



**Agenda Item 4: Regional air navigation planning and implementation performance framework: Review of programmes and projects**

**4.1 Projects under the PBN Programme (B0-APTA, B0-FRTO, B0-CDO and B0-CCO)**

**FOLLOW-UP OF PBN PROGRAMME PROJECT ACTIVITIES**

(Presented by the Secretariat)

<b>SUMMARY</b>	
<p>This working paper presents a report on the evolution of the implementation activities related with the projects under the Performance-Based Navigation (PBN) Programme for the CAR and SAM Regions.</p>	
<b>References</b>	
<ul style="list-style-type: none"> <li>• Doc 9613 — Performance-based Navigation (PBN) Manual</li> <li>• Doc 9750 — Global Air Navigation Plan</li> <li>• Seventeenth CAR/SAM Regional Planning and Implementation Group Meeting (GREPECAS/17) Report, Cochabamba, Bolivia, 21 - 25 July 2014</li> <li>• Third Programmes and Projects Review Committee (PPRC/3) Meeting Report, Mexico City, Mexico, 21 – 23 July 2015</li> <li>• Fourth Programmes and Projects Review Committee (PPRC/4) Meeting Report, Lima, Peru, 12 – 14 July 2016</li> </ul>	
<p><i>ICAO Strategic Objectives:</i></p>	<ul style="list-style-type: none"> <li>• <i>Safety</i></li> <li>• <i>Air navigation capacity and efficiency</i></li> <li>• <i>Environmental protection</i></li> </ul>

**1. Introduction**

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

- a) PBN Implementation
- b) Air navigation systems in support of PBN

## **2. Discussion**

2.1 The progress on the activities related to the projects under Programme A: Performance-based navigation (PBN) is as follows:

### **2.2 CAR Region**

#### ***Project A1 “PBN Implementation”***

2.2.1 Under the NAM/CAR Air Navigation Implementation Working Group (ANI/WG) activities, with the support of the PBN Task Force (TF), and under the NACC No Country Left Behind (NCLB) Strategy, the ICAO NACC Regional Office has held PBN Technical Assistance Missions (TEAM), with the aim of reaching the regional agreed targets.

2.2.2 57.9% of CAR States have completed the regional implementation target for approach procedures according to what was established in the Port-of- Spain Declaration. Additionally, in order to reflect the progress of the PBN implementation, it has been indicated that in the CAR Region there are 217 runways with instrument approach , of which 108 have PBN procedures, representing a 49.8% of the implementation (Source: iStars PBN Implementation Progress – Current, last revision: November 2017).

2.2.3 Based on the agreements made in the two ICAO/IATA/CANSO Performance-Based Navigation (PBN) Harmonization, Modernization and Implementation meetings, the amendment to the electronic Regional Air Navigation Plan for the Caribbean and South American Regions, Volume II, e-ANP Part IV – Air Traffic Management (ATM) was developed. This amendment includes additional new Area Navigation (RNAV) routes, amendments to existing routes, and elimination of routes or routes segments. In summary, 41 improvement initiatives have been implemented, which represents a progress in the adoption of more efficient RNAV-5 routes, progressively replacing conventional radio-based routes.

2.2.4 A new proposal of amendment to the interregional route network included in the electronic Regional Air Navigation Plan for the Caribbean and South American Regions, Volume II, e-ANP Part IV – Air Traffic Management (ATM) (or PfA 2) will be presented in the Third ICAO/IATA/CANSO Performance-Based Navigation (PBN) Harmonization, Modernization and Implementation Meeting, to be held in the ICAO NACC Regional Office in Mexico City, Mexico, from 2 to 6 July 2018.

2.2.5 With the support of the RLA/09/801 Project, the NACC Regional Office proposes to develop an air space and Terminal Area (TMA) model structure, which allows a continuous flow in the adjacent Flight Information Regions (FIRs) and TMAs of the lower air space, proposing a feasible solution to a complex existing FIR structure in the CAR Region. Using the abovementioned air space model structure, an evaluation of the regional and individual steps that will be required to comply with the expected objectives for the implementation will be performed.

2.2.6 The ICAO NACC Regional Office is currently working in a project to readjust its metric system for the regional implementation progress measurement, which will allow to have more updated and objective information for decision-making, aligned with the Aviation System Block Upgrade (ASBU) modules.

2.2.7 Progress and results of the PBN implementation in the CAR Region are presented in the **Appendix A**.

## 2.3 SAM Region

### *Project A1“PBN Implementation”*

2.3.1 The detail of the main activities of the PBN SAM Implementation Project is presented in the **Appendix B1** to this working paper. The South American (SAM/IG) Implementation Group Meetings mainly focus its actions in the delivery of the forecasted results for the En Route, TMA and Approach phases. The progress of this project since the PPRC/4 (July 2016) are presented in the following paragraphs.

#### *PBN National Plans Update*

2.3.2 During the PPRC/4 meeting, a 77% of the States having updated PBN National Plans was informed. The results achieved in May 2017 indicate that 100% of the States have complied with this activity.

#### *PBN Operational Concept*

2.3.3 With the purpose of strengthening the implementation of the Declaration of Bogota and at the same time providing a conceptual framework for the SAM Regional Performance-Based Air Navigation Implementation Plan (SAM-PBIP), the proposal of the PBN Concept of Operations (CONOPS) for the SAM Region Air Space was developed.

2.3.4 The first CONOPS draft was reviewed during the SAM/IG/19 meeting, agreeing on the project contents and defining the document application period for the 2018 – 2020 triennium.

2.3.5 The CONOPS proposes a table with metrics and target indicators that will allow measuring the degree of continuity and results of the PBN implementation. Until now, the CONOPS is included as Attachment H of the SAM-PBIP (Version 1.5) ATM matters, which is available in the following link as part of the SAM/IG/20 Meeting Report:

[https://www.icao.int/SAM/Documents/2017-SAMIG20/SAMIG20\\_Final%20Report.pdf](https://www.icao.int/SAM/Documents/2017-SAMIG20/SAMIG20_Final%20Report.pdf)

#### *PBN En Route*

2.3.6 PBN en-route implementation is discussed in the ATS Routes Network Optimization (ATSRO) meetings, based on the network versions concept, in order to always guarantee the best possible structure of the air space within a integrated development concept. The ATSRO/08 Meeting activities regarding the SAM Region route network Version 04 are detailed in paragraphs below.

2.3.7 During the PPRC/4 meeting, it was informed that the region has made progress in the optimization of the SAM Region routes network, maintaining the percentage of 65% of upper air space routes that have been improved, exceeding by 5% the target established in the Bogota Declaration. In September 2017, actions have been initiated for the implementation of the Version 4 to improve ATS routes, whose results will be seen from the second half of 2018.

*PBN in TMA*

2.3.8 The redesign process with PBN application in the main SAM TMAs were promoted through implementation workshops funded by the RLA/06/901 Regional project. In 2016 two PBN training workshops have been held, as well as a Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS)/1 Workshop on flight procedures design and the corresponding criteria provided by ICAO, which strengthens the competences of the designers of the Region and allows the exchange of information regarding the requirements of the users. The PANS/OPS/2 Workshop was also held, in the week of 18 September 2018; its result is presented below in this working paper.

2.3.9 In August 2017, Paraguay enforced the new air space with PBN application of the Asunción FIR and TMA and the Silvio Pettirossi International Airport. Similarly, *Aerocivil de Colombia* implemented the new Bogota TMA on 12 October, with RNAV/ Required Navigation Performance (RNP) approach procedures and standard routes for the El Dorado Airport, which included the reconfiguration of main flows to/from Medellin and to/from the Colombian Caribbean.

2.3.10 The PBN optimization in the East-West flow of traffic between Brazil, Argentina and Uruguay is still under development. Through the PBN SUL project, enforced on 12 October, important improvements were made in the Curitiba FIR, influencing some main TMAs (Curitiba, Florianopolis, Santa Maria, Porto Alegre, etc.) and main airports of the south of Brazil, planning a route set realignment, which has been coordinated with Uruguay.

2.3.11 In the Aeroparque, Córdoba, Salta and Iguazú Airports in Argentina, PBN procedures have been implemented. The implementation of the routes Version 04 is expected to provide the conditions to connect the spaces that attend the flows between Curitiba, Montevideo and Buenos Aires, and vice versa. On the other hand, completion of the TMA Baires designs and TMA reorganization is expected for the first half of 2019. Panama is currently defining the process to promote the improvement and space redesign activities in the TMA in the Tocumen Airport.

2.3.12 A positive aspect is the personnel training investment in the PANS-OPS area for the personnel in the Argentina, Bolivia, Ecuador, Guyana, Peru and Uruguay Administrations. The lack of PANS-OPS designers in the region is progressively being reverted.

2.3.13 93% of the States have presented their Action Plans for selected airspaces redesign applying PBN, representing a progress of 15% with respect to the information presented in the PPRC/4 meeting. The detail of the tentative dates for implementation is presented in the SAM/IG/20 Meeting Report, in the following link:

[https://www.icao.int/SAM/Documents/2017-SAMIG20/SAMIG20\\_Final%20Report.pdf](https://www.icao.int/SAM/Documents/2017-SAMIG20/SAMIG20_Final%20Report.pdf)

*SID, STAR and PBN Approach Procedures Implementation*

2.3.14 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, the mentioned Declaration encourages States to implement APV approach procedures, to attend ICAO Assembly Resolution A37-11.

2.3.15 Considering the recent implementations in Argentina, Brazil, Colombia and Paraguay, a 72.9% SIDs/STARs implementation was reached in the Region on 12 October 2017. This represents an increase of 2.2% with respect of the information in the PPRC/4 meeting. The Bogota Declaration goal of 60% has been reached.

