Agenda Item 3: SAM airspace optimisation
a) En-route PBN
b) PBN in terminal areas
c) PBN procedures

National PBN Implementation Plans

(Presented by the Secretariat)

SUMMARY

The purpose of this working paper is to urge States to update their National PBN Implementation Plans.

REFERENCES:

- SAM/IG meetings

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

1. Background

1.1 The GREPECAS/15 meeting, pursuant to Resolution A36-23 of the ICAO 36th Assembly, approved Conclusion 15/38 urging CAR/SAM States and Territories to develop their national PBN implementation plans by December 2009 and submit them to the corresponding Regional Offices.

1.2 The SAM/IG/3 meeting considered that national PBN implementation plans, which had to be submitted to the SAM Regional Office in December 2009, should be presented at the SAM/IG/4 meeting for their harmonisation in the South American Region. The meeting also noted that the ICAO PBN website contained a model PBN Implementation Plan, which was available to the States. In this regard, the meeting formulated Conclusion SAM/IG/3-3 – National PBN implementation plans, with a view to:

- implementing RNAV and RNP operations (where required) for en-route (oceanic and continental) and terminal area (TMA) operations, in accordance with the established timetables;

- implementing Baro-VNAV or SBAS approach procedures with vertical guidance (APV) for all IFR runway ends, whether as primary approach or as backup for precision approaches by 2016, with the following scheduling: 30 per cent by 2010 and 70 per cent by 2014.

1.3 Eleven SAM States sent their national PBN implementation plans to the SAM Regional Office in 2009.

2. **Discussion**

2.1 Taking into account that national PBN implementation plans were drafted 5 years ago, they need to be updated based on the strategy applied in the SAM Region.

2.2 National PBN implementation plans must be drafted based on the plans established by each State to meet the PBN goals of the Bogota Declaration, which are shown in **Appendix A**. The aforementioned plans must contemplate, *inter alia*, the following:

- TMAs whose airspace will be completely redesigned based on the methodology established at the PBN workshops. TMAs encompassing the main international airports of each State should be included.
- Implementation of PBN SIDs and STARs, using CDO and CCO techniques.
- Implementation of APV approach procedures.
- Fuel and CO_2 savings.

2.3 In order to harmonise the drafting of national PBN implementation plans, the Secretariat has developed a model, which is shown in **Appendix B**.

3. **Suggested action:**

3.1 The Meeting is invited to:

3.1.1 Approve the following draft conclusion:

Draft Conclusion SAM/IG/14-XX National PBN implementation plans

That SAM States submit their updated National PBN Implementation Plans to the SAM/IG/15 meeting, using the national PBN implementation plan model shown in Appendix XX.

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APPENDIX A

GOALS OF THE BOGOTA DECLARATION CONCERNING PBN IMPLEMENTATION

Indirect relation

2. Accidents

Reduce the SAM regional accident rate gap in 50% with regard to the global accident rate.

3. Runway excursions

Reduce runway excursions in 20% with regard to the average rate of the Region (2007 – 2012).

11. ATFM

100% of the area control centre (ACCs) providing air traffic flow management (ATFM).

Direct relation

6. PBN terminal

Full compliance with goals established in ICAO Assembly Resolution A37-11 regarding approach procedure with vertical guidance (APV).

7. PBN enroute

- 60% of the international aerodromes with standard instrument departure (SID) / standard instrument arrival (STAR) PBN.

- 60% of the routes/airspaces with performance based navigation (PBN).

8. CDO

40% of the international aerodromes / terminal control areas (TMA) with continuous descent operation (CDO).

9. CCO

40% of the international aerodromes / TMAs with continuous climb operations (CCO).

10. Estimated fuel savings/ $C0_2$ emissions reduction based on the ICAO fuel savings estimation tool (IFSET)

Reach 40,000 tons of regional CO_2 emissions reduction per year in en-route PBN implementation.

APPENDIX B

PBN IMPLEMENTATION PLAN

MODEL

PBN Implementation Plan
State XX

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1. Objective

This PBN Implementation Plan has the following objectives:

a) Provide a high-level strategy for PBN implementation in (indicate STATE and/or ANSP). This strategy is based on PBN, area navigation (RNAV), and required navigation performance (RNP) concepts to be applied in aircraft operations in all flight phases: en-route (oceanic and continental), TMA (SIDs and STARs), and IFR approach, in accordance with implementation objectives set forth in ICAO Assembly Resolution A37-11, and based on the Bogota Declaration formulated at the Thirteenth Meeting of Civil Aviation Authorities of the SAM Region.

b) Avoid unnecessarily imposing the requirement of carrying multiple equipment units on board or having multiple ground equipment.

c) Avoid the need for multiple aircraft and operator approvals for intra- and inter-regional navigation.

