Agenda Item 2: Optimisation of the SAM airspace

Follow-up to the PBN implementation related to the goals of the Bogota Declaration

(Presented by the Secretariat)

SUMMARY

This working paper presents a report on the evolution of implementation activities related to the goals of the Bogota Declaration for the SAM Region, to the effect that States can identify the activities on which efforts have to be focused to meet the established goals.

References:	
RAAC/13 (Bogota, Colombia, 4 to 6 December 2013) - Bogota Declaration Second Meeting of Air Navigation and Flight Safety Directors of the SAM Region	
ICAO Strategic Objectives:	*A - Safety* *E - Environmental protection*

1. **Introduction**

1.1 During the Second Meeting of Air Navigation and Flight Safety Directors of the SAM Region (Lima, Peru, 14 to 16 October 2015), the status of PBN implementation in the optimisation of routes, terminal areas (SIDs, STARs, CCO and CDO), PBN approach procedures, as well as the reduction on CO_2 emissions, among other issues, were discussed as part of the goals approved by RAAC/13 Meeting (Bogota, Colombia, 4 to 6 December 2013) through the Bogota Declaration (Conclusion RAAC/13-8 - *Implementation of air navigation and safety oversight priorities*.

1.2 In addition to the specific issues, the status of activities associated with these implementations was also analysed.

2. **Discussion**

National PBN Plans and Action Plans update

2.

2.1 Within the activities associated with the implementation goals, are the National PBN Implementation Plans, in reference with SAM/IG/14-5 Conclusion, by which SAM States should present their updated National PBN Plans in the SAM/IG meetings. The updated status of National PBN Plans submission is shown under **Table 01**. Although a National Plan model was submitted to States, since GREPECAS/17 meeting (July 2014), the regional progress in updating PBN National Plans has been 35%. The goal to achieve before end of 2015 is 50% and in 2016, 100%. These Plans are requested by Headquarters in order to update those submitted in 2007.

	ARG	BOL	BRA	CHI	COL	FGY	ECU	GUY	PAN	PAR	PER	SUR	URU	VEN
2015 42%	YES	NO	YES	YES	NO	NO	YES	NO	NO	YES	YES	NO	NO	NO

Table 01 - States that have presented their updated National PBN Plans to date

2.2 Likewise, as a complement to PBN Plans, SAM Region States should present their Action Plan for PBN-based redesign of their selected airspaces using the Action Plan model approved for that purpose. The status of updated Action Plans is shown under **Table 02**.

	ARG	BOL	BRA	CHI	COL	FGY	ECU	GUY	PAN	PAR	PER	SUR	URU	VEN
2015 78%	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	NO	YES	YES

Table 02 - States that have presented their updated Action Plans for PBN-based redesign in selected airspaces to date

2.3 Since GREPECAS/17, the progress on Action Plans development for selected airspaces redesign applying PBN has been of 78%. Goal of 50% by 2015 has been exceeded. By 2016, the goal is 100% in PBN Action Plans development.

PBN en-route

2.4 PBN en-route implementation is discussed in the ATS/RO meetings, grounded on the route network versions concept. The usage of the route network versions reflects the need of a periodical review, in a comprehensive manner, in order to guarantee the best possible airspace structure within a comprehensive development concept.

2.5 In this regard, the implementation of Route Network Version 03 depends on a consistent and harmonized implementation in the SAM TMAs and any delay on projects of one or more States affects the rest of the States and the Regional Project as a whole.

2.6 Considering that the complete redesign process of the main SAM TMAs has not yet achieved the required maturity level for a comprehensive implementation, SAM Region States have decided to split the implementation of SAM Routes Network Version 03 in two stages. Stage 1 includes realignment and removal of routes proposals, as well as new RNAV routes implementation based on the current main South American TMAs design. Stage 2 of Routes Network Version 03 includes routes depending on PBN redesigns of main TMAs, which establish the new entry and exit points. This implementation process is being performed in the SAM PBN workshops.

2.7 Since GREPECAS/17 to date, the progress on RNAV routes implementation in the upper airspace has been 20%, reaching 60% and achieving the goal of 60% established in the Bogota Declaration. For a clearer display, **Table 03** below shows the number of upper airspace conventional and PBN regional routes, as well as the percentage of PBN routes achieved.

