E/CAR/CATG/3 — WP/22
19/10/16

Third Eastern Caribbean Civil Aviation Technical Group Meeting (E/CAR/CATG/3)
Basseterre, Saint Kitts and Nevis, 19 to 21 October 2016

Agenda Item 3: Air Navigation Matters
3.2 Follow-up on the implementation of the NAM/CAR Regional Performance Based Air Navigation Plan (RPBANIP) and the *Port-of-Spain* Declaration Air Navigation Targets in the Eastern Caribbean:
3.2.1 Progress reports of the AIM, AGA, ATM, CNS, MET and SAR Committees

AIR NAVIGATION SUPPORTING EVENTS

(Presented by the Secretariat)

EXECUTIVE SUMMARY

ICAO NACC Office is continuously supporting the region in the Air Navigation implementation matters through the provision of workshops and implementation meetings. The summaries of discussion of the recent workshops since the last ECARCATG /02 Meeting are listed in **Appendices A, B, C**, and **D**.

Action:	E/CAR/CATG to take note and reference of the recommendations and actions from each workshop.
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• CAR/SAM Seminar/Workshop for the Implementation of Advanced Surveillance and Automation Systems, Panama City, Panama, 22 – 25 September 2015 • ICAO/IATA/CANSO Performance-Based Navigation (PBN) Harmonization, Modernization and Implementation Meeting for the Caribbean (CAR) Region, Fort Lauderdale, United States, 28 March – 1 April 2016 • Meeting/Workshop to Enhance State Coordination Between MET, AIM, AND ATM FIELDS, Mexico City, Mexico; 26 to 28 July 2016 • Seminar/Workshop for the Implementation of Navigation Infrastructure to Support PBN and GNSS Precision Approach Operations in the NAM/CAR/SAM Regions, Lima, Peru, 15 to 17 August 2016 • NAM/CAR/SAM Air Traffic Services (ATS) Data Link Implementation Workshop, Philisburg, Sint Maarten, 18-21 April 2016

— — — — — — — — — — —

International Civil Aviation Organization

NACC and SAM Regional Offices

CAR/SAM Seminar/Workshop for the Implementation of Advanced Surveillance and Automation Systems

(Panama City, Panama, 22 to 25 September 2015)

Summary of Discussions

Presented by the Secretariat September 2015

CAR/SAM SEMINAR/WORKSHOP FOR THE IMPLEMENTATION OF ADVANCED SURVEILLANCE AND AUTOMATION SYSTEMS

SUMMARY OF DISCUSSIONS

Date:	22 to 25 September 2015
Venue:	Panama City, Panama
Participants:	The workshop was attended by 82 representatives of 18 NAM CAR SAM States, 2 international organisations of the Regions and 12 companies. The list of participants appears in the **Attachment** to this document.

1. Introduction

1.1 The workshop was conducted by ICAO and had the following objectives:

a) Support the implementation of advanced surveillance (ADS-B and multilateration) and automation (AIDC) systems to meet the operational surveillance and automation requirements specified in the NAM/CAR and SAM Regional performance-based implementation plans, within the framework of the ICAO Global Air Navigation Plan (Fourth Edition);

b) Receive information from ICAO, the industry, and NAM/CAR/SAM States, mainly on:
- Regional planning and status of implementation of surveillance and automation systems in the CAR/SAM Regions based on NAM/CAR and SAM regional performance-based air navigation plans and the goals of the *Declaration of Bogota* and the *Declaration of Port of Spain.*
- The importance of ADS-B and multilateration as technical enablers of ICAO ASBUs through operational guidance and implementation support.
- Users' vision on the implementation of surveillance and situational awareness systems on board the aircraft.
- Technical and operational information on the new surveillance and automated systems at ATS units, as well as on the activities to be taken into account for their implementation.

1.2 This event supported the implementation of the following Block 0 modules of the Aviation System Block Upgrades (ASBU), contemplated in the NAM/CAR and SAM Regional Plans, B0 *SURF - Safety and efficiency of surface operations;* B0 ASURF - *Initial capability for ground surveillance,* B0 FICE - *Increased interoperability, efficiency and capacity through ground-ground interaction,* and B0 SNET - *Increased effectiveness of ground-based safety nets*. All presentations are posted on the following website http://www.icao.int/SAM/Pages/MeetingsDocumentation.aspx?m=2015-SEMAUTOM

1.3 Mr. Onofrio Smarrelli, CNS Regional Officer of the ICAO SAM Regional Office welcomed the participants and highlighted the importance of the event in supporting the implementation of advanced surveillance and automation systems. Eng. Alfredo Fonseca Mora, Director General of the Civil Aviation Authority of Panama, stressed the relevance of these activities for efficiency and safety in the Region and officially inaugurated the event. Mr. Onofrio Smarrelli and Mr. Julio Siu, CNS Regional Officer of the ICAO NACC Regional Office, acted as Secretary of the event.

2. Conduction of the Workshop

2.1 The workshop was conducted in 5 sessions, as proposed during the introduction:

SESSION 1: ICAO SARPS, DOCUMENTATION, AND GLOBAL AND REGIONAL PLANS FOR THE IMPLEMENTATION OF AERONAUTICAL SURVEILLANCE AND AUTOMATION SYSTEMS FOR ATS OPERATIONS

2.2 ICAO presented a list of ICAO Annexes and Documents containing technical information on surveillance and ATM automation systems at ATS units concerning technical, operational, and training aspects.

2.3 ICAO presented an overview of air navigation implementation, from its vision of the global ATM operational concept to the implementation of national and regional plans, including the aviation system block upgrades (ASBU) methodology, describing block 0 modules related to surveillance and automation.

2.4 Likewise, ICAO presented surveillance and automation information related to the CAR/SAM Regional Air Navigation Plan; the NAM/CAR and SAM regional performance-based plans, GREPECAS organisation, and the implementation of surveillance and automation systems in the NAM/CAR and SAM Regions.

SESSION 2: AVIONIC SOLUTIONS AND ADVANCED SURVEILLANCE SYSTEM ROADMAP

2.5 The presentation by BOEING highlighted compliance by BOEING of existing global mandates on the installation of ADS B avionics, coordination with ANSPs to ensure common avionics requirements to support global harmonisation, and the willingness of BOEING to assist the CAR/SAM Regions in the implementation of ASBU modules.

2.6 The presentation by EMBRAER noted that the E-JET line meets existing global mandates on ADS B under Standard DO 260 since 2010 and under Standard DO 260B since 2012.

2.7 IATA presented the point of view of its members regarding the implementation of CNS infrastructure, stressing the surveillance aspect, the support to the implementation of ground-based ADS-B Out /In 1090 ES and its use for data link, TIS-B and MLAT.

2.8 Rockwell Collins/ARINC presented their Multilink flight tracking service in support of airlines, which uses multiple surveillance sources (ground-based ADS-B, ADS-C, United States TFM radar information, EUROCONTROL radar position information, ACARS reports, HFDL, etc.). Global tracking will be done by airlines together with IATA.

SESSION 3: TECHNICAL AND OPERATIONAL GUIDANCE ON ADVANCED SURVEILLANCE TECHNIQUES AND AIDC AS AUTOMATION APPLICATION

ADVANCED SURVEILLANCE ISSUES

3.1 Thales informed that it could support States in the identification of surveillance solutions and highlighted performance-based surveillance. Regarding performance-based surveillance, it was noted that ICAO had amended Document 9868 by introducing performance-based surveillance, since the initial document only contemplated the performance of communication systems.