2.3.16 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 34% and CCO 26%.

2.3.17 According to the Resolution A37-11 concerning the implementation of PBN approach, the States maintain their efforts to achieve the goal of 100% which was expected to be reached by 2016. Up to 12 October 2017, a 78.6% implementation had been reached.

*Environmental benefits derived from CO<sub>2</sub> reduction during the period 2014 – 2017*

2.3.18 It was estimated with the ICAO Fuel Savings Estimation Tool (IFSET) that, between January 2014 and December 2016, the airspace improvements in the SAM Region derived from the PBN application for the regional routes realignment and the implementation of standard departure and arrival routes RNAV/RNP in TMAs has allowed CO<sub>2</sub> savings, according to the following table:

<i>Year</i>	<i>Reduction in Tonnes of CO<sub>2</sub> generated by routes optimization</i>
2014	51.132
2015	23.351
2016	11.000

Reduction of CO<sub>2</sub> generated by SAM routes optimization

2.3.19 From the previous table, the reduction in tonnes of CO<sub>2</sub> is highlighted, which showed a decreasing trend because, with each improvement, it became more difficult to produce larger CO<sub>2</sub> savings in the following year. Nevertheless, for the defined triennium, the CO<sub>2</sub> emission savings cumulative effect can be reflected in the following table:

<i>Year</i>	<i>Tonnes of CO<sub>2</sub></i>	<i>Tonnes of CO<sub>2</sub> Cumulative reduction</i>
2014	51.132	51.132
2015	23.351 + 51.132	74.483
2016	11.000 + 74.483	85.483
	<b>Total from 2014 to 2016</b>	<b>211.098</b>

Cumulative reduction of CO<sub>2</sub> generated by routes optimization from 2014 to 2016

2.3.20 As part of the lessons learned, the Meeting identified the need to receive feedback on calculations of fuel and CO<sub>2</sub> savings based on data from aircraft operators, and also to include, as part of the variables to be analysed, the increase in the number of aircraft operations in the flows of the Region.

*Coordination for SAM route network Version 04 and ATSRO/08*

2.3.21 In order to maintain the airspace optimization and PBN implementation activities in the en route segment, the draft document of the SAM route network Version 04 was developed in June 2017.

2.3.22 The Eighth South American Meeting on ATS Routes Network Optimisation (ATSRO/8) was held from 11 to 15 September 2017, where the States evaluated and coordinated the implementation of the route network Version 04. The Meeting created three working groups that presented the results for each initiative showed in the final report, which can be seen in the Regional Office website:

[https://www.icao.int/SAM/Documents/2017-ATSRO8/SAMATSRO8\\_final%20report.pdf](https://www.icao.int/SAM/Documents/2017-ATSRO8/SAMATSRO8_final%20report.pdf)

2.3.23 In total, 95 initiatives were analysed, of which 30 had been accepted and 13 rejected. The remaining 52 initiatives will follow the coordination among States.

2.3.24 The Meeting defined a three stage schedule for the route changes publication, in the Aeronautical Information Regulation and Control (AIRAC) dates: June, August and October 2018, considering two AIRAC cycles prior to the effective implementation.

2.3.25 A SAM States meeting on the third week of March 2018 is scheduled for the Letters of Agreement and Contingency Plans update, where the on aircraft transfer and ATS management on optimised routes will be revised.

*PANS-OPS Workshops*

2.3.26 PBN and PANS-OPS workshops are addressed to improve the competencies of the flight procedures designers under the ICAO criteria and other methods of international usage, while strengthening at the same time the collaborative link with experts and airlines pilots, as to receive valuable feedback of the users requirements.

2.3.27 The Second PANS-OPS implementation Workshop (PANS-OPS/2) held from 18 to 22 September 2017. Experts from 10 States, IATA and airlines participated. The subjects taught on the application of criteria of Doc 8168 — OPS — Aircraft Operations, Doc 9613 — Performance-based Navigation (PBN) Manual, Doc 9905 — Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual, other documents relates to these activities, and the topics presented by the airlines on operational requirements, coding, in flight and aircraft performance validation, are shown in the following link:

[https://www.icao.int/SAM/Pages/ES/MeetingsDocumentation\\_ES.aspx?m=2017-PANSOPS2](https://www.icao.int/SAM/Pages/ES/MeetingsDocumentation_ES.aspx?m=2017-PANSOPS2)

*Actions to optimize the longitudinal separations between enroute aircraft*

2.3.28 There are a set of Letters of Agreement and Memorandums of Understanding containing the commitments assumed at the SAM/IG/17 meeting (Lima, Peru, 9 to 13 May 2016) regarding the reduction of longitudinal separation from 80 to 40 NM. Although the Paramaribo FIR and Atlántico FIR (managed by Brazil) remained mostly with oceanic separation, the implementation process has been positive in the SAM Region, recognising that coordination with adjacent CAR States is still pending.

2.3.29 With the support of Project RLA/06/901 a 4-day workshop was held from 6 to 10 November 2017 in the SAM Regional Office, where an Action Plan was proposed to promote the reduction from 40 to 20 NM, and the signature of Letters of Agreement between States to consolidate the 40-NM separation was coordinated. Brazil has initiated the standardized application of the 20 NM separation for the aircrafts entering in its FIRs. The summary of results of this workshop is shown in the following link:

<https://www.icao.int/SAM/Pages/MeetingsDocumentation.aspx?m=2017-OPTSEPLONG>

*Project A2 Air navigation systems in support of PBN*

2.3.30 Within Project A2 of the SAM Region remains pending the review to the Ground-Based Augmentation Systems (GBAS) practical implementation guide. 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, this activity is being carried out by Brazil, in collaboration with universities and Honeywell company. The current risk model is only applied in medium latitudes. The risk model development is expected to be completed by the last quarter of 2018.

2.3.31 The description of activities of this project is presented in the **Appendix B2** to this working paper.

### **3. Conclusion**

3.1 Although significant progress has been made in the PBN implementation in the CAR Region, the need to review the measurement and implementation support process in order to reflect more objectively the progress towards the agreed regional targets. In this sense, work is being made on the development of a regional air space model, the evaluation of the implementation status of each State and the identification of improvement opportunities for each CAR Region FIR.

3.2 Additionally, work is being made in the development of a new progress measurement scheme of the regional implementation, with metrics based on clearly established criteria so they can objectively reflect the progress to achieve the agreed implementation targets.

3.3 Among the factors that hinder the achievement of the CAR Region objectives, the following have been identified:

- a) Deficiencies in the implementation planning process at the States level
- b) Lack of qualified personnel for the procedure and air space design tasks, as well as for the safety surveillance tasks; and
- c) Lack of strategic alignment in the activities related to the compliance of the implementation regional plans.

3.4 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 accompanying and guiding States on the Region in PBN implementation and air space design improvements.

3.5 Regarding the PANS-OPS design activities required for the air space and routes optimization in the Region, an expert collaboration process has been developed, and the mutual assistance among States has been strengthened in order to achieve bilateral or multilateral implementation, for example, among Argentina, Brazil, Paraguay and Uruguay.

3.6 Among the factors that hinder the achievement of the SAM Region objectives, the following have been identified:

- a) Lack of specialized software for the PANS-OPS design in 40% of the States; and
- b) Overlap of ATS improvement activities, air space and airports that in some States affect the progress of the GREPECAS A Project in the expected periods.

3.7 Appendices A, B1 and B2 to this working paper show the description of the Project A1 and A2 implementation progress for the CAR and SAM Regions, respectively, based on the PBN programme approved by GREPECAS.

#### **4. Suggested actions**

4.1 The Meeting is invited to:

- a) take note of the information provided in this working paper; and
- b) review project activities and status of implementation in Appendices A, B1 and B2, and formulate other actions as deemed appropriate by the Meeting.

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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)**

<i>CAR Region / Región CAR</i>	<b>PROJECT DESCRIPTION / DESCRIPCION DEL PROYECTO (DP)</b>	<b>DP N° A1</b>	
<i>Programme / Programa</i>	<b>Project Title / Título del Proyecto</b>	<b>Start / Fecha inicio</b>	<b>End / Fecha término</b>
<i>Performance Based Navigation /Navegación basada en la performance (PBN)  Programme Coordinator / Coordinador del Programma: Eddian Mendez)</i>	<i>Performance Based Navigation / Navegación Basada en la Performance (PBN)</i>  Project Coordinator / Coordinador Proyecto: Riaaz Mohamed (Trinidad and Tobago) Experts / Expertos contribuyentes: Carl Gayner (Jamaica) Jose Gil (México) Julio Mejia Alcantara (Dominican Republic) Marco Vidal(IATA)	2008	2017 <u>2018</u> <u>(new date /nueva fecha)</u>
<b>Objective /Objetivo</b>	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)		
<b>Scope /Alcance</b>	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.		

