International Civil Aviation Organization
CAR/SAM Planning and Implementation Regional Group (GREPECAS)
Fourth Meeting of the Programmes and Projects Review Committee (PPRC/4)
Lima, Peru, 12 - 14 July 2016

Agenda Item 3: Review of GREPECAS Programmes and Projects
3.1 Projects under the PBN Programme (B0-APTA, B0-FRTO, B0-CDO and B0-CCO)

FOLLOW-UP TO THE ACTIVITIES UNDER PROJECT A1 (PBN IMPLEMENTATION) AND PROJECT A2 (AIR NAVIGATION SYSTEM IN SUPPORT OF PBN)

(Presented by the Secretariat)

SUMMARY

This working paper presents a report on the evolution of implementation activities related to "PBN implementation" and "Air navigation system in support of PBN" projects under the PBN Programme, approved by the GREPECAS/17 for the CAR and SAM Regions.

References:

- Report of the Seventeenth Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/17) Meeting Report
- Report of the Third Meeting of the Programmes and Projects Review Committee (PPRC/3) Mexico City, Mexico, from 21 to 23 July 2015
- Report of the Third NAM/CAR Air Navigation Implementation Working Group Meeting (ANI/WG/3) Mexico City, Mexico, from 4 to 6 April 2016
- Seventeenth Meeting/Workshop of the SAM Implementation Group (SAM/IG/17) Lima, Peru, 9 – 13 May 2016
- Report of the ICAO/IATA/CANSO Performance-Based Navigation (PBN) Harmonization, Modernization and Implementation Meeting for the Caribbean (CAR) Region, Fort Lauderdale, United States, from 28 March to 1 April 2016

Strategic Objective(s)	*This working paper is related to Strategic Objective(s)* • *Air Navigation Capacity and Efficiency* • *Environmental Protection*

1. Introduction

1.1 Pursuant to GREPECAS Decisions 16/45 and 16/47, the Programme entitled *"Performance-Based Navigation (PBN)"* was structured with the following associated projects:

a) Operational implementation of PBN; and
b) Air navigation systems in support of PBN

2. Discussion

2.1 The progress status of implementation of the project activities that compose Programme A: *Performance-based navigation (PBN)* are as follows:

2.2 CAR Region

Project A1 "PBN Implementation"

2.2.1 Within the ANI/WG activities with the PBN TF support and under the NACC "*No Country Left Behind"* (NCLB)strategy the ICAO NACC Regional Office is carrying out PBN Technical Assistance Missions (TEAMs) with the assistance of two Subject Matter Experts (SMEs) to CAR States, as required, in order to achieve agreed global and regional targets. Under this strategy individual PBN implementation projects are coordinated with the CAR States in accordance with their own implementation needs.

2.2.2 75% of CAR States have completed the regional target of approach procedures implementation as established in the *Port-of- Spain Declaration.* States that are behind the global target, in accordance with Assembly Resolution A37-11, have developed action plans on PBN approach procedures to be published during 2016.

2.2.3 The ICAO/IATA/CANSO Performance-Based Navigation (PBN) Harmonization, Modernization and Implementation Meeting for the Caribbean (CAR) Region served as a catalyst to show the progress in the understanding and commitment if using PBN and other possible technologies, so that States may harmonize and modernize their air navigation systems. Based on these results, the Third NAM/CAR Air Navigation Implementation Working Group Meeting (ANI/WG/3) agreed that, to date several PBN implementation tasks have been completed and others will be carried out in the next months as a comprehensive enhancement to Airspace Organization and Management (AOM) in the CAR Region, as follows:

- 100% of CAR States have presented their PBN implementation action plans, timely coordinated with the ICAO Headquarters, Montreal, for the dashboards
- 70.6% of States use the Collaborative Decision-Making (CDM) process in PBN planning
- 64.7% of States have properly trained personnel; however, only 58.8% of States have published PBN training programmes for pilots/Air Traffic Controllers (ATCOs), etc.

- All participating States agreed, to the extent applicable, to reduce longitudinal separation from 80 NM to 40 NM between transferred air traffic operating in the Flight Information Regions (FIRs) of the CAR Region. Some States agreed to apply 20 NM between transferred air traffic operating in the FIRs of the CAR Region. The Air Traffic Service (ATS) Letter of Agreements (LoAs) update will also be timely coordinated with this approach between CAR and SAM adjacent States, as deemed necessary
- Six (6) LoAs have been signed to date with updates for the coordination and operational procedures between the Air Traffic Control (ATC) facilities in the CAR Region
- States and Air Navigation Service Providers (ANSPs) for the CAR and SAM Regions agreed to further review ATS LoAs not later than 30 November 2016, to apply longitudinal separation minima of 40 NM or 20 NM between transferred air traffic operating in the FIRs of the CAR Region and adjacent FIRs of the SAM Region
- Eight (8) routes have been agreed by the CAR States and ANSPs in their respective FIRs with jurisdiction and will be submitted to the ICAO NACC Regional Office for Proposal for Amendment (PfA) development to ICAO Doc 8733 - *Caribbean and South American Regions.* ATS routes that involve the SAM Region will be timely coordinated with the ICAO SAM Regional Office
- United States will timely submit proposed Area navigation (RNAV) routes from the METROPLEX and "Y" projects to harmonize the regional ATS route network
- The new PBN route network includes implementation of Required Navigation Performance (RNP) 10, RNP 4 and RNP 2 in the Oceanic airspace of the CAR Region FIRs
- It is expected that the new PBN route network will improve regional capacity and efficiency taking into consideration air operations growth of 6% per year over the 2014-2017 period
- The CAR States will review availability of restricted areas to air operations for prompt implementation of the Flexible Use of Airspace (FUA)
- Guyana, Suriname and Trinidad and Tobago agreed to host trials for the available RANDOM routes and applicable procedures that should be published previously in the Aeronautical information Publication (AIP) for airspace users. Airlines that confirmed participation in RANDOM route trails in continental airspace are American Airlines, Azul, Caribbean Airlines and Delta Airlines
- Special consideration will be given by States to increase implementation of Continuous Climb Operations (CCOs) and Continuous Descent Operations (CDOs) criteria in all Standard Instrument Departures (SIDs) and Standard Instrument Arrivals (STARs) linked to the upper airspace, to the greatest extent possible, in order to obtain the greatest operational benefits
- The Regional PBN Implementation Project will be coordinated with Points-of-Contact (PoCs) of Central American, Eastern Caribbean and Central Caribbean States to ensure completion and monitoring of all implementation activities

- The next PBN Task Force (PBN/TF) meeting for the implementation of CAR seamless airspace will be held from 6 to 9 December 2016, hosted by the Civil Air Navigation Services Organization (CANSO), to ensure harmonized implementation based on traffic flows and homogenous areas

2.2.4 Trinidad and Tobago, in coordination with Anguilla, Antigua and Barbuda, Barbados, Dominica, France, Grenada, Montserrat, Saint Kitts and Nevis Saint Lucia and Saint Vincent and the Granadines has developed a comprehensive airspace redesign project for the Piarco FIR with December 2017 as deadline. Additionally, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and COCESNA have developed a comprehensive Central American airspace redesign Project (ARESAC) with July 2017 as deadline. In both projects, involved States will timely publish their instrument procedures and Terminal Areas (TMAs) redesign, as necessary.