3.2 INDRA underlined the benefits of ADS B, such as the high update ratio (0.5 seconds), higher radar precision, and lower installation and maintenance costs. It also described the INDRA ADS-B system, indicating that it had four ADS-B data validation methods: by angle of arrival, time of arrival, power *versus* distance, speed reported by the target *versus* position of the target. Furthermore, its multichannel receiver allowed for a reduction of multipath, reflection and noise, thus increasing range (300 nautical miles).

3.3 INDRA also highlighted that the precision of an MLAT system depended on two factors: the location of receiver stations and the aiming precision of the received signal. It also noted the benefits of the LAT/WAN, such as scalable coverage, ease of expansion, target detection on the surface and at levels where necessary, establishment of configurations to keep the MLAT in operation despite malfunction of one, two or N stations, better precision compared to conventional radar, higher update ratio compared to radar (0.5 sec to 1), stations are easy to install, lower maintenance requirements.

3.4 SAAB presented A SMGCS and ACDM solutions, as well as airspace solutions such as WAM and ADS-B. The multilateration system was first used in 2003 at Heathrow Airport, in London.

3.5 Note was taken of products manufactured by IACIT of Brazil, such as ADS-B and multilateration surveillance systems, VHF T/A communication systems, DME and NDB navigation systems, and meteorological equipment and radars.

3.6 AIREON informed that satellite ADS-B implementation was foreseen to be completed and operational in the period 2018-2020, initially providing surveillance coverage in oceanic and remote continental areas. The Meeting noted that in order to protect the aircraft-satellite link, the forthcoming ITU World Radiocommunication Conference (WRC-15) to be held in November 2015, was expected to approve such protection. The required protection for satellite ADS-B is supported by IATA and many States.

3.7 INTELCAN presented the ADS-B solution implemented in Guyana, with an ADS-B earth station integrated with the automated ATC system, and explained the components and functionalities of its SKYSURV system.

3.8 Harris provided an overview of the United States ADS-B Programme, explaining the requirements, design, integration, implementation, operation, and maintenance of ADS-B stations, which improve safety and efficiency to meet the growing air transport needs in the United States. Furthermore, Harris proposed possible solutions for the Caribbean and Central American Region, explaining the benefits of a regional ADS-B network architecture.

3.9 VNIIRA OVR presented the various surveillance and automation products, describing the experience in the construction of the multi-positional surveillance system with ground vehicle traffic control functions/WAM-MLAT Project in Varadero, Cuba, and the convenience of functional co-existence of ADS-B receivers and MLAT sensors.

3.10 ATECH presented the work done through its project in Bacía de Campos, with the installation of a set of ADS-B antennae on oil platforms, integrated into the SAGITARIO Multi Sensor Tracking System at the Macaé approach centre, in Rio de Janeiro, the purpose of which is to provide air surveillance for helicopters flying to oil platforms and commercial flights flying in the upper airspace.

AUTOMATION

3.11 The Secretariat presented information on regional activities for the integration of automated systems between adjacent ACCs in the NAM CAR and SAM Regions.

3.12 Likewise, ICAO presented various considerations relevant to the implementation of the AIDC service, including GREPECAS conclusions and the description of the CAR/SAM ICD. Information was provided on the benefits of AIDC implementation, such as a significant reduction of controller workload, reduced speech coordinations, reduced coordination errors, mitigation of LHDs, thus avoiding possible mid air collisions, possibility of reverting to manual procedures. The AIDC goals defined in the Declarations of Bogota and Port-of-Spain were identified. Information was provided on the AIDC implementation process in each NAM/CAR and SAM Region, and on the regional guides that had been developed. Finally, a comparison was made of messages between ICDs.

3.13 Thales informed about the implementation of ASBU Block 0 and Block 1 modules, such as B0 SURF, B1 SURF, B0RSEQ, B1 RSEQ, B0 FICE,B1 FICE, BO TBO and B1 TBO, flow management, A CDM and AIDC.

3.14 Thales also informed about its activities concerning ATM automation systems, such as the implementation of AIDC in 19 countries worldwide, the installation of AMN/DMAN, the installation of ACDM at the Charles De Gaulle airport, and the evolution of ASBU modules.

3.15 United States noted the need for a harmonised process and the use of standard protocols for a successful and efficient implementation of automation, and described the various existing and valid ICDs, including the NAM ICD, the selection of the optimum protocol based on an interface environment between specific flight information regions (FIRs),

and continuity of AIDC/NAM information following operational implementation. It highlighted the status of implementation of AIDC in the United States with adjacent FIRs, which had reduced ATC controller workload by 50%.

3.16 ATECH informed the Meeting about the automation of ATM/ATFM systems in Brazil, highlighting its SIGMA and Sagitario systems.

SESSION 4: IMPLEMENTATION OF ADVANCED SURVEILLANCE AND AUTOMATION SYSTEMS BY CAR/SAM STATES

Argentina

4.1 Argentina informed that it had 28 radar stations. (It has started the radar updating process in Ezeiza, Córdoba, Mendoza, Mar del Plata and Paraná. ATM automated systems in Ezeiza and Córdoba. Three new automated systems in Comodoro Rivadavia, Mendoza and Resistencia are in the process of being installed, estimating their pre-operational commissioning in December 2015.) The Córdoba and Ezeiza systems were updated based on the version installed in Resistencia, Mendoza and Comodoro Rivadavia. Capability of automated systems to transmit the Asterix 62 protocol. Installation of two ADS-B stations in the Mendoza to Ezeiza route. Automated processes can process ADS-B and ADS-C (currently integrated into the system). Regarding AIDC: pre-operational phase in Ezeiza - Cordoba; satisfactory testing between Carrasco and Ezeiza; tests pending between Ezeiza - Chile until such time as they make the required adjustments to their system. Exchange of radar data with Uruguay completed through the REDDIG II; conversations were resumed to continue radar data interconnection between Argentina and Chile; and coordination started with Paraguay for radar exchange.

Brazil

4.2 Brazil provided information on the Sirius Programme, progress made in ADS implementation at Cuenca de Campo, plans for implementing ADS-B in the continental area, plans for implementing MLAT in Vitoria, and plans for implementing AIDC and FIXM.

COCESNA

4.3 COCESNA presented the results of its analysis of the reports received from its ADS-B station in Cerro de Hula, highlighting the coverage and precision observed, as compared to radar information. It informed on the status of implementation of the AIDC service through the NAM ICD with Mérida and Cuba and between CENAMER ACC and Central American APPs, illustrating the process of implementation and the operational benefits achieved.

Colombia

4.4 Colombia reported having 12 primary radars providing 80% coverage of airspace at 30000 feet, and 70% at 10000 feet, as well as 16 SSR radars providing 96% coverage at 30000 feet and 70% at 10000 feet. As to advanced surveillance systems, 13 ADS B stations, 4 WAM stations, and 13 ADS-B stations have been installed. Implementation planning in Colombia is recorded in document PNAV COL. The Bogota and Barranquilla ACCs and the Villavicencio, Cali, Rio Negro, San Andrés and Leticia ACCs that control lower level flights have been modernised.

Cuba

4.5 Cuba presented the advantages provided by its ADS-B data analysis software tool, the progress made in aircraft equipage, as well as future modules to be developed. It also described the experience in the implementation of the AIDC service under the NAM ICD, with class I messages.

