REGIONAL AIR NAVIGATION PLANS IMPLEMENTATION CONSIDERATION ON NAVIGATION INFRASTRUCTURE TO SUPPORT PBN IN THE NAM/CAR AND SAM REGIONS

WORKSHOP / SEMINAR FOR THE IMPLEMENTATION OF NAVIGATION INFRASTRUCTURE TO SUPPORT PBN AND GNSS PRECISION APPROACH OPERATIONS IN THE NAM CAR SAM REGION

(Lima Peru 15-17 August 2015)

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CONTENTS

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

- Air navigation plans exposed in detail the **facilities**, **services** and **procedures** required for international air navigation within a specific area.

- These plans contain **recommendations** that Governments can follow when programming the **provision of facilities and air navigation** services, with the assurance that the facilities and services provided in accordance with the plan form of the other States an **integral system appropriate for the foreseeable future**.

- Each Contracting State is responsible for the **provision of facilities and services in its territory**, in accordance with **article 28 of the Convention**. The **Council** has **recommended** that these **facilities and services** include those specified in **air navigation plans.**

- On June 18, 2014, ICAO Council decided that Air Navigation Plan (ANP) will be published in **three volumes** replacing in this way regional air navigation plans approved by the Council on 26 February 1997 formed a **basic ANP** and a document on facilities and services **(FASID)** in two volumes. For the CAR/SAM regions the number of the document to the air navigation Plan is still the **8733**

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

Volume I contains **the stable elements of the Plan**, whose amendment requires the approval of the **Council,** referred to a:

- ✓ the assignment of responsibilities;
- ✓ subject to a regional agreement mandatory requirements;
- ✓ and/or additional requirements specific to the region and are not covered by the SARP.

Partial list of these elements:

- ✓ (Tables and charts) boundaries of flight information regions (FIR);
- ✓ Search and rescue (SRR) regions (tables and charts) boundaries;
- ✓ (VAAC) volcanic ash advisories centers;
- ✓ Warnings of tropical cyclones (CAGR) centers; Volcano observatories (VO);

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

Volume II contains the **dynamic elements** of the plan, whose amendment **does not require the approval of the Council** (the approval is for regional agreement of the relevant **PIRG**), a:

- ✓ referred to the assignment of responsibilities;
- ✓ subject to a regional agreement mandatory requirements; and/or
- ✓ additional requirements specific to the region and are not covered by the SARP.

Partial list of these elements:

- ✓ principal flows of air traffic service (ATS) routes ;
- ✓ Meteorological Watch Office (MWO);
- ✓ codes of the Secondary Surveillance Radar (SSR),
- ✓ five letters codes
- ✓ VOLMET broadcasts.

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

Volume III will contain **dynamic/flexible elements** of the plan, providing guidance for the implementation of its modernization and air navigation systems planning, taking into account emerging programs such as the **ASBU** and **roadmaps** of associated technologies described in the GANP.

Volume III of the ANP will also contain **additional guidance material** appropriate, especially in relation to the i**mplementation**, to **complement** the material contained in **volumes I** and **II** of the ANP.

Volume III amendment would **not require** the approval of the **Council** but a regional agreement (**Secretariat and PIRG**)

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

VOLUME I

PART III – COMMUNICATION , NAVIGATION AND SURVEILLANCE (CNS)

2 GENERAL REGIONAL REQUIREMENTS

Navigation

2.6 Planning of **aeronautical radio navigation services** should be done on a **total system basis**, taking full account of the **navigation capabilities** as well as **cost effectiveness**. The total system composed of **station-referenced navigation aids**, **satellite-based navigation systems** and **airborne capabilities** should meet the **performance based navigation (PBN)** requirements for all aircraft using the system and should form an adequate basis for the **provision of positioning, guidance and air traffic services**.

2.7 Account should be taken of the fact that **certain aircraft may be able to meet their navigation needs by means of self-contained or satellite-based aids**, thus **eliminating the need for the provision of station-referenced aids along the ATS routes** used by such aircraft, as well as the **need to carry on board excessive redundancies**.

PART IV - AIR TRAFFIC MANAGEMENT (ATM)

2. GENERAL REGIONAL REQUIREMENTS

Performance-based Navigation (PBN)

2.6 PIRGs are responsible for the development of the Regional PBN Plan. States' PBN Plans should be consistent with the Regional PBN Plan.

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

VOLUME II

PART III COMMUNICATION , NAVIGATION AND SURVEILLANCE (CNS)

2 GENERAL REGIONAL REQUIREMENTS

Navigation Infrastructure

2.34 The navigation infrastructure should meet the requirements for all phases of flight from take-off to final approach and landing.

Note: Annex 10 to the Convention on International Civil Aviation—Aeronautical Telecommunications, Volume I — Radio Navigation Aids, Attachment B, provides the strategy for introduction and application of non-visual aids to approach and landing.

2.35 The CAR and SAM PBN Regional Roadmap/Plans provides guidance to air navigation service providers, airspace operators and users, regulators, and international organizations, on the expected evolution of the regional air navigation system in order to allow planning of airspace changes, enabling ATM systems and aircraft equipage. It takes due account of the operational environment of the CAR/SAM Regions.

VOLUME II

PART III COMMUNICATION , NAVIGATION AND SURVEILLANCE (CNS)

2 GENERAL REGIONAL REQUIREMENTS

PBN Transition Strategy

2.36 During transition to performance-based navigation (PBN), **sufficient ground infrastructure for conventional navigation systems should remain available**. Before existing ground infrastructure is considered for removal, users should be given reasonable transition time to allow them to equip appropriately to attain a performance level equivalent to PBN. **States** should approach **removal** of existing ground infrastructure **with caution to** ensure that safety is not compromised. This should be guaranteed by conducting **safety assessments** and consultations with the users.

Use of specific navigation aids

2.37 Where, within a given airspace, specific groups of users have been authorized by the competent authorities to use **special aids for navigation.** The respective ground facilities should be located and aligned so as to provide for full compatibility of navigational guidance with that derived from the SARPs.

2.38 States should ensure and oversee that service providers take appropriate corrective measures promptly whenever required by a significant degradation in the accuracy of navigation aids (either space based or ground based or both) is detected.

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

VOLUME II

PART III COMMUNICATIÓN , NAVIGATION AND SURVEILLANCE (CNS)

SPECIFIC REGIONAL REQUIREMENTS

Table CNS II-5 — ATN IPv4 addressing scheme

Table CNS II-6 — Aeronautical mobile service and the AMSS

Table CNS II-7 — Navaids Plan

Table CNS II-8 — ASTERIX SAC code assignment

Table CNS II-9 — Surveillace Plan

Table CNS II-10- geographical separation criteria

Table CNS II-11—AM (R) VHF sub-bands allotment table

AIR NAVIGATION PLAN IN THE CAR/SAM REGIONS

TABLE CNS II-7

Station/Territory	Rwy type	Function	ILS	L	DMF	VOR	NDB	Coverage	GN			Remarks
									ABA	GBA	SBA	
1	2	3	4	5	6	7	8	9	10	11	12	13
ANGUILLA (United Kingdom)												
THE VALLEY WALL BLAKE, Anguilla I.	10 NPA	A/L					X		X		X	
ANTIGUA AND BARBUDA	07 PA1	A/	II* D		X	X	X			X		
SAINT JOHNS/V.C. Bird, Antigua I.	25 NPA	L			X	X			X	X		
		A/			X	X		200/45			X	
		L					X	400			X	
		T										
		E										
ARGENTINA	13 PA1		II D		X	X	X			X		
BUENOS AIRES/Aeroparque Jorge Newbery	11 PA3	A/	III D II		X	X	X			X		
	35 PA1				X	X				X		
		L			X	X						
BUENOS AIRES/Ezeiza Ministro Pistarini	23 NPA	A/			X	X		160/45				
			I D		X	X				X		
	31 PA1	L			X	X	X					
	13 NPA	A/				X						
BUENOS AIRES/San Fernando		L			X	X						
		T						190/45				
CATARATAS DEL IGUAZU/My. D. Carlos Eduardo Krause	25 PA1	E	I		X	X				X		
	07 NINST	A/			X	X	X	200/45				
		L										
		T	II* D		X	X				X		
CERES		A/					X	200/45				
COMODORO RIVADAVIA/Gral. Mosconi	18 PA1	L			X	X	X					
	36 NINST	A/			X	X	X					
		L			X	X						
		T/	I D				X			X		
		E			X	X	X	200/45				
CORDOBA/Ing. Aer. A. L. Taravella	03 NPA	E			X	X	X	90				
	21 PA1	A/			X	X						
		L				X	X	200/45				
		E	I D							X		
FORMOSA/Formosa		E					X					
		A/						160/4				

GUIDELINES FOR TRANSITION TO SATELLITE NAVIGATION SYSTEMS IN THE CAR/SAM REGIONS

GNSS should be introduced in an evolutionary manner, with improvements in GNSS capability generating increasing benefits, and culminating in GNSS supporting all phases of flight. As GNSS evolves, the planning for the removal of ground-based navigation aids should take account of the issues described below

The ground infrastructure for current navigation systems must remain available during the transition period.

States/regions can consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance where this can be done without reducing airspace capacity.

Before any existing ground infrastructure is considered for removal, users shall be given reasonable transition time to allow them to equip with GNSS to attain equivalent navigation service.

As GNSS is introduced for enroute operation, States/regions should coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in all flight information regions along major traffic flows to allow for a seamless transition to GNSS-based navigation

GUIDELINES FOR TRANSITION TO SATELLITE NAVIGATION SYSTEMS IN THE CAR/SAM REGIONS

In planning the transition to GNSS, the following issues must be considered:
Maintaining or improving the current level of safety;
schedule for provision and/or adoption of a GNSS service, including aircraft and operator approval processes;
extent of existing ground-based radio navigation services;
strategy for transition schedule to GNSS capability (i.e. benefits-driven or mandatory);
appropriate level of user equipage with GNSS capability;
provision of other air traffic services (i.e. surveillance and communications);
density of traffic/frequency of operations;
mitigation of risks associated with radio frequency interference failures and ionospheric issues;
design and implementation of procedures; and
over-all economics and lead times to introduce aircraft avionics requirements.

STRATEGIES FOR THE INTRODUCTION AND APPLICATION OF NON VISUAL AIDS IN APPROACH, LANDING AND DEPARTURE IN THE CAR/SAM REGION

Maintain the ILS as the ICAO standard precision approach and landing system as long as necessary and as long as it remains operationally acceptable and economically beneficial, doing everything possible to not deny access to airports to aircraft equipped only with ILS;

implement GNSS with augmentation as required for APV and Category I operations where operationally required and technically feasible and economically beneficial, taking into account GNSS evolution;

promote the development and use of a multi-modal airborne landing capability;

promote the use of APV operations, particularly those using GNSS vertical guidance, to enhance safety and accessibility; and

identify and resolve operational and technical feasibility issues for GNSS with ground-based augmentation system (GBAS) to support Category II and III operations, Implement GNSS for Category II and III operations where operationally required and economically beneficial.

APPENDIX D

CAR/SAM STRATEGY FOR THE EVOLUTION OF AIR NAVIGATION SYSTEMS

First Edition
Rev 2.0

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EVOLUTION OF AIR NAVIGATION INFRASTRUCTURE

SHORT TERM (UP TO 2010)

- Initial deactivation of NDBs.
- Definition of the GNSS backup infrastructure.
- Changes to DME infrastructure to meet ICAO RNAV (DME/DME) requirements at selected TMAs.
- Initial implementation of ABAS for en-route, TMA, and NPA operations

Medium term (2011-2015)

- The implementation of GBAS CAT I stations at airports with sufficient operational demand will improve en-route and TMA operations (SIDs and STARs) on paths similar to those of the ILS.
- At some airports, ILS systems will be maintained as GNSS/GBAS backup.
- Initial deactivation of VOR for en-route operations.