Upper airspace total ATS routes	Conventional routes	PBN routes	% of PBN routes implemented	Bogota Declaration indicator: % PBN Routes
165	66	99	**60%**	**60%**

Table 03 - Upper airspace ATS routes (conventional and PBN)

PBN in TMA

2.8 The processes of complete redesign with PBN application in the main South American TMAs are being performed through PBN workshops, under the support of Regional Project RLA/06/901. Since GREPECAS/17 meeting, four PBN workshops were already carried out, focusing on planning, design, validation and implementation phases, respectively.

2.9 Considering the PBN optimisation impact in the east-west flows among Argentina, Brazil and Uruguay, a series of teleconferences have been started with the Regional Office support and coordination meeting have been carried out to establish requirements and procedures that will be applied taking into account the new design. These activities have required longer time in coordination for PBN implementation in said airspaces.

2.10 In the PBN workshops, it has been recognized that one or more leader operators' participation in diverse PBN implementation phases helps collaborative decision-making processes and improves planning, design and validation phases' results. This has been demonstrated, in a practical way, in the projects presented by Chile, Panama and Peru.

2.11 Another positive aspect that supported the development of this implementation was the personnel training investment, mainly in the PANS-OPS area, example PANS-OPS Basic course and PBN held in Ecuador, and PANS-OPS PBN and NRP AR courses held in Argentina, as well as Peru strategy in sending their experts to the ENAC, France courses.

2.12 Guyana sent an expert to Airspace Planning training at Singapore Academy. Likewise, Argentina and Peru acquired logic support for procedures design..

2.13 PBN implementation in terminal areas continues well under way in Brazil, Chile, Panama and Peru and out of 34 selected TMAs, there are already 6 terminal areas with PBN application implemented. In order to progress in this application, major commitment and support from air navigation authorities is needed to complete on time the tasks required for the implementation.

2.14 Complementary and more detailed information can be found in working paper referring to the results of PBN/4 Workshop (SAM/IG/16-WP/04).

SID, STAR and PBN Approach Procedures implementation

2.15 Bogota Declaration urges States to implement PBN, SID and STAR in international airports, in order to achieve established goals, based on CDO and CCO techniques. Additionally, said Declaration encourages States to implement APV approach procedures, to attend ICAO 37th Assembly Resolution A37-11. The data that support the presented information on SID, STAR and PBN IAC implementation status to date in shown in **Table 04**. Following aspects need to be highlighted:

a) Data highlighted in yellow shows States' participation to achieve each one of the Bogota Declaration goals. Red information shows SAM Region status, which is the main indicator to be considered, taking into account that the goal to be achieved is regional.

b) IAP APV or RNP AR or LNAV columns consider that the apron counts with an APV procedure, with an IAC APV based in RNP APCH with VNAV or by IAC RNP AR APCH. It is also considered that the apron attends to Bogota Declaration requirements and has a LNAV procedure, in accordance with the ICAO 37th Assembly Resolution A37-11. Nevertheless, it is expected that States implement APV procedures.

c) Information was submitted by SAM States and their AIPs. For Colombia, Guyana, French Guiana and Suriname data was collected only from respective AIPs, taking into account that no direct information from these States has been received to date.

d) SID and STAR RNAV for which no navigation specification was indicated were considered as SID and STAR PBN.

e) Only airports were considered with CDO and CCO implemented, those that followed a complete validation process, considering, among other aspects, controllers training, LoAs required changes and operational procedures that avoid aircrafts to unnecessary level during climbing or descent, etc.

Note: SAM States should notify on airports that have followed the implementation process with recommended CDO and CCO.

f) Airports that have at least one apron with IFR operation, in accordance with FASID AOP-1 Table were considered.

g) Only aprons operating IFR, in accordance with FASID AOP-1 Table were considered.