Ecuador

4.6 Ecuador reported that before 1997, Ecuador had 35% radar coverage (Quito and Guayaquil). It currently has 95% coverage, and 4 additional radar stations have been installed. Likewise, WAM is available in Loja and Latacunga.

Mexico

4.7 Mexico stated that it was planning to implement some 35 ADS-B stations by 2018. At present, 10 stations have been implemented. Likewise, other three stations had been implemented and will be commissioned by late 2015, whose data will be shared with the United States in order to offer surveillance services in the Gulf of Mexico. A description was given of the benefits pursued with this implementation and the improvements to be introduced, such as DO-260B processing. Finally, Mexico shared its experience and benefits obtained with the implementation of AIDC/ PAN ICD between Oakland – Mazatlán and its current AIDC / NAM ICD implementations with the United States, Cuba, and Central America.

Panama

4.8 Panama informed about the evolution of surveillance and automation system implementation. Regarding AIDC, it noted that it had implemented a practical training programme and conducted positive tests with Bogota, and that it expected to enter the operational phase by late 2015.

Paraguay

4.9 It was noted that Paraguay had a single radar (type IRS/20/MP/S), located in Mariano Roque Alonso, which limited its coverage when considering range *versus* level. In terms of implementation of advanced surveillance systems, 6 ADS-B stations have been installed to meet radar coverage needs in support of the main Mode S radar surveillance system. At present, the ADS system is not fully implemented. The current AIRCON 2100 version does not support the ADS-B

Asterix 21 radar data protocol, reason why it cannot be integrated into the automated system. An attempt is being made to solve this problem by updating the AIRCON 2100 system to its latest version, which supports Asterix 21 processing.

4.10 Regarding AIDC, note was taken of positive AIDC tests conducted between Paraguay and Argentina and the implementation of the maintenance programme.

Peru

4.11 Peru informed about the operation of AIDC between Ecuador and Peru and plans to start operational interconnection between Peru-Brazil and Peru-Colombia, to be completed before the end of 2015. Information was also provided on surveillance coverage in the Lima FIR.

Dominican Republic

4.12 Information was provided on plans to implement AIDC under the NAM ICD to be resumed in October 2015, the revision of the draft MOU with the United States, and the achievements made by the technical assistance mission under Project RLA/09/801 for this implementation. Information was also provided on the existing radar coverage and ADS-B implementation plans.

4.13 The ANI/WG AIDC Task Force informed about the tasks it had been entrusted for the implementation of AIDC in the NAM/CAR Regions, describing its activities, mandate, establishment of the FPL monitoring *ad-hoc* group, the technical assistance through the Goteams of Project RLA/09/801, and an assessment of the progress made in the achievement of the regional AIDC goal.

Uruguay

4.14 It was noted that Uruguay had 2 radar stations, one in Durazno and the other in Carrasco, and that radar information of Ezeiza was integrated with the radars of Uruguay. Integration is also underway with the Carrasco radar of Argentina. There are plans to install MLAT, ADS-B in Punta del Este, and WAM in the northern part of the country to improve coverage at low levels.

Venezuela

4.15 Venezuela presented the current status of radar coverage and plan for implementing advanced surveillance system and automation at the Maiquetía ACC. In this regard, it was noted that 10 surveillance radars were interconnected through the Venezuelan VSAT network. This VSAT network also carries voice and data (AMHS) and there are plans to install VSAT, which carries voice, data and AMHS. There are plans to install multilateration and ADS-B systems.

SESSION 5: OPERATIONAL REQUIREMENTS, DESIGN, INSTALLATION, VALIDATION, AND COMMISSIONING OF SURVEILLANCE AND AUTOMATION SYSTEMS

5.1 The United States informed about the Acquisition Management System (AMS), describing its functions, policy, life cycle, and gave an example of WAM implementation. It also informed about the regulations and the list of reference documents required by the FAA for the implementation and operation of surveillance and automation systems, specifically highlighting those related to in-flight validation of ADS-B and multilateration stations.

6. CONCLUSIONS/ RECOMMENDATIONS

6.1 Based on the presentations and discussion, the participants agreed on the following conclusions and recommendations:

General

a) Surveillance implementations on civil aircraft must be coordinated between users and airspace service providers, and supported by a business case and/or a positive operational assessment.

b) Airborne equipment requirements must be harmonised and synchronised (standards and timelines) and be based on pragmatic needs in order to deliver feasible benefits to the customers of airspace users.

c) For air navigation implementation, all CAR/SAM States should follow the Global Air Navigation Plan (GANP), its technological roadmaps, the ICAO ASBU methodology, CAR/SAM regional plans, and align their implementation activities by developing their respective national air navigation plans.

d) The staff in charge of surveillance and automation system planning should have at their disposal all ICAO documents and annexes published on the topic.

e) It is recalled that the third meeting of the GREPECAS Programmes and Projects Review Committee formulated Conclusion 3/10 *Drafting of national air navigation plans aligned with the GANP and the regional performance-based implementation plans.* Accordingly, States that had already drafted their national air navigation plans and that were not yet aligned with the Global Plan (Fourth Edition) and the respective regional plans were urged to complete such process, and those States that had not yet drafted their national air navigation plans were urged to start doing so, based on the same considerations.

f) In order to address the installation of new advanced surveillance systems, the personnel in charge of their installation and maintenance must be properly trained. In this sense, TRAINAIR PLUS member States were invited to develop a standard training package (STP) in the areas of advanced surveillance and automation. Once developed, the STP could be acquired by interested States. Likewise, ICAO was requested to increase this type of activities and to continue collective efforts to help training centres meet these requirements.

AUTOMATION/ AIDC

g) In order to optimise AIDC implementation, States should consider taking action to mitigate/resolve filed flight plan (FPL) issues. It was recommended that regional efforts be consolidated in order to coordinate mitigation actions between the CAR and SAM Regions.

h) The importance for States to comply with plans and commitments to implement radar data and flight plan interconnection was recognised.

i) Close cooperation is required among States in order to achieve the interconnection of automated systems, for instance, the establishment of MoUs, letters of operational agreement, and definition of common aspects to be implemented.

j) Non-compliance with ICAO procedures on management of flight plans and associated messages results in increased flow of unnecessary messages.

k) AIDC implementation has shown its advantages in terms of safety and efficiency:
- ✓ significantly reduces the need for oral coordination between ATS units
- ✓ reduces controller workload
- ✓ reduces repetition/readback errors during coordination
- ✓ reduces coordination errors and "controller-to-controller" language barrier issues
- ✓ mitigates LHDs, thus avoiding mid-air collisions
- ✓ greater support to performance-based navigation initiatives and emerging technologies through automation

l) It recognised the importance of evaluating each operational scenario involving AIDC implementation and management of desirable messages, and subsequently assessing its impact on controller workload and its end results in order to select the most appropriate AIDC ICD for implementation.

m) The preferred ICD for the CAR and NAM Regions is the NAM ICD, and the PAN ICD for the SAM Region.

n) AIDC implementation represents the initial phase towards ground-ground integration and FF/ICE implementation.