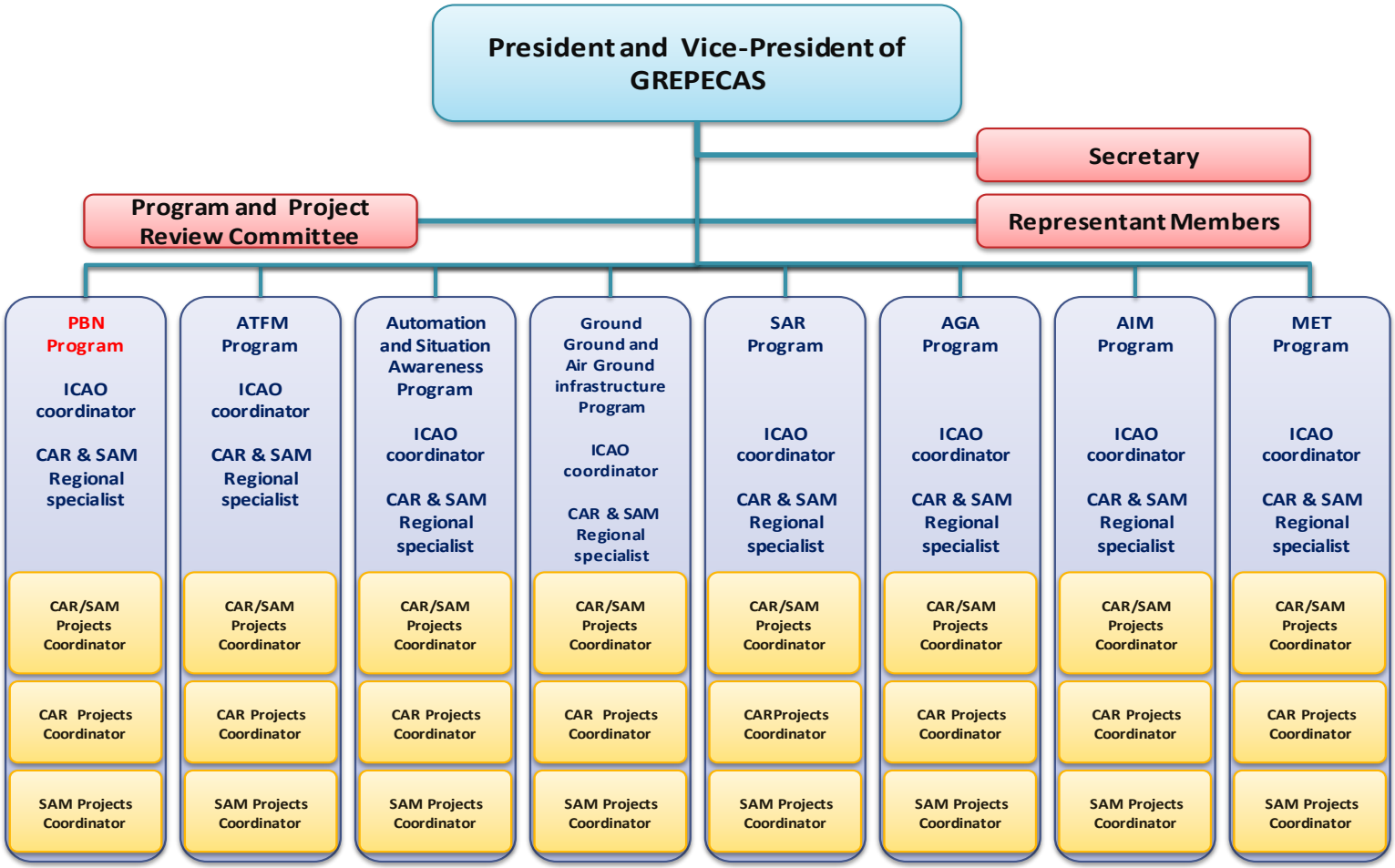
EVOLUTION OF AIR NAVIGATION INFRASTRUCTURE

Long term (2016-2025)

- Continue deactivating conventional aids, maintaining the backup structure, if necessary.
- Implementation of GBAS Cat II/III at selected airports.
- Implementation of GBAS CAT I approach at other CAR/SAM airports with sufficient operational demand.
- Possible implementation of SBAS, depending on feasibility studies already carried out and underway under ICAO projects, taking into account current mono-frequency systems and the evolution of ionosphere algorithms, as well as the future availability of a multi-frequency, multi-constellation satellite structure.

GREPECAS NAVIGATION ASPECTS

GREPECAS ORGANIZATION



GREPECAS NAVIGATION ASPECTS

PROJECT A2 : AIR NAVIGATION SYSTEMS IN SUPPORT OF PBN

No.	Task	Target Date	Responsible	Status	Deliverable
1	2	3	4	5	6
A 2.1	Feasibility of regional application, technical aspects, operational benefits , th costs associated, of the implementation of the SBAS (WAAS / SACCSA). As well as the implications for board equipment (new or upgrade of avionics) and other relevant aspects	2008-2012	ICAO SBAS type WAAS (RLA/00/009) SBAS SACCSA (RLA/03/902)	Completed	**Study on the feasibility of the regional application, technical aspects, operational benefits, associated costs for the implementation of the SBAS (WAAS / SACCSA) and avionics equipment implication** • **SBAS WAAS type study completed** • **SBAS SACCSA study completed**
A 2.2	Review of practical guide for the implementation of GBAS systems	November 2016	Alessander Santoro (Brasil)	Valid	Practical guide for the implementation of GBAS systems
A 2.3	Review and update navigation aid table CNS II 7 eANP(Table CNS 3 FASID) and COM LIST 1 and 2	Continue	States/Territory ICAO	Valid	ICAO CNS II 7 Table and COM LIST 1 and 2 reviewed and updated
A 2.4	Analysis of the DME/DME and GNSS infrastructure required to support PBN implementation in the SAM Region	2012	Fabio Augusto Andrade and Andre Jansen (Brazil) Paulo Vila and Tomas Macedo (Peru)	Completed	A *DME/DME coverage study for RNAV5 routes*
A 2.5	Development of guidance on use of and available tools required for assessment of GNSS performance and service prediction. Desarrollo de orientación sobre el uso y disponibilidad de herramientas de previsión / validación de prestaciones del GNSS	2014		Completed	A regional RAIM prediction availability service via WEB was implemented and in operation since October 2014 for SAN Region. www.satdis.aero

NAM CAR PERFORMANCE BASED IMPLEMENTATION PLAN

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http://www.icao.int/NACC/Pages/namcar-RPBANIP.aspx

NAM/CAR – Regional Performance Objectives (RPOs)

- Performance approach to reflect the necessary implementation activities needed to support the air navigation regional priorities.
- the high-level tasks for implementing the regional priorities, establishing the expected operational benefits and the metrics for progress measurements, benefits and achievements.

ASBU / RPO	PIA1 Airport Operations					PIA2 SWIM			PIA3 Global Collaborative ATM							PIA4 Trajectory-based Operations		
	B015 RSEQ	B0 65 APTA	B070 WAKE	B075 SURF	B0 80 ACDM	B025 FICE	B030 DAIM	B0105 AMET	B010 FRTO	B035 NOPS	B084 ASUR	B085 ASEP	B086 OPFL	B0101 ACAS	B102 SNET	B005 CDO	B020 CCO	B040 TBO
PBN Implementation		X							X							X	X	
FUA									X									
DCB	X									X								
ATM Situational Awareness	X			X							X				X			X
Improve SAR																		
Improve Cap/Efficiency Aerodrome Operations				X	X													
COM					X	X								X				X
AIM							X											
MET								X										

NAM/CAR REGIONAL PERFORMANCE OBJECTIVES

1. IMPLEMENTATION OF PERFORMANCE BASED NAVIGATION (PBN)				
Benefits				
Environment	• Reductions in fuel consumption			
Efficiency	• Ability of aircraft to conduct flight more closely to preferred trajectories • Increase in airspace capacity • Facilitate the utilization of advanced technologies (e.g., FMS based arrivals) and ATC decision support tools (e.g., metering and sequencing)			
Strategy				
ATM Component	**TASK DESCRIPTION**	**START-END**	**RESPONSIBLE**	**STATUS**
AOM	a) Implement Collaborative Decision-Making (CDM) process in coordination with stakeholders	2013- 2016	States, Territories, Int. Orgs	Valid
	b) Implement PBN airspace concept for oceanic, continental and terminal areas in accordance with the ICAO PBN Manual	2013- 2016	States, Territories, Int. Orgs	Valid
	c) Update Letters of Agreement between ATC units	2013- 2016	States, Territories, Int. Orgs	Valid
	d) Publish regulations and procedures for PBN operational approval	2013- 2016	States, Territories, Int. Orgs	Valid
	e) Evaluate and implement PBN requirements for ATC automated systems, as required	2013- 2016	States, Territories, Int. Org	Valid
	f) Analyze and enhance air communication, navigation (ground navaids GNSS) and surveillance infrastructure in accordance with PBN requirements	2013- 2018	States, Territories, Int. Orgs	Valid
	g) Develop and implement PBN training programme for pilots, ATCOs, operators and regulators, as well as implementation of GNSS technologies	2013- 2018	States, Territories, Int. Orgs	Valid
	h) Optimize the ATS route structure through implementation of RNAV routes between major city pairs with navigation specification RNAV-5 /2 for en-route operations	2013- 2016	States, Territories, Int. Orgs	Valid
	i) Implement CDOs/CCOs for SIDs/STARS in terminal areas based on RNAV 1-2 and RNP 1-/2 navigation specification, as required	2013- 2016	States, Territories, Int. Org	Valid
	j) Design and implement PBN APV in accordance with Assembly Resolution A37-11	2013- 2016	States, Territories, Int. Orgs	Valid
	k) Conduct PBN safety assessment based ATC simulations (fast time and/or real time), live trials, etc., as required	2013- 2016	States, Territories, Int. Orgs	Valid
	l) Develop performance measurement programme	2013- 2016	States, Territories, Int. Orgs	Valid
	m) Develop post-implementation PBN Safety Assessment Programme	2013- 2016	States, Territories, Int. Orgs	Valid
	n) Monitor implementation progress	2013- 2018	States, Territories, Int. Orgs	Valid
GPIs	GPI/5: Performance-Based Navigation; GPI/7: Dynamic And Flexible ATS Route Management; GPI/8: Collaborative Airspace Design And Management; GPI/10: Terminal Area Design and Management; GPI/11: RNP and RNAV SIDS and STARS; and GPI/12: FMS-Based Arrival Procedures			

AIR NAVIGATION REPORT FORM (ANRF)			
		Date Updated	December 2, 2015
Region (or State)		NAM	
Block	**0**	**Module Description:** To use Performance- based airspace and arrival procedures allowing aircraft to fly their optimum profile using Continuous Descent Operations (CDOs). This will optimize throughput, allow fuel efficient descent profiles, and increase capacity in terminal areas.	
PIA	**4**		
Module Code	**CDO**		

Elements		**Date**	**Status**
1.	CDO implementation	Dec 2014	Implemented
2.	PBN STARs	Spring 2014	Implemented
3.	***If applicable, list ASBU Module element(s) the State does not plan to implement***		
4.	***Add Regional/State specific elements if any*** *(for example enroute PBN feeding into the PBN STARs); list elements associated with a Regional (or National) Performance Objective*		
Implementation Challenges *Enter description – Classify by whether the challenges are in the area of Ground System Implementation, Avionics Implementation, Procedures Availability or Operational Approvals Availability.*			

Element Implementation Status Description		
1	CDO implementation	**International aerodromes with CDO implemented** CDO/OPD is implemented at approximately 98 airports (as of October 2013). The RNAV STARs designated as OPD were identified based on the below criteria: ● The procedure has coded altitudes. ● ATC can use 'descend via' phraseology with it. ● An 'expect' altitude is okay with other coded altitudes. The 'expect' can be 'cleared' by ATC issuing a restriction for the WP. ● It should NOT have any 'jets cross at xxx, turboprops cross at xxx' notes on it.
2	PBN STARs	**International aerodromes/TMAs with PBN STARs implemented** PBN STARs are implemented at approximately 197 airports (as of October 2013). 253 RNAV STARs in the NAS with some of the procedures serving multiple airports (as of October 2013).

Quantitative and Qualitative Benefits from the Implementation	
Element 1. CDO implementation	
Access & Equity	Only at locations where PBN STARs can be published to deconflict traffic flows with additional/different routing options. For example, RNAV STARs with OPDs implemented at Dulles and Regan National airports are now laterally separated.
Capacity	N/A
Efficiency	Cost savings through reduced fuel burn due to improved vertical profiles. Reduction in the number of required radio transmissions, and therefore controller and pilot workloads; however, we do not have empirical data to evaluate this particular benefit. Operational benefits: — Arrivals exhibited more efficient vertical profiles — Average time and distance within 250 nm of the airport did not change
Environment	Reduced emissions as a result of reduced fuel burn – if there is a quantitative value, show the value.
Safety	RNAV STARs facilitate executing stabilized approaches. Example of a quantitative benefit: In 10 years prior to implementation, there were x CFIT occurrences that were attributed to non-stabilized descent. In the 3 years since the implementation, there have been 0 CFIT occurrences where non-stabilized descent was suspected or attributed.
Element 2. PBN STARs	
Access & Equity	N/A (from GANP)
Capacity	N/A (from GANP)
Efficiency	Cost savings and environmental benefits through reduced fuel burn. Authorization of operations where noise limitations would otherwise result in operations being curtailed or restricted. Reduction in the number of required radio transmissions. Optimal management of the top-of-descent in the en-route airspace. (from GANP)
Environment	N/A (from GANP)
Safety	More consistent flight paths and stabilized approach paths. Reduction in the incidence of controlled flight into terrain (CFIT). Separation with the surrounding traffic (especially free-routing). Reduction in the number of conflicts. (from GANP)

	Vertical Profile Performance Outcomes					Additional Efficiency Performance Outcomes	
Weather	Proportion of Flights (%)	Number of Level Segments	Time in Level Flight (min)	Distance in Level Flight (nm)	Time-Weighted Altitude (feet)	Flights Without Level Segments (%)	Time (min)	Distance (nm)
VMC	86	2.0 (-16%)	5.4 (-13%)	31.2 (-12%)	17,300 (6%)	17 (72%)	43.4 (0%)	269.7 (0%)
Non-VMC	14	2.6 (-9%)	8.0 (-6%)	41.6 (-6%)	14,500 (6%)	9 (37%)	47.0 (0%)	280.7 (0%)
All	100	2.1 (-15%)	5.7 (-12%)	32.7 (-11%)	16,800 (6%)	16 (70%)	43.9 (0%)	271.2 (0%)

Notes
Enter notes/comments, etc. if any.

This is new ANRF template agreed at ANI WG/2.