2.2.5 Other States, if required, will develop a Airspace Redesign implementation project to improve AOM in accordance with the ICAO Doc 9613 — *Performance-based Navigation (PBN) Manual* and Doc 9992 - *Manual on the Use of Performance-based Navigation (PBN) in Airspace Design*.

2.2.6 Similarly, during the ANI/WG/3 meeting, were agreed Regional Supplementary Procedures (SUPPs) and LoAs for PBN procedures implementation update for more dynamic Air Traffic Management (ATM) among adjacent FIRs.

2.2.7 To this end, the ANI/WG/3 meeting agreed that, CAR States and Territories submit to the ICAO NACC Regional Office their RNAV route network change proposal by 30 December 2016; and the ICAO NACC Regional Office coordinate as appropriate in order to develop by 30 December 2016 a Proposal for Amendment (PfA) to ICAO Doc 8733 - *Air Navigation Plan — Caribbean and South American Regions*, with implementation deadline by 30 June 2017, which includes AIP publication based on three AIRAC cycles.

2.2.8 Follow up actions for the next months are:

- States will coordinate the assessment of the reduced track miles and CO_2 emission mitigation with the International Air Transport Association (IATA) and the ICAO NACC Regional Office, as needed. In this regard, IATA will provide States the correct reporting form
- ICAO, in coordination with CANSO and IATA, will follow-up on deficient use of PBN routes, procedures and PBN route constraints
- Development of a practical guidance for the implementation of Ground-Based Augmentation Systems (GBAS) for the ANI/WG

2.2.9 CAR States and Territories have recognized that PBN implementation has improved operations safety and efficiency and reduced the environmental impact of CO_2 emissions. For some States, reduction of lateral/longitudinal separation standards has positively impacted the efficiency of their operations.

2.2.10 **Appendix A** shows the progress and results of PBN implementation in the CAR Region, that have been timely coordinated with the ICAO Headquarters, for the dashboards. More information is available at: http://www.icao.int/safety/pbn/Pages/default.aspx.

2.3 **SAM Region**

Project A1 "PBN Implementation"

2.3.1 The South American Implementation Group (SAM/IG) Meetings integrated the tasks related with the en-route, TMA and approach phases, to facilitate the achievement of PBN goals in accordance with the *Bogota Declaration*.

2.3.2 Actions were focused, mainly on deliverables projected to results on the en-route, TMA and approach phases. Main activities of the PBN SAM project are attached as **Appendix B1** to this working paper.

National PBN plans update

2.3.3 During PPRC/3 meeting, it was informed that the update of PBN National Plans, based on Conclusion SAM/IG/14-5, has been 21%. Results achieved to the date of this Meeting indicate that a 77% of States have submitted their PBN National Plans. This progress of 56% is reflected in following table:

2016 77%	**ARG**	**BOL**	**BRA**	**CHI**	**COL**	**FGI**	**ECU**	**GUY**	**PAN**	**PAR**	**PER**	**SUR**	**URU**	**VEN**
	YES	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	NO	YES	YES

PBN en-route

2.3.4 PBN en-route implementation is discussed in the ATSRO meetings, grounded on the network versions concept. The usage of the 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.

2.3.5 Although the complete redesign process of the main SAM TMAs has not achieved yet the required maturity level for a comprehensive implementation, the ATSRO/7 meeting validated SAM routes Version 03, which integration process is expected to be reached by 2017, once designs based on PBN of Terminal Areas have been finalized.

2.3.6 In spite of the above and as an outcome of the teleconferences on routes implementation through Amendment SAM 16/01-ATM, 8 RNAV routes were added, 9 RNAV routes and 1 conventional route were realigned and 16 conventional routes and 1 RNAV were eliminated.

2.3.7 A reduction of 23,351 tonnes of CO_2 was obtained in 2015. It is expected that during 2016 more annual CO_2 savings will be achieved, and even to surpass the savings obtained during 2015, if the implementation of plans foreseen for this year are met. In such sense, several States have done a good job at calculating savings resulting from the optimisation of selected airspaces. Most States have used the

ICAO IFSET tool. Other States have calculated such savings in collaboration with operators, using more sophisticated tools.

2.3.8 Since PPRC/3 up-to-date, the progress on routes network optimization in the SAM Region has been 7% in RNAV implementation, reaching 65% of the total of routes in the upper airspace. The goal established in the *Bogota Declaration* of 60%, has been surpassed in 5%, as shown in following table:

Total ATS routes upper airspace	Conventional routes	PBN routes	% PBN routes implemented	Bogota Declaration indicator: % PBN routes
145	52	93	**65%**	60%

PBN in Terminal Area (TMA)

2.3.9 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 PPRC/3 meeting, PBN/4 workshop, as well as an implementation workshop for more advanced terminals projects, were carried out.

2.3.10 PBN optimization in the east-west flows among Argentina, Brazil and Uruguay has been started, but no needed progress has been achieved yet. Nevertheless, this optimization is expected to be completed by the second half of this year, at least with respect to the main traffic flows and the airlift Montevideo-Buenos Aires. These activities have required longer time in coordination for PBN implementation in these airspaces.

2.3.11 In the PBN workshops it has been recognized that one or more leader operators' participation in diverse PBN implementation phases helps decision-making processes in collaboration and to improve planning, design and validation phases' results. Nevertheless, there have been unexpected delays in the projects of Colombia, Panama and Paraguay. In all three States this implementation has coincided with updates and implementation of new air traffic control systems, whereby it is expected these delays will be overcome soon.

2.3.12 Another positive aspect to be highlighted is that the personnel training investment, mainly in the PANS-OPS area, is still being performed at good pace, although there are some States that still lack from experts trained in PANS-OPS. In such sense, an *ad-hoc* Group has been formed in the SAM/IG meetings, within the PBN Group, to help to solve the problem related to this issue.

2.3.13 The PANS-OPS *ad-hoc* Group aims to assist States through the PBN Group in the SAM/IG meetings, harmonize publications in the Region, study solutions to problems faced by operators in different scenarios were these procedures are applied, as well as analyze and comment amendments to PANS-OPS documents issued by the Panel and Headquarters.

2.3.14 Flight Operations Quality Assurance (FOQA) data is still being used for design, and mainly for post-implementation PBN airspace concept assessment, because it offers real data on achieved benefits in those States having leader airlines. The other States are using statistics and radar data.

2.3.15 SAM Region States are working in the implementation of dates update for Action Plans. The States that have submitted their Action Plans updated for PBN-based redesign in their selected airspace are shown in the below table:

	ARG	BOL	BRA	CHI	COL	FGI	ECU	GUY	PAN	PAR	PER	SUR	URU	VEN
2016 78%	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	NO	YES	YES

States that have presented their Action plans updated for PBN-based redesign in selected airspaces

2.3.16 Since PPRC/3 the progress on Action Plans development for selected airspaces redesign applying PBN has been of 38%, achieving a total of 78% of States with PBN Action Plan by the date of this Meeting. The goal of 100% is expected to be completed before December 2016.