SURVEILLANCE

o) Performance-based surveillance helps to identify the best surveillance solution, based on operational requirements.

p) ADS B and multilateration provide more precision compared to radar.

q) ADS-B acquisition and maintenance costs are much lower than those required for installing a radar.

r) ADS-B is an important element that makes it possible to derive the operational benefits of ASBU modules B0 ASUR, SURF, SNET, TBO, etc.

s) For ADS-B implementation, some established target dates shall be considered, such as 31 December 2018 for this same implementation for the NAM and CAR Regions, and 1 January 2020 for ADS-B out in the United States with DO-260B transponder. States/Territories should expedite the trials, analysis and commissioning of their ADS-B stations.

t) Support ICAO's position before the ITU WRC, and establish the necessary protection measures for the installation and operation of surveillance systems.

u) Taking into account the importance of having common situational awareness information, which is achieved by sharing surveillance data, CAR/SAM States/Territories were urged to continue striving to achieve data sharing both at radar and ADS-B system level.

v) The study, acquisition, installation, validation, and commissioning of advanced surveillance and automation systems require the development of a management process by a group of technical and operational experts. Examples are cited for the validation of these systems, such as those presented by the United States (Order 8200.25 for ADS-B and 8200.1D for different systems, including WAM).

— END —

ICAO | OACI

North American, Central American and Caribbean Office (NACC)
Oficina para Norteamérica, Centroamérica y Caribe (NACC)

ICAO/IATA/CANSO Performance-Based Navigation (PBN) Harmonization, Modernization and Implementation Meeting for the Caribbean (CAR) Region

SUMMARY OF DISCUSSIONS

Date: 28 March – 1 April 2016

Location: EMBRAER Complex, Fort Lauderdale, United States

Objectives:

- Review, enhance and sign new Letters of Agreement (LoAs) for the coordination of operational procedures between Air Traffic Control (ATC) facilities
- Propose changes to existing applicable longitudinal separation minima between adjacent Flight Information Regions (FIRs)
- Discuss and propose changes for the optimization of routes in the upper airspace
- Analyze regional PBN implementation efforts and discuss best practices concerning Air Traffic Flow Management (ATFM)
- Discuss methodology to enhance route efficiency and agree to implementing action plan(s) to improve Airspace Organization and Management (AOM)

Output and Outcomes:

1. A key outcome is the Collaborative Decision Making (CDM) process in which participating States, air operators, and key industry stakeholders worked together to accomplish key tasks that will lead to true safety and efficiency efforts in the Caribbean Region for future PBN Task Force Meetings.
2. All participating States agreed, to the extent applicable, to reduce longitudinal separation from 80 NM to 40 NM between transferred air traffic operating in the FIRs of the CAR Region. Some States, in some areas, agreed to reduce to 20 NM between transferred air traffic operating in the FIRs of the CAR Region. United States also informed on the progress made with Haiti and other CAR States to improve application of separation minima for transferring traffic with adjacent FIRs in CAR Region (**Appendix A**).
3. Four (4) LoAs for the coordination and operational procedures between the air traffic control facilities were signed on 31 March 2016. A fifth LoA should be signed by 8 April 2016. Understanding the need for consistency, the proposed controller to controller phraseology for separation shall be discussed and agreed upon at the first teleconference with the PBN Task Force (TF) in May 2016.
4. States and Air Navigation Service Providers (ANSPs) of the CAR and SAM Regions agreed to further review Air Traffic Service (ATS) LoAs not later than 30 November 2016, to introduce applicable longitudinal separation minima of 40 NM or 20 NM between transferred air traffic operating in the FIRs of the CAR region and adjacent FIRs of the SAM Region.
5. Seven (7) routes have been agreed by the respective FIRs and will be submitted to ICAO for a Proposal for Amendment (PfA) not later than 22 May 2016. The currently agreed PBN routes are shown in **Appendix B**.
6. The Federal Aviation Administration (FAA) will submit proposed Area Navigation (RNAV) routes from the METROPLEX and “Y” projects to harmonize regional ATS route network.

7. The agreed new PBN route network includes implementation of Required Navigation Performance (RNP) 10, RNP 4 and RNP 2 in the Oceanic airspace of the FIRs of the CAR Region.
8. It is expected that the new PBN route network will improve regional capacity and efficiency to future traffic growth of 6% per year over the period 2014-2017.
9. CAR States also agreed to review availability of restricted areas to the air operations for prompt implementation of the Flexible Use of Airspace (FUA).
10. States should take advantage of the use of RANDOM route in Continental airspace. Guyana, Suriname and Trinidad and Tobago agreed to host the RANDOM route trials. The available RANDOM routes and/or areas and applicable procedures should be published in advance in the Aeronautical information Publication (AIP) for airspace users. Advanced flight planning systems of air operators takes into account various factors as wind, costs and fuel for day flights. Airlines that confirmed participation in RANDOM route trails in continental airspace are: American Airlines, Delta Airlines, Caribbean Airlines and Azul.
11. The Central American Airspace Harmonization Project (ARESAC) between Central American States for the implementation of a comprehensive PBN airspace concept in July 2017 was recognized as a regional project model. Panama will join as full participant in the ARESAC Project.
12. All CAR States are committed to achieve the PBN implementation targets as established in Assembly Resolution A 37-11 and the *Port-of-Spain Declaration*.
13. Special consideration will be given by States to increase implementation of Continuous Climb Operations (CCOs) and Continuous Descent Operations (CDOs) criteria in all Standard Instrument Departure (SIDs) and Standard Instrument Arrival (STARs) linked to the upper airspace to the greatest extent possible in order to obtain the most operational benefits
14. The regional PBN implementation project will be coordinated between Points-of-Contact (PoCs) of Central American, Eastern Caribbean and Central Caribbean States to ensure completion and monitoring of all implementation activities as depicted in **Appendix C**. The next PBN TF meeting for the Implementation of CAR Seamless Airspace will be held from 6 to 9 December 2016 to ensure harmonized implementation based on traffic flows and homogenous areas.

Follow-up actions:

- Draft PfA to the ICAO Doc 7030 — *Regional Supplementary Procedures* and Doc 8733— *Caribbean and South American Regions* will be developed for the implementation of new PBN route network, which will include realignment and deletion of some ATS routes, not later than 22 May 2016 for submission to States and International Organizations. The regional implementation date will be 30 November 2016, which includes AIP publication based on 3 AIRAC cycles
- States will coordinate with ICAO NACC Regional Office the assessment of the reduced track miles and CO_2 emission mitigation, as needed
- The ICAO NACC Regional Office will also carry out timely coordination with all States, Territories and International organizations of the CAR/SAM Regions to ensure in coordination with the SAM Regional Office the new PBN route network implementation of in CAR Region

— — — — — — — — — — — —

APPENDIX A

APPLICATION OF SEPARATION MINIMA FOR TRANSFERRING TRAFFIC WITH ADJACENT FLIGHT INFORMATION REGIONS (FIRS) IN THE CAR REGION

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
Trinidad & Tobago	United States (San Juan)	TBD	TBD	TBD	TBD	**Currently 10Mins MNT** United States has advised that there is a current issue regarding the United States classification of their airspace that is preventing the use of this type of separation. United States and Trinidad and Tobago will continue discussion on this issue bilaterally. TJSJ has possible VHF issues at FIR BDY. This is being investigated.
	Guyana	Agreed (GNSS) LOA to be finalized and signed by April 8, 2016	May 31, 2016	TBD	TBD	**Currently 10 Mins MNT** Analysis will be conducted over the first six months of use and a decision will be made by DEC 2016 as to the timeframe to reduce to 20 NM

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
	Suriname	TBD	TBD	TBD	TBD	**Currently 10 Mins MNT** Currently there is a VHF communication challenge for T&T at position TRAPP. Solutions to this challenge are being investigated.
	Venezuela	TBD	TBD	TBD	TBD	**Currently 10 Mins MNT** Confirmation required from Venezuela. T&T is ready to implement 40NM GNSS with Venezuela
Curacao	San Juan	TBD	TBD	TBD	TBD	**Currently 10 Mins MNT** United States has advised that there is a current issue regarding the United States classification of their airspace that is preventing the use of this type of separation. United States and Curacao will continue discussion on this issue bilaterally.