1. AIR NAVIGATION REPORT FORM (ANRF)

2. REGIONAL PERFORMANCE OBJECTIVE – ASBU B0-10/FRTO: Improved Operations through Enhanced En-Route Trajectories Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM					
3. ASBU B0-10/FRTO: Impact on Main Key Performance Areas (KPA)					
	Access and Equity	Capacity	Efficiency	Environment	Safety
Applicable	Y	Y	Y	Y	N

4. ASBU B0-10/FRTO: Planning Targets and Implementation Progress	
5. Elements	6. Targets and Implementation Progress (Ground and Air)
1. Airspace Planning	100% of States to have completed a PBN plan by Dec. 2018
2. Flexible Use Airspace	50% of selected segregated airspaces available for civil operations by Dec. 2016

7. ASBU B0-10/FRTO: Implementation Challenges				
Elements	Implementation Area			
	Ground System Implementation	Avionics Implementation	Procedures Availability	Operational Approvals
1. Airspace Planning	- Lack of organized and managed airspace prior to the time of flight -Lack of AIDC		Lack of procedures, training, and LOAs	
2. Flexible Use Airspace	NIL		Lack of CDM between ANSPs and military Lack of LOAs	

8. ASBU B0-10/FRTO: Performance Monitoring and Measurement 8A. ASBU B0-10/FRTO: Implementation Monitoring	
Elements	Performance Indicators/Supporting Metrics
1. Airspace Planning	% of States with PBN plans completed
2. Flexible Use Airspace	**Indicator:** % of selected segregated airspaces available for civil operations **Supporting Metric:** Reduced civil flight delays

8. ASBU B0-10/FRTO: Performance Monitoring and Measurement 8 B. ASBU B0-10/FRTO: Performance Monitoring	
Key Performance Areas	Metrics (if not indicate qualitative benefits)
Access and Equity	Better access to airspace by reducing permanently segregated airspace
Capacity	-Flexible routing reduces potential congestion on trunk routes and at busy crossing points. Flexible Use Airspace provides greater opportunities to separate flights horizontally. -PBN helps to reduce route spacing and aircraft separation.
Efficiency	-The module will reduce flight length and related fuel burn and emissions. -The module will reduce the number of flight diversions and cancellations. It will also support avoiding noise sensitive areas.

1. AIR NAVIGATION REPORT FORM (ANRF)

2. REGIONAL PERFORMANCE OBJECTIVE – B0-20/CCO: Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCOs) Performance Improvement Area 4: Efficient Flight Path – Through Trajectory-based Operations					
3. ASBU B0-20/CCO: Improved Flexibility and Efficiency in Departure Profiles (CCO)					
	Access & Equity	Capacity	Efficiency	Environment	Safety
Applicable	N	N	Y	Y	Y

4. ASBU B0-20/CCO: Planning Targets and Implementation Progress	
5. Elements	6. Targets and Implementation Progress (Ground and Air)
1. CCO Implementation	60 % of selected aerodromes with continuous climb operations (CCO) implemented by Dec.2016
2. PBN SIDs Implementation	60% of selected aerodromes with PBN SIDs implemented by Dec.2016

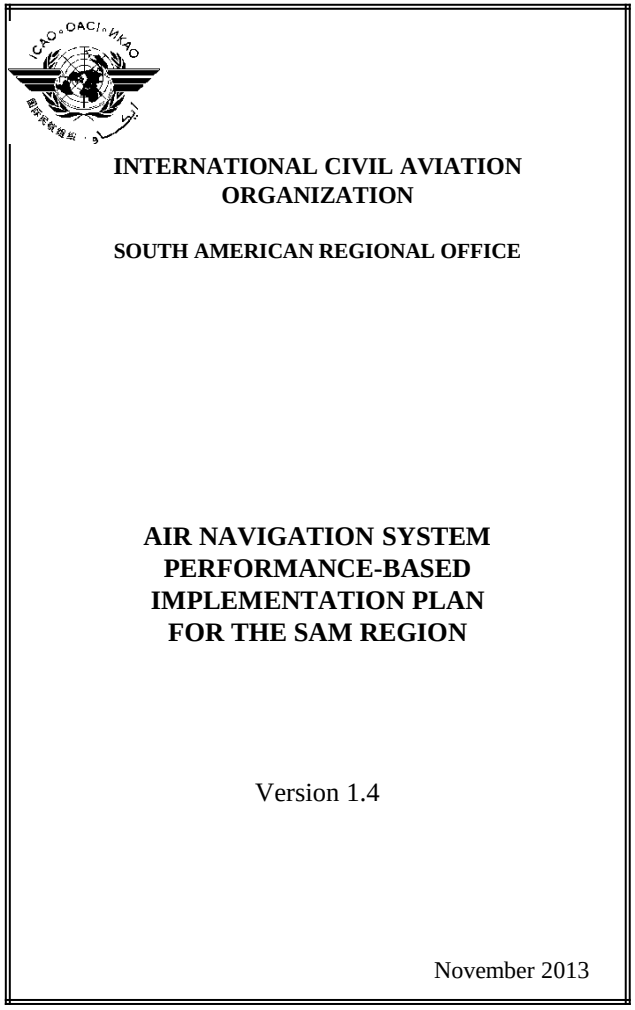
7. ASBU B0-20/CCO: Implementation Challenges				
Elements	Implementation Area			
	Ground System Implementation	Avionics Implementation	Procedures Availability	Operational Approvals
1. CCO Implementation	NIL	NIL	LOAs and training	In accordance with application requirements
2. PBN SIDs Implementation	Airspace design	Lack of aircraft equippage	LOAs and training	In accordance with application requirements

8. ASBU B0-20/CCO: Performance Monitoring and Measurement 8A. ASBU B0-20/CCO: Implementation Monitoring	
Elements	Performance Indicators/Supporting Metrics
1. CCO Implementation	**Indicator:** Percentage of selected aerodromes with CCO implemented **Supporting metric:** Number of selected aerodromes with CCO implemented
2. PBN SIDs Implementation	**Indicator:** Percentage of selected aerodromes with PBN SIDs implemented **Supporting metric:** Number of selected aerodromes with PBN SIDs implemented

Those two are ANRFs included in the current RPBANIP but since ANWG/2 agreed new ANRFs template, those will be updated in due course.

ICAO UNITING AVIATION

SAM PERFORMANCE BASED IMPLEMENTATION PLAN



INTERNATIONAL CIVIL AVIATION ORGANIZATION

SOUTH AMERICAN REGIONAL OFFICE

AIR NAVIGATION SYSTEM PERFORMANCE-BASED IMPLEMENTATION PLAN FOR THE SAM REGION

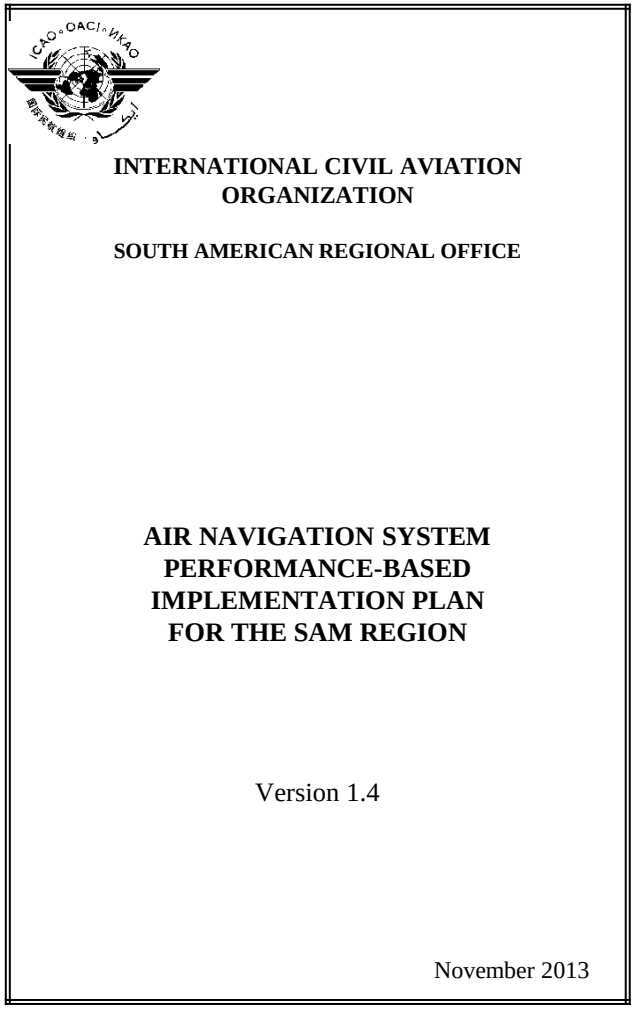
Version 1.4

November 2013

Chapter 1	Foreword
Chapter 2	Air Traffic in the SAM Region
Chapter 3	Planning Considerations
Chapter 4	Air Traffic Management (ATM)
Chapter 5	Communications, Navigation and Surveillance (CNS)
Chapter 6	Meteorology
Chapter 7	Search and Rescue (SAR) Services
Chapter 8	Aeronautical Information Services
Chapter 9	Aerodromes and Ground Aids / Aerodrome Operational Planning (AGA/AOP)
Chapter 10	Development of Human Resources and Competence Management
Chapter 11	Safety
Chapter 12	Performance Improvement Areas (PIA), modules and Air Navigation Report Forms (ANRF)

ICAO UNITING AVIATION

SAM PERFORMANCE BASED IMPLEMENTATION PLAN



INTERNATIONAL CIVIL AVIATION ORGANIZATION

SOUTH AMERICAN REGIONAL OFFICE

AIR NAVIGATION SYSTEM PERFORMANCE-BASED IMPLEMENTATION PLAN FOR THE SAM REGION

Version 1.4

November 2013

ATTACHMENT A -	Traffic forecasts in the SAM Region
ATTACHMENT B -	Global plan initiatives and their relationship with the main groups
ATTACHMENT C -	Performance framework form (PFF)
ATTACHMENT D -	Description of modules considered for the SAM Region
ATTACHMENT E -	Air navigation report forms (ANRF)
ATTACHMENT F -	Glossary of acronyms
ATTACHMENT G –	MET information provided by MET units
ATTACHMENT H -	List of reference documents

CNS SAM PBIP

- Aeronautical Fixed Service in the SAM Region (PFF SAM CNS/01);
- **Aeronautical Mobile Service in the SAM Region (PFF SAM CNS/02);**
- **Navigation Systems in the SAM Region (PFF SAM CNS/03)**; and
- **Air Surveillance service in the SAM Region (PFF SAM CNS/04).**

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SAM PERFORMANCE BASED IMPLEMENTATION PLAN

PFF CNS 03 SAM

REGIONAL PERFORMANCE OBJECTIVE: SAM CNS/03 IMPROVEMENTS TO NAVIGATION SYSTEMS IN THE SAM REGION	
Benefits	
Safety	• Support to aircraft spacing; • Reduced pilot and controller workload; and • Increased landing safety, avoiding CFIT
Environmental protection and sustainable development of air transport	• Increased airspace capacity and structure; • Increased integrity of the GNSS system; • Support to PBN implementation; and • Reduced costs.
Metrics	
• Number of deactivated NDBs in accordance with FASID Table 3-3; and • Number of GBAS implemented at airports with sufficient operational demand.	

2012 - 2018
Strategy

ATM OC COMPONENTS	TASKS	PERIOD	RESPONSIBILITY	STATUS
AOM ATM-SDM TS AUO	a) Continue with NDB phase-out	*- 2018+	States	Valid
	b) Implement new DME systems in support of en route operations where the PBN plan so considers it	2012-2018	States ICAO	Valid
	c) Implement GBAS at airports with sufficient operational demand	2015-2018+	States	Valid
	d) Modernisation of flight trial platforms for GNSS applications	2012-2017	States	Valid
	e) Guarantee the protection of the radio frequency spectrum used for current and future radio navigation services	(*)-2018	States ICAO	Valid
	f) Monitor implementation progress	2012-2018	GREPECAS	Valid
Relation-ship with GPIs	GPI/5: RNAV and RNP; GPI/6: ATFM; GPI/7: dynamic and flexible ATS route management; GPI/10: terminal area design and management; GPI/11: RNP and RNAV SIDs and STARs; GPI/12: functional integration of ground and airborne systems; GPI/13: aerodrome design and management; GPI/14: runway operations; GPI/21: navigation systems; GPI 23: aeronautical radio spectrum.			