SID, STAR and PBN Approach Procedures Implementation

2.3.17 *Bogota Declaration* urges States to implement PBN SID and STAR in international airports, in scope to achieve established goals, based on CDO and CCO techniques. Additionally, the mentioned Declaration encourages States to implement APV approach procedures, in scope to attend ICAO Assembly Resolution A37-11. The data that support the presented information up-to-date on SID, STAR and PBN IAC implementation status is shown in following table:

ESTADO/ STATE	IAC							SID		STAR		SID o STAR PBN Airport %	CCO %	CDO %
	LNAV/ VNAV %	RNP AR %	LNAV/ VNAV o RNP AR %	LNAV/ VNAV o RNP AR Airport %	RNPAR "ONLY" Airport %	LNAV %	LNAV/ VNAV o RNP AR o LNAV %	SID PBN Airport %	SID PBN Airport %	STAR PBN Airport %	STAR PBN %			
Argentina	36.00	0.00	16.00	37.50	0.00	36.00	16.00	17.65	28.00	47.06	48.00	56.25	16.67	20.83
Bolivia	33.33	0.00	33.33	33.33	0.00	33.33	33.33	33.33	50.00	0.00	0.00	0.00	0.00	0.00
Brasil /Brazil	82.26	4.84	82.26	85.71	10.71	88.71	88.52	92.86	91.94	42.86	46.77	92.86	35.42	35.42
Chile	60.00	30.00	75.00	62.50	50.00	85.00	85.00	75.00	66.67	87.50	80.00	87.50	35.29	41.18
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	25.00	50.00	50.00	50.00	37.50	25.00	50.00	37.50	50.00	25.00	50.00	0.00	0.00	25.00
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	0.00	0.00	0.00
Peru	11.11	77.78	77.78	87.50	75.00	22.22	44.44	12.50	55.56	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	25.00	0.00	25.00	50.00	0.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venezuela	100.00	0.00	100.0	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	53.41	13.07	53.14	60.82	18.37	71.02	69.14	57.58	62.07	45.00	43.18	69.70	18.06	19.35

2.3.18 In the PPRC/3 meeting, SIDs/STARs implementation in the Region was 64.29%. Up-to-date it can be observed that the PBN SIDs/STARs implementation is of 70.7%, thus exceeding the *Bogota Declaration* goal of 60%, as shown in following table:

Total Airports	Total SID/STAR	Total SID/STAR PBN	ICAO Indicator: % SID/STAR PBN in international airports	ICAO Indicator: % SID/STAR PBN in international airports
			April 2016	GOAL 2016
99	1680	1159	70,7 %	60%

2.3.19 Associated with the designs of arrival and departure procedures, there is the application of CDO and CCO techniques, which have reached following percentages of implementation: CDO 18% and CCO 19%, representing a progress of 13,5% since the PPRC/3 meeting.

Reduction of longitudinal separation to 40 NM for aircraft with GNSS capacity

2.3.20 An important aspect which has been included in the PBN project due to its close relation with the airspace optimization, was the reduction of the en-route longitudinal separation from 80 NM to 40 NM to be applied in aircraft with GNSS capacity. In case one of the aircraft or the two aircraft involved in the longitudinal separation lacked GNSS capabilities, then the reduction would not apply, and they would maintain a separation of 80 NM. States which would apply this reduction to date represent 78%, with a commitment for implementation by 31 October 2016, as shown in the following table:

2016 78%	**ARG**	**BOL**	**BRA**	**CHI**	**COL**	**FGY**	**ECU**	**GUY**	**PAN**	**PAR**	**PER**	**SUR**	**URU**	**VEN**
	YES	NO	YES	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES

2.3.21 Concerning the commitment assumed by all States during the 37th ICAO General Assembly according to Resolution A37-11 concerning the implementation of PBN approach, States should intensify efforts to achieve the goal of 100% which should be reached by 2016. The following table shows the current status of implementation.

Total of International Airports	Total thresholds	Total IAP APV or RNP AR or LNAV	ICAO A37-11 indicator % APV per IFR runway	
			Current regional	GOAL 2016
99	175	120	69%	100%

2.3.22 One of the main problems faced not only by SAM Region States, but most States worldwide, is the lack of procedure designers trained in PBN. SAM Region has made many efforts in this

regard and several States have conducted training courses, but this is still insufficient in some States to achieve the goals set out in Resolution A37-11.

Activities and resources needed for the implementation of the Action Plan for the optimisation of the SAM airspace, with the support of Project RLA/06/901

2.3.23 SAM/IG/17 meeting reviewed the activities approved by the Ninth meeting of the Coordination Committee of Project RLA 06/901 and considered the need to establish tasks in the PANS-OPS field, as it had been scheduled at SAM/IG/16 meeting.

2.3.24 While considering some delays in the implementation of PBN design in several terminal areas, it was noted that the activity involving the continuation of the detailed study of the SAM ATS route network for the development of Version 04 of the Route Network would be affected, as well as the holding of the ATSRO/8 meeting.

2.3.25 It is also to be noted that the activities to be conducted under the projects defined for the period 2017-2019 should be considered within an operational concept and the PBIP, and that a study was required to proceed with the planned implementation. This study involves not only the implementation strategy, but also includes the navigation specification to be applied en-route and TMA, as well as metrics and indicators.

2.3.26 Based on the foregoing, States participating in RLA/06/901 Regional Project were requested to modify the objective of some activities, according to following table:

Activity	Tentative date	Fellow-ships	Objective	Remarks
Second Workshop on PBN implementation in TMAs and related PANS-OPS activities	September 2016	2 per State	- Analysis for PBN impementation in the TMAs of Argentina (Baires), Bolivia (Cochabamba, La Paz, Santa Cruz), Brazil (PBN Sur), Chile (Santiago - PAMPA SUR), Panama (Panama), Paraguay (Asuncion), and Uruguay (Carrasco and Laguna del Sauce). - PANS-OPS activities	2 fellowships are requested per State

Activity	Tentative date	Fellow-ships	Objective	Remarks
PBN route structure operational concept (ATS routes, SIDs and STARs) for the period 2017-2019)	October 2016	----	Development of the PBN route structure operational concept (ATS routes, SIDs and STARs) for the period 2017-2019, including: - Implementation strategy - Navigation specification to be applied en-route and in TMAs - Metrics and indicators	Hiring / "secondment" of 2 experts for a period of 2 weeks to develop the operational concept. Invitation to experts of States and users to participate in the study, based on the profile designed by the Secretariat.

2.3.27 To conclude this programming, it was decided that the SAM/IG/18 meeting would be forum to validate the operational concept for the implementation planned for the period 2017-2019. The activities for the 2017-2019 triennium have been included in the description of Project A1, as shown in Appendix B1.

Project A2 Air navigation systems in support of PBN

2.3.28 Within Project A2 of the SAM Region remains pending the review to the GBAS systems practical implementation guide. This guide was foreseen to be submitted in May 2016, but GBAS trials in Brazil have not been yet completed.

