more in-depth assessment of PBN design at the Asunción TMA.

2.6.1.9 The Panama project showed significant progress, where the participation of its main operator contributed to collaborative decision-making. In the case of Guyana, which had not attended the previous PBN workshops, significant efforts were being made, and which should continue to be supported by the Administration for successful completion.

2.6.2 *Negative aspects*:

2.6.2.1 The main objective of the PBN/3 workshop was to analyse PBN design validation. The States submitted part of the data required for validation, but full validation had not been achieved, preventing progress to the next implementation phase.

2.6.2.2 States must double their efforts to complete the validation phase as soon as possible, since this delay has a negative impact on the optimum development of Version 03 of the SAM Route Network, except for TMAs where PBN implementation is already consolidated (Lima, Santiago and Rio de Janeiro).

2.6.2.3 Experts have been requested to improve the use of the Action Plan model so that it may be a true reflection of activities to be performed, based on the resources available in each State.

2.6.2.4 States are requested to pay special attention to the setting of deadlines, so that they will take into account the results that may be obtained in each activity to be performed in each phase of the process.

2.6.2.5 It is important to note that, in the case of the Lima TMA, for example, that has medium/high complexity, the implementation process took 15 months. In most of the cases analysed, deadlines seem too long. At present, the dates submitted to the ICAO SAM Office are as follows:

State	Implementation date
Argentina (Baires)	10 November 2016
Bolivia (Santa Cruz)	30 December 2016
Brazil (PBN SUR)	2nd semester 2017
Chile (Santiago)	17 September 2015
Ecuador (Guayaquil)	19 June 2016
Guyana	¿?
Panama (Panama)	02 July 2015
Paraguay (Asuncion)	23 November 2016

State	Implementation date
Peru	¿?
Uruguay (Carrasco)	¿?
Venezuela (Maiquetia)	28 May 2015

2.6.2.6 The delegations of Brazil and Peru presented the restructuring of their PBN projects, involving some delays in the dates foreseen because of other priorities established by each State.

2.6.2.7 The workshop took note that there were still some States where the lack of human resources in the PANS-OPS field prevented follow-up of the PBN implementation project. The most serious case is that of Uruguay, whose only PANS-OPS expert is to retire soon.

2.6.2.8 The Meeting regretted the absence of some States at the workshop and the negative impact it had on regional optimisation programmes applied to South American airspace.

2.7 **Operational complexity of airspace**

2.7.1 The workshop identified differences in some aspects that should be taken into account in the various air traffic scenarios that may be encountered in the Region.

2.7.1.1 The operational complexity of the scenarios to be analysed by airspace planners, with a view to identifying opportunities for design improvements and thus increase the efficiency or capacity, is not limited to high or low air traffic volume. A comprehensive analysis for the optimisation of these complex airspaces could take into account the need to optimise the flexible use of airspace (FUA), terrain or obstacle restrictions, the different types of aircraft, flight rules, local weather conditions, provided they are significant, or airspace classification, among other elements.

2.7.1.2 In scenarios of a lower operational complexity, it is possible to use more direct horizontal flight profiles, for instance, directly from the initial STAR segment to the IAF.

2.7.1.3 It is assumed that, in a scenario of low complexity, operations are already significantly efficient, especially in settings with ATS surveillance. Accordingly, the main challenge for the validation process, in terms of efficiency, is to ensure that fuel consumption and CO_2 emissions are reduced or, in the worst-case scenario, remain the same, generating benefits in other strategic objectives, like safety.

2.7.1.4 In this sense, it should be noted that airspace planners must stay focused on aircraft separation rather than on “path separation”, bearing in mind that a STAR and/or SID in a low-complexity setting must be as direct as possible and must not “prevent” other STARs and SIDs from being also as direct as possible. This assessment is essential during the validation phase.

2.7.1.5 There are scenarios that, due to their low operational complexity, permit the implementation of RNP AR APCH procedures to improve efficiency, taking into account that the natural spacing between successive approaches enables ATC to use the RNP AR APCH procedure, in combination with other procedures for aircraft not approved for RNP AR APCH.

2.7.1.6 For scenarios of higher operational complexity, the PBN/3 workshop deemed it advisable to make a more in-depth use of the airspace planning techniques foreseen in Doc 9992.

2.7.1.7 In these scenarios, the main challenge is to strike a balance between optimum horizontal and vertical profiles, through direct paths and optimum crossing windows, and ATCO workload.

2.7.1.8 As a first approach, taking into account traffic volume, the representatives of the participating States identified the TMAs of Asunción, Guayaquil, Guyana, Montevideo and Santa Cruz as low-complexity scenarios, and the TMAs of Belo Horizonte, Brasilia, Buenos Aires, Panama, Lima, Rio de Janeiro, Santiago and Sao Paulo as higher operational complexity scenarios.

2.7.1.9 The Meeting is expected to review these scenarios initially identified at the PBN/3 workshop and, in light of the operational complexity of each scenario, identify other regional airspace optimisation opportunities that had not been considered in the aforementioned workshop.