SAM PERFORMANCE BASED IMPLEMENTATION

SAM BLOCK 0 REGIONAL MODULE

Performance Improvement Areas (PIA)	Performance Improvement Area Name	Module	Module Name
PIA 1	Airport Operations	B0-RSEQ	Improve Traffic flow through Runway Sequencing (AMAN/DMAN)
		B0-APTA	Optimization of Approach Procedures including vertical guidance
		B0-SURF	Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)
		B0-ACDM	Improved Airport Operations through Airport-CDM
PIA 2	Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management	B0-FICE	Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration
		B0-DATM	Service Improvement through Digital Aeronautical Information Management
		B0-AMET	Meteorological information supporting enhanced operational efficiency and safety
PIA 3	Optimum Capacity and Flexible Flights – Through Global Collaborative ATM	B0-FRTO	Improved Operations through Enhanced En-Route Trajectories
		B0-NOPS	Improved Flow Performance through Planning based on a Network-Wide view
		B0-ASUR	Initial capability for ground surveillance
		B0-ACAS	ACAS Improvements
		B0-SNET	Increased Effectiveness of Ground-Based Safety Nets
PIA 4		B0 CDO	Improved Flexibility and Efficiency Departure Profiles - Continuous Descend Operations (CDO)
		B0-TBO	Improved Safety and Efficiency through the initial application of Data Link En-Route
		B0-CCO	Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCO)

SAM PERFORMANCE BASED IMPLEMENTATION PLAN

AIR NAVIGATION REPORT FORM (ANRF)

REGIONAL PERFORMANCE OBJECTIVE – B0-65: Optimization of Approach Procedures Including Vertical Guidance Performance Improvement Area 1: Airport Operations					
ASBU B0-65: Impact on Main Key Performance Areas (KPA)					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	Y	Y	Y	Y	Y

ASBU B0-65: Implementation Progress	
Elements	**Implementation Status (Ground and Air)**
1. APV with Baro VNAV	December 2016 – Service Providers and users
2. APV with SBAS	Not applicable
3. APV with GBAS	To be determined December 2018-

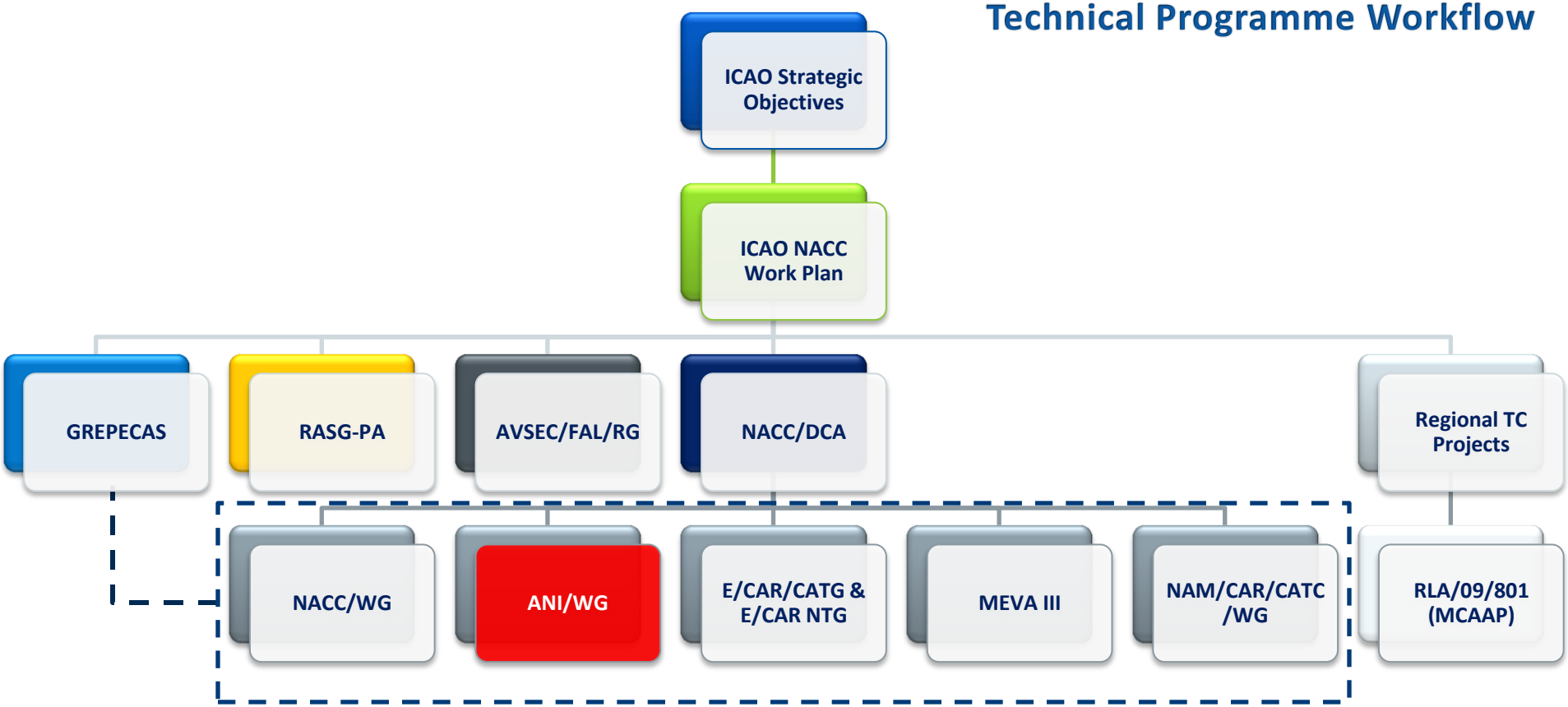
ASBU B0-65: Implementation Roadblocks/Issues				
Elements	**Implementation Area**			
	Ground system Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
1. APV with Baro VNAV	NIL	Insufficient number of equipped aircraft	Insufficient appropriate training	Lack of appropriate training
2. APV with SBAS	Not Applicable	Not applicable	Not applicable	Not applicable
3. APV with GBAS	Lack of cost benefit analysis Adverse ionosphere	Insufficient number of equipped aircraft	Insufficient appropriate training	Lack of appropriate training Evaluation of a real operational requirement

ASBU B0-65: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
1. APV with Baro VNAV	Indicator: Percentage of international aerodromes having instrument runways provided with APV with Baro VNAV procedure implemented Supporting metric: Number of international airport having approved APV with Baro VNAV procedure implemented
2. APV with SBAS	Not Applicable
3. APV with GBAS	Indicator: Percentage of international aerodromes having instrument runways provided with APV GBAS procedure implemented Supporting metric: Number of international airport having APV GBAS procedure implemented.

ASBU B0-65: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Performance Metrics**
Access & Equity	Increased aerodrome accessibility
Capacity	Increased runway capacity
Efficiency	Reduced fuel burn due to lower minima, fewer diversions, cancellations, delays

NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

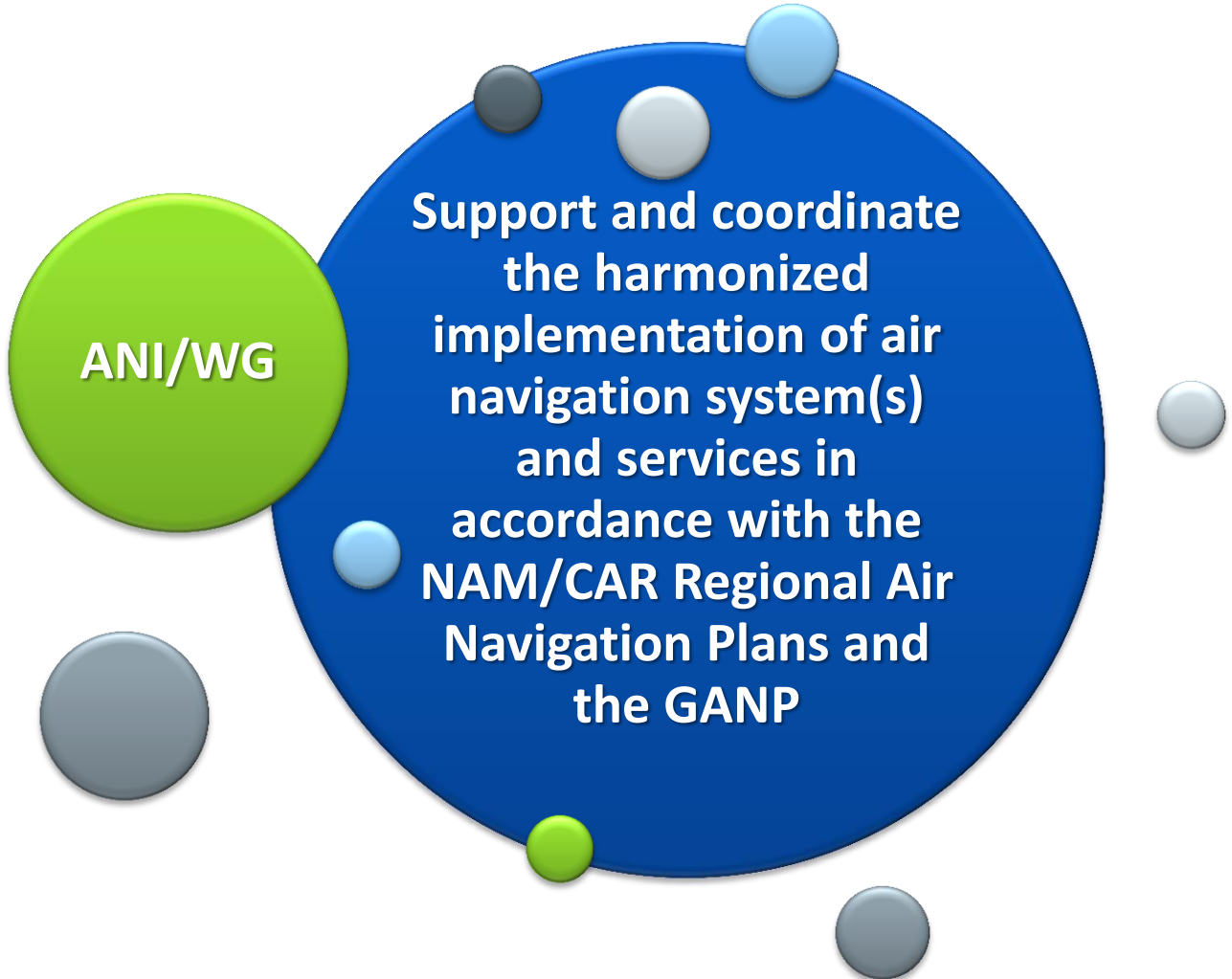
ICAO NACC Regional Office Technical Programme Workflow



ANIWG as the implementation body for NAM

NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

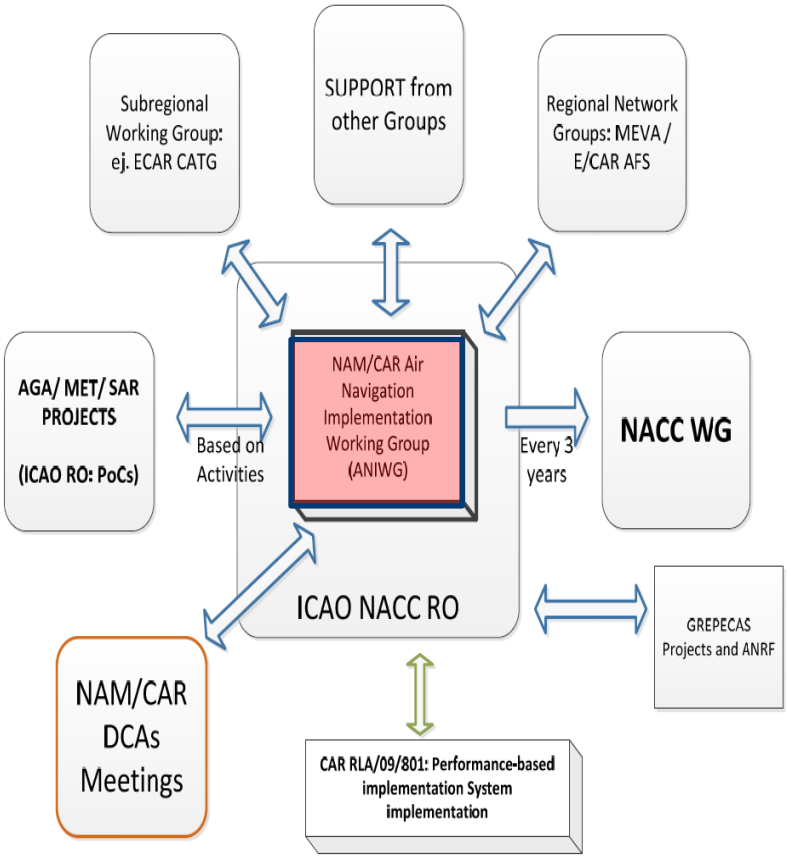
Air Navigation Performance-based Implementation
Air Navigation Implementation Working Group

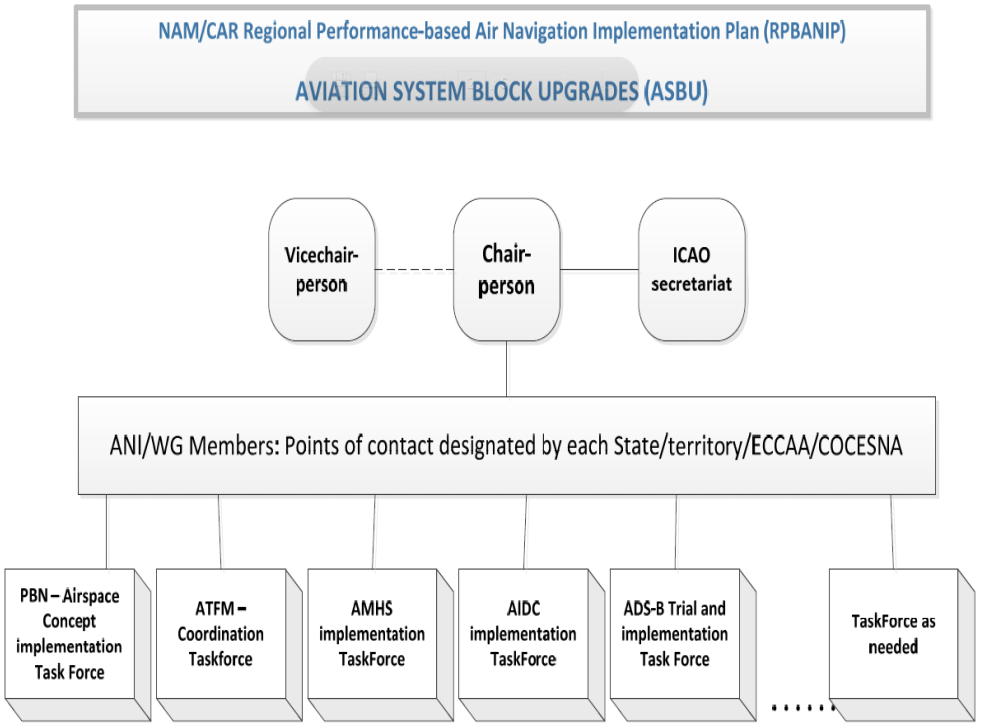


NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

ICAO UNITING AVIATION

Air Navigation Performance-based Implementation
Air Navigation Implementation Working Group (ANI/WG)