ESTADO/ STATE	IAC							SID		STAR		SID O STAR PBN AIRPORT	CCO	CDO
	APV/LNAV													
	IAP APV	IAP RNPAR	IAP APV o RNP AR	IAP APV o RNP AR AIPORT	IAP RNPAR "ONLY" AIRPORT	IAP LNAV	IAP APV o RNP AR o LNAV	SID PBN AIRPORT	SID PBN	STAR PBN AIRPORT	STAR PBN			
Argentina	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	31,25%	20,83%	31,25%	0,00%	0,00%
Bolivia	20,00%	0,00%	20,00%	33,33%	0,00%	40,00%	40,00%	33,33%	20,00%	0,00%	0,00%	33,33%	0,00%	0,00%
Brasil / Brazil	82,76%	5,17%	82,76%	85,19%	11,11%	89,66%	89,66%	85,19%	86,21%	33,33%	39,66%	85,19%	10,42%	10,42%
Chile	60,00%	30,00%	75,00%	75,00%	50,00%	85,00%	85,00%	75,00%	61,11%	87,50%	80,00%	87,50%	5,88%	5,88%
Colombia	0,00%	8,33%	8,33%	9,09%	9,09%	75,00%	75,00%	81,82%	83,33%	66,67%	66,67%	83,33%	0,00%	0,00%
Ecuador	0,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%	0,00%	0,00%
Guyana Francesa Fr. Guiana	0,00%	0,00%	0,00%	0,00%	0,00%	100,00%	100,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Guyana	0,00%	0,00%	0,00%	0,00%	0,00%	75,00%	75,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Panamá	28,57%	57,14%	57,14%	50,00%	40,00%	57,14%	71,43%	20,00%	28,57%	20,00%	28,57%	20,00%	0,00%	0,00%
Paraguay	100,00%	0,00%	100,00%	100,00%	0,00%	100,00%	100,00%	50,00%	50,00%	0,00%	0,00%	50,00%	0,00%	0,00%
Peru	0,00%	33,33%	33,33%	37,50%	37,50%	11,11%	44,44%	12,50%	22,22%	87,50%	77,78%	87,50%	12,50%	12,50%
Suriname	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Uruguay	0,00%	0,00%	0,00%	0,00%	0,00%	62,50%	62,50%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Venezuela	100,00%	0,00%	100,00%	100,00%	0,00%	100,00%	100,00%	100,00%	100,00%	0,00%	0,00%	100,00%	0,00%	0,00%
Región SAM/SAM Region	43,53%	11,18%	50,00%	47,92%	14,43%	63,53%	65,88%	51,55%	51,79%	38,78%	37,06%	64.29%	4,52%	4,52%

Table 04 – Status of implementation of SID, STAR and IAC PBN 16/09/15

2.16 SIDs/STARs implementation progress since GREPECAS/17 to date is 11% in accordance with SIDs and 5% in accordance with STARs. The total current PBN SIDs/STARs is 64.29% and the Bogota Declaration goal of 60% has been exceeded.

2.17 Regarding CDO and CCO operations techniques application progress, since GREPECAS/17 to date same is 4.52%, representing only 10% of the Bogota Declaration, which goal is 40%.

Reduction in CO_2 emissions resulting from PBN implementation in TMA

2.18 As a result of teleconferences held for the implementation of Stage 1 of Version 03, route optimisation network was developed through Amendment SAM 15/01-ATM. In such sense, 13 RNAV routes were added, 7 RNAV routes and 3 conventional routes were aligned as well as 6 conventional and one RNAV routes were removed. During 2014 the goal of 40.000 Tons. established by the Bogota Declaration was exceeded by more than 11.000 Tons. CO_2 reduction. 51.132 Tons. CO_2 reduction was achieved in the South American Region. During 2015 up-to-date, annual savings calculated using the IFSET tool were 2.133 Tons fuel, equivalent to a reduction of only 6.738 Tons. CO_2.

2.19 With reference to the above, the annual goal of 40.000 Tons. CO_2 reduction has been negatively impacted by the delay of several States in the PBN redesign of their terminal areas (TMA), not allowing them to provide timely new entry and exit points to connect the optimised routes that generate such savings. Moreover, some States have not attended the routes optimisation meetings and PBN design workshops where such issues are treated.

2.20 During this meeting, it is expected to receive the latest information on fuel savings resulting from each airspace optimisation and that States report their CO_2 reduction contributions in order to collaborate with the environmental goals established by the Bogota Declaration.

3. Conclusion

3.

3.1 With the support of RLA/06/901 Regional Project, direct assistance has been followed-up to SAM Region States for PBN implementation in the selected airspaces. The history of PBN training in the SAM Region, as well as the number of experts trained in different seminars, courses and workshops can be seen in **Appendix A** to this working paper.

3.2 PBN projects progress in the SAM Region since GREPECAS/17 meeting to date regarding the goals established by the Bogota Declaration, is as follows:

a) CO_2 annual reduction: 51.132 Tons. in 2014 + 6.738 Tons. in the first semester 2015. These figures show that the reduction planned for 2015 has not been reached.

b) RNAV routes implementation: 22%, reaching 60%, **complying with the goal of 60%** foreseen by the Bogota Declaration for 2016.

c) SIDs/STARs PBN implementation is 64.29% and **goal of 60% established by the Bogota Declaration has been exceeded**.

d) CDO and CCO operational techniques application progress is 4.52%, which represents 10% of the goal established by the Bogota Declaration, which intends to reach 40% in the application of such techniques.