2.8 **PBN/4 workshop**

2.8.1 In order to continue with the established strategy, the States must complete the validation phase. It should be noted that the PBN/4 workshop focuses on the following aspects of the implementation stage:

a) Go/no-go decision.

b) Pre-implementation review:
- ATC system update.
- Training programme.
- Approach, arrival and departure charts.
- Area and en-route charts.
- Contingency and back-up procedures.
- Letters of Operational Agreement.
- ATC unit procedures.
- User preparation.

2.8.2 Based on the above, and with a view to ensuring the success of the PBN/4 workshop, the States must complete the following activities:

a) Submit a consistent and feasible Action Plan to the SAM Office for its inclusion in, and harmonisation with, the SAM PBN Implementation Plan.

b) Complete the validation of the PBN design of the TMA (SMS, IFSET, ground validation of procedures).

c) Prepare an ATCO training programme.

d) Complete the aeronautical charts (IAC, SID, STAR, ARC, ERC).

e) Prepare the Letter of Operational Agreement model.

f) Complete the “operational model”.

g) Participate in Project follow-up teleconferences on:
- 20 May
- 18 June
- 17 July
- 03 August
- 19 August (subject to subsequent confirmation)

h) Deadline for delivery of the material developed: **3 August 2015**.

i) Participation in the PBN/4 workshop: 31 August to 4 September 2015 (subject to timely submission of the material requested in the previous paragraph).

2.9 **SAM PBN Implementation Strategy**

2.9.1 Upon conclusion of the PBN/4 workshop, the Second Workshop on the Interface between TMAs/Version 03 of the SAM Route Network has been scheduled, whose main objective is to continue the drafting of Version 03 of the SAM Route Network, based on validated PBN designs of the main SAM TMAs. For this event to occur, the aforementioned material to be analysed at the PBN/4 workshop needs to be sent by the foreseen date (3 August 2015), especially the full validation of TMA PBN design (SMS, IFSET, ground validation of procedures). Otherwise, it would be better to postpone the workshop until the work is completed and delivered to the ICAO Office in Lima.

2.9.2 For those States that are undergoing the full validation process, it might be necessary to conduct bilateral or multilateral meetings to adjust implementation details, mainly aspects related to improved air traffic routing and letters of operational agreement.

2.9.3 At SAM/IG meetings, the PBN Project manages PBN implementation, including all flight phases, with a view to meeting the goals of the Bogota Declaration. At SAM/IG meetings, the Group in charge of analysing PBN operations is responsible for providing the necessary implementation guidance and monitor the status of implementation of the SAM PBN.

2.9.4 The purpose of ATS/RO meetings is to assess the results of the analyses conducted by the consultants and by the Workshops on the Interface between TMAs/Version 03 of the SAM Route Network, and to consolidate Version 03 of the SAM Route Network. Furthermore, the ATS/RO analyses the proposals submitted by users, in order to ensure consistency with the implementation strategy of Version 03.

2.10 **Assessment of the PBN/3 Workshop**

2.10.1 A survey was conducted to measure the degree of satisfaction of participants with respect to the PBN/3 workshop. Survey details are given in **Appendix A**. In summary, the results revealed that 89% of participants rated the workshop as excellent, while 11% rated it as good.

3. **Suggested action:**

3.1 The Meeting is invited to:

3.1.1 Take note of the information presented herein.

3.1.2 Approve the following draft conclusion:

Draft Conclusion SAM/IG/15-xx: PBN implementation in South American TMAs

That, in order to give continuity to the PBN implementation process in the selected TMAs, the States meet the following requirements:

a) Submit to the SAM Office a consistent and feasible Action Plan for inclusion in, and harmonisation with, the SAM PBN Implementation Plan, in accordance with the updated National PBN Plan.
b) Complete the validation of the PBN design of the TMA (SMS, IFSET, ground validation of procedures).
c) Prepare an ATCO training programme.
d) Complete the aeronautical charts (IAC, SID, STAR, ARC, ERC).
e) Prepare a model Letter of Operational Agreement.
f) Complete the "operational model".
g) Participate in Project follow-up teleconferences on the following tentative dates:
   - 20 May
   - 18 June
   - 17 July
   - 03 August
   - 19 August (subject to subsequent confirmation).
h) Deliver the material mentioned in paragraphs a) to f) before 3 August 2015.
i) Participate in the PBN/4 workshop, tentatively scheduled for 31 August to 4 September 2015 (subject to timely submission of the material requested in the previous paragraph).

3.1.3 Review the dates for PBN implementation at the TMAs selected by SAM States (par. 2.6.2.5) and complete the dates for those States that have not confirmed them yet.

3.1.4 Assess the operational complexity of the different scenarios identified at the PBN/3 workshop and propose any changes it may deem appropriate.