ANIWG as the implementation body for NAM

NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

ANI WG PBNTASKFORCE WORKPLAN

REVISED JAN 2105 (DRAFT 1.0)

Task Name/Area	Deliverables	START DATE (DD/MM/YY)	END DATE (DD/MM/YY)	PERCENTAGE COMPLETED (%)	RESPONSIBLE	REMARKS
IMPLEMENTATION OF PERFORMANCE BASED NAVIGATION (PBN)						
1. Establish a Regional PBN Task Force to assist with implementation	NACC PBN TASKFORCE to aid with facilitating PBN implementation as identified in NAM/CAR RPBANIP	30/Jul/13	28/Oct/13	100%	ICAO ICAO NACC/States Territories/International Organizations	COMPLETED
2. Conduct a review of NAM/CAR RPBANIP RPO (1) and make suggestions/recommendations to ICAO (if required)	TASKFORCE ensures that PBN initiatives within the RPBANIP are current/valid and cater to the needs of the operations within the region	July 2013	15/Dec/2013	100%	NAM/CAR PBN TASKFORCE	COMPLETED
3. Develop and promulgate a survey form to all States within the region to establish updated PBN implementation status and also to identify roadblocks	Current status of PBN implementation within the region is known. Roadblocks are identified,	1 November 2013	15 December 2013	100%	NAM/CAR PBN TASKFORCE/ ICAO NACC	COMPLETED February 20th 2014 Survey Form promulgated by NACC Regional Office
4. Report Regional PBN Implementation status to ICAO NACC Office with recommendations on solving implementation issues	reported to ICAO NACC Regional Office and the TASKFORCE will work with ICAO and the States involved to develop plan of action to solve the problems	31 January 2014	June 30th 2014		NAM/CAR PBN TASKFORCE Rapporteur	OVERDUE Revised date JAN 31 2015
5. Develop a		June 2014	December		NAM/CAR PBN	

Task Name/Area	Deliverables	START DATE (DD/MM/YY)	END DATE (DD/MM/YY)	PERCENTAGE COMPLETED (%)	RESPONSIBLE	REMARKS
4 phased project template regarding Plan, Design, Validation and Implementation	Assist States in developing PBN airspace re-design Project, based on ICAO Doc 9992		2015		TASKFORCE	Assisting States in the implementation of PBN airspace concept : a) Revision of regional Route network in the upper airspace, b) TMA redesign. PBN approach procedures Revised Target Date: December 31 2016
6 Conduct a study on PBN requirements for ATC Automated Systems	Report identifying the information required to be displayed to ATCOs on their situational displays	1/Jan/14	30/Dec/14		NAM/CAR PBN TASKFORCE	OVERDUE Revised Date JUNE 30 2015
7 Assist States within region with modifying LOAs	Templates for States to follow in developing LOA's Assistance from the TASKFORCE, through ICAO, in collaborating with other regions (E.g SAM, NAT, AFI etc.)	1 January 2014	30 December 2014		NAM/CAR PBN TASKFORCE/ICAO NACC	Overdue Revised Target Date AUG 31 2015

Task Name/Area	Deliverables	START DATE (DD/MM/YY)	END DATE (DD/MM/YY)	PERCENTAGE COMPLETED (%)	RESPONSIBLE	REMARKS
8 Assist States in developing training programme/ for Pilots, ATCOs, operators and regulators Riaaz: the ICAO Doc 9613 (V-II) already points out basic guidance	Regional guidance for States to utilize in designing the PBN training programs	30 Jun 2014	December 2015		NAM/CAR PBN TASKFORCE/ICAO NACC	VALID
Develop a performance measurement programme	Inputs to ANI/WG Rapporteur for presentation to NACC/WG/04 Meeting Standardized method for performance metrics	June 2014	December 2015		NAM/CAR PBN TASKFORCE	VALID
ANI/WG Meeting	Follow-up activities	25/Jul/15	December 2015		All Members	

ACTION PLAN FOR PBN IMPLEMENTATION

Status — Not started/ no iniciado | Lack of progress/ falta de avance | Behind scheduled/ retrasada | Ongoing- as scheduled/ Ok segun programa

Revision: June / Junio 2015

ACTION PLAN FOR PBN IMPLEMENTATION

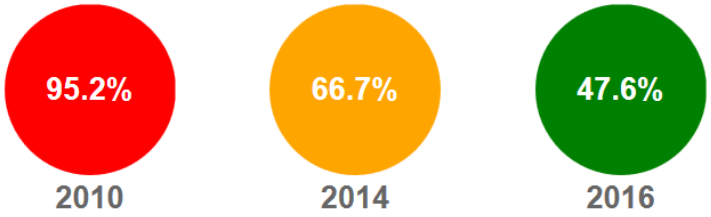
Task Name/ Tarea	Start/ Inicio	Finish/ Final	Deliverables/ Resultados	Follow-up/ Seguimiento	Responsible/ Responsables	Observations/ Comments- Observaciones/ Comentarios
a) Implement Collaborative Decision-Making (CDM) process in coordination with stakeholders	Abril 2008	Dec 2016	CDM implementation	ATFM/CDM Workshop conducted in 2015. Completed	PBN TF States, Territories, Int. Orgs	States to develop a PBN Airspace Redesign Project including: a) revision of regional ATS Route network, b) implementation of CDOs/CCOs c) TMA redesign d) Implementation of PBN approach procedures
b) Implement PBN Airspace Redesign Project for oceanic, continental and terminal areas in of CAR Region in accordance with the ICAO PBN Manual Doc 9613 and Doc 9992	Abril 2015	Dec 2017	Up-to-date the regional PBN Airspace concept with implementation activities for the period 2015-2017	PBN Workshop conducted in 2015 to update the Regional PBN Airspace Concept	PBN TF States, Territories, Int. Orgs	
c) Analyze GNSS implementation in accordance with PBN airspace concept requirements	Abril 2016	Dec 2018	SACSA Project completed a feasibility study (2015) on the use of GNSS Introduction of GNSS (GBAS and SBAS- Ionosphere matters)	GNSS workshop agreed for 2016	SACCSA Project support / WAAS States, Territories, Int. Orgs	
d) GNSS mitigations Plannings	April 2016	Dec 2018	Mitigation means	GNSS workshop agreed for 2016 RAIM Prediction topic presented in ANI/WG/02 Meeting DW Presentation	States, Territories, Int. Orgs	
e) Develop and implement PBN training programme for pilots, ATCOs, operators and regulators	Abril 2014	Dec 2018	PBN training programme	ICAO PBN Manual includes guidelines to develop training programmes	States, Territories, Int. Orgs	PBN TF to support Training Centers WG to develop PBN training programmes for pilots and controllers
f) Optimize the ATS route structure through implementation of RNAV routes between major city pairs with navigation specification RNAV-5 /2 for en-route operations	Abril 2015	Dec 2017	Develop a proposal for amendment (PFA) to Doc 8733 in Dec 2015	A Workshop on Regional Implementation on Performance-Based Navigation PBN Airspace Redesign was conducted on May 2015 States will submit proposals not later than 31st August 2015	PBN TF States, Territories, Int. Orgs	On-going revision of ATS route network States to send proposals to ICAO NACC Regional Office by 31st August 2015
g) Implement CDOs/CCOs for SIDs/STARS in terminal areas based on RNAV 1-2 and RNP 1-/2 navigation specification, as required	Abril 2015	Dec 2016	Implement CDOs/CCOs in TMAs	States continue implementation of CDOs and CCOs	PBN TF States, Territories, Int. Org	
h) Design and implement PBN APV in accordance with Assembly Resolution A37-11	2008	Dec 2016	PBN Instrument Approach Procedures implementations (APV, etc.)	Completed	PBN TF States, Territories, Int. Orgs	
i) Efficient application of longitudinal separation across the NAM/CAR/SAM regions.	Abril 2014	Dec 2017	Analysis of applicable separation minima for transfer traffic between FIRs	ANSPs of States, Territories, Int. Orgs to update existing Letters of Agreement (LOAs) between ATC units	ANSPs of States, Territories, Int. Orgs	PBN TF to support ANSPs While some FIRs were using as low as 5NM in their own airspace, based on existing procedures and LOAs, in most
j) Conduct PBN safety assessment based ATC simulations (fast time and/or real time), live trials, etc., as required	Abril 2014	Dec 2016	States to conduct PBN safety assessment	Completed	PBN TF States, Territories, Int. Orgs	cases, ten (10) minutes (80NM) were required for transfer from one FIR to the next.
k) Develop performance measurement programme	2008	Dec 2016	performance measurement programme	PBN Targets have been defined in the RPBANIP and the Port of Spain Declaration as Performance metrics. Completed	States, Territories, Int. Orgs	Reviewed by the NACC/DCA Meetings
l) Develop post-implementation PBN Safety Assessment Programme	2010	Dec 2016	States to conduct post-implementation PBN Safety Assessment	Permanent On going activity conducted by States	States, Territories, Int. Orgs	
m) Monitor implementation progress	2008	Dec 2018	Annual review of PBN implementation	On-going activity conducted by ICAO	ICAO, States, Territories, Int. Orgs	