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
						TJSJ has possible VHF issues at FIR BDY. This is being investigated.
	DR	Agreed A319, remain at 80nm	TBD	TBD		**Currently 10 Mins MNT**
	Venezuela	Agreed via telcon to be confirmed	TBD	TBD	TBD	**Currently 10 Mins MNT**
	Jamaica	Agreed	TBD	TBD	TBD	**Currently 10 Mins MNT**
	Haiti	UG444 remain at 80nm based on Curacao's VHF situation	TBD	TBD	TBD	**Currently 10 Mins MNT** Discussions ongoing
	Colombia	Agreed A319, UG444 remain at 80nm	DEC 2016	TBD		**Currently 10 Mins MNT**
COCESNA	Mexico	Implemented	In effect	TBD	TBD	Challenge to Reduction to 20 is due to required separation between Mexico and Houston
	Cuba	N/A	N/A	Implemented	implemented	Data sharing agreements in effect. 2017 proposed RADAR handoffs

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
	Jamaica	Implemented	In effect	Discussions		Limitation is VHF at BDY with Jamaica. Request has been made by Jamaica for solution. When this is accomplished, analysis for use of 20nm will be done by Jamaica
	Panama	Implemented	In effect	Reduce to 20NM in a certain area that include the FIX points. • UM659 LESIR • UM328 PAPIN • UR773/UA502 POXON • UL655 EGODI • UG440 ISEBA • UA317 BUFEO • UM796 PADUR • UM419 ANSON • UA322 AMUBI • UR505 DURAM Maintain 40NM the next points: • UA552 FALLA		•

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
				• UA321 PELRA		
	Colombia	Agreed	TBD	TBD	TBD	LOA being revised.
Dominican Republic	Haiti	In discussion	TBD	TBD	TBD	Discussions Ongoing
	Curacao	Agreed A319, remain at 80nm	TBD	TBD	TBD	
	Miami	Discussion with Miami re procedural contingency				**Currently 10 NM Surveillance in use** Discussion if required
	San Juan	Willing to reduce. Procedural. Discussion with San Juan	TBD			**Currently 10 Mins MNT** **United States has advised that there is a current issue regarding the United States classification of their airspace that is preventing the use of this type of separation.**

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
						United States and Curacao will continue discussion on this issue bilaterally. **TJSJ has possible VHF issues at FIR BDY. This is being investigated.**
Mexico	COCESNA	Already implemented (Surveillance) Discussion about procedural use of 40NM with GNSS				Northbound traffic from COCESNA Challenge to Reduction to 20 is due to required separation between Mexico and Houston
	Houston	N/A				**Continental – 10 NM miles Surveillance** The proposed separation standard is currently being reviewed by FAA HQs to determine applicability in ZHU offshore airspace.
		N/A				**Oceanic 10 minutes (MNT)** The proposed separation standard is currently being reviewed by FAA HQs to determine applicability in

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
						ZHU offshore airspace.
	Albuquerque	N/A				**Currently Continental – 10NM miles Surveillance** Bilateral Discussions required
	Los Angeles	N/A				**Currently 10 nm Surveillance** Bilateral Discussions required
	Cuba	TBD	TBD	TBD	TBD	**Currently 40 nm (surveillance)** Discussion regarding use of 40NM procedural under a letter of agreement
Haiti	Kingston	TBD	TBD	TBD	TBD	10 Mins MNT Discussions Ongoing
	Cuba	TBD	TBD	TBD	TBD	10 Mins MNT Discussions Ongoing
	Dominican Republic	TBD	TBD	TBD	TBD	10 Mins MNT Discussions Ongoing
	Miami	TBD	TBD	TBD	TBD	10 MINS MNT

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
	Curacao	LOA agreement in place				
Guyana	Trinidad & Tobago	Agreed	May 31 2016	TBD	TBD	
	Suriname	Agreed	May 31, 2016	TBD	TBD	
	Brazil	Signed	Implemented	TBD	TBD	
	Venezuela	TBD	TBD	TBD	TBD	
Suriname	Guyana					10 Mins MNT
	Brazil	Suriname in favour	TBD	TBD	TBD	Sent draft to Brazil. TELCON on April 7 for discussion
	French Guiana	TBD	TBD	TBD	TBD	10 Mins MNT
	Trinidad and Tobago	Suriname willing, Trinidad and Tobago has challenges with VHF	TBD	TBD	TBD	**Currently 10 NM MNT** Currently there is a VHF communication challenge for T&T at position TRAPP.
Antigua and Barbuda (with Trinidad)						
Bahamas		TBD				**Discussions needed with United States**
Barbados (with Trinidad)						
Belize (with COCESNA)						

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
Colombia	PANAMA	Agreed Air traffic flying between the FIRs maintain 20 nm separation	December 2016	As agreed between FIRs	December 2016	
	JAMAICA	Agreed				**20nm will depend on estab lishing communication in the north of the Barranquilla FIR**
	CURACAO	Agreed	December 2016	TBD	TBD	
	VENEZUELA	TBD	TBD	TBD	TBD	
Costa Rica (with COCESNA)						
Cuba	COCESNA	N/A	N/A	Implemented	Implemented	**Data sharing agreements in effect. 2017 proposed RADAR handoffs**
	MEXICO	TBD	TBD	TBD	TBD	**Currently 40 nm (surveillance)** **Discussion regarding use of 40NM procedural under a letter of agreement**
	HAITI	TBD	TBD	TBD	TBD	**10 Mins MNT** **Discussions Ongoing**

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
	JAMAICA	TBD	TBD	TBD	TBD	**Currently 40nm overflight based on surveillance, 20nm landing based on surveillance.** **Use of GNSS procedural minima to be discussed**
Honduras (with COCESNA)						
Panama	COCESNA	In effect	Implemented	Reduce to 20NM in a certain area that include the FIX points. • UM659 LESIR • UM328 PAPIN • UR773/UA502 POXON • UL655 EGODI • UG440 ISEBA • UA317 BUFEO • UM796 PADUR • UM419 ANSON • UA322 AMUBI • UR505 DURAM Maintain 40NM the next points: • UA552 FALLA • UA321 PELRA		

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
	COLOMBIA	Agreed Air traffic flying between the FIRs maintain 20 nm separation	December 2016	As agreed between FIRs	December 2016	
	JAMAICA	Agreed	1 May 2016	TBD	TBD	
United States	TRINIDAD AND TOBAGO	TBD	TBD	TBD	TBD	**Currently 10Mins MNT** **United States has advised that there is a current issue regarding the United States classification of their airspace that is preventing the use of this type of separation.** **United States and Trinidad and Tobago will continue discussion on this issue bilaterally.** **TJSJ has possible VHF issues at FIR BDY. This is being investigated.**
	CURACAO	TBD	TBD	TBD	TBD	**Currently 10 Mins MNT**