2.3.29 The GBAS systems practical implementation guide review will be carried out once is completed the development of a risk model capable of holding the ionosphere behavior in low latitudes. It is expected that such result be presented in the Workshop on navigation infrastructure supporting PBN and GNSS approach precision operations that will be celebrated in Lima, Peru, from 15 to 17 August 2016.

3. Conclusion

3.1 Although significant progress has been made in PBN implementation in the CAR Region, the need has been identified to increase the number of qualified personnel, enhance training programmes, and improve PBN operational approval programmes. Accordingly, States need to review and improve their own PBN implementation programmes with the assistance from the ICAO CAR and SAM Regional Offices.

3.2 With the support of RLA/06/901 Project, direct assistance has been followed-up to SAM Region States for PBN implementation in the selected airspaces. Used tools to this end by the SAM Region are PBN workshops and implementation meetings (SAM/IG). This strategy has allowed to accompany and guide States of the Region in PBN implementation with several specialized training and implementation workshops.

3.3 The activities on airspace redesign for the SAM Region based on PBN application has a positive impact in the efficiency, safety and the inclusion of Civil aviation authorities, air navigation service providers, air operators, pilots and industry in these processes.

3.4 SAM Region PBN Projects current status since PPRC/3 up-to-date is the following:

a) 77% PBN national plans update out of 100% foreseen to reach in 2016;
b) CO_2 annual reduction during year 2015 23.351 TN CO_2;
c) 65% RNAV Routes implementation, exceeding the goal of 60% for 2016;
d) 78% on action plans development for selected airspace redesign applying PBN out of 100% goal for 2016;
e) SIDs/STARs PBN implementation is 70.7%, exceeding *Bogota Declaration* goal of 60%;
f) Application of 18% CDO and 19% CCO techniques, representing a progress of 13.5% since PPRC/3 meeting;
g) Reduction of longitudinal separation to 40 NM between aircraft with GNSS capacity, 78%.

3.5 Among the factors affecting the achievement of the goals in the SAM Region, following can be identified:

a) Difficulties to count with PBN procedures designers in 14% of States;
b) Difficulties in the Project management for the fulfillment of goals in 28% of States;
c) 14% of States have interrupted PBN in TMA design Project to meet the requirements of other ATS projects.

3.6 Appendices A and B to this working paper show the description on Project A1 and A2 progress for the CAR and SAM Regions, respectively, based on PBN programme approved by GREPECAS.

4. Suggested action

4.1 The Meeting is invited to:

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

b) review project activities and status of implementation in Appendices A and B, and formulate other actions it as deemed appropriate.

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APPENDIX A / APÉNDICE A

PROJECT IMPLEMENTATION OF PERFORMANCE BASED NAVIGATION (PBN)
PROYECTO IMPLANTACIÓN DE LA NAVEGACION BASADA EN LA PERFORMANCE (PBN)

CAR Region / Región CAR	**PROJECT DESCRIPTION / DESCRIPCION DEL PROYECTO (DP)**	**DP N° A1**	
Programme / Programa	**Project Title / Titulo del Proyecto**	**Start / Fecha inicio**	**End / Fecha término**
Performance Based Navigation /Navegación basada en la performance (PBN) Programme Coordinator / Coordinador del Programma: Victor Hernandez)	*Performance Based Navigation / Navegación Basada en la Performance (PBN)* Project Coordinator / Coordinador Proyecto: ~~Alfredo Mondragón~~Riaaz Mohamed (~~COCESNA~~Trinidad and Tobago) Experts / Expertos contribuyentes: Carl Gayner (Jamaica) Jose Gil (México) Julio Mejia Alcantara (Dominican Republic) ~~Riaaz Mohamed (Trinidad and Tobago)~~ Marco Vidal(IATA)	2008	2017
Objective /Objetivo	Support the implementation of the ATS route structure in terminal areas (SID/STAR RNAV) and en-route (RNAV) optimization Project, as well as the implementation of RNP approach procedures according to regional performance objectives of the Performance-based Air Navigation Implementation Plan for NAM/CAR (RPBANIP NAM/CAR) Regions. / Apoyar la implementación del proyecto de optimización de la estructura de rutas ATS en las áreas terminales (SID/STAR RNAV) y espacio aéreo en ruta (RNAV), así como la implantación de aproximaciones RNP en base a los Objetivos regionales de performance del Plan de Regional de Implementación de Navegación Aérea Basada en la Performance para las Regiones NAM/CAR (RPBANIP NAM/CAR)		
Scope /Alcance	Progressive implementation of PBN and use of GNSS according to the goals of Assembly Resolution A37-11 and the PBN Airspace Concept for the CAR Region. / Implantación progresiva de la PBN y uso del GNSS acorde a las metas de la Resolución de la Asamblea A37-11 y el Concepto de Espacio Aéreo PBN para la Región CAR.		

Metrics / Métricas	• Percentage of instrument runway with an Approach procedure with vertical guidance (APV), (BARO-VNAV and/or augmented GNSS) either as the primary approach or as a back-up for precision approaches; • Percentage of international aerodromes with implanted SID/STAR RNAV, RNP and continuous descent and climb operations (CDO/CCO); • Estimated fuel saved with operational improvements. • Porcentaje de pistas por instrumentos con un Procedimiento de aproximación con guía vertical (APV), (BARO-VNAV y/o aumentación GNSS) ya sea como aproximación primaria o como apoyo para aproximaciones de precisión; • Porcentaje de aeropuertos internacionales con SID/STAR RNAV, RNP y operaciones de descenso y ascenso continuo (CDO/CCO) implantados; • Ahorros estimados de combustible debidos a mejoras operacionales.
Strategy / Estrategia	The implementation of activities will be coordinated between Project members, the Project Coordinator and the Programme Coordinator. The Programme Coordinator will coordinate with the Project Coordinator requirements of other projects and NAM/CAR implementation working groups. States will develop their respective national programmes of implementation of routes and approach procedures according to PBN Airspace Concept in the CAR Region. Experts nominated by States, Territories and International Organizations will be incorporated to develop tasks as required. / La ejecución de las actividades será coordinada entre miembros del proyecto, el coordinador del proyecto y el Coordinador del Programa. El Coordinador del Programa coordinará con el Coordinador del Proyecto los requerimientos de otros proyectos y Grupos de Trabajo de implementación NAM/CAR. Los Estados elaborarán sus respectivos programas nacionales de implantación de rutas y procedimientos de aproximación acorde al Concepto de Espacio Aéreo PBN de la Región CAR. Se incorporarán expertos nominados por los Estados, Territorios y Organizaciones Internacionales para desarrollar las tareas, según se requiera.
Goals / Metas	• Implement RNAV/RNP routes and RNP approach procedures according to Assembly Resolution A37-11 in 2016: • Implement a PBN Airspace Redesign Project (CDOs, CCOs, SIDs, STARs, RNAV/RNP route and RNP approach procedures) in 8 FIRs by December 2017: • Implementar rutas RNAV/RNP y procedimientos de aproximación RNP de acuerdo a la Resolución de la Asamblea A37-11, en diciembre de 2016; • Implementar un Proyecto de Rediseño de Espacio Aéreo PBN (CDO, CCO, SID, STAR, rutas RNAV/RNP y procedimientos de aproximación RNP) en 8 FIR en diciembre de 2017