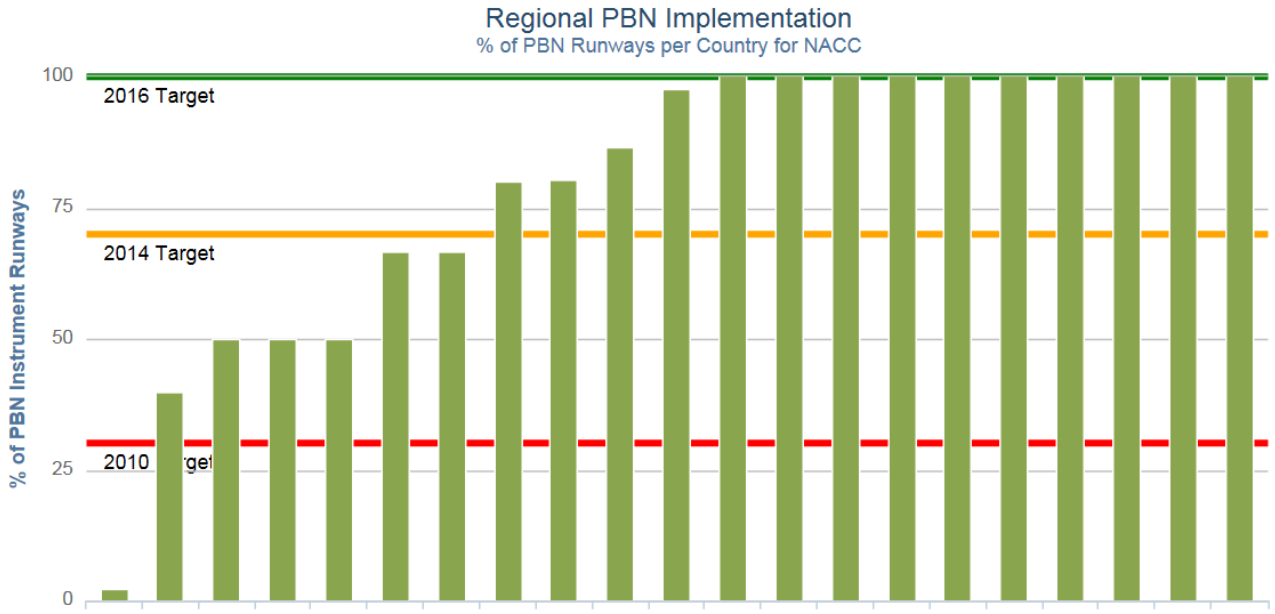
PBN Validation

Guidance

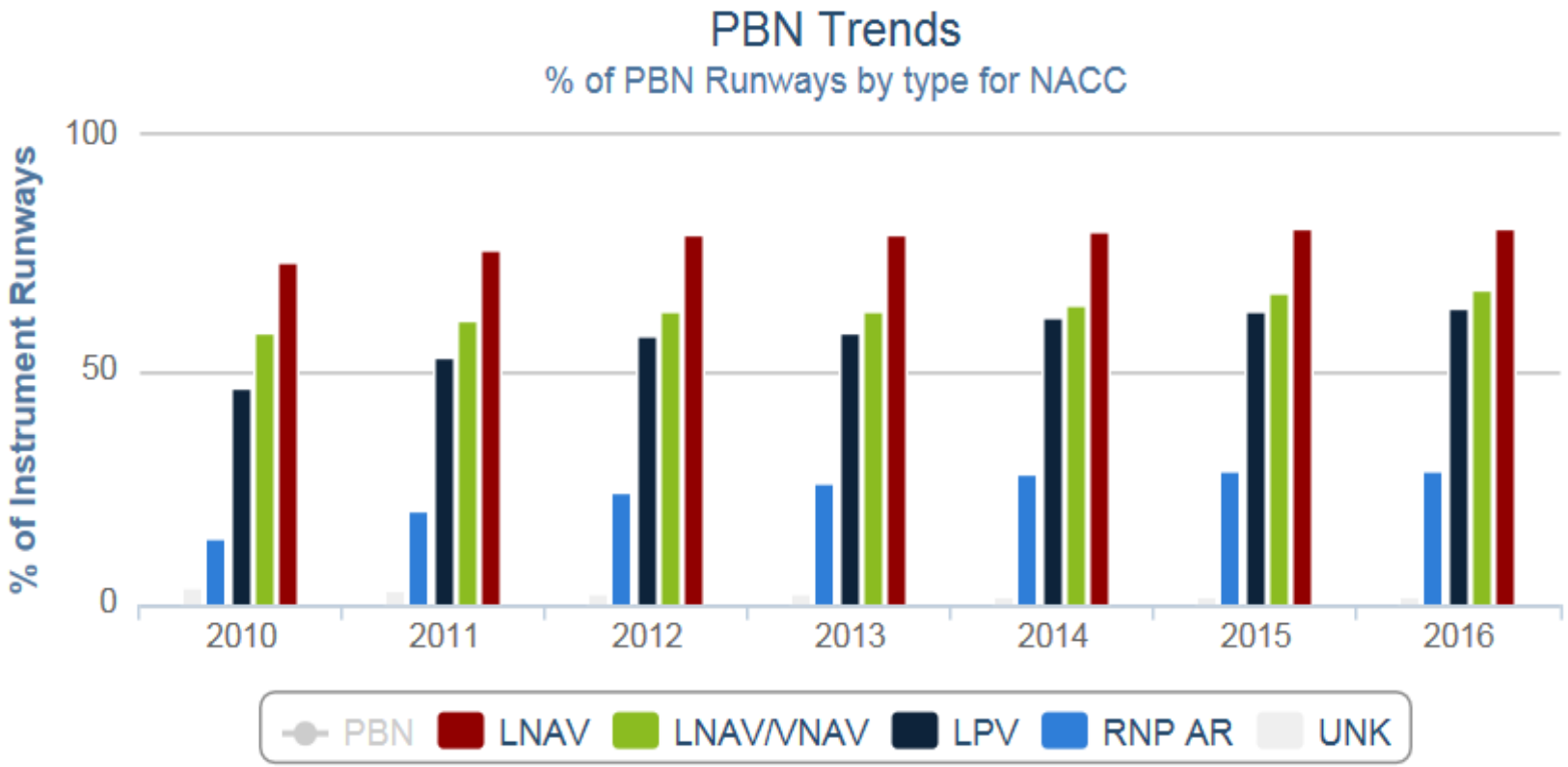
- PBN Manual (DOC 9613)
- Quality Assurance Manual for Flight Procedure Design (Doc 9906),
  - Volume 5 - Validation of Instrument Flight Procedures.
  - Volume 6 - Flight Validation Pilot Training and Evaluation
- Manual on Testing of Radio Navigation Aids, Volume II, Testing of Satellite-based Radio Navigation Systems (Doc 8071)

NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN



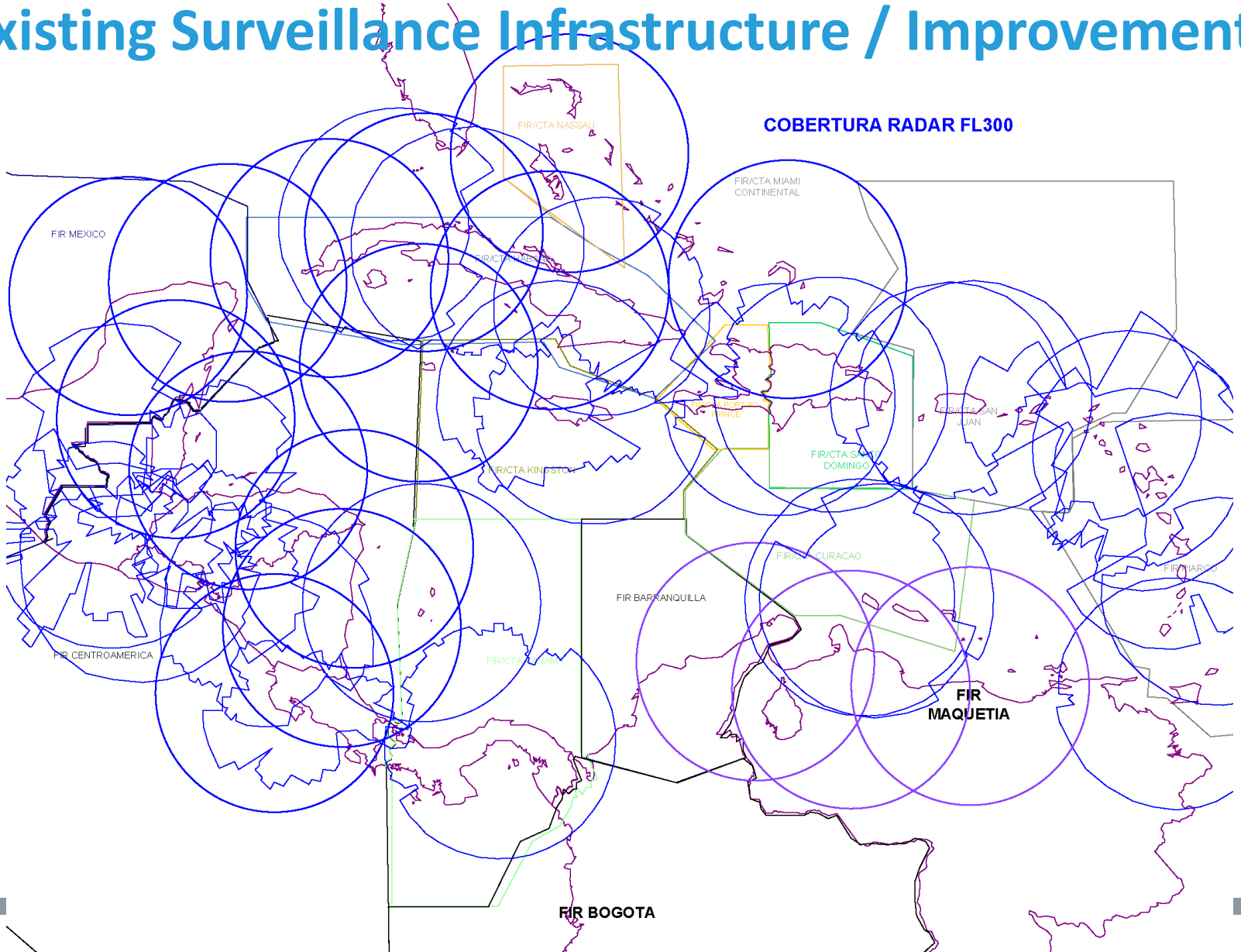


NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN



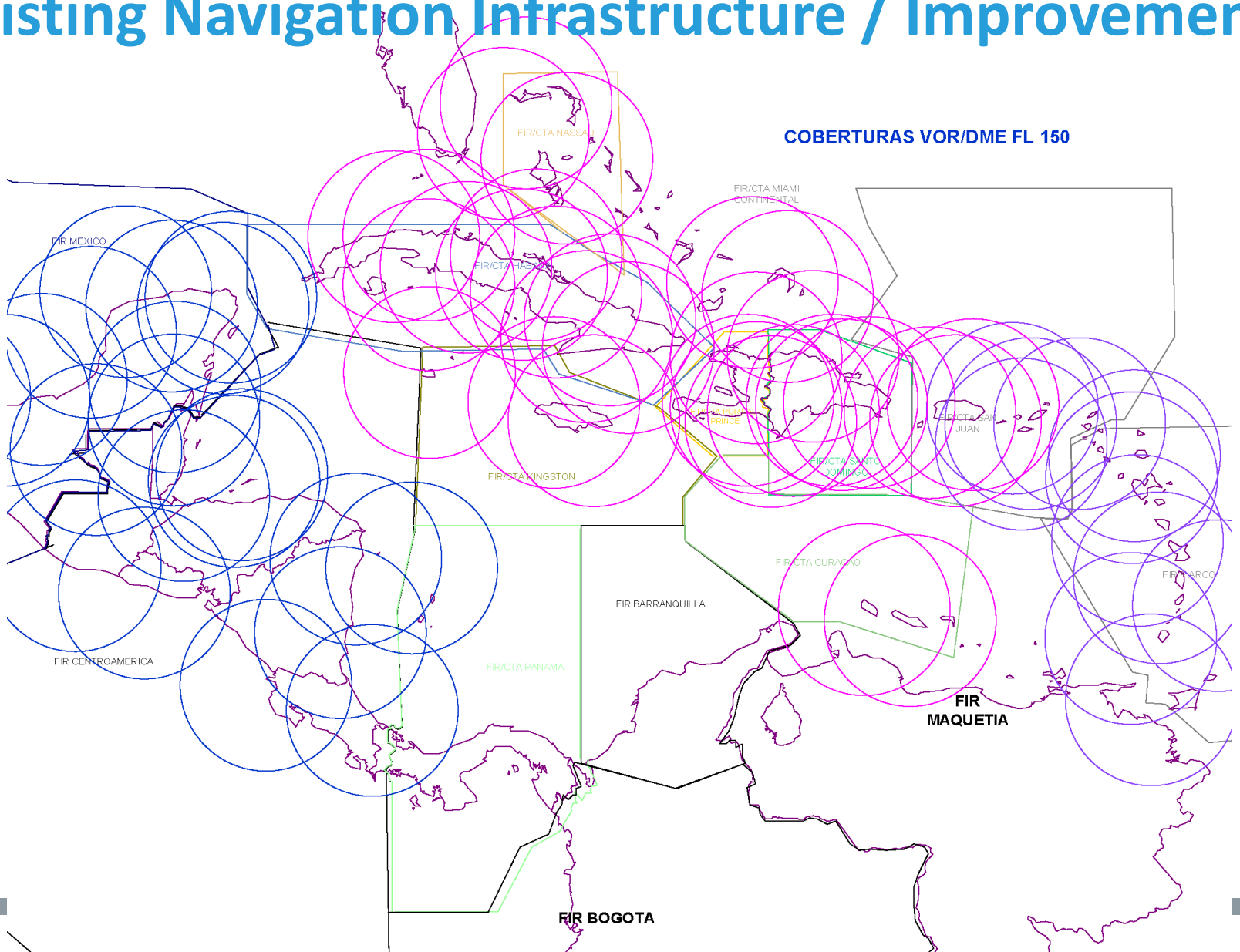
NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

Existing Surveillance Infrastructure / Improvements



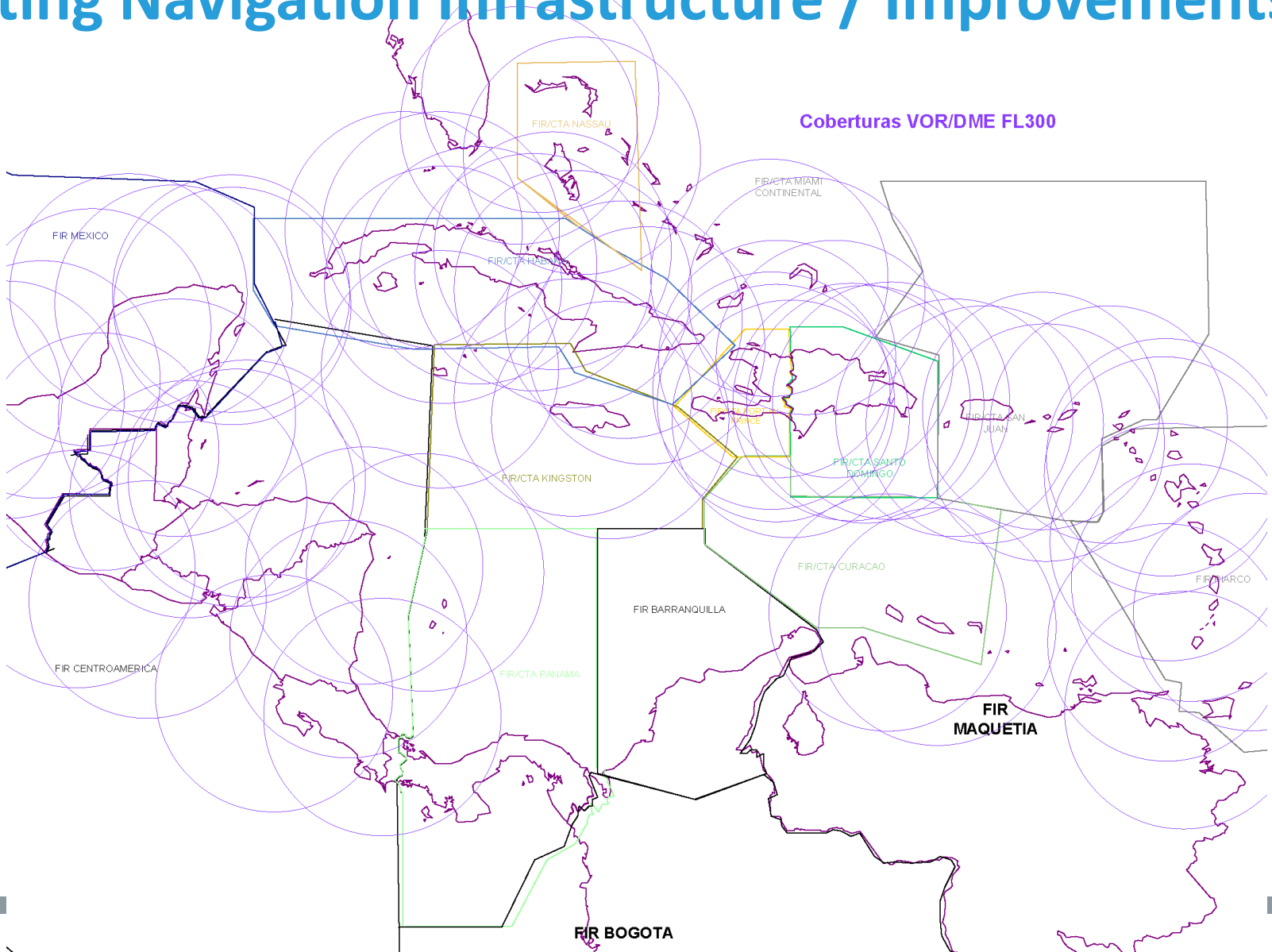
NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