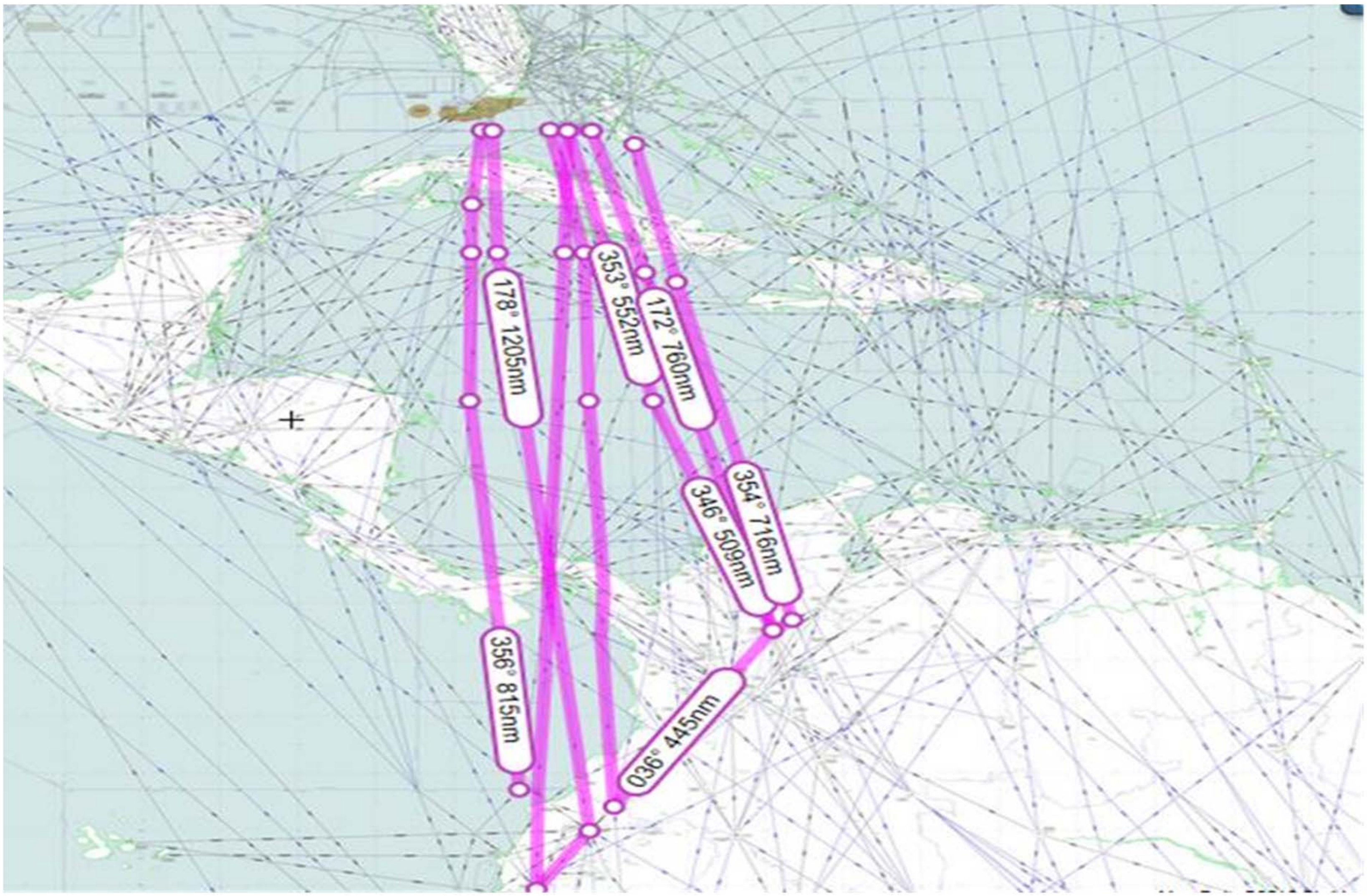
STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
						United States has advised that there is a current issue regarding the United States classification of their airspace that is preventing the use of this type of separation. **United States and Curacao will continue discussion on this issue bilaterally.** **TJSJ has possible VHF issues at FIR BDY. This is being investigated.**
	DR	Willing to reduce Procedural Discussion with San Juan				**Currently 10 Mins MNT** **United States has advised that there is a current issue regarding the United States classification of their airspace that is preventing the use of this type of separation.** **United States and Curacao will continue discussion on this issue bilaterally.**

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
						TJSJ has possible VHF issues at FIR BDY. This is being investigated.
	MEXICO (Reference Above)					
	HAITI	TBD	TBD	TBD	TBD	**10 MNT**
Jamaica	Curacao	Agreed	TBD	TBD	TBD	**Currently 10 Min MNT in use** Discussions on ground to ground communications in progress and LOA revision to be signed soon. Automated coordination being investigated.
	COCESNA	Implemented EXCEPTION: UM782 10 MIN MNT	In effect	Discussions	TBD	Limitation is VHF at BDY with Jamaica. Request has been made by Jamaica for solution. When this is accomplished, analysis for use of **20nm will be done by Jamaica**
	PANAMA	agreed	1 May 2016	TBD	TBD	
	COLOMBIA	Implemented	In use	TBD	TBD	

STATE/ORGANIZATION	Adjacent State/Organization	40 NM GNSS/DME Longitudinal	Proposed implementation dates	20 NM GNSS/DME Longitudinal	Proposed implementation dates	Remarks
	HAITI	TBD	TBD	TBD	TBD	
	CUBA	TBD	TBD	TBD	TBD	**Currently 40nm overflight based on surveillance, 20nm landing based on surveillance.** Use of GNSS procedural minima to be discussed

— — — — — — — — — — —

Agreed PBN Routes



	March	April	May	June	July	August	September	October	November	December
28 March - 1 April	PBN Meeting									
5 - 6 April		ANI/WG/3 Meeting - Regional agreements of the implementation of the PBN route network - Regional agreement towards separation minima between adjacent FIR´s in the CAR region								
May			NACC DG Meeting -Endorse of agreements from the ANI/WG/3 meeting -Endorse proposal for amendmen to ICAO Doc 8733							
July					Expected approval for PBN implementation route network in the CAR region					
30-Nov									Implementation of the new PBN route network for the CAR region -Implementation of regional ATC separation minima between adjacent FIRs for the CAR region	
6 - 9 December										Next PBN CAR Seamless Airspace Meeting

International Civil Aviation Organization
North American, Central American, and Caribbean Regional Office

MEETING/WORKSHOP TO ENHANCE STATE COORDINATION BETWEEN MET, AIM, AND ATM FIELDS

(Mexico City, Mexico, 26-28 July 2016)

Summary of Discussions
Draft

Presented by the Secretariat July 2016

MEETING/WORKSHOP TO ENHANCE STATE COORDINATION BETWEEN MET, AIM, AND ATM FIELDS

SUMMARY OF DISCUSSIONS

Date: 26 to 28 July 2016

Venue: ICAO NACC Regional Office, Mexico City, Mexico

Participants: The Meeting/Workshop was attended by 41 representatives of 11 NAM/CAR States, 3 International Organizations representatives. The list of participants appears in the **Appendix** to this document.