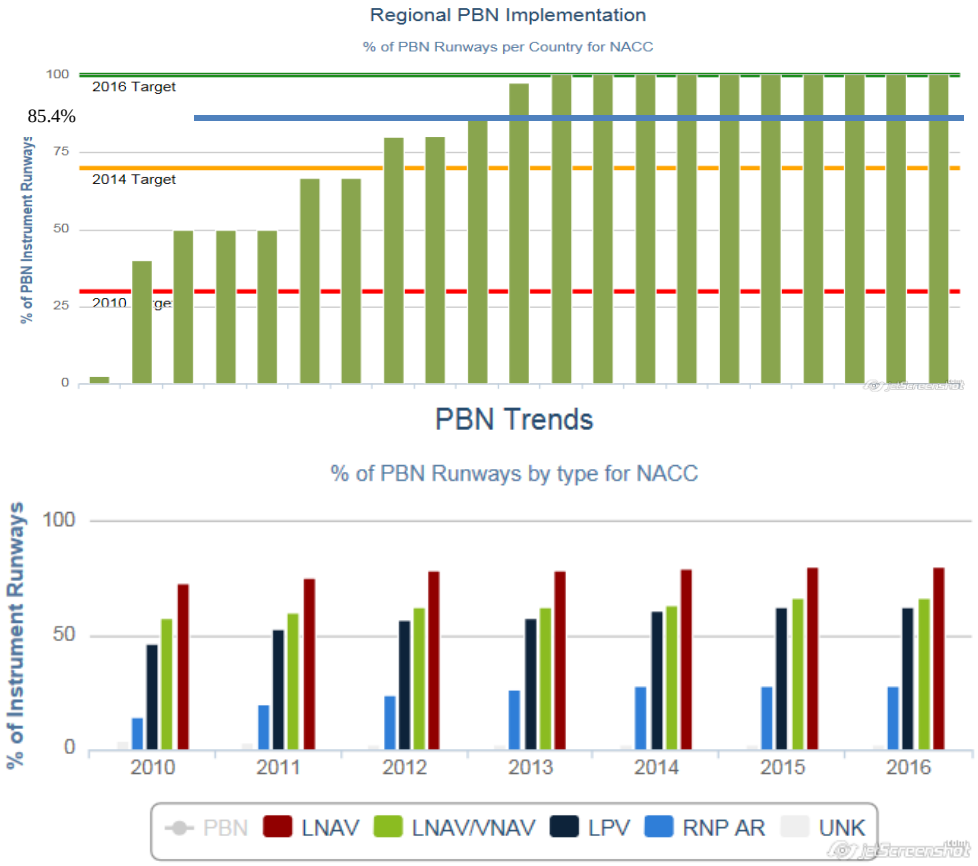
Justification/ Justificación	The Assembly Resolution A37-11 on performance-based navigation (PBN) global goals, urged States to implement RNAV and RNP ATS routes and instrument approach procedures in accordance with the ICAO Performance-based Navigation (PBN) Manual, Doc 9613, and requested the PIRGs to include in their work programme the review of status of implementation of PBN by States and report annually to ICAO any deficiencies that may occur. In addition, NAM/CAR States adopted a regional performance framework on the basis of the regional performance objectives (RPO) of the performance based air navigation implementation plan (RPB-ANIP) for NAM/CAR Regions and the Global ATM Operational Concept. The framework includes the implementation of a set of performance metrics to facilitate comparative analysis of operational and economic regional development, such as capacity and efficiency of gate-to-gate flight operations, and the protection of the environment in the planning, implementation and operation processes of the ATM system. / La Resolución A37-11 de la Asamblea sobre metas mundiales de Navegación basada en performance (PBN), instó a los Estados a implantar rutas ATS RNAV y RNP, así como procedimientos de aproximación por instrumentos de acuerdo al Manual de la OACI sobre Navegación Basada en la Performance (PBN), Doc 9613, solicitando a los PIRG incluir en sus programas de trabajo la revisión del estado de implantación de PBN por los Estados e informar anualmente a la OACI sobre cualquier deficiencia que pudiera ocurrir. Además, los Estados NAM/CAR adoptaron un marco regional de performance con base en los Objetivos regionales de performance (RPO) del plan de implantación de navegación aérea basada en performance (RPB-ANIP) para las Regiones NAM/CAR y el Concepto Operacional ATM Global. El marco de referencia incluye la implantación de un conjunto de métricas de performance para facilitar el análisis comparativo operacional y económico del desarrollo regional, tales como la capacidad y eficiencia de operaciones aéreas puerta a puerta y la protección del medio ambiente en los procesos de planificación, implantación y operación del sistema ATM.
Related Projects / Proyectos relacionados	• Enhance demand and capacity balancing; • Flexible use of airspace; • Improve ATM situational awareness; • Mejorar el equilibrio entre la demanda y capacidad; • Uso flexible del espacio aéreo; • Mejorar la conciencia situacional ATM;

Resultados entregables del Proyecto	Relación con el RPB-ANIP NAM/CAR	Responsable	Estado de Implantación*	Fecha entrega	Comentarios
Implement PBN Airspace Redesign Project for CAR Region	RPO 1	States, Territories, International Organizations / Estados, Territorios, Organizaciones Internacionales		Dec 2017	-Up-to-date the regional PBN Airspace concept -States to develop and implement a PBN Airspace Redesign Project for oceanic, continental and terminal areas in accordance with the ICAO Doc 9613 and Doc 9992, as needed / -Actualizar el Concepto de Espacio Aéreo PBN regional -Los Estados implementan un Proyecto de Rediseño de Espacio Aéreo acorde a los Doc 9613 y 9992 de la OACI, según sea necesario.
Optimize the ATS route structure in the upper continental and oceanic airspace. / Optimizar la estructura de rutas ATS en el espacio aéreo superior continental y oceánico	RPO 1	States, Territories, International Organizations / Estados, Territorios, Organizaciones Internacionales		Dec 2017~~6~~	RNAV 5 Routes implemented in the upper airspace. On-going revision of 8 ATS routes / States to send proposals to ICAO NACC Regional Office by 30 June 2016 Rutas RNAV 5 implantadas en el espacio aéreo superior. Revisión de 8 rutas ATS en progreso Los Estados enviarán sus propuestas a la Oficina Regional NACC de la OACI a más tardar el 30 de junio de 2016
Implement SIDs/STARS, CDO and CCO in terminal areas based on RNAV/1-2 and RNP1	RPO 1	States, Territories, International Organizations /		Dec 2017	-On-going revision of TMAs - Revisión de las TMA en progreso