Existing Navigation Infrastructure / Improvements



NAM CAR NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

Existing Navigation Infrastructure / Improvements



Existing Navigation Infrastructure / Improvements

Navigation Improvements and Relevant events

- Navaids replacement/modernization
- GBAS studies
- SBAS Study by SACCSA Project

CONCLUSIONS IN CAR REGION

a) The CAR Region has a well-developed telecommunication infrastructure (regional networks) that satisfies all Air Navigation Plan requeriments and is being upgraded to facilitate the implementation of new operational requirements including the performance based navigation

b) AMS VHF communication services in the CAR region cover great part of the CAR Airspace Service volume, with several improvements in its voice quality and coverage.

c) Surveillance services in the CAR region had been improving significantly under a collaborative basis with the exchange of radar data.

d) ADS-B data activities are ongoing with data collection and trials

CONCLUSIONS IN CAR REGION

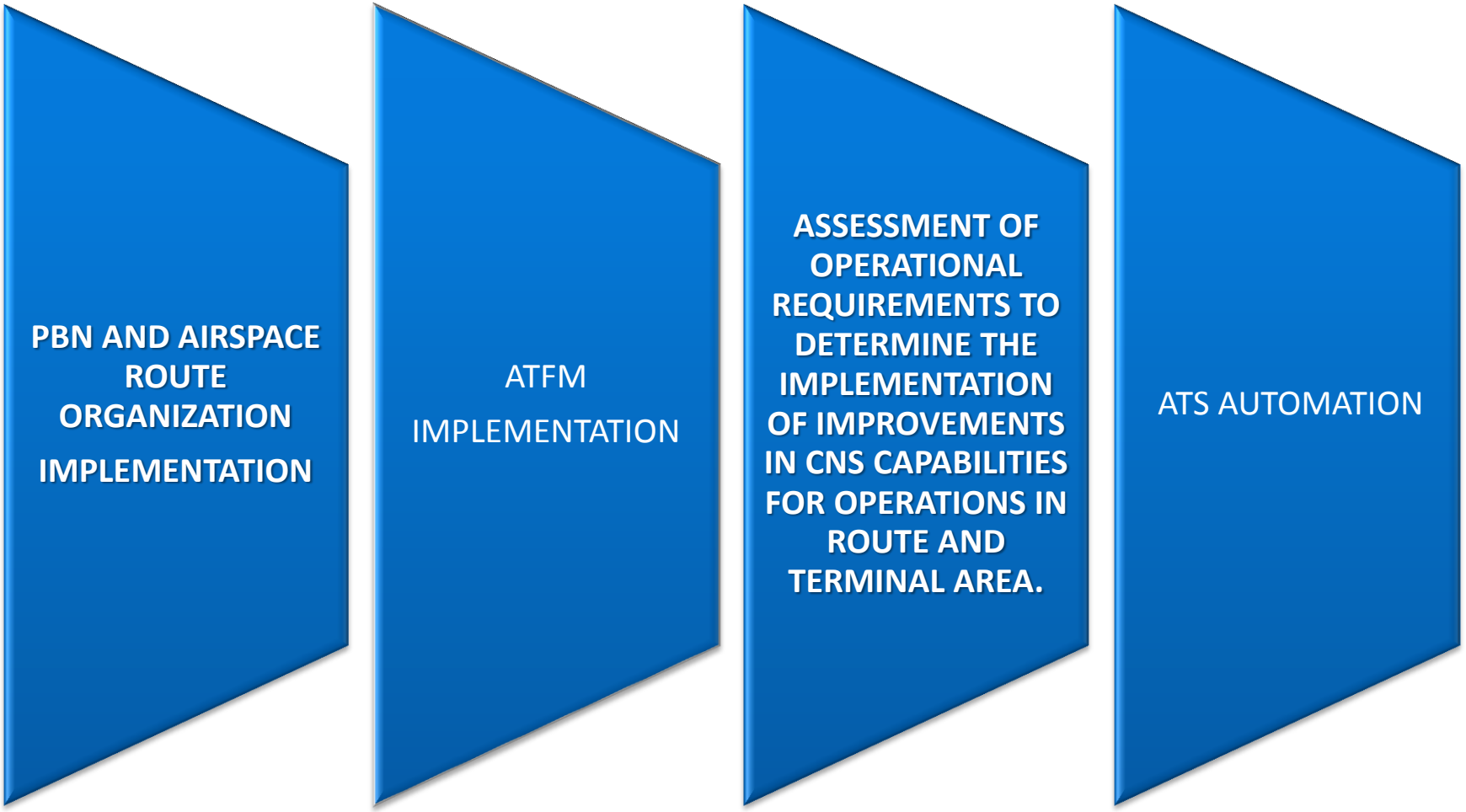
- **Even though VOR/DME coverage in the CAR Region has improved significally, several areas need to improve the quality and coverage of navaids services.**

- **Very few activities/evaluations in the CAR Regions for Aumentation system implementations (GBAS, SBAS)**

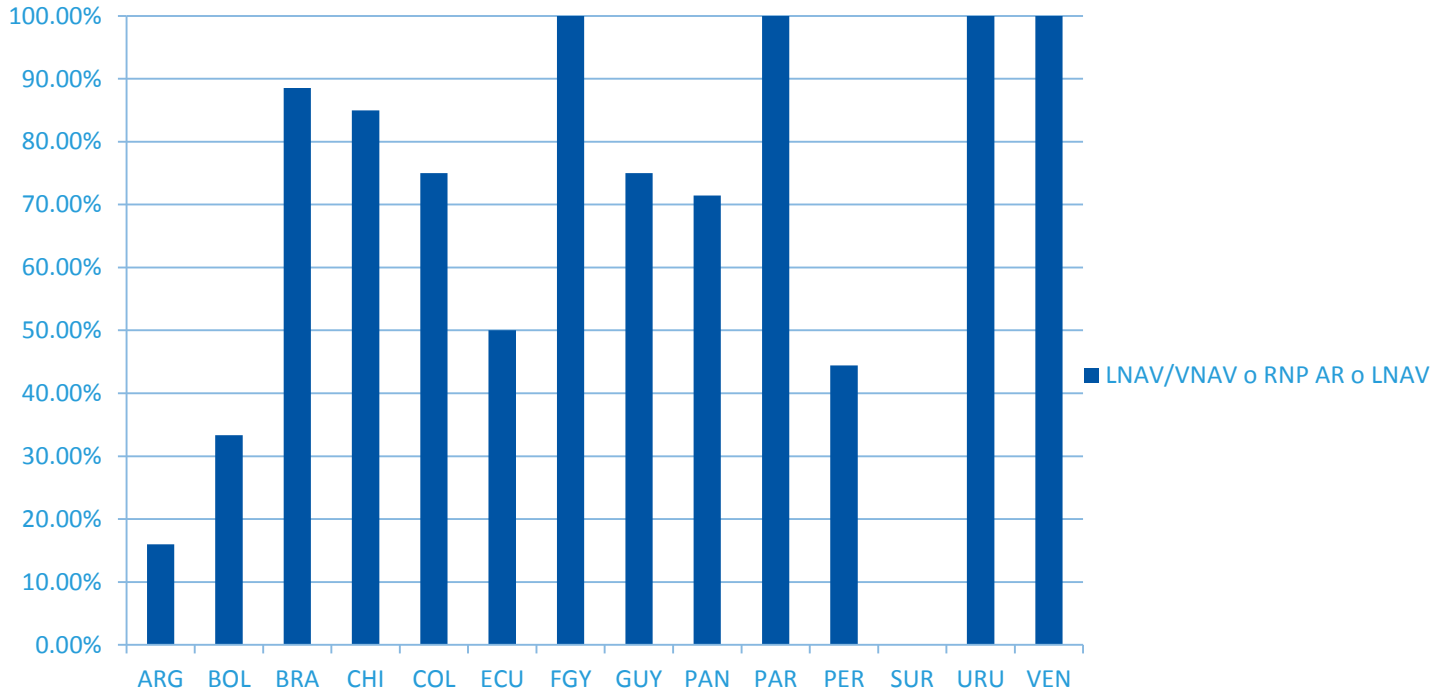
- **Need for navigation infrastructure analysis (DME/DME coverage, VOR, etc.) based on CAR airspace concept redesign/ update.**

SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

RLA/06/901 PROJECT
SAM/IG MEETING

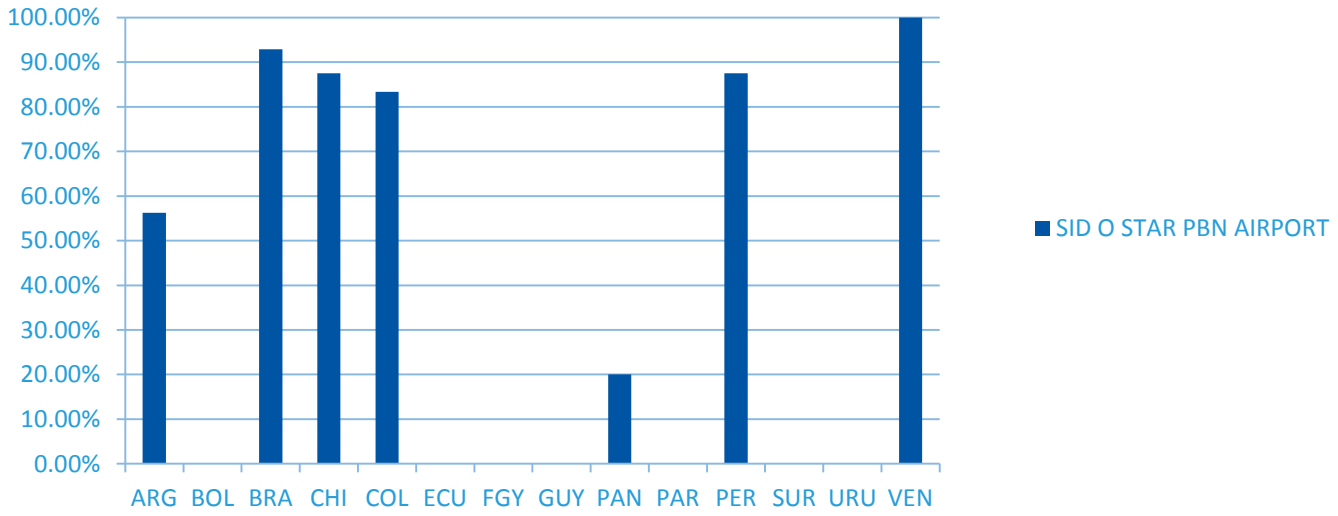


PBN PROCEDURES IMPLEMENTATION STATUS (Res. A37/11)



SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

SIDS/STARS PBN IMPLEMENTATION STATUS



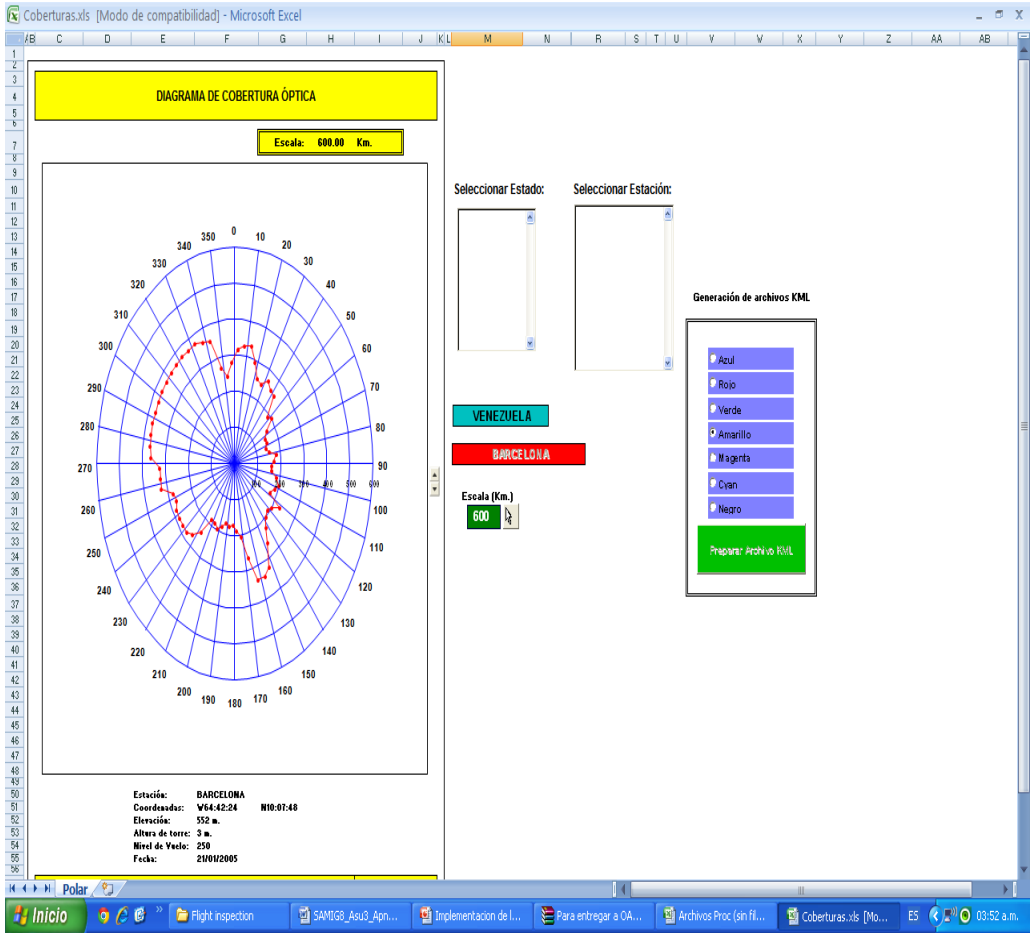
SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