<b>Metrics / Métricas</b>	<ul style="list-style-type: none"> <li>• 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;</li> <li>• Percentage of international aerodromes with implanted SID/STAR RNAV, RNP and continuous descent and climb operations (CDO/CCO);</li> <li>• Estimated fuel saved with operational improvements.</li> <li>• 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;</li> <li>• Porcentaje de aeropuertos internacionales con SID/STAR RNAV, RNP y operaciones de descenso y ascenso continuo (CDO/CCO) implantados;</li> <li>• Ahorros estimados de combustible debidos a mejoras operacionales.</li> </ul>
<b>Strategy / Estrategia</b>	<p>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. /</p> <p>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.</p>
<b>Goals / Metas</b>	<ul style="list-style-type: none"> <li>• Implement RNAV/RNP routes and RNP approach procedures according to Assembly Resolution A37-11 in 2016:</li> <li>• Implement a PBN Airspace Redesign Project (CDOs, CCOs, SIDs, STARs, RNAV/RNP route and RNP approach procedures) in 8 FIRs by December 2018 (new date):</li> <li>• Implementar rutas RNAV/RNP y procedimientos de aproximación RNP de acuerdo a la Resolución de la Asamblea A37-11, en diciembre de 2016;</li> <li>• 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 2018 (nueva fecha)</li> </ul>

<p><b>Justification/ Justificación</b></p>	<p>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.</p> <p>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. /</p> <p>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.</p> <p>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.</p>
<p><b>Related Projects / Proyectos relacionados</b></p>	<ul style="list-style-type: none"><li>• Enhance demand and capacity balancing;</li><li>• Flexible use of airspace;</li><li>• Improve ATM situational awareness;</li><li>• Mejorar el equilibrio entre la demanda y capacidad;</li><li>• Uso flexible del espacio aéreo;</li><li>• Mejorar la conciencia situacional ATM;</li></ul>

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 - 2018 (new date / nueva fecha)	<p>-Up-to-date the regional PBN Airspace concept</p> <p>-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 /</p> <p>Mitigating measures: approved MCAAP project to address this deliverable</p> <p>-Actualizar el Concepto de Espacio Aéreo PBN regional</p> <p>-Los Estados implementan un Proyecto de Rediseño de Espacio Aéreo acorde a los Doc 9613 y 9992 de la OACI, según sea necesario.</p> <p>Acciones de mitigación: Proyecto MCAAP aprobado para atender este entregable</p>
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 2016 Completed / Completado	<p>RNAV 5 Routes implemented in the upper airspace.</p> <p>On-going revision of 8 ATS routes / States to send proposals to ICAO NACC Regional Office by 30 June 2016</p> <p>Rutas RNAV 5 implantadas en el espacio aéreo superior.</p> <p>Revisión de 8 rutas ATS en progreso</p> <p>Los Estados enviarán sus propuestas a la Oficina Regional NACC de la OACI a más tardar el 30 de junio de 2016</p>
Implement SIDs/STARS, CDO	RPO 1	States, Territories,		Propose a new date	On-going revision of TMAs

<p>and CCO in terminal areas based on RNAV/1-2 and RNP1 navigation specifications. / Implementar SIDs/STARS, CDO y CCO en áreas terminales en base a especificaciones de navegación RNAV/1-2 y RNP1</p>		<p>International Organizations / Estados, Territorios, Organizaciones Internacionales</p>		<p>/ Proponer nueva fecha</p>	<p>- Revisión de las TMA en progreso</p>
<p>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</p>	<p>RPO 1</p>	<p>States, Territories, International Organizations / Estados, Territorios, Organizaciones Internacionales</p>		<p>Propose a new date / Proponer nueva fecha</p>	<p>-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.</p>
<p>Analysis of regional feasibility for SBAS (WAAS/SACSA) implementation. / Estudio de factibilidad regional de la implantación del SBAS (WAAS / SACCSA)</p>	<p>RPO 1</p>	<p>Alfredo Mondragón assisted by / asistido por SACCSA and/y WAAS</p>		<p>Completed / Finalizada</p>	<p>-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</p>

Practical guidance for the implementation of GBAS Systems/ Guía práctica para la implementación de sistemas GBAS.	RPO 1	ANI/WG		Propose a new date / Proponer nueva fecha	- Regional agreement to organize GNSS workshop in 2016 -Acuerdo regional para organizar un Taller GNSS en 2016
<b>Required Resources / Recursos necesarios</b>	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				

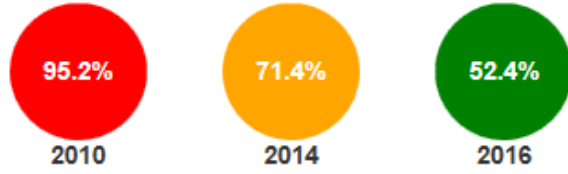
*Grey / Gris: Task not started / Tarea no iniciada;*

*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;*

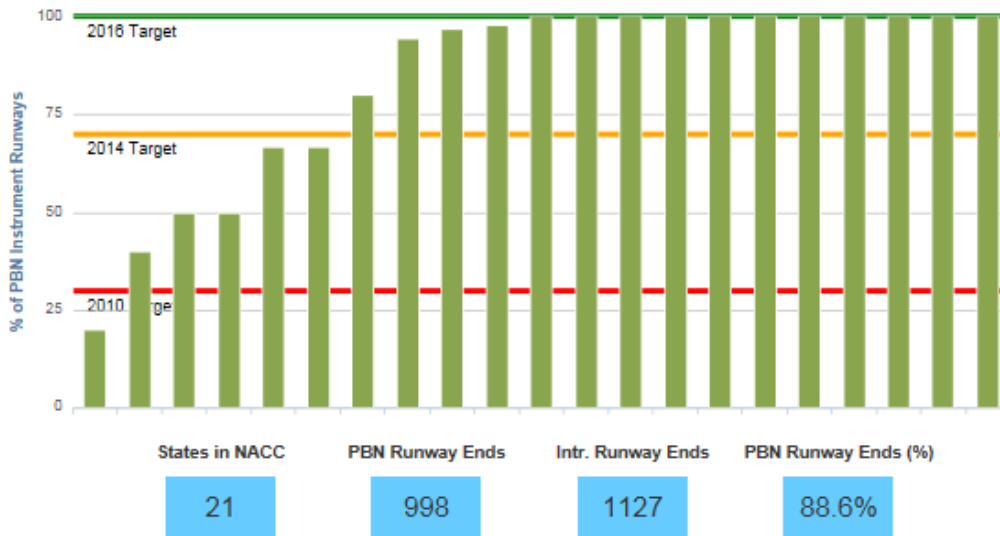
*Red / Rojo: It has not been posible to implement this activity as scheduled; mitigating measures are required / No se ha logrado la implantación de la actividad en el lapso de tiempo estimado se requiere adoptar medidas mitigatorias.*

85.4% **the Resolution Targets for Applicable Years**



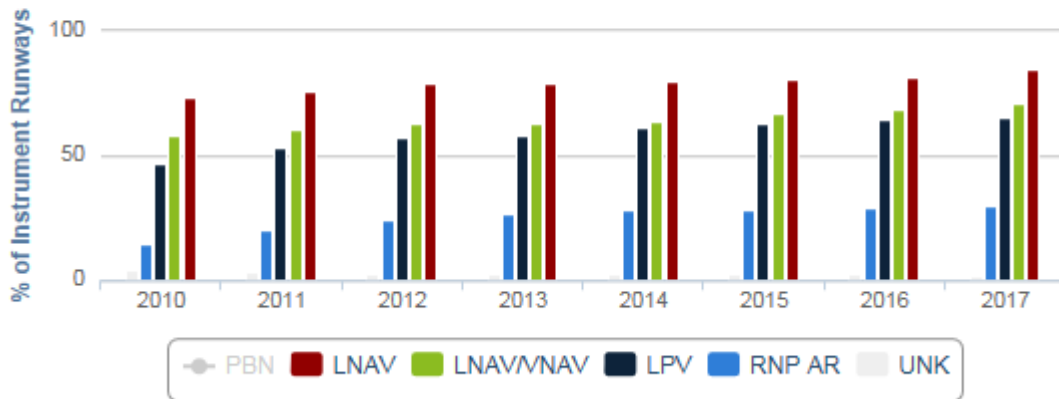
**Regional PBN Implementation**

% of PBN Runways per Country for NACC



**PBN Trends**

% of PBN Runways by type for NACC



## APPENDIX B1

## PROJECT A1 FOR THE SAM REGION – PBN OPERATIONAL IMPLEMENTATION

<i>SAM Region</i>	PROJECT DESCRIPTION (PD)	PD N° A1	
<i>Programme</i>	Project Title	Start	End
<i>SAM airspace optimisation</i>  (Programme coordinator: ATM RO Fernando Hermoza Hübner)	PBN operational implementation  <i>Project coordinator:            Julio Cesar de Souza Pereira (IATA)</i>	2011	2019
<b>Objective</b>	Support the optimisation of the SAM airspace structure through the optimisation of the ATS route structure in terminal airspace (RNAV/RNP SID/STARs) and en-route (RNAV/RNP), as well as the implementation of PBN approaches in accordance with ICAO Assembly Resolution A37-11, with a view to attaining the goals set forth in the Declaration of Bogota.		
<b>Scope</b>	The implementation project contemplates the optimisation of the SAM airspace through PBN implementation and the application of the flexible use of airspace (FUA) concept, as well as phased optimisation of the ATS route network of the Region.		
<b>Metrics</b>	<ul style="list-style-type: none"> <li>• Reduction of CO<sub>2</sub> emissions per each route optimisation version, in tonnes.</li> <li>• Percentage of international airports with RNAV and/or RNP SID/STARs implemented.</li> <li>• Percentage of international airports with continuous descent and climb operations implemented.</li> <li>• Number of RNAV/RNP routes implemented, realigned and/or eliminated.</li> <li>• Percentage of thresholds with APV approaches at international airports.</li> </ul>		