2. Background

Resolution A37-11: The global performance-based navigation goals require States to develop a PBN implementation plan, as a matter of urgency, with a view to:

a) implementing RNAV and RNP operations (where required) for en-route and terminal areas, in accordance with the established deadlines;

b) implementing by 2016 approach procedures (Baro-VNAV and/or augmented GNSS) with vertical guidance (APV), including minima for LNAV only, for all instrument flight runway ends, whether as main approach or in support of precision approach, with the following intermediate milestones: 30% by 2010 and 70% by 2014; and

c) implementing direct LNAV procedures only, as an exception to b) above, for instrument flight runways at aerodromes lacking local altimeter facilities and where there are no aircraft properly equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more.

Pursuant to Resolution A37-11, SAM States have signed the Bogota Declaration. Out of the 15 goals established in said declaration, 5 are directly related and 3 are indirectly related to PBN implementation. These goals are:

Indirectly related

- Accidents – Reduce the SAM regional accident rate gap by 50% with respect to the global accident rate.
- Runway excursions – Reduce runway excursions by 20% with respect to the average rate of the Region (2007 – 2012).
- ATFM - 100% of area control centres (ACCs) providing air traffic flow management (ATFM) services.

Directly related

- Performance-based navigation (PBN) terminal – Compliance with goals established in ICAO Assembly Resolution A37-11 regarding approach procedures with vertical guidance (APV).
- En-route PBN
  - 60% of international aerodromes with PBN standard instrument departures (SIDs) / standard instrument arrivals (STARs).
  - 60% of routes/airspaces with PBN.
- CDO - 40% of international aerodromes / terminal control areas (TMAs) with continuous descent operations (CDO).
- CCO - 40% of international aerodromes / TMAs with continuous climb operations (CCO).
- Estimation of fuel savings / reduction of $C0_2$ emissions based on the ICAO fuel savings estimation tool (IFSET) - Reach 40,000 tonnes of regional CO_2 emission reduction per year in en-route PBN implementation.

Thus, PBN implementation is assigned high priority within the ATM Work Programme of the South American Regional Office and of (indicate the State and/or ANSP).

3. Introduction

(AT THE DISCRETION OF THE STATE)

The success of PBN implementation will depend on effective participation by the ATM community to ensure that the operational requirements of the various airspace users, as well as those of service providers are met.

4. Strategic Objectives

4.1 En-route operations

The implementation of PBN for en-route operations in continental airspace within the jurisdiction of (INDICATE THE STATE) will be done in accordance with the SAM regional strategy to meet the following strategic objectives:

a) Safety – The implementation of RNAV-5 has enabled formal and harmonised use of RNAV in new and existing RNAV routes, and created the necessary conditions for a complete restructuring of the route network. Consequently, it will be possible to develop a less complicated route network, reducing the controller workload and thus, increasing safety.

b) Capacity – Taking into account reduced airspace complexity and the resulting reduction in controller workload, there will be an increase in ATC capacity of sectors, allowing a larger number of aircraft to fly at the same time.

c) Efficiency – The implementation of RNAV-5 will increase operational efficiency, since it will permit:

- Airspace management improvements through the repositioning of intersections.
- Better use of available airspace through a route structure that allows for the establishment of:
  - More direct routes (double and parallel, if necessary) to accommodate more air traffic.
  - "Bypass" routes for aircraft overflying highly dense TMAs.
  - Alternate or contingency routes.
  - Optimum in-flight holding positions.
  - Optimised feeder routes.
- Reduction of distances flown, resulting in fuel savings.
- Reduction in the number of navigation radio aids.

d) Environmental protection – As a result of increased efficiency and fuel savings, there will be a reduction of harmful gas emissions into the atmosphere.

4.2 Terminal control areas (SIDs and STARs) and approach

The implementation of RNP1 and/or RNAV1 at the main TMAs, and of RNP APCH with Baro-VNAV at all thresholds used for IFR and/or RNP AR APCH operations where

operational benefits (safety, efficiency, and access) can be obtained will mainly satisfy the following strategic objectives:

a) Safety – The implementation of RNP1 and/or RNAV-1 at the TMAs will permit segregation of arrival and departure paths, avoiding conflicts between aircraft. Use of RNP APCH with APV/Baro-VNAV and/or RNP AR ACPH will reduce the risk of controlled flight into terrain (CFIT).

b) Capacity – Use of RNAV-1 and/or RNP1 SIDs/STARs will permit reduced use of radar vectors and, thus, a reduction in airspace complexity and controller workload, increasing ATC capacity of sectors and allowing a larger number of aircraft to fly at the same time.

c) Efficiency – The implementation of RNP1 and/or RNAV-1 will improve efficiency, since the establishment of well-defined departure and arrival points will permit the restructuring of the routes arriving to/departing from the TMA, reducing flight time. STAR and approach interaction will create the conditions for the establishment of optimum arrival paths, from the en-route phase to the final approach. Likewise, RNP1 and RNAV-1 navigation precision will make aircraft paths more predictable, facilitating aircraft separation and reducing the need for air traffic controller intervention in case of aircraft deviation from the foreseen paths. STAR and approach integration will also improve predictability.

d) Environmental protection – Improved efficiency and fuel savings will reduce the emission of harmful gases into the atmosphere. Furthermore, the use of CDO/CCO will help reduce aeronautical noise.

e) Access – The implementation of RNAV (GNSS) approach with Baro-VNAV and/or RNP AR APCH at airports lacking ILS or whose terrain/obstacles result in high meteorological operational minima, will improve aerodrome access under adverse meteorological conditions.