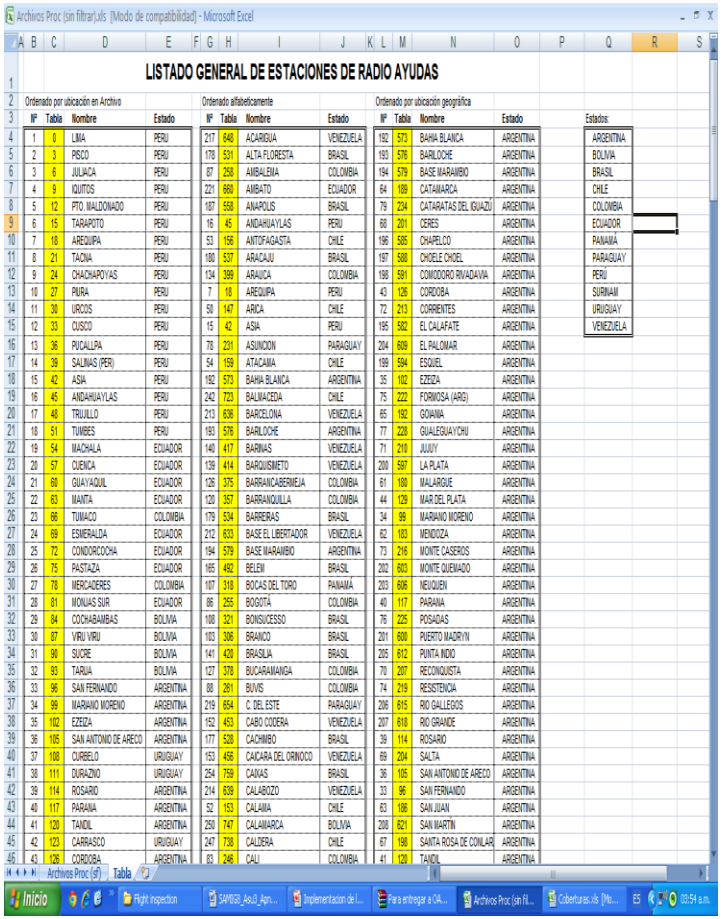
SAM ATS ROUTES PBN (RNAV 5)

TOTAL ATS ROUTES UPPER AIRSPACE ATS	CONVENCIONAL ROUTES	PBN ROUTES	% PBN IMPLEMENTED	INDICATOR BOGOTA DECLARATION 2016 : % PBN ROUTES
145	52	93	65%	60%

SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

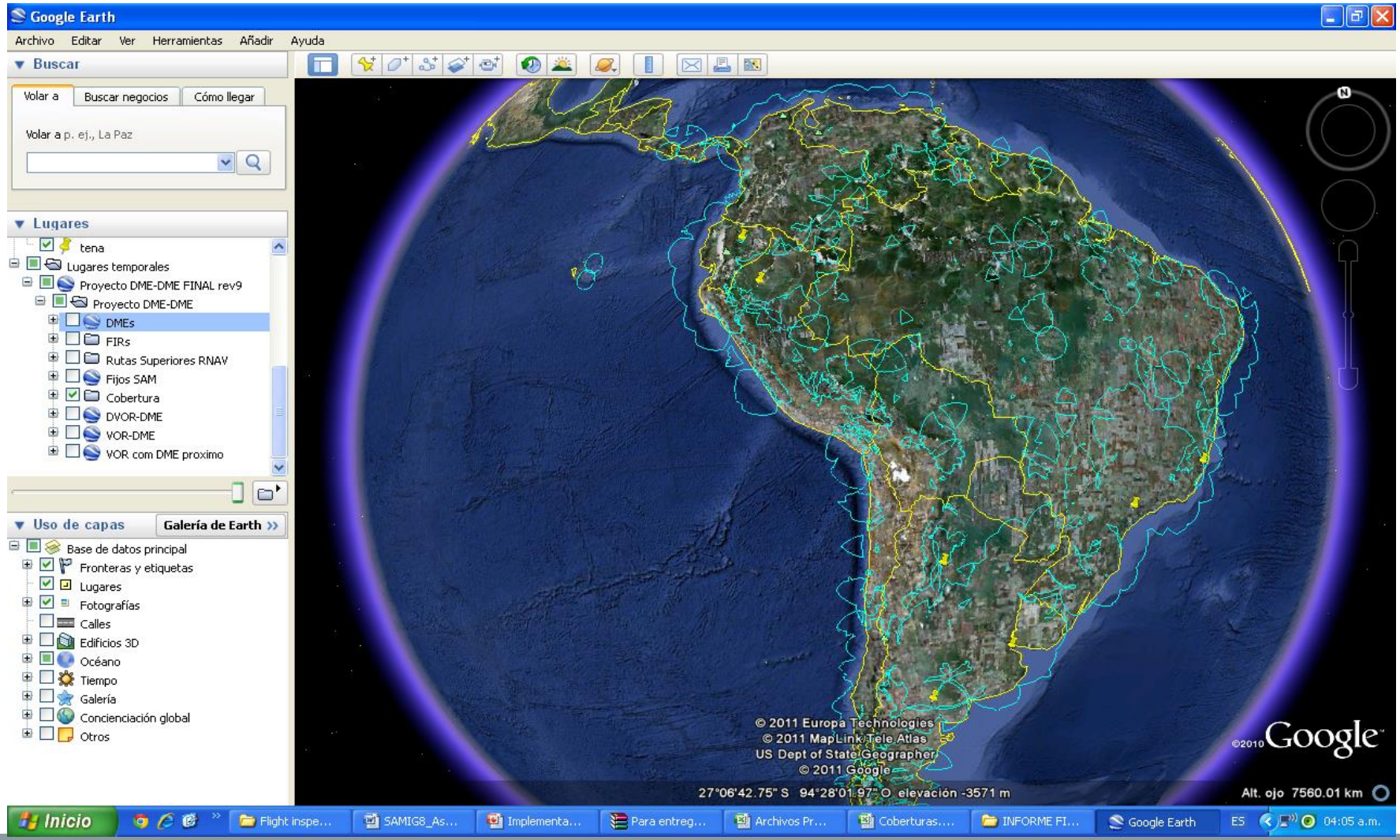
VOR DME COVERAGE DATABASE





SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

DME DME COVERAGE TO SUPPORT RNAV 5



SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

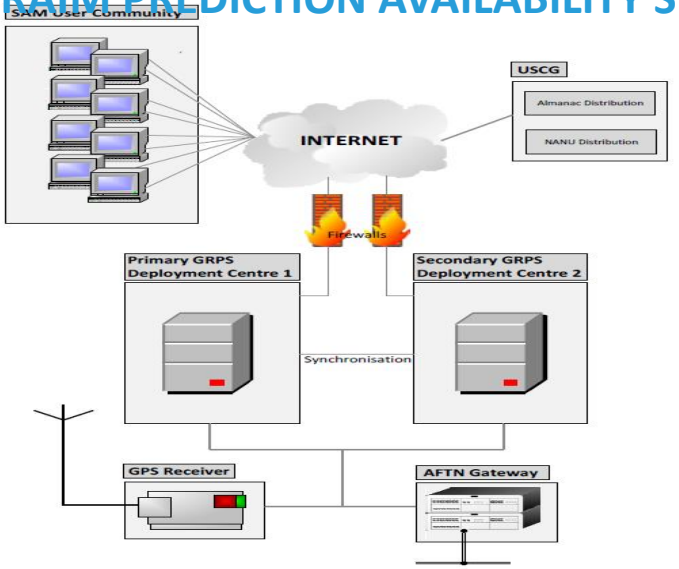
DME DME COVERAGE ANALYSIS IN THE RNAV5 ROUTES

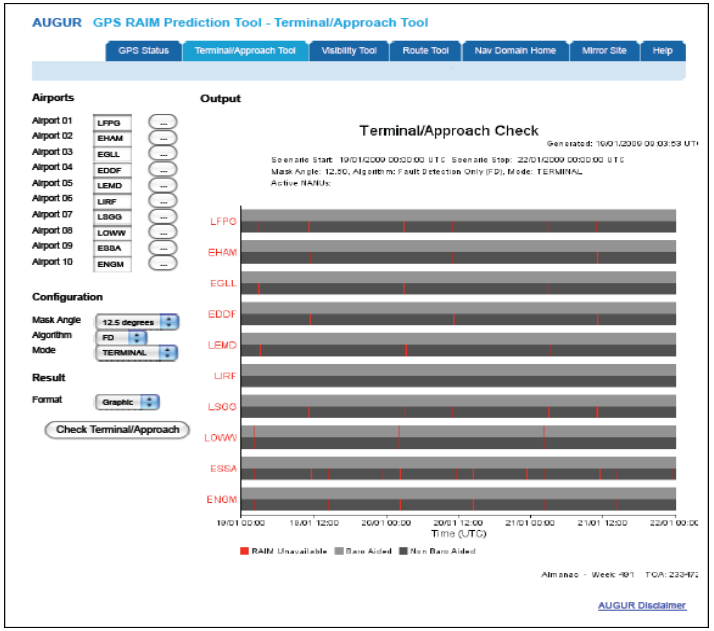
RUTAS RNAV Región SAM

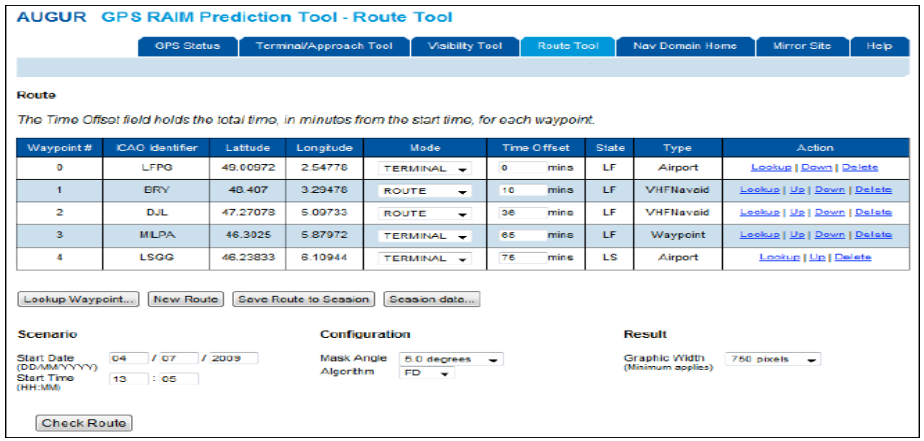
RUTA/ ROUTE	WP	RESULTADOS DE ANALISIS DE COBERTURA DME/DME -DME/DME Coverage Analysis Results	FIR
UL201			
	MITU CO VOR/DME (MTU)		
	ABIDE	TRAMO SIN COBERTURA DME/DME / SEGMENT WITHOUT DME/DME COVERAGE	
	ABIDE	TRAMO CON COBERTURA DME/DME PARCIAL/SEGMENT WITH PARTIAL DME/DME COVERAGE	AMAZONICA
	CLOTI	TRAMO SIN COBERTURA DME/DME / SEGMENT WITHOUT DME/DME COVERAGE	
	MINIB		
	BUMBA	TRAMO CON COBERTURA DME/DME PARCIAL/SEGMENT WITH PARTIAL DME/DME COVERAGE	
	EGLER PERSA OBEBA IRUMI BARGE	TRAMO SIN COBERTURA DME/DME / SEGMENT WITHOUT DME/DME COVERAGE	
	RONEN ARPAR KUGMA CANON		
	CANON	TRAMO SIN COBERTURA DME/DME / SEGMENT WITHOUT DME/DME COVERAGE	BRASILIA
	ILMOK EQUAL		
		TRAMO CON COBERTURA DME/DME PARCIAL/SEGMENT WITH PARTIAL DME/DME COVERAGE	
	ANGOL	TRAMO SIN COBERTURA DME/DME / SEGMENT WITHOUT DME/DME COVERAGE	
	GRACE		
	MABMA		
	ABUSE	TRAMO SIN COBERTURA DME/DME / SEGMENT WITHOUT DME/DME COVERAGE	
	TESEK		
	ISIRO		
	ASTOB HASTE	TRAMO CON COBERTURA DME/DME / SEGMENT WITH DME/DME COVERAGE	
	PIRASSUNUNGA VOR/DME (PIR)		

SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

RAIM PREDICTION AVAILABILITY SERVICE IN THE SAM REGION







SAM NAVIGATION INFRASTRUCTURE IMPLEMENTATION TO SUPPORT PBN

CONCLUSION SAM REGION

- Complete the DME DME coverage to support PBN procedure
- Increase the use of the Regional SAM RAIM prediction availability service
- A cost-benefit analysis based on its own operational demand each States must makes to determine which airports are suitable for the installation of GBAS CAT I stations.
- For each eligible airport, a GBAS ionosphere threat model will be required for certification and commissioning purposes
- Continue the assessment of the technical, operational, and financial feasibility of SBAS systems with a multi constellation and dual frequencies environment .