<b>Strategy</b>	<p>Project activities will be coordinated among Project members, the Project coordinator and the Programme coordinator through SAM/IG meetings, ATS route optimisation (ATS/RO) meetings and other events deemed necessary (PBN workshops, hiring of experts, etc.). The Project coordinator will coordinate with the Programme coordinator the incorporation of additional experts if so required by the tasks and work to be performed. Likewise, States must review their respective national PBN implementation programmes to ensure they are compatible with the SAM PBN project. Activities to review, implement, modify or eliminate routes in the SAM Region have been scheduled in order to continue optimising the ATS route structure.</p>
<b>Goals</b>	<ul style="list-style-type: none"><li>• Implementation of Version 3 of the PBN-based ATS route network in order to respond to current airspace user requirements by the end of 2017.</li><li>• Achievement of the goals set forth in the Declaration of Bogota.</li><li>• PBN-based redesign of 30% of the main SAM TMAs by 2016, 50% by 2018.</li><li>• Development of Version 4 of the PBN-based ATS route network and design of PBN-based TMAs.</li><li>• Optimisation of longitudinal separation.</li></ul>

<p><b>Rationale</b></p>	<p>The 37<sup>th</sup> ICAO General Assembly formulated Resolution A37-11 (<i>Performance-based navigation global goals</i>) in which it took note that the Planning and Implementation Regional Groups (PIRG) had completed regional PBN implementation plans and urged States to implement RNAV and RNP air traffic service (ATS) routes and approach procedures in accordance with ICAO PBN concept laid down in the Performance-based navigation (PBN) manual (Doc 9613), and resolved that States should complete a PBN implementation plan as a matter of urgency to achieve:</p> <ol style="list-style-type: none"> <li>1) implementation of RNAV and RNP operations (where required) for en-route and terminal areas according to established timelines and intermediate milestones;</li> <li>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 and 70% by 2014; and</li> <li>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 certified take-off mass of 5 700 kg or more.</li> </ol> <p>Furthermore, the Global air navigation plan (GANP), Chapter 2 (implementation) defines performance-based navigation as its main priority. The GANP specifies that <i>“the introduction of PBN met the expectations of all the aviation community. Current implementation plans should help provide additional benefits, but they are still subject to the availability of proper training, the provision of specialised support by the States, continuing maintenance and development of international standards and recommended practices (SARPs) and closer coordination between States and aviation stakeholders.”</i></p> <p>Accordingly, this project provides specialised support and close coordination between States and other stakeholders to ensure harmonised PBN implementation in all the corresponding flight phases: en-route, TMA and approach.</p>
<p><b>Related projects</b></p>	<ul style="list-style-type: none"> <li>• Flexible use of airspace</li> <li>• Automation</li> <li>• Air navigation systems in support of PBN</li> </ul>

Project deliverables	Relationship with the regional performance-based plan	Responsible party	Status of implementation*	Date of delivery	Comments
Implementation of Version 1 of the ATS route network based on RNAV, with the required PBN values to respond to the current requirements of airspace users.	B0-FRTO	Alexandre Luiz Dutra Bastos		October 2010 FINALISED	
Implementation of RNAV5 in the SAM Region	B0-FRTO	Alexandre Luiz Dutra Bastos		October 2011 FINALISED	
Action plan for the implementation of Version 2 of the ATS route network optimisation programme	B0-FRTO	Alexandre Luiz Dutra Bastos		ATSRO/3 FINALISED	

Traffic data to understand airspace traffic flows	B0-FRTO	ICAO coordinator		SAM/IG/6 FINALISED	
Navigation capacity of the fleet	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		SAM/IG/9 FINALISED	
List of gateways of the main SAM TMAs	PFF SAM ATM 02	Alexandre Luiz Dutra Bastos		SAM/IG/9	Assistance was provided to States for the redesign of their TMAs in order to expedite PBN implementation, by training their experts in airspace planning. Several States are delayed in 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 with a view to developing Version 2 of the route network	B0-FRTO	Alexandre Luiz Dutra Bastos		April 2012 FINALISED	
Risk analysis for the implementation of Version 2 of the ATSRO programme	B0-FRTO	External consultants		SAM/IG/10 FINALISED	
<b><u>SAM Route Network Optimisation</u></b>					
Planning of Version 3 - Stage 1	B0-FRTO	External consultants		SAM/IG/14 FINALISED	

Implementation Version 3 - Stage 1 - Flow 1 (Argentina -Chile - Paraguay)	B0-FRTO	States SAM Regional Office		April 2015 FINALISED	
Implementation Version 3 - Stage 1 - Flow 2 (Argentina –Brazil - Uruguay)	B0-FRTO	States SAM Regional Office		March 2017 FINALISED	The optimisation of this traffic flow is delayed.
Implementation Version 3 - Stage 1 - Flow 3 (Panama - CENAMER - Caribbean)	B0-FRTO	States SAM Regional Office		March 2017 FINALISED	Coordination started with CAR States. The optimisation of this traffic flow is delayed. Panama will start the TMA and FIR airspace optimisation process. Improvements between Panama – Jamaica were coordinated at ATSRO/8.
Implementation Version 3 - Stage 1 - Flow 3 (Brazil -Guyana – French Guiana - Suriname - Venezuela - Caribe)	B0-FRTO	States SAM Regional Office		October 2016 FINALISED	The optimisation of the main flows has been coordinated.
Airspace concept Version 3 – Stage 2	B0-FRTO	States SAM Regional Office		ATSRO/7 FINALISED	The validated PBN airspace concept of the main SAM TMAs was agreed upon
Implementation Version 3 – Stage 2	B0-FRTO	States SAM Regional Office		November 2017 FINALISED	In October 2016. Routes not directly related to TMA re-structuring were implemented. The remaining initiatives were transferred to Version 4.

<p>Development of the PBN route structure operational concept (ATS routes, SIDs, STARs) for the period 2017-2019</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>November 2016 FINALISED</p>	<p>Hiring of experts and invitation to States to contribute with human resources. The CONOPS has been presented at the SAM/IG/19 and ATSRO/8 meetings</p>
<p>Regional strategy and work programme for the implementation of the flexible use of airspace through a phased approach, starting with an increasingly dynamic sharing of reserved airspace.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2013-2018</p>	<p>The flexible use of airspace is being enhanced through route optimisation.</p>
<p>Reduction of conventional longitudinal separation from 80 to 40 NM for GNSS-equipped aircraft.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2016-2017</p>	<p>Significant progress has been made in this task, which is expected for completion on time. Some States like Venezuela depend on action taken by adjacent CAR States. A regional workshop was held in November 2017, where activities were designed to consolidate implementation.</p>
<p>Reduction of conventional longitudinal separation from 40 to 20 NM for GNSS-equipped aircraft.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2017-2019</p>	<p>A proposal of Action Plan for the implementation of 20-NM separation minima was agreed at the regional workshop held in November 2017. Brazil started applying this minimum ONLY for aircraft ENTERING its FIRs, on continental airspace.</p>
<p>Reduction of conventional longitudinal separation from 20 to 10 NM for scenarios in which ATS surveillance systems are used that cover the boundaries of the FIRs under consideration.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2019 2020 - 2021</p>	

<b><u>PBN TMA</u></b>					
Updating of action plans. PBN implementation in the main TMAs	PFF SAM ATM 02	States		May 2017 FINALISED	Conclusion SAM/IG/14-6. 100% of States have updated their action plans.
Updating of the status of implementation of PBN SIDs/STARs	PFF SAM ATM 02	States		September 2017	Yearly update prior to 30 June and prior to 31 December, in accordance with Conclusion SAM/IG/14-4. Tables were updated at the ATSRO/08 meeting. No information is available for French Guiana.
Updating of Table AOP-1	PFF SAM ATM 02	States		TBD	Conclusion SAM/IG/15-3.
<b><u>Approach</u></b>					
Updating of the status of implementation of APV IAC	PFF SAM ATM 03 B0 APTA	States		30 June 2019	Yearly update prior to 30 June and prior to 31 December, in accordance with Conclusion SAM/IG/14-4. Implementation of RNP APCH procedures with Baro-VNAV vertical guidance or RNP AR APCH must be reported. Tables were updated at the ATSRO/8 meeting. No information is available for French Guiana.

<b><u>Meetings/Workshops</u></b>					
SAM/IG/07	PFF SAM ATM	States SAM Regional Office		May 2011 FINALISED	SAM PBN implementation group
SAM/IG/08	PFF SAM ATM	States SAM Regional Office		October 2011 FINALISED	SAM PBN implementation group
SAM/IG/09	PFF SAM ATM	States SAM Regional Office		Mayo 2012 FINALISED	SAM PBN implementation group
SAM/IG/10	PFF SAM ATM	States SAM Regional Office		October 2012 FINALISED	SAM PBN implementation group
SAM/IG/11	PFF SAM ATM	States SAM Regional Office		May 2013 FINALISED	SAM PBN implementation group
SAM/IG/12	PFF SAM ATM	States SAM Regional Office		October 2013 FINALISED	SAM PBN implementation group
SAM/IG/13	PFF SAM ATM	States SAM Regional Office		Mayo 2014 FINALISED	SAM PBN implementation group
SAM/IG/14	PFF SAM ATM	States SAM Regional Office		October 2014 FINALISED	SAM PBN implementation group