navigation specifications. / Implementar SIDs/STARS, CDO y CCO en áreas terminales en base a especificaciones de navegación RNAV/1-2 y RNP1		Estados, Territorios, Organizaciones Internacionales			
Design and implement PBN APV approach procedures in accordance with Assembly Resolution A37-11 (BARO-VNAV), / Diseñar e implementar procedimientos de aproximación PBN APV (BARO-VNAV) según la Resolución de la Asamblea A37-11	RPO 1	States, Territories, International Organizations / Estados, Territorios, Organizaciones Internacionales		Dec 2016	-RNP approach procedures implemented that represent 85.4% of the global target/ -Procedimientos de aproximación RNP implementados que representan el 85.4% de la meta global.
Analysis of regional feasibility for SBAS (WAAS/SACSA) implementation. / Estudio de factibilidad regional de la implantación del SBAS (WAAS / SACCSA)	RPO 1	Alfredo Mondragón assisted by / asistido por SACCSA and/y WAAS		Completed / Finalizada	-Mexico is testing 5 WAAS stations for domestic use. WAAS requirements will be regionally reviewed in the medium term. -Feasibility of regional application, technical aspects, operational benefits, associated costs, for an SBAS (WAAS/SACSA) implementation. Implications for airborne equipment (new or avionics update) and other relevant aspects. / -México tiene a prueba 5 estaciones WAAS para uso nacional. Los requisitos WAAS serán regionalmente revisados en el mediano plazo. -Factibilidad de la aplicación regional, los aspectos técnicos, los beneficios operacionales, los costos asociados, de la implantación del SBAS (WAAS / SACCSA), así como las implicaciones para los equipos de a bordo (nuevas o actualización de aviónicas) y otros aspectos pertinentes

Practical guidance for the implementation of GBAS Systems/ Guía práctica para la implementación de sistemas GBAS.	RPO 1	~~Alfredo Mondragón assisted by / asistido por SACCSA and/y WAAS~~ANI/WG		2018	- Regional agreement to organize GNSS workshop in 2016 -Acuerdo regional para organizar un Taller GNSS en 2016
Required Resources / Recursos necesarios	CAR Regional PBN Airspace Redesign Project, which includes PBN technical assistance programme to States / Proyecto regional de Rediseño de Espacio Aéreo PBN CAR que incluye programa de asistencia técnica PBN a los Estados				

Grey / Gris: *Task not started / Tarea no iniciada;*
Green / Verde: *Activity underway as scheduled / Actividad en progreso de acuerdo con el cronograma;*
Yellow / Amarillo: *Activity started with some delay but expected to be complete don time / Actividad iniciada con cierto retardo pero estaría llegando a tiempo en su implantación;*
Red / Rojo: *It has not been posible to implement this activity as scheduled; mitigating measures are required / No se ha logrado la implantación de la actividad en el lapso de tiempo estimado se requiere adoptar medidas mitigatorias.*


Regional PBN Implementation
% of PBN Runways per Country for NACC
100
75
50
25
0
2016 Target
85.4%
2014 Target
% of PBN Instrument Runways
PBN Trends
% of PBN Runways by type for NACC
% of Instrument Runways
100
50
0
2010
2011
2012
2013
2014
2015
2016
PBN
LNAV
LNAV/VNAV
LPV
RNP AR
UNK

END - FIN

APPENDIX B1

PBN OPERATIONAL IMPLEMENTATION PROJECT A1

SAM Region	**PROJECT DESCRIPTION (DP)**	DP N° A1	
Programme	**Title of the Project**	**Start**	**End**
SAM Airspace Optimisation (Programme Coordinator: Roberto Sosa España)	PBN Operational Implementation *Project coordinator:* *Julio de Souza Pereira (IATA)*	2011	2019
Objective	Support the optimisation of the South American airspace structure through the optimisation of the ATS route structure in terminal (RNAV/RNP SIDs/STARs) and en-route (RNAV/RNP) airspace, as well as the implementation of PBN approaches pursuant to ICAO Assembly Resolution A37-11, aiming to achieve the goals established in the Bogota Declaration.		
Scope	The implementation project contemplates the optimisation of the South American airspace through the implementation of PBN and the application of the flexible use of airspace (FUA) concept, as well as the phased optimisation of the ATS route network of the Region.		
Metrics	• Reduction of CO_2 emissions in tonnes for each route optimisation version. • Percentage of RNAV and/or RNP SIDs/STARs implemented at international airports. • Percentage of continuous descent and climb operations implemented at international airports. • Number of RNAV/RNP routes implemented, realigned and/or eliminated. • Percentage of thresholds with APV approaches in international airports.		

Strategy	The conduction of project activities will be coordinated among project members, the Project Coordinator, and the Programme Coordinator, at SAM/IG meetings, ATS route optimisation meetings (ATS/RO) and other events deemed necessary (PBN workshops, hiring of experts, etc.). The Project Coordinator will coordinate with the Programme Coordinator the inclusion of additional experts, if warranted by the tasks and works to be executed. Furthermore, the States must check their respective national PBN implementation programmes for consistency with the PBN Project. Activities involving the review, implementation, modification, or elimination of routes in the SAM Region are foreseen in order to continue with the optimisation of the ATS route structure.
Goals	• Implementation of Version 03 of the ATS route network, based on PBN, to meet the current requirements of airspace users by the end of 2017. • Achieve the goals established in the Bogota Declaration. • 30% of main SAM TMAs redesigned based on PBN by 2016, 50% by 2018. • Development of Version 04 of the ATS Route Network based on PBN and TMAs designed with base on PBN. • Optimisation of longitudinal separation.

Rationale	The 37th ICAO General Assembly established Resolution A37-11 (*Performance-based navigation global goals*), noting that Planning and Implementation Regional Groups (PIRGs) have completed regional PBN implementation plans and urged States to implement 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). It resolved that States complete a PBN implementation plan as a matter of urgency to achieve: 1) implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones; 2) implementation of approach procedures with vertical guidance (APV) (Baro-VNAV and/or augmented GNSS), including LNAV only minima, 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% by 2010, 70% by 2014; and 3) implementation of straight-in LNAV only procedures, as an exception to 2) above, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more. Furthermore, the Global Air Navigation Plan (GANP), Chapter 2 (implementation) establishes Performance-based Air Navigation as its highest priority. The GANP indicates that "*the introduction of PBN procedures has thus far met or exceeded the expectations of the entire aviation community. Current implementation plans should help deliver additional benefits but remain contingent upon adequate training, expert support to States, continued maintenance and development of international SARPs, and closer coordination between States and partnering organizations.*" Thus, this Project provides specialized support and performs close coordination between States and other stakeholders, in order to ensure a harmonized implementation of PBN in all corresponding flight phases: En route, TMA and approach.
Related projects	• Flexible use of airspace. • Automation. • Air navigation systems in support of PBN.