1. Introduction

1.1 The Meeting/Workshop was held in accordance with the North American, Central American and Caribbean Air Navigation Implementation Working Group Conclusion ANI/WG/1/11,which was superseded by Decision ANI/WG/2/1 *:*

DECISION ANI/WG/2/1 MEETING/WORKSHOP ON ATM, AIM AND MET COORDINATION

That, in preparation for the Meeting/Workshop on ATM/AIM/MET Coordination (May 2016), and in order to promote coordination to improve safety during natural events with major aviation impact, States/Territories of the CAR Region and COCESNA provide information on coordination among ATM, AIM and MET services to the ICAO NACC Regional Office by 28 December 2015.

1.2 The main objective of the Meeting/Workshop was to analyze the mechanisms established by States to ensure the access and exchange of aeronautical and meteorological information services in support of Air Traffic Management (ATM) and Air Traffic Flow Management (ATFM) under contingency conditions.

1.3 All meeting/workshop documentation and presentations are available at: http://www.icao.int/NACC/Pages/meetings-2016-aimmetatm.aspx.

2. Discussions

2.1 States noted the regional guidelines and processes of Air Traffic Services (ATS) contingency plans approved by the CAR/SAM Regional Planning and Implementation Group (GREPECAS) (http://www.icao.int/NACC/Pages/edocs-atm.aspx) to develop and/or update their own ATS contingency plan.

2.2 States should develop Collaborative Decision-Making (CDM) Processes for Airspace organization and management (AOM), ATFM, Aerodrome Operations (AO) and Airspace user operations (AUO) elements, and coordination procedures in prevention of volcanic ashes and hurricanes affectations for ATM community, in accordance with Doc 9854 — *Global Air Traffic Management Operational Concept* and Doc 9766 – *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List (IAVW)* concepts, as appropriate.

2.3 In view of the updates provided in Amendment 77 to Annex 3, the Secretariat presented an Information Concerning En-Route Weather Phenomena which may Affect the Safety of Aircraft Operations (SIGMET) analysis report explaining its contribution in support to ATM and ATFM providing specific information regarding the occurrence or expected occurrence of specified en-route weather and other phenomena in the atmosphere, such as volcanic ashes, radioactive material, and toxic chemical clouds.

2.4 Results on Volcanic ash exercise – FICTITUS were disseminated. This exercise was established to verify communication channels and quality of the information broadcasted between Volcanic Ash Advisory Centre (VAAC), International NOTAM Offices (NOFs) and Meteorological Watch Offices (MWOs). The need to provide an interagency simulation scenario which involves other stakeholders in accordance with Doc 9966 — *Oversight of Fatigue Management Approaches* was mentioned.

2.5 Mechanisms which allow appropriate and timely SIGMET preparation and dissemination within the Region were explained, emphasizing the need to provide exchange in a digital environment enhancing team work between MWOs and explaining the introduction to digital format established by Amendment 77 that will get into force from 10 November 2016 as a recommended method. Finally, a survey developed to meet the participants' perceptions on SIGMET information and its impact on the AIM-ATM-MET coordination process was circulated, with the aim to direct efforts to assist ICAO Standards and Recommended Practices (SARPs) implementation, particularly related with Annex 3. The results support the recommendation formulated by the Secretariat.

2.6 In regard to volcanic ash, *Mexican Instituto Politécnico Nacional* (IPN), on behalf of the Working Group on the Development of Identification Maps of Volcanic Ashes Cloud Dispersion for the Aviation Risks Mitigation provided a presentation on the update of the activities carried out by the Group since 2013, which included the impact to the airports located at 50, 10, and 200 NM radius around the Popocatepetl Volcano, as well as the adjacent airways, the temporary closure of the airways and their operational and financial impact, and the seasonal risk map product of the volcanic ashes dispersion.

2.7 The Secretariat provided a presentation on the contributing factors in aviation accidents. The presentation began with global statistics on accidents of scheduled commercial flights extracted from the ICAO Safety Report - 2016 Edition and from the Regional Aviation Safety Group – Pan America (RASG-PA) Annual Safety Report (ASR), 7th Edition – Draft on fatality risk, showing good progress in relation to the established target in the *Port-of-Spain Declaration*.

2.8 The Secretariat presented a thorough analysis on the contributing factors in accidents related to the threats and latent conditions in the NAM and Latin American region. Moreover, the Secretariat established the eventual correlation between the aforementioned factors and the lack of implementation of the Critical Elements (CE) in accordance with the Universal Safety Oversight Audit Programme (USOAP) – Continuous Monitoring Approach (CMA), State Safety Programme (SSP), aerodrome certification, and the CAR/SAM Regional Planning and Implementation Group (GREPECAS) Air Navigation Deficiencies Database (GANDD).

2.9 The Meeting was made aware of the challenges and opportunities for the region on safety matters. The Meeting expressed concern on the presented issues, especially in the ones related to aviation personnel training to practice a safety effective surveillance as it is expected by the regulator.

2.10 The Secretariat explained the scope of the audits, the multidisciplinary visits under the NACC No Country Left Behind (NCLB) strategy and the ICAO Global Aviation Training (GAT) activity.

2.11 The Secretariat provided a presentation on flight operations with low visibility conditions in order to highlight the importance of a proper coordination among the different air navigation services to reach the required international standards in matter of safety and efficiency.

2.12 The Secretariat emphasized that the precise and updated meteorological information, as well as the NOTAMs and ASHTAM, are key aspects during the preflight and flight phases, in order to have a successful air operation.

2.13 The Meeting acknowledged the importance to involve all the actors in this type of information dissemination, especially to pilots and air traffic controllers as the end users through the Aeronautical Information Publication (AIP) and NOTAM, in order to increase the level of awareness on the activities that each group of professionals execute the operations looking for a greater level of safety and efficiency.

2.14 The Secretariat mentioned that as part of RASG-PA activities, workshops between pilots and air traffic controllers were initiated to improve the use of aviation phraseology, in accordance with ICAO Doc 4444 — *Air Traffic Management*, in English and Spanish, and urged the Meeting to promote this type of initiatives at the national and regional level.

2.15 United States mentioned that the FAA has resumed the initiative to allow that ATC be in the cockpit during the flight execution and also pilots can visit the control towers and control centers in order to optimize the operations.

2.16 The Secretariat referred to the A39-WP/31 that will be presented by the Secretariat in the ICAO 39th Triennial Assembly to inform the Meeting about the outcomes on emerging issues of the Second High-level Safety Conference 2015 (HLSC 2015) that was held at ICAO Headquarters from 2 to 5 February 2015. It can be found in Doc 10046 — *Montréal Declaration* on *Planning for Aviation Safety Improvement* published in the *Second High-level Safety Conference 2015 Report*.

2.17 The Secretariat highlighted the following issues: regulatory oversight for the effective implementation of Performance-Based Navigation (PBN); global flight tracking; conflict zones; civil/military cooperation; extreme meteorological conditions; Civil/military cooperation; Public health (CAPSCA); Remotely piloted aircraft systems (RPAS); Global Aviation Safety Plan (GASP); Fatigue Risk Management System (FRMS) for pilots and ATCs; cybersecurity; lithium batteries; spectrum allocations (Automatic dependent surveillance – broadcast - ADS-B, and Global Aeronautical Distress and Safety System-GADSS).