3.3 Based on the above it is evidenced that in order to achieve the PBN goals established in the Bogota Declaration, a major commitment regarding processes of TMA design optimisation with PBN application, optimisation of routes, as well as application of validation processes for CDO and CCO techniques applied to STAR and SIDS respectively, is required.

4. **Suggested action**:

4.

4.1 The Meeting is invited to:

a) take note of the information contained in this working paper;

b) review the status of development of PBN en-route, terminal areas and approach implementation with regard to the goals established in the Bogota Declaration and formulate other actions it may deem appropriate;

c) encourage those States that have not yet done so, to present to this Meeting their updated PBN national plans;

d) submit the CO_2 reduction calculations as a result of airspace optimization in their respective States; and

e) strengthen the commitment and give major support to achieve the goals of the Bogota Declaration, as approved by RAAC/13.

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APPENDIX A

PBN TRAINING IN THE SAM REGION

1. **PBN training events in the SAM Region 2009-2015**

1.1 Since 2009 to date, 15 PBN training events funded by Technical Cooperation Projects, Special Implementation Projects, with funds from the regular programme or direct State funding have been carried out.

1.2 During the events detailed below, 325 experts of the Region have been trained in PBN:

- **Course on RNAV/RNP instrument procedures design**

Under the support of RLA/06/901 Regional Project, a Special Implementation Project (SIP) and the collaboration of Brazil and Chile, a course on RNAV/RNP instrument procedures design was held from 1 to 11 September 2009 in Lima, Peru. As a result, 12 experts from 9 States of the Region have been trained in the design of such procedures.

- **Course on RNP AR approach procedures**

Under the support of RLA/06/901 Regional Project, a Special Implementation Project (SIP) and the collaboration of Brazil and Chile, a course on RNP AR approach design procedures (RNP AR APCH) was held from 5 to 16 October 2009 in Lima, Peru. As a result, 12 experts from 9 States of the Region have been trained in the design of such procedures.

- **Course on RNAV approvals Curso de aprobaciones RNAV**

This course on aircraft and operators approval for RNAV operations intended for airworthiness and operations safety inspectors was carried out in Lima, Peru, from 22 to 26 March 2010, under the auspices of RLA/06/901 Regional Project and the support of RLA/99/901 Regional Project, SRVSOP. 37 experts from 11 States of the SAM Region (Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Panama, Paraguay, Peru, Uruguay and Venezuela), 1 State of the CAR Region (Costa Rica) and 1 airline were trained.

- **Course on design of approach procedures with vertical guidance (APV) using RNAV and VNAV-APV Baro/VNAV avionics systens**

This course was held in Lima, Peru, from 6 to 16 April 2010, under the support of RLA/06/901 Regional Project and the collaboration of Brazil and Chile. As a result, 12 experts from 9 States of the SAM Region and 1 expert of the CAR Region were trained in the design of APV Baro/VNAV approach procedures.

- **PBN course**

In this course, held in Santiago de Chile from 12 to 15 July 2010, 28 experts from 7 States of the SAM Region and 4 experts from the airlines were trained. It was conducted by 4 speakers from EUROCONTROL and 2 speakers from the FAA.

- **Course on safety assessment required for RNAV 5 implementation and the implementation of Version 01 of the ATS route network, applying a quantitative methodology using SMS**

This course was held from 2 to 6 August 2010 in Lima, Peru. 18 experts from 10 States of the Region and 2 experts from airlines were trained. This activity was complemented with the hiring of one expert who supported the Secretariat during the course.

- **Course on RNP approvals**

This course for airworthiness and operations safety inspectors was sponsored by RLA/06/901 Regional Project, with the support of RLA/99/901 Regional Project. It was carried out in Lima, Peru, from 17 to 21 May 2010. The objective of the course was to train experts in the approval of aircraft and operators for RNP operations. 36 experts from 10 SAM States, 1 CAR State and 1 airline participated. 14 fellowships were granted.

- **Seminar/Workshop on airspace planning**

This Seminar was held from 11 to 22 March 2013 in Miami, Florida. 11 participants from 5 States were trained in the design of airspace based on PBN.

- **Train-the-trainer course**

This course aimed to train trainers for States in operational approval. It was carried out in Miami, Florida, from 11 to 15 March 2013. 4 inspectors from 3 States of the SAM Region were trained for the training in PBN operational approval.