SAM/IG/15	PFF SAM ATM	States SAM Regional Office		May 2015 FINALISED	SAM PBN implementation group
SAM/IG/16	PFF SAM ATM	States SAM Regional Office		October 2015 FINALISED	SAM PBN implementation group
SAM/IG/17	PFF SAM ATM	States SAM Regional Office		May 2016 FINALISED	SAM PBN implementation group
SAM/IG/18	PFF SAM ATM	States SAM Regional Office		October 2016 FINALISED	SAM PBN implementation group
SAM/IG/19	PFF SAM ATM	States SAM Regional Office		May 2017 FINALISED	SAM PBN implementation group
ATSRO/03	PFF SAM ATM 03	States SAM Regional Office		July 2011 FINALISED	SAM route network optimisation
ATSRO/04	PFF SAM ATM 03	States SAM Regional Office		July 2012 FINALISED	SAM route network optimisation
ATSRO/05	PFF SAM ATM 03	States SAM Regional Office		July 2013 FINALISED	SAM route network optimisation
ATSRO/06	PFF SAM ATM 03	States SAM Regional Office		October 2014 FINALISED	SAM route network optimisation

ATSRO/07	PFF SAM ATM 03	States SAM Regional Office		October 2015 FINALISED	SAM route network optimisation
ATSRO/08	PFF SAM ATM 03	States SAM Regional Office		September 2017 FINALISED	- Held on 11-15 September 2017. Implementation of Version 4 of the route network was begun.
ATSRO/09	PFF SAM ATM 03	States SAM Regional Office		July 2018	SAM route network optimisation
Hiring of experts for consolidation of Version 4 of the SAM ATS route network	PFF SAM ATM 03	States SAM Regional Office		June 2017 FINALISED	- Two experts from the Region were hired. The Route Network Version 4 deliverable was developed with 91 route improvement initiatives.
Hiring of experts for consolidation of Version 5 of the SAM ATS route network	PFF SAM ATM 03	States SAM Regional Office		September 2018	SAM route network optimisation
Workshop on PBN airspace planning	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		March 2013 FINALISED	Initial training in the PBN airspace planning process.
PBN/1 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		May 2014 FINALISED	Objective: Preliminary PBN training and design of the Asunción and Bogota TMA.s.
PBN/2 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2014 FINALISED	Objective: Preliminary PBN design of the main South American TMA.s.
PBN/3 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		March 2015 FINALISED	Objective: Validation of the preliminary PBN design of the main South American TMA.s.

PBN/4 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2015 FINALISED	Objective: Guide PBN implementation at the main South American TMAs.
PBN/IMP/1 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		April 2016 FINALISED	Review the status of implementation in States whose implementation date was the first semester of 2016.
PBN/IMP/2 workshop and related PANS-OPS activities	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2016 FINALISED	Review the status of implementation in States whose implementation date is the second half of 2016 and carry out the related PANS-OPS activities.
<b><u>Others</u></b>					
Updating and submission of the National PBN implementation plan to the Regional Office	B0 APTA B0 CCO B0 CDO	States		SAM/IG/15	93% of States have completed the task. French Guiana is still pending. Headquarters has requested the delivery of the national PBN implementation plans.
<b>Resources needed</b>	Designation of experts for completion of some of the deliverables.				

\*

**Grey*****Task not started yet*****Green*****Activity being implemented as scheduled*****Yellow*****Activity started with some delay, but will be implemented on time*****Red*****Activity not implemented on time; mitigation measures are required***

## APPENDIX B2

## PROJECT A2 – AIR NAVIGATION SYSTEMS IN SUPPORT OF PBN

SAM Region	PROJECT DESCRIPTION (DP)	DP N° A2	
<i>Programme</i>	Project Title	Start	End
PBN  <i>(Programme coordinator: ATM RO Fernando Hermoza)</i>	Air navigation systems in support of PBN  <i>Project coordinator:            Julio César de Souza Pereira Pereira (IATA)</i>  <i>Experts contributing to the Project: Alessander Santoro, Andre Jansen, Fabio Augusto Andrade (Brazil), Paulo Vila, Tomas Macedo (Peru) and SAM/IG SAM PBN Group</i>	January 2011	December  2018
<b>Objective</b>	Develop guides, conduct analyses and implement services in support of PBN implementation in the SAM Region.		
<b>Scope</b>	Support to PBN implementation in the SAM Region, initially consisting of: <ul style="list-style-type: none"> <li>• Practical guide for the implementation of GBAS systems.</li> <li>• Analysis of DME/DME coverage to support PBN procedures.</li> <li>• Implementation of a RAIM availability prediction service.</li> </ul>		
<b>Metrics</b>	<ul style="list-style-type: none"> <li>• Drafting of a practical guide for the implementation of a GBAS system.</li> <li>• DME/DME coverage in the SAM Region.</li> <li>• Availability of a RAIM availability prediction service.</li> <li>• % States providing the RAIM availability service.</li> </ul>		
<b>Strategy</b>	<ul style="list-style-type: none"> <li>• All activities will be conducted by experts designated by SAM States and organisations participating in the project entitled “<i>Air navigation systems in support of PBN</i>”, 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, the project coordinator and the contributing experts can meet at the SAM/IG implementation meetings.</li> <li>• 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.</li> </ul>		

<b>Goals</b>	<ul style="list-style-type: none"> <li>• Guide for the implementation of a GBAS system, by October 2012. (Revision November 2016).</li> <li>• Assessment of DME/DME coverage to support PBN procedures, by May 2011.</li> <li>• RAIM availability prediction service in the SAM Region implemented by September 2014.</li> <li>• 11 SAM States with RAIM availability prediction service available by February 2014.</li> <li>• 3 SAM States and one territory with the service available by the end of 2014.</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• This project contributes to the implementation of SAM PFF CNS 03, ATM 01, ATM 02, and ATM 03 of the <i>SAM Performance-based navigation system implementation plan (SAM PBIP)</i>.</li> </ul>
<b>Related projects</b>	<ul style="list-style-type: none"> <li>• Implementation of PBN operational aspects.</li> </ul>

<b>Project deliverables</b>	<b>Relationship with the performance-based regional plan and ASBU block 0 modules</b>	<b>Responsible party</b>	<b>Status of implementation</b>	<b>Delivery date</b>	<b>Comments</b>
<i>Develop a practical guide for the implementation of the GBAS system</i>					
Review of practical guide for the implementation of GBAS systems	SAM PFF CNS 03 ANRF B0-APTA (65)	Alessander Santoro (Brazil)		December  2018	The practical guide for the implementation of GBAS systems was presented for review at SAM/IG/8 meeting. It 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, joint work was undertaken using the SLS-4000 station and other 110 GPS L1 and L2 stations installed in Brazil. Data was collected over a period of maximum solar activity, although it was the lowest in the

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
					<p>last 100 years.                      From the data obtained, Brazil concluded that so far, the SLS-4000 station may not be used in full for CAT I operations in low latitude regions. Accordingly, ICEA (<i>Instituto de Control del Espacio Aéreo</i>) will continue research in cooperation with the FAA and the supplier (Honeywell), seeking to develop a risk model capable of withstanding ionosphere behaviour in low latitudes.</p> <p>As of December 2017, the SLS-4000 station does not meet ICAO's integrity and availability requirements.</p> <p>Brazil continues research in collaboration with universities and Honeywell, seeking to develop a risk model applicable to the SAM Region.</p> <p>A review of the practical guide for the implementation of the GBAS system will follow after completing the development of a risk model capable of withstanding ionosphere behaviour at low latitudes.</p> <p>This is to be completed by the last quarter of 2018.</p>

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
<i>Analyse DME/DME and GNSS infrastructure and coverage needed to support PBN implementation</i>					
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 Tomás Macedo (Peru)		Coverage study to support RNAV-5 completed (SAM/IG/8, October 2011)	A <i>DME/DME coverage study</i> 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 <i>Google Earth</i> . The study only supports the RNAV-5 procedure.
<i>Development of guidance on the use and availability of GNSS performance forecast/validation tools.</i>					

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
Implementation of a RAIM availability prediction service	SAMPFF CNS/03 SAM PFF ATM/01 ATM/02 ATM/03 ANRF B0-APTA (65), B0-FRTO(10) B0-CDO(05) and B0-CCO(20)	Project coordinator SAM/IG PBN Group		November 2014	<p>Two web-based remote 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 RAIM availability prediction service website (SATDIS), the code assignment procedure, data import and export, and the query and failure resolution procedure. The course was attended by all focal points nominated by the States, as well as by other participants designated by the States.</p> <p>All focal points received from the service provider the respective user name and password to access SATDIS as administrators.</p> <p>The SATDIS website in three languages (Spanish, Portuguese and English), became operational on 17 September 2014.</p> <p>The SATDIS FSAT was conducted on 18 November 2014.</p> <p>The RAIM availability prediction service is operating since 16 November 2014.</p>

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
Monitor activities for the implementation of air navigation systems in support of PBN		ICAO		January 2011 - December 2018	
Resources needed	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

## APPENDIX A / APÉNDICE A

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

<i>CAR Region / Región CAR</i>	<b>PROJECT DESCRIPTION / DESCRIPCION DEL PROYECTO (DP)</b>	<b>DP N° A1</b>	
<i>Programme / Programa</i>	<b>Project Title / Título del Proyecto</b>	<b>Start / Fecha inicio</b>	<b>End / Fecha término</b>
<i>Performance Based Navigation /Navegación basada en la performance (PBN)  Programme Coordinator / Coordinador del Programma: Eddian Mendez)</i>	<i>Performance Based Navigation / Navegación Basada en la Performance (PBN)</i>  Project Coordinator / Coordinador Proyecto: Riaaz Mohamed (Trinidad and Tobago) Experts / Expertos contribuyentes: Carl Gayner (Jamaica) Jose Gil (México) Julio Mejia Alcantara (Dominican Republic) Marco Vidal(IATA)	2008	2017 <u>2018</u> <u>(new date /nueva fecha)</u>
<b>Objective /Objetivo</b>	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)		
<b>Scope /Alcance</b>	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.		