5. Implementation

5.1 En-route operations

En-route PBN implementation is dealt with at regional level, taking into account that the main traffic flows stradding two or more States.

The regional PBN implementation strategy for en-route operations is based on the route network version concept, taking into account that airspace structure changes resulting from air traffic growth, traffic demand displacement from one Region or airport to another, and available technology, amongst other aspects. The use of route network versions reflects the need for periodic, comprehensive reviews to make sure that the best possible airspace structure is always available within the context of an integrated development concept. Route network versions are the result of a broader route network analysis based on traffic and fleet navigation capacity statistics, seeking the elimination of routes not being used and the exclusion or reduced use of "conventional" routes in a given airspace volume where most users have the capability of conducting RNAV-5 operations.

Furthermore, SAM route network versions must seek a complete route network restructuring through full integration of ATS routes, control sectors, TMAs, etc., using the flexible use of airspace concept. Likewise, the use of specific airspace modelling and fast-time ATC simulation tools should be assessed.

5.2 Complete redesign of terminal areas

5.2.1 TMA XX

5.2.1.1 Preliminary operational requirements

5.2.1.2 Tentative date of implementation

5.2.2 TMA YY

5.2.2.1 Preliminary operational requirements

5.2.2.2 Tentative date of implementation

5.2.3 TMA ZZ

5.2.3.1 Preliminary operational requirements

5.2.3.2 Tentative date of implementation

5.3 Implementation of arrivals and departures, using CDO and CCO

The purpose of the PBN SID and STAR implementation programme is to publish these instrument procedures for all thresholds that operate IFR, with the use of CDO and CCO techniques.

Plans for, and the status of, implementation of PBN arrivals and departures, with or without the use of CDO and CCO techniques, are shown in **Appendix A** (example: BOLIVIA), and will be updated and delivered to the SAM Regional Office every six months, on 30 June and 31 December each year.

5.4 PBN approach

The purpose of the Aerodrome Approach Implementation Programme is to publish RNAV (GNSS) approach procedures for all thresholds that operate IFR, with the possibility of using vertical navigation (LNAV/VNAV) by using Baro-VNAV. Furthermore, ILS approach procedures will be published for airports with ILS equipment to facilitate arrival and approach interface.

Plans for, and the status of, implementation of PBN approach procedures are shown in **Appendix A** (example: BOLIVIA), which will be updated and delivered to the SAM Regional Office every six months, on 30 June and 31 December each year.

5.5 Fuel savings and reduction of CO_2 emissions

Fuel savings and the reduction of CO_2 emissions to be achieved through PBN implementation will be calculated using the IFSET tool, with a view to determining the efficiency of such implementation. The aforementioned calculation will be part of the complete redesign of the main TMAs and of the implementation

of SIDs, STARs, and APV approach procedures. These calculations of fuel savings and CO_2 emission reduction will be delivered to the SAM Regional Office every six months, on 30 June and 31 December each year.

Calculations of actual fuel savings and reduction of CO_2 emissions will be performed during the post-implementation phase, using tools that retrieve data from Flight Operations Quality Assurance and/or other means that could provide actual information on fuel savings. Once these data are available, they will be delivered to the SAM Regional Office.

Appendix A

Status of implementation of PBN SIDs, STARs, and approach procedures

DATA COLLECTION DATE: 10 OCTOBER 2014											
STATE	**CAR/SAM ANP INTERNATIONAL AIRPORTS**	**IFR thresholds**	**VFR thresholds**	**APV IAP**	**LNAV IAP**	**RNPAR IAP**	**PBN SID**	**PBN STAR**	**CCO SIC**	**CDO STAR**	**OBS**
BOLIVIA	**BOLIVIA (5 AIRPORTS)**										
	SLCB COCHABAMBA	(1)	(2)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(4)
	SLLP LA PAZ										
	SLVR SANTA CRUZ										
	SLTJ TARIJA										
	SLTR TRINIDAD										

Note: The cited AIRAC dates are tentative, based on the capability of publishing instrument procedures.

(1) Insert the direction of thresholds that have IFR operations or that are capable of supporting them.
(2) Insert the direction of thresholds where **only** VFR operations are conducted or that are **not** in a position of supporting IFR operations.
(3) Insert "yes" if the airport threshold already has the instrument procedure indicated in the title of the column (APV IAP, LNAV IAP, RNAV AR IAP, PBN SID or PBN STAR). Insert the tentative AIRAC date of implementation for the type of procedure, if not yet implemented.
(4) Insert any relevant remarks. If applicable, provide summarised information on the reason whey the threshold does not support IFR operations.