3.1.5 Analyse the SAM PBN implementation strategy and, if necessary, propose the modifications it may deem appropriate.

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APPENDIX A

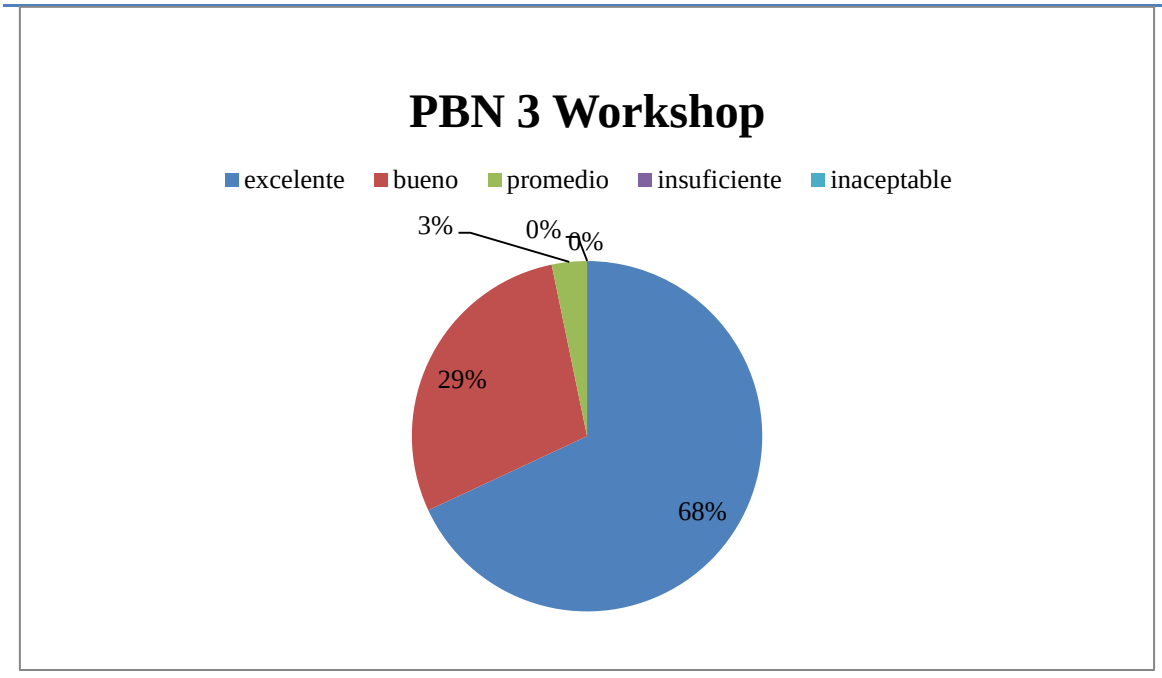
THIRD WORKSHOP ON THE USE OF PBN IN AIRSPACE DESIGN IN THE SAM REGION

SURVEY RESULTS

ASSESSMENT OF COURSE CONTENTS

(**Rating:** **5** = *Excellent* / **4** = *Good* / **3** = *Fair* / **2** = *Inadequate* / **1** = *Unacceptable*)

	Average
a) How relevant were the topics discussed?	4.96
b) How do you rate the training programme of the PBN workshop?	4.63
c) How do you rate the training material?	4.5
d) Is theory reinforced with exercises and practices?	4.58
e) Are topics related to reality and/or applicable to real cases?	4.79
f) How do you rate the level of information?	4.67
g) Has the workshop met your expectations?	4.88
h) Is the information provided sufficient to carry out the PBN implementation plan in your State or company?	4.58
i) Would the material and information provided in the workshop permit the conduction of a course/workshop in your State or company?	4.46
General average	4.67



What would you suggest to improve the workshop?

- Create an Internet forum for queries, suggestions, etc., so as not to wait for teleconferences to make them.
- More information should have been provided to better understand the validation stage.
- The summary of each presentation can be made and included in the final report, with corresponding notes to improve where necessary.
- Have an updated database among States so they can identify areas of improvement between adjacent TMAs or city pairs.
- Stay focused on the development of topics.
- Monitor and give continuity to activities.
- Continued participation of airlines/IATA. Feedback by users is very important.
- The schedule was a little too long.
- Allow Julio to continue participating at the next workshop.
- More participation by the representatives of the operators.
- Urge States to send the documentation duly in advance to the meeting.
- All presentations should be posted on the ICAO website in order to be able to follow the conference.
- All the material was excellent and posted on the website on a timely basis.

Comments

- The workshop was well organized and set out. I learnt a lot of new concepts.
- The true value of the workshop lies not only on the theoretical knowledge shared but also on the transfer of experiences and lessons learned by States in the different PBN implementation phases.
- Congratulations to the participating States, ICAO officers, experts and Office staff.
- Thanks to the States for sharing their experiences.
- Excellent opportunity for sharing our reality with the States of the Region, and make it possible to introduce the necessary improvements, developing and sharing material to further PBN implementation at regional level.
- Excellent assistance provided by ATM officers.
- Continue with this type of events, since they help experts to share experiences that benefit States that are just starting to develop new procedures.
- Very timely workshop that enabled the exchange among States and training for PBN implementation in the CAR/SAM Regions.

13 March 2015

-END-