<b>Metrics / Métricas</b>	<ul style="list-style-type: none"> <li>• 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;</li> <li>• Percentage of international aerodromes with implanted SID/STAR RNAV, RNP and continuous descent and climb operations (CDO/CCO);</li> <li>• Estimated fuel saved with operational improvements.</li> <li>• 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;</li> <li>• Porcentaje de aeropuertos internacionales con SID/STAR RNAV, RNP y operaciones de descenso y ascenso continuo (CDO/CCO) implantados;</li> <li>• Ahorros estimados de combustible debidos a mejoras operacionales.</li> </ul>
<b>Strategy / Estrategia</b>	<p>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. /</p> <p>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.</p>
<b>Goals / Metas</b>	<ul style="list-style-type: none"> <li>• Implement RNAV/RNP routes and RNP approach procedures according to Assembly Resolution A37-11 in 2016:</li> <li>• Implement a PBN Airspace Redesign Project (CDOs, CCOs, SIDs, STARs, RNAV/RNP route and RNP approach procedures) in 8 FIRs by December 2018 (new date):</li> <li>• Implementar rutas RNAV/RNP y procedimientos de aproximación RNP de acuerdo a la Resolución de la Asamblea A37-11, en diciembre de 2016;</li> <li>• 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 2018 (nueva fecha)</li> </ul>

<p><b>Justification/ Justificación</b></p>	<p>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.</p> <p>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. /</p> <p>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.</p> <p>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.</p>
<p><b>Related Projects / Proyectos relacionados</b></p>	<ul style="list-style-type: none"><li>• Enhance demand and capacity balancing;</li><li>• Flexible use of airspace;</li><li>• Improve ATM situational awareness;</li><li>• Mejorar el equilibrio entre la demanda y capacidad;</li><li>• Uso flexible del espacio aéreo;</li><li>• Mejorar la conciencia situacional ATM;</li></ul>

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 - 2018 (new date / nueva fecha)	<p>-Up-to-date the regional PBN Airspace concept</p> <p>-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 /</p> <p>Mitigating measures: approved MCAAP project to address this deliverable</p> <p>-Actualizar el Concepto de Espacio Aéreo PBN regional</p> <p>-Los Estados implementan un Proyecto de Rediseño de Espacio Aéreo acorde a los Doc 9613 y 9992 de la OACI, según sea necesario.</p> <p>Acciones de mitigación: Proyecto MCAAP aprobado para atender este entregable</p>
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 2016 Completed / Completado	<p>RNAV 5 Routes implemented in the upper airspace.</p> <p>On-going revision of 8 ATS routes / States to send proposals to ICAO NACC Regional Office by 30 June 2016</p> <p>Rutas RNAV 5 implantadas en el espacio aéreo superior.</p> <p>Revisión de 8 rutas ATS en progreso</p> <p>Los Estados enviarán sus propuestas a la Oficina Regional NACC de la OACI a más tardar el 30 de junio de 2016</p>
Implement SIDs/STARS, CDO	RPO 1	States, Territories,		Propose a new date	On-going revision of TMAs

<p>and CCO in terminal areas based on RNAV/1-2 and RNP1 navigation specifications. / Implementar SIDs/STARS, CDO y CCO en áreas terminales en base a especificaciones de navegación RNAV/1-2 y RNP1</p>		<p>International Organizations / Estados, Territorios, Organizaciones Internacionales</p>		<p>/ Proponer nueva fecha</p>	<p>- Revisión de las TMA en progreso</p>
<p>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</p>	<p>RPO 1</p>	<p>States, Territories, International Organizations / Estados, Territorios, Organizaciones Internacionales</p>		<p>Propose a new date / Proponer nueva fecha</p>	<p>-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.</p>
<p>Analysis of regional feasibility for SBAS (WAAS/SACSA) implementation. / Estudio de factibilidad regional de la implantación del SBAS (WAAS / SACCSA)</p>	<p>RPO 1</p>	<p>Alfredo Mondragón assisted by / asistido por SACCSA and/y WAAS</p>		<p>Completed / Finalizada</p>	<p>-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</p>

Practical guidance for the implementation of GBAS Systems/ Guía práctica para la implementación de sistemas GBAS.	RPO 1	ANI/WG		Propose a new date / Proponer nueva fecha	- Regional agreement to organize GNSS workshop in 2016 -Acuerdo regional para organizar un Taller GNSS en 2016
<b>Required Resources / Recursos necesarios</b>	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				

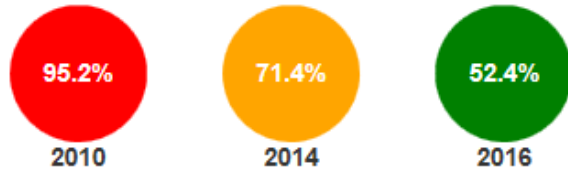
*Grey / Gris: Task not started / Tarea no iniciada;*

*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;*

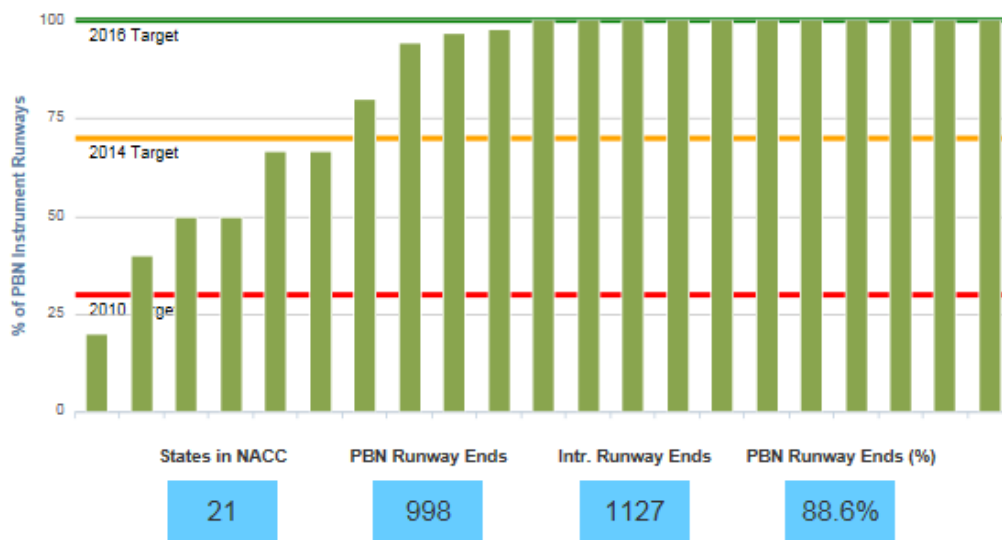
*Red / Rojo: It has not been posible to implement this activity as scheduled; mitigating measures are required / No se ha logrado la implantación de la actividad en el lapso de tiempo estimado se requiere adoptar medidas mitigatorias.*

85.4% **the Resolution Targets for Applicable Years**



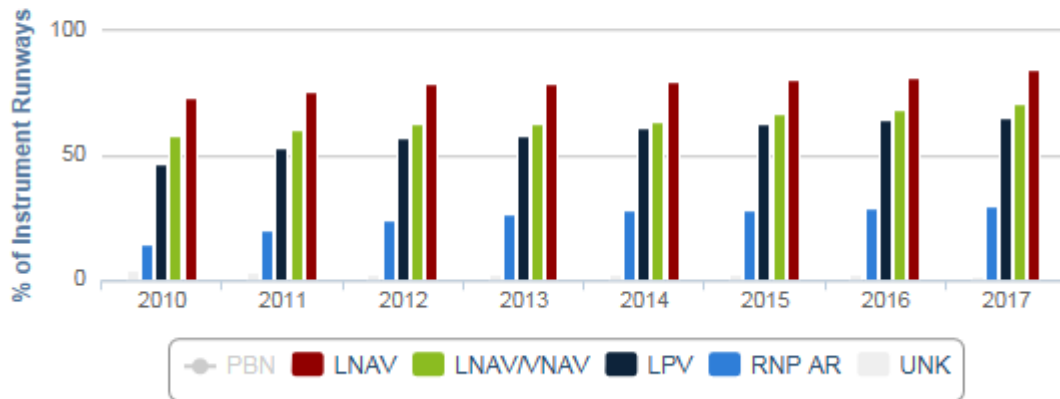
**Regional PBN Implementation**

% of PBN Runways per Country for NACC



**PBN Trends**

% of PBN Runways by type for NACC



## APPENDIX B1

## PROJECT A1 FOR THE SAM REGION – PBN OPERATIONAL IMPLEMENTATION

<i>SAM Region</i>	PROJECT DESCRIPTION (PD)	PD N° A1	
<i>Programme</i>	Project Title	Start	End
<i>SAM airspace optimisation</i>  (Programme coordinator: ATM RO Fernando Hermoza Hübner)	PBN operational implementation  <i>Project coordinator:            Julio Cesar de Souza Pereira (IATA)</i>	2011	2019
<b>Objective</b>	Support the optimisation of the SAM airspace structure through the optimisation of the ATS route structure in terminal airspace (RNAV/RNP SIDs/STARs) and en-route (RNAV/RNP), as well as the implementation of PBN approaches in accordance with ICAO Assembly Resolution A37-11, with a view to attaining the goals set forth in the Declaration of Bogota.		
<b>Scope</b>	The implementation project contemplates the optimisation of the SAM airspace through PBN implementation and the application of the flexible use of airspace (FUA) concept, as well as phased optimisation of the ATS route network of the Region.		
<b>Metrics</b>	<ul style="list-style-type: none"> <li>• Reduction of CO<sub>2</sub> emissions per each route optimisation version, in tonnes.</li> <li>• Percentage of international airports with RNAV and/or RNP SIDs/STARs implemented.</li> <li>• Percentage of international airports with continuous descent and climb operations implemented.</li> <li>• Number of RNAV/RNP routes implemented, realigned and/or eliminated.</li> <li>• Percentage of thresholds with APV approaches at international airports.</li> </ul>		