Project deliverables	Relationship with the performance-based regional plan	Responsible party	Status of Implemen-tation*	Delivery date	Comments
Implementation of Version 01 of the ATS route network, based on RNAV, with the necessary PBN values to meet current requirements of airspace users.	B0-FRTO	Alexandre Luiz Dutra Bastos		October 2010	FINALISED
Implementation of RNAV-5 in the SAM Region.	B0-FRTO	Alexandre Luiz Dutra Bastos		October 2011	FINALISED
Action plan for the implementation of Version 02 of ATS route network optimisation.	B0-FRTO	Alexandre Luiz Dutra Bastos		ATS/RO/3	FINALISED

Traffic data to understand airspace traffic flows.	B0-FRTO	ICAO coordinator		SAM/IG/6	FINALISED
Fleet navigation capacity.	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		SAM/IG/9	FINALISED
Listing of gateways of the main TMAs in the SAM Region.	PFF SAM ATM 02	Alexandre Luiz Dutra Bastos		SAM/IG/9	Support was given to States in the re-design of their TMAs so as to expedite PBN implementation, training their experts in airspace planning. Several States are delayed with their projects.
Letters of Agreement and Contingency with adjacent States	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		SAM/IG/10	FINALISED
Detailed study of the SAM ATS route network, route network Version 02	B0-FRTO	Alexandre Luiz Dutra Bastos		April 2012	FINALISED
Risk analysis for the implementation of Version 02 of the ATSRO Programme	B0-FRTO	External consultants		SAM/IG/10	FINALISED
SAM Route Network optimisation					
Planning Version 03 - Stage 1	B0-FRTO	External consultants		SAM/IG/14	FINALISED

Implementation Version 03 - Stage 1 - Flow 1 (Argentina - Chile - Paraguay)	B0-FRTO	States SAM Regional Office		April 2015	FINALISED
Implementation Version 03 - Stage 1 - Flow 2 (Argentina - Brazil - Uruguay	B0-FRTO	States SAM Regional Office		March 2017	The optimisation of this traffic flow is delayed.
Implementation Version 03 - Stage 1 - Flow 3 (Panama - CENAMER - Caribbean)	B0-FRTO	States SAM Regional Office		March 2017	Coordination with CAR Region States was initiated.
Implementation Version 03 - Stage 1 - Flow 3 (Brazil - Guyana - French Guiana - Suriname - Venezuela - Caribbean	B0-FRTO	States SAM Regional Office		October 2016	Optimisation of main flows has been coordinated.
Airspace concept Version 03 - Stage 2	B0-FRTO	States SAM Regional Office		ATSRO/7	Main SAM TMA validated PBN airspace concept has been agreed.
Implementation Version 03 - Stage 2	B0-FRTO	States SAM Regional Office		November 2017	Routes that had no direct dependency on TMAs restructurings were implemented.
Operational Concept development on the structure of PBN routes (ATS, SIDs, STARs routes) for the period 2017-2019.	B0-FRTO	States SAM Regional Office		October 2016	Hiring of experts and invitation to States for providing human resources.

Regional strategy and work programme for the implementation of the flexible use of airspace, applying a phased approach, starting with a more dynamic sharing of reserved airspace	B0-FRTO	States SAM Regional Office		2013-2018	Flexible use of airspace is being optimised with the routes optimisation.
Reduction of conventional longitudinal separation from 80 to 40 NM for GNSS equipped aircraft.	B0-FRTO	States SAM Regional Office		2016-2017	This task has advanced greatly it is expected to be completed on time.
Reduction of conventional longitudinal separation from 40 to 20 NM for GNSS equipped aircraft.	B0-FRTO	States SAM Regional Office		2017-2018	
Reduction of conventional longitudinal separation from 20 to 10 NM for scenarios where ATS surveillance systems are used and these systems cover FIRs boundaries considered.	B0-FRTO	States SAM Regional Office		2019	
PBN TMA					
Update PBN implementation action plans for main TMA	PFF SAM ATM 02	States		October 2016	Conclusion SAM/IG/14-6. 78% of States which updated their action plans has been achieved. Colombia, French Guiana and Suriname have not presented their action plan.

Update SID/STAR PBN status of implementation	PFF SAM ATM 02	States		30 June 2015	Update by 30 June and by 31 December annually, according to Conclusion SAM/IG/14-4
Update Table AOP-1	PFF SAM ATM 02	States		TBD	Conclusion SAM/IG/15-3
Approach					
Update IAC APV status of implementation	PFF SAM ATM 03 B0 APTA	States		30 June 2016	Update by 30 June and by 31 December annually, according to Conclusion SAM/IG/14-4. Implementation of RNP APCH procedures with vertical guidance Baro-VNAV or RNP AR APCH, must be informed.
Meetings/Workshops					
SAM/IG/07	PFF SAM ATM	States SAM Regional Office		May 2011	SAM PBN Implementation Group
SAM/IG/08	PFF SAM ATM	States SAM Regional Office		October 2011	SAM PBN Implementation Group

SAM/IG/09	PFF SAM ATM	States SAM Regional Office		May 2012	SAM PBN Implementation Group
SAM/IG/10	PFF SAM ATM	States SAM Regional Office		October 2012	SAM PBN Implementation Group
SAM/IG/11	PFF SAM ATM	States SAM Regional Office		May 2013	SAM PBN Implementation Group
SAM/IG/12	PFF SAM ATM	States SAM Regional Office		October 2013	SAM PBN Implementation Group
SAM/IG/13	PFF SAM ATM	States SAM Regional Office		May 2014	SAM PBN Implementation Group
SAM/IG/14	PFF SAM ATM	States SAM Regional Office		October 2014	SAM PBN Implementation Group
SAM/IG/15	PFF SAM ATM	States SAM Regional Office		May 2015	SAM PBN Implementation Group
SAM/IG/16	PFF SAM ATM	States SAM Regional Office		October 2015	SAM PBN Implementation Group
SAM/IG/17	PFF SAM ATM	States SAM Regional Office		May 2016	SAM PBN Implementation Group

SAM/IG/18	PFF SAM ATM	States SAM Regional Office		October 2016	SAM PBN Implementation Group
ATSRO/03	PFF SAM ATM 03	States SAM Regional Office		July 2011	SAM route network optimisation
ATSRO/04	PFF SAM ATM 03	States SAM Regional Office		July 2012	SAM route network optimisation
ATSRO/05	PFF SAM ATM 03	States SAM Regional Office		July 2013	SAM route network optimisation
ATSRO/06	PFF SAM ATM 03	States SAM Regional Office		October 2014	SAM route network optimisation
ATSRO/07	PFF SAM ATM 03	States SAM Regional Office		October 2015	SAM route network optimisation
ATSRO/08	PFF SAM ATM 03	States SAM Regional Office		July 2016	SAM route network optimisation
Hiring of experts for the consolidation of Version 03 Stage 2 of the SAM ATS route network	PFF SAM ATM 03	States SAM Regional Office		2017	Suspended, expecting meeting for 2017.
Workshop on PBN Airspace Design in the SAM	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		March 2013	Initial training on PBN airspace planning

PBN/1 Workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		May 2014	FINALISED Objective: Training and preliminary PBN design of Asuncion and Bogota TMAs
PBN/2 Workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2014	FINALISED Objective: Preliminary PBN design of main South American TMAs
PBN/ 3 Workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		March 2015	FINALISED Objective: Validation of preliminary PBN design of main South American TMAs
PBN/4 Workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2015	FINALISED Objective: Guide implementation of main South American TMAs
PBN/IMP/1 Workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		April 2016	Review the implementation phase of States with implementation date expected for the first half of 2016.
PBN/IMP/2-PANS-OPS Workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2016	Review the implementation phase of States with implementation date expected for the second half of 2016 and perform related PANS-OPS activities.
Others					
Update and forward national PBN implementation plans	B0 APTA B0 CCO B0 CDO	States		SAM/IG/15	70% of States have fulfilled this task. Bolivia, Colombia, Panama and Suriname are still remaining. Headquarters has requested to forward National PBN implementation plans.