- **First Workshop on the design of PBN airspace (planning and design)**

This workshop was held from 12 to 23 May 2014 in Bogota, Colombia. 42 participants from 10 States of the SAM Region were trained in the design of PBN airspace.

- **PBN Seminar**

This Seminar was held in the ICAO Regional Office in Lima, Peru, from 27 to 29 August 2014, sponsored by Airbus ProSky. 35 experts from 5 States and 22 specialists from airlines were trained.

- **Second Workshop on the design of PBN airspace (panning and design)**

This Workshop was held from 8 to 12 September 2014, in Lima, Peru. 34 experts from 11 States of the SAM Region were trained. 14 fellowships were assigned.

- **Course on the design of approach procedures based on PBN**

This course, funded by the Special Implementation Project (SIP) for CAR/SAM Regions, was held in Mexico City, Mexico, from 17 to 28 November 2014. 3 States of the SAM Region attended the course and 4 experts were trained.

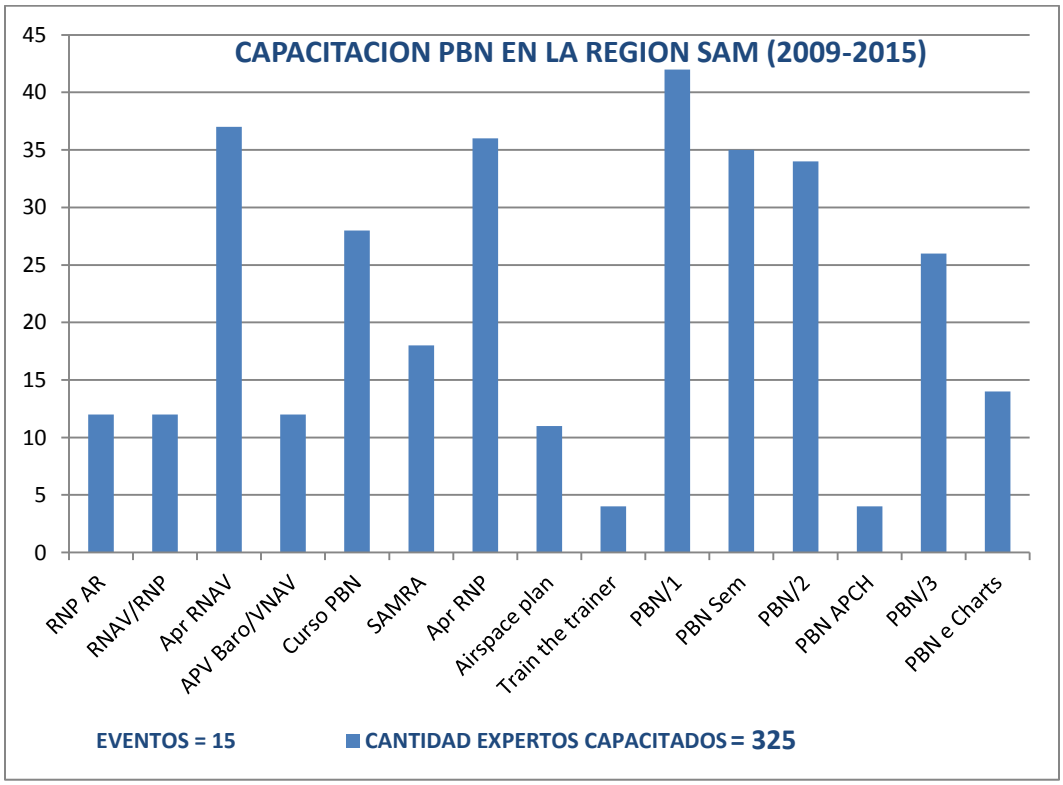
- **Third Workshop on the design of PBN airspace (Validation)**

This Workshop focused on the validation tasks of airspace designs based on PBN. 10 States of the SAM Region participated and 26 experts as well as 9 specialists of airlines were trained.

- **CAR/SAM Electronic Aeronautical Charts of Performance Based Navigation (PBN), Terminal Procedures and Aerodrome Mapping Seminar**

This Seminar was held in Mexico City, Mexico, from 24 to 27 August 2015. 10 States of the SAM Region participated and 14 experts were trained.

1.3 Following chart visually shows the information detailed above:



1.4 In addition to these events, Ecuador and Argentina conducted training courses on PANS OPS design procedures, basic and advanced, with the support of the Regional Office, Brazil and Peru, which provided the instructors, achieving to strengthen a very sensitive area in the design of procedures with PBN.