<b>Strategy</b>	<p>Project activities will be coordinated among Project members, the Project coordinator and the Programme coordinator through SAM/IG meetings, ATS route optimisation (ATS/RO) meetings and other events deemed necessary (PBN workshops, hiring of experts, etc.). The Project coordinator will coordinate with the Programme coordinator the incorporation of additional experts if so required by the tasks and work to be performed. Likewise, States must review their respective national PBN implementation programmes to ensure they are compatible with the SAM PBN project. Activities to review, implement, modify or eliminate routes in the SAM Region have been scheduled in order to continue optimising the ATS route structure.</p>
<b>Goals</b>	<ul style="list-style-type: none"><li>• Implementation of Version 3 of the PBN-based ATS route network in order to respond to current airspace user requirements by the end of 2017.</li><li>• Achievement of the goals set forth in the Declaration of Bogota.</li><li>• PBN-based redesign of 30% of the main SAM TMAs by 2016, 50% by 2018.</li><li>• Development of Version 4 of the PBN-based ATS route network and design of PBN-based TMAs.</li><li>• Optimisation of longitudinal separation.</li></ul>

<p><b>Rationale</b></p>	<p>The 37<sup>th</sup> ICAO General Assembly formulated Resolution A37-11 (<i>Performance-based navigation global goals</i>) in which it took note that the Planning and Implementation Regional Groups (PIRG) had completed regional PBN implementation plans and urged States to implement RNAV and RNP air traffic service (ATS) routes and approach procedures in accordance with ICAO PBN concept laid down in the Performance-based navigation (PBN) manual (Doc 9613), and resolved that States should complete a PBN implementation plan as a matter of urgency to achieve:</p> <ol style="list-style-type: none"> <li>1) implementation of RNAV and RNP operations (where required) for en-route and terminal areas according to established timelines and intermediate milestones;</li> <li>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 and 70% by 2014; and</li> <li>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 certified take-off mass of 5 700 kg or more.</li> </ol> <p>Furthermore, the Global air navigation plan (GANP), Chapter 2 (implementation) defines performance-based navigation as its main priority. The GANP specifies that <i>“the introduction of PBN met the expectations of all the aviation community. Current implementation plans should help provide additional benefits, but they are still subject to the availability of proper training, the provision of specialised support by the States, continuing maintenance and development of international standards and recommended practices (SARPs) and closer coordination between States and aviation stakeholders.”</i></p> <p>Accordingly, this project provides specialised support and close coordination between States and other stakeholders to ensure harmonised PBN implementation in all the corresponding flight phases: en-route, TMA and approach.</p>
<p><b>Related projects</b></p>	<ul style="list-style-type: none"> <li>• Flexible use of airspace</li> <li>• Automation</li> <li>• Air navigation systems in support of PBN</li> </ul>

Project deliverables	Relationship with the regional performance-based plan	Responsible party	Status of implementation*	Date of delivery	Comments
Implementation of Version 1 of the ATS route network based on RNAV, with the required PBN values to respond to the current requirements of airspace users.	B0-FRTO	Alexandre Luiz Dutra Bastos		October 2010 FINALISED	
Implementation of RNAV5 in the SAM Region	B0-FRTO	Alexandre Luiz Dutra Bastos		October 2011 FINALISED	
Action plan for the implementation of Version 2 of the ATS route network optimisation programme	B0-FRTO	Alexandre Luiz Dutra Bastos		ATSRO/3 FINALISED	

Traffic data to understand airspace traffic flows	B0-FRTO	ICAO coordinator		SAM/IG/6 FINALISED	
Navigation capacity of the fleet	PFF SAM ATM 01	Alexandre Luiz Dutra Bastos		SAM/IG/9 FINALISED	
List of gateways of the main SAM TMAs	PFF SAM ATM 02	Alexandre Luiz Dutra Bastos		SAM/IG/9	Assistance was provided to States for the redesign of their TMAs in order to expedite PBN implementation, by training their experts in airspace planning. Several States are delayed in 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 with a view to developing Version 2 of the route network	B0-FRTO	Alexandre Luiz Dutra Bastos		April 2012 FINALISED	
Risk analysis for the implementation of Version 2 of the ATSRO programme	B0-FRTO	External consultants		SAM/IG/10 FINALISED	
<b><u>SAM Route Network Optimisation</u></b>					
Planning of Version 3 - Stage 1	B0-FRTO	External consultants		SAM/IG/14 FINALISED	

Implementation Version 3 - Stage 1 - Flow 1 (Argentina -Chile - Paraguay)	B0-FRTO	States SAM Regional Office		April 2015 FINALISED	
Implementation Version 3 - Stage 1 - Flow 2 (Argentina –Brazil - Uruguay)	B0-FRTO	States SAM Regional Office		March 2017 FINALISED	The optimisation of this traffic flow is delayed.
Implementation Version 3 - Stage 1 - Flow 3 (Panama - CENAMER - Caribbean)	B0-FRTO	States SAM Regional Office		March 2017 FINALISED	Coordination started with CAR States. The optimisation of this traffic flow is delayed. Panama will start the TMA and FIR airspace optimisation process. Improvements between Panama – Jamaica were coordinated at ATSRO/8.
Implementation Version 3 - Stage 1 - Flow 3 (Brazil -Guyana – French Guiana - Suriname - Venezuela - Caribe)	B0-FRTO	States SAM Regional Office		October 2016 FINALISED	The optimisation of the main flows has been coordinated.
Airspace concept Version 3 – Stage 2	B0-FRTO	States SAM Regional Office		ATSRO/7 FINALISED	The validated PBN airspace concept of the main SAM TMAs was agreed upon
Implementation Version 3 – Stage 2	B0-FRTO	States SAM Regional Office		November 2017 FINALISED	In October 2016. Routes not directly related to TMA re-structuring were implemented. The remaining initiatives were transferred to Version 4.

<p>Development of the PBN route structure operational concept (ATS routes, SIDs, STARs) for the period 2017-2019</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>November 2016 FINALISED</p>	<p>Hiring of experts and invitation to States to contribute with human resources. The CONOPS has been presented at the SAM/IG/19 and ATSRO/8 meetings</p>
<p>Regional strategy and work programme for the implementation of the flexible use of airspace through a phased approach, starting with an increasingly dynamic sharing of reserved airspace.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2013-2018</p>	<p>The flexible use of airspace is being enhanced through route optimisation.</p>
<p>Reduction of conventional longitudinal separation from 80 to 40 NM for GNSS-equipped aircraft.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2016-2017</p>	<p>Significant progress has been made in this task, which is expected for completion on time. Some States like Venezuela depend on action taken by adjacent CAR States. A regional workshop was held in November 2017, where activities were designed to consolidate implementation.</p>
<p>Reduction of conventional longitudinal separation from 40 to 20 NM for GNSS-equipped aircraft.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2017-2019</p>	<p>A proposal of Action Plan for the implementation of 20-NM separation minima was agreed at the regional workshop held in November 2017. Brazil started applying this minimum ONLY for aircraft ENTERING its FIRs, on continental airspace.</p>
<p>Reduction of conventional longitudinal separation from 20 to 10 NM for scenarios in which ATS surveillance systems are used that cover the boundaries of the FIRs under consideration.</p>	<p>B0-FRTO</p>	<p>States SAM Regional Office</p>		<p>2019 2020 - 2021</p>	

<b><u>PBN TMA</u></b>					
Updating of action plans. PBN implementation in the main TMAs	PFF SAM ATM 02	States		May 2017 FINALISED	Conclusion SAM/IG/14-6. 100% of States have updated their action plans.
Updating of the status of implementation of PBN SIDs/STARs	PFF SAM ATM 02	States		September 2017	Yearly update prior to 30 June and prior to 31 December, in accordance with Conclusion SAM/IG/14-4. Tables were updated at the ATSRO/08 meeting. No information is available for French Guiana.
Updating of Table AOP-1	PFF SAM ATM 02	States		TBD	Conclusion SAM/IG/15-3.
<b><u>Approach</u></b>					
Updating of the status of implementation of APV IAC	PFF SAM ATM 03 B0 APTA	States		30 June 2019	Yearly update prior to 30 June and prior to 31 December, in accordance with Conclusion SAM/IG/14-4. Implementation of RNP APCH procedures with Baro-VNAV vertical guidance or RNP AR APCH must be reported. Tables were updated at the ATSRO/8 meeting. No information is available for French Guiana.