Resources required	Designation of experts in the execution of some of the deliverables.

*

Grey	Task not started
Green	Activity underway as scheduled
Yellow	Activity started with some delay but expected to be completed on time
Red	It has not been possible to implement this activity as scheduled; mitigating measures are required
Blue	Task completed

APPENDIX B2

PROJECT A2 – AIR NAVIGATION SYSTEMS IN SUPPORT OF PBN

SAM Region	**PROJECT DESCRIPTION (DP)**	**DP N° A2**	
Programme	**Title of the Project**	**Start**	**End**
PBN (*Programme Coordinator: Roberto Sosa España)*	Air navigation systems in support of PBN *Project Coordinator: Julio Pereira (IATA)* *Experts contributing to the project: Alessander Santoro, Andre Jansen, Fabio Augusto Andrade (Brazil), Paulo Vila and Tomas Macedo (Peru), and the SAM/IG SAM PBN Group*	January 2011	November 2016
Objective	Develop guides, conduct analyses and implement services in support of PBN implementation in the SAM Region.		
Scope	Support to PBN implementation in the SAM Region, initially consisting of: • Practical guide for the implementation of GBAS systems. • Analysis of DME/DME coverage to support PBN procedures. • Implementation of a RAIM availability prediction service.		
Metrics	• Drafting of a practical guide for the implementation of a GBAS system. • Analysis of DME/DME coverage in the SAM Region completed. • Availability of a RAIM availability prediction service. • % of States providing the RAIM availability service.		
Strategy	• All activities will be conducted by experts designated by SAM States and organisations participating in the project entitled "*Air navigation systems in support of PBN"*, under the management of the project coordinator and the supervision of the programme coordinator. Communications among project members, and between the project coordinator and the programme coordinator shall be done through teleconferences and the Internet. Likewise, the programme coordinator may meet with the project coordinator and the contributing experts at the SAM/IG implementation meetings. • Once the studies have been completed, the results will be sent to the ICAO programme coordinator as a final consolidated document, and to the GREPECAS PPRC for analysis, review and approval.		

Goals	• Guide for the implementation of a GBAS system, by October 2012. (Review November 2016). • Assessment of DME/DME coverage to support PBN procedures, by May 2011. • RAIM availability prediction service in the SAM Region implemented by September 2014. • 11 SAM States with RAIM availability prediction service available by February 2014. • 3 SAM States and one territory with the service available by the end of 2014.
Rationale	• The implementation of PBN procedures for approach, terminal and en-route operations requires the implementation of air navigation systems, services and infrastructure studies, such as the proper installation of DME to support the DME/DME navigation required in the event of failure of the GNSS system, the RAIM availability prediction service to enable the user to know what is RAIM availability for en-route, terminal and approach operations, and the implementation of GBAS systems to support precision landing procedures. • This project contributes to the implementation of SAM PFF CNS 03, ATM 01, ATM 02, and ATM 03 of the *SAM Performance-based navigation system implementation plan (SAM PBIP).*
Related projects	• Implementation of PBN operational aspects.

Project deliverables	**Relationship with the performance-based regional plan and ASBU block 0 modules**	**Responsible party**	**Status of implementa-tion**	**Delivery date**	**Comments**
Develop a practical guide for the implementation of the GBAS system					
Review of practical guide for the implementation of GBAS systems	SAM PFF CNS 03 ANRF B0-APTA(65)	Alessander Santoro (Brazil)		November 2016	The practical guide for the implementation of GBAS systems was presented for review at SAM/IG/8 meeting. Same was circulated to all States of the Region for review and final version was presented at SAM/IG/11 meeting. In order to measure the real impact, a joint work was developed using station SLS-4000 and other 110 GPS L1 and L2 stations installed in Brazil. Data was collected over a period of maximum solar activity, although it has been the lowest in the last 100 years.

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementa-tion	Delivery date	Comments
					From the data obtained, Brazil concluded that to date, SLS-4000 station may not be used in full for CAT 1 operations in low latitude regions, for which ICEA (Instituto de Control del Espacio Aéreo) will continue with the research in cooperation with FAA and the supplier (Honeywell), aiming to develop a risk model capable to support ionosphere behaviour in low latitudes. Brazil will continue with the research in collaboration with universities and Honeywell, aiming to develop a threat model applicable to the SAM Region. Following the results, a review of the practical guide for the implementation of GBAS systems will be conducted. The review of the practical guide for the implementation of GBAS systems will be conducted once the development of a risk model capable to support the ionosphere behaviour in low latitudes has been concluded. The result is expected to be presented at the Workshop on the implementation of the air navigation infrastructure in support of the PBN and GNSS precision approach operations, to be held in Lima, Peru, from 15 to 17 August 2016.

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementa-tion	Delivery date	Comments
Analyse DME/DME and GNSS infrastructure and coverage needed to support PBN implementation					
Analysis of the DME/DME and GNSS infrastructure required to support PBN implementation in the SAM Region	SAM PFF CNS/03 SAM PFF ATM/01 ATM/02 ATM/03 ANRF B0-APTA(65), B0-FRTO(10), B0-CDO(05), and B0-CCO(20)	Fabio Augusto Andrade and Andre Jansen (Brazil) Paulo Vila and Tomas Macedo (Peru)		The coverage study to support RNAV-5 was completed (SAM/IG/8 October 2011)	A *DME/DME coverage study* was presented and reviewed at the SAM/IG/7 meeting (Lima, Peru, 23-27 May 2011). The coverage study was conducted using the EMACS tool and the results were delivered in a KMZ file clearly showing DME/DME coverage over the geographical map of the SAM Region, using *Google Earth*. The study only supports the RNAV-5 procedure.

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementa-tion	Delivery date	Comments
Development of guidance on the use and availability of GNSS performance forecast/validation tools.					
Implementation of a RAIM availability prediction service	SAM PFF CNS/03 SAM PFF ATM/01 ATM/02 ATM/03 B0-APTA(65), B0-FRTO(10), B0-CDO(05), and B0-CCO(20)	Project coordinator PBN Group SAM/IG		November 2014	Two web-based distance courses were conducted on 15 and 16 September 2014, one in English and the other in Spanish, mainly including explanation of the tools contained in the SAM Region RAIM availability prediction service website (SATDIS), the procedure for assigning codes, the import and export of data, and the query and fault resolution procedure. The course was attended by all focal points nominated by the States, as well as by other participants designated by the States. All focal points received from the service provider the respective user name and password to access SATDIS as administrators. The SATDIS website in three languages (Spanish, Portuguese and English) started operating on 17 September 2014. The SATDIS FSAT final acceptance test was conducted on 18 November 2014. The RAIM availability prediction service is operating since 16 November 2014.

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementa-tion	Delivery date	Comments
Monitor activities for the implementation of air navigation systems in support of PBN		ICAO		January 2011 - May 2016	
Resources required	Implementation of the RAIM availability prediction service.				

Grey *- Task not started*
Green *- Activity underway as scheduled*
Yellow *- Activity started with some delay but expected to be completed on time*
Red *- It has not been possible to implement this activity as scheduled; mitigating measures are required*