<b><u>Meetings/Workshops</u></b>					
SAM/IG/07	PFF SAM ATM	States SAM Regional Office		May 2011 FINALISED	SAM PBN implementation group
SAM/IG/08	PFF SAM ATM	States SAM Regional Office		October 2011 FINALISED	SAM PBN implementation group
SAM/IG/09	PFF SAM ATM	States SAM Regional Office		Mayo 2012 FINALISED	SAM PBN implementation group
SAM/IG/10	PFF SAM ATM	States SAM Regional Office		October 2012 FINALISED	SAM PBN implementation group
SAM/IG/11	PFF SAM ATM	States SAM Regional Office		May 2013 FINALISED	SAM PBN implementation group
SAM/IG/12	PFF SAM ATM	States SAM Regional Office		October 2013 FINALISED	SAM PBN implementation group
SAM/IG/13	PFF SAM ATM	States SAM Regional Office		Mayo 2014 FINALISED	SAM PBN implementation group
SAM/IG/14	PFF SAM ATM	States SAM Regional Office		October 2014 FINALISED	SAM PBN implementation group

SAM/IG/15	PFF SAM ATM	States SAM Regional Office		May 2015 FINALISED	SAM PBN implementation group
SAM/IG/16	PFF SAM ATM	States SAM Regional Office		October 2015 FINALISED	SAM PBN implementation group
SAM/IG/17	PFF SAM ATM	States SAM Regional Office		May 2016 FINALISED	SAM PBN implementation group
SAM/IG/18	PFF SAM ATM	States SAM Regional Office		October 2016 FINALISED	SAM PBN implementation group
SAM/IG/19	PFF SAM ATM	States SAM Regional Office		May 2017 FINALISED	SAM PBN implementation group
ATSRO/03	PFF SAM ATM 03	States SAM Regional Office		July 2011 FINALISED	SAM route network optimisation
ATSRO/04	PFF SAM ATM 03	States SAM Regional Office		July 2012 FINALISED	SAM route network optimisation
ATSRO/05	PFF SAM ATM 03	States SAM Regional Office		July 2013 FINALISED	SAM route network optimisation
ATSRO/06	PFF SAM ATM 03	States SAM Regional Office		October 2014 FINALISED	SAM route network optimisation

ATSRO/07	PFF SAM ATM 03	States SAM Regional Office		October 2015 FINALISED	SAM route network optimisation
ATSRO/08	PFF SAM ATM 03	States SAM Regional Office		September 2017 FINALISED	- Held on 11-15 September 2017. Implementation of Version 4 of the route network was begun.
ATSRO/09	PFF SAM ATM 03	States SAM Regional Office		July 2018	SAM route network optimisation
Hiring of experts for consolidation of Version 4 of the SAM ATS route network	PFF SAM ATM 03	States SAM Regional Office		June 2017 FINALISED	- Two experts from the Region were hired. The Route Network Version 4 deliverable was developed with 91 route improvement initiatives.
Hiring of experts for consolidation of Version 5 of the SAM ATS route network	PFF SAM ATM 03	States SAM Regional Office		September 2018	SAM route network optimisation
Workshop on PBN airspace planning	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		March 2013 FINALISED	Initial training in the PBN airspace planning process.
PBN/1 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		May 2014 FINALISED	Objective: Preliminary PBN training and design of the Asunción and Bogota TMAs.
PBN/2 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2014 FINALISED	Objective: Preliminary PBN design of the main South American TMAs.
PBN/3 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		March 2015 FINALISED	Objective: Validation of the preliminary PBN design of the main South American TMAs.

PBN/4 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2015 FINALISED	Objective: Guide PBN implementation at the main South American TMAs.
PBN/IMP/1 workshop	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		April 2016 FINALISED	Review the status of implementation in States whose implementation date was the first semester of 2016.
PBN/IMP/2 workshop and related PANS-OPS activities	B0 APTA B0 CCO B0 CDO	States SAM Regional Office		September 2016 FINALISED	Review the status of implementation in States whose implementation date is the second half of 2016 and carry out the related PANS-OPS activities.
<b><u>Others</u></b>					
Updating and submission of the National PBN implementation plan to the Regional Office	B0 APTA B0 CCO B0 CDO	States		SAM/IG/15	93% of States have completed the task. French Guiana is still pending. Headquarters has requested the delivery of the national PBN implementation plans.
<b>Resources needed</b>	Designation of experts for completion of some of the deliverables.				

\*

**Grey*****Task not started yet*****Green*****Activity being implemented as scheduled*****Yellow*****Activity started with some delay, but will be implemented on time*****Red*****Activity not implemented on time; mitigation measures are required***

## APPENDIX B2

## PROJECT A2 – AIR NAVIGATION SYSTEMS IN SUPPORT OF PBN

SAM Region	PROJECT DESCRIPTION (DP)	DP N° A2	
<i>Programme</i>	Project Title	Start	End
PBN  (Programme coordinator: ATM RO Fernando Hermoza)	Air navigation systems in support of PBN  <i>Project coordinator:</i> <i>Julio César de Souza Pereira Pereira (IATA)</i>  <i>Experts contributing to the Project: Alessander Santoro, Andre Jansen, Fabio Augusto Andrade (Brazil), Paulo Vila, Tomas Macedo (Peru) and SAM/IG SAM PBN Group</i>	January 2011	December  2018
<b>Objective</b>	Develop guides, conduct analyses and implement services in support of PBN implementation in the SAM Region.		
<b>Scope</b>	Support to PBN implementation in the SAM Region, initially consisting of: <ul style="list-style-type: none"> <li>• Practical guide for the implementation of GBAS systems.</li> <li>• Analysis of DME/DME coverage to support PBN procedures.</li> <li>• Implementation of a RAIM availability prediction service.</li> </ul>		
<b>Metrics</b>	<ul style="list-style-type: none"> <li>• Drafting of a practical guide for the implementation of a GBAS system.</li> <li>• DME/DME coverage in the SAM Region.</li> <li>• Availability of a RAIM availability prediction service.</li> <li>• % States providing the RAIM availability service.</li> </ul>		
<b>Strategy</b>	<ul style="list-style-type: none"> <li>• All activities will be conducted by experts designated by SAM States and organisations participating in the project entitled “<i>Air navigation systems in support of PBN</i>”, 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, the project coordinator and the contributing experts can meet at the SAM/IG implementation meetings.</li> <li>• 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.</li> </ul>		

<b>Goals</b>	<ul style="list-style-type: none"> <li>• Guide for the implementation of a GBAS system, by October 2012. (Revision November 2016).</li> <li>• Assessment of DME/DME coverage to support PBN procedures, by May 2011.</li> <li>• RAIM availability prediction service in the SAM Region implemented by September 2014.</li> <li>• 11 SAM States with RAIM availability prediction service available by February 2014.</li> <li>• 3 SAM States and one territory with the service available by the end of 2014.</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• This project contributes to the implementation of SAM PFF CNS 03, ATM 01, ATM 02, and ATM 03 of the <i>SAM Performance-based navigation system implementation plan (SAM PBIP)</i>.</li> </ul>
<b>Related projects</b>	<ul style="list-style-type: none"> <li>• Implementation of PBN operational aspects.</li> </ul>

<b>Project deliverables</b>	<b>Relationship with the performance-based regional plan and ASBU block 0 modules</b>	<b>Responsible party</b>	<b>Status of implementation</b>	<b>Delivery date</b>	<b>Comments</b>
<i>Develop a practical guide for the implementation of the GBAS system</i>					
Review of practical guide for the implementation of GBAS systems	SAM PFF CNS 03 ANRF B0-APTA (65)	Alessander Santoro (Brazil)		December  2018	The practical guide for the implementation of GBAS systems was presented for review at SAM/IG/8 meeting. It 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, joint work was undertaken using the SLS-4000 station and other 110 GPS L1 and L2 stations installed in Brazil. Data was collected over a period of maximum solar activity, although it was the lowest in the

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
					<p>last 100 years. From the data obtained, Brazil concluded that so far, the SLS-4000 station may not be used in full for CAT I operations in low latitude regions. Accordingly, ICEA (<i>Instituto de Control del Espacio Aéreo</i>) will continue research in cooperation with the FAA and the supplier (Honeywell), seeking to develop a risk model capable of withstanding ionosphere behaviour in low latitudes.</p> <p>As of December 2017, the SLS-4000 station does not meet ICAO's integrity and availability requirements.</p> <p>Brazil continues research in collaboration with universities and Honeywell, seeking to develop a risk model applicable to the SAM Region.</p> <p>A review of the practical guide for the implementation of the GBAS system will follow after completing the development of a risk model capable of withstanding ionosphere behaviour at low latitudes.</p> <p>This is to be completed by the last quarter of 2018.</p>

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
<i>Analyse DME/DME and GNSS infrastructure and coverage needed to support PBN implementation</i>					
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 Tomás Macedo (Peru)		Coverage study to support RNAV-5 completed (SAM/IG/8, October 2011)	A <i>DME/DME coverage study</i> 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 <i>Google Earth</i> . The study only supports the RNAV-5 procedure.
<i>Development of guidance on the use and availability of GNSS performance forecast/validation tools.</i>					

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
Implementation of a RAIM availability prediction service	SAMPFF CNS/03 SAM PFF ATM/01 ATM/02 ATM/03 ANRF B0-APTA (65), B0-FRTO(10) B0-CDO(05) and B0-CCO(20)	Project coordinator SAM/IG PBN Group		November 2014	<p>Two web-based remote 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 RAIM availability prediction service website (SATDIS), the code assignment procedure, data import and export, and the query and failure resolution procedure. The course was attended by all focal points nominated by the States, as well as by other participants designated by the States.</p> <p>All focal points received from the service provider the respective user name and password to access SATDIS as administrators.</p> <p>The SATDIS website in three languages (Spanish, Portuguese and English), became operational on 17 September 2014.</p> <p>The SATDIS FSAT was conducted on 18 November 2014.</p> <p>The RAIM availability prediction service is operating since 16 November 2014.</p>

Project deliverables	Relationship with the performance-based regional plan and ASBU block 0 modules	Responsible party	Status of implementation	Delivery date	Comments
Monitor activities for the implementation of air navigation systems in support of PBN		ICAO		January 2011 - December 2018	
Resources needed	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