2.18 As a follow-up regional actions to the HLSC 2015 and the Assembly — 39th Session (AN-WP/31), the following topics were mentioned:

2.18.1 *Item 4 – c) Regulatory oversight for the effective implementation of performance-based navigation (PBN):* In accordance with the Resolution A37-11 and the performance-based navigation global goals, more than 90% of States have successfully implemented PBN approach procedures, and it is expected that by December 2016 a 97% will be reached including their publication in the AIPs.

2.18.2 *Item 10 – 4) ICAO should support regional Search and Rescue (SAR) training exercises related to abnormal flight behavior and share the outcomes with the international community*: the next SAR event will be held in Trinidad and Tobago in October 2016, the agenda item will include civil-military coordination, oceanic areas oversight and flight tracking.

Theme 2: FUTURE APPROACH TO MANAGE AVIATION SAFETY

2.18.3 *Item 28 – 4) ICAO should expedite the development of provisions to be used by States to regulate remotely piloted aircraft system (RPAS) operations within their airspace and to educate users regarding the risks associated with their operations:* RPAS discussion was held at the ANI/WG/3 meeting and 60% of States have already published airspace and international aerodromes regulations and Aeronautical Information Circulars (AICs).

2.18.4 As part of the NACC No Country Left Behind (NCLB) strategy some associations between safety oversight entities has been created such as the Caribbean Aviation Safety and Security Oversight System (CASSOS) for the Eastern Caribbean (English-speaking States) and ACSA in Central American (Spanish-speaking States), devoted to ensure inspections programme and Standards and Recommended Practices (SARPs) compliance.

2.19 In regard to the presentation from SENEAM Mexico, it was noted that real-time information from seismographs installed at the Popocatepetl volcano is used to detect significant volcanic ash eruptions to prompt SIGMET and ASHTAM issuance provided by AFTN and web page.

3. Recommendations

3.1 Based on the presentations and discussions, the Meeting agreed on the following Recommendations:

Recommendation 1. States to inform their training needs to the ICAO NACC Regional Office in order present them in the Third NAM/CAR Civil Aviation Training Centres Working Group Meeting (NAM/CAR/CATC/WG/3) to be held in Mexico City, Mexico, from 19 to 20 October 2016, and to be considered in the regional catalog of courses for 2017.

Recommendation 2. Additionally to their ATS Contingency Plan, States should develop Natural Disaster Emergency Response Plans, considering timely messaging coordination between ATS, AIM and MET and SAR services

Recommendation 3.	That ICAO formulate and develop mechanisms to assist States in order to promote the implementation of digital exchange of operational meteorological information – OPMET based on ICAO Meteorological Information Exchange Model (IWXXM).
Recommendation 4.	Increase efforts to assure the effective implementation of Quality Management Systems (QMS) AIM/MET, in order to fulfill the stakeholders' requirements. In order to assist the States on SIGMET information production, the NACC Office will promote the planning of a workshop in 2017 and the update of related guidance materials, requesting active involvement of member States.
Recommendation 5.	States to update the current Letters of Agreement (LoA) between ATM, AIM, and MET services, with the propose to improve the regional coordination, following the recommendation exposed in the Doc 9691 - *Manual on Volcanic Ash, Radioactive material and Toxic Chemical Clouds* as required.
Recommendation 6.	That States analyze and assure the Access and exchange of aviation and meteorological information in real time in support the Air Traffic Flow Management (ATFM).
Recommendation 7.	The Meeting recommended start regional works on CDM (ATM, MET and AIM) using emerging technologies and concepts according the System Wide Information Management (SWIM) seeking to meet expectations of ATM and pilots community members, MET, AIM and CNS areas, as required.
Recommendation 8.	That the Working Group on the Development of Identification Maps of Volcanic Ashes Cloud Dispersion for the Aviation Risks Mitigation continues with its activities and to prepare a national drill for 2018 fostering an inter-agency simulation scenario which involves other stakeholders.
Recommendation 9.	CAR Region States to promote multidisciplinary initiatives in order to achieve regional integration on this matter; and consider the inclusion of contingency plans investigation results to assess the possibility of formulating projects aimed to increase expected information by Volcanology Observatories in Mexico.

4. Other Business

4.1 Finally, the Meeting was informed that the Fifth North American, Central American and Caribbean Working Group Meeting (NACC/WG/5) and Eighteenth Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/18) will be held next year as a follow-up on necessary actions to meet the recommendations aforementioned.

4.2 The Meeting agreed to have another meeting in 2017 in the ICAO NACC Regional Office. The tentative date would be by second semester.

— — — — — — — — — — — —

ICAO | OACI

North American, Central American and Caribbean Office (NACC)
Oficina para Norteamérica, Centroamérica y Caribe (NACC)

Meeting/Workshop to enhance State Coordination between the MET, AIM, and ATM Fields
Reunión/Taller para mejorar la coordinación entre las áreas MET, AIM y ATM
(AIM/MET/ATM)
Mexico City, Mexico, from 26 to 28 July 2016 / Ciudad de México, México, del 26 al 28 de julio de 2016

LIST OF PARTICIPANTS / LISTA DE PARTICIPANTES

ANTIGUA AND BARBUDA / ANTIGUA Y BARBUDA

Luana Issac
Shenneth Phillips

BAHAMAS

Colyn Brown
Bryan Wilson

BARBADOS

Shirley Ianthe Ford

CUBA / CURAZAO

Carlos Alberto Fornés Valdés
Joel Beltrán Archer Santos

CURAÇAO

Natasha Leonora Belefanti

DOMINICAN REPUBLIC / REPÚBLICA DOMINICANA

Jose Rafael Molina Paulino
Agustin José de los Santos Marte

GUATEMALA

Silvia Jeaneth Herrera Melendez
Julio Roberto Carpio Castellanos
Romeo Marco Tulio Garcia Chavarria

HAITI / HAITÍ

Reginald Guignard
Jacques Boursiquot

MEXICO / MÉXICO

Joaquín Humberto Rodríguez Hernández
Rodrigo Bruce Magallón de la Teja
Enrique Camarillo Cruz
José Antonio Villanueva Solis
Jesús Carlos Reynoso Sandoval
Sergio González Chávez
Manuel Rodríguez Santiesteban
Oscar Vargas Antonio
Maria Aleli Barrera Cruz
Matilde Nava Tadeo
Luciano Arturo Pérez García
David Villaseñor Millán
Beatriz Delgado Sanchez
José Eduardo Ávila Razo
José Antonio Villanueva Solis
José Carlos Jiménez Escalona

TRINIDAD AND TOBAGO / TRINIDAD Y TABAGO

Ricky Bissessar
Robert Ricardo Rooplal

UNITED STATES / ESTADOS UNIDOS

Midori Tanino
Terry L. Rhea
Leah Moebius
Michael Murphy
Thomas A. Nielson

CANSO

Javier Alejandro Vanegas

COCESNA

Alexis Mauricio Pérez
Rawling Padilla

IFALPA

Alfonso Sierra Candela

ICAO / OACI

Víctor Hernández
Raúl Martínez
Eduardo Chacin
Luis Sánchez

LIST OF PARTICIPANTS / LISTA DE PARTICIPANTES

Name / Position Nombre / Puesto	Administration / Organization Administración / Organización	Telephone / E-mail Teléfono / Correo-e
	Antigua and Barbuda / Antigua y Barbuda	
Luana Issac Coordinator Aeronautical Information Service	V.C. Bird Air Traffic Services	Tel. +268 562 5235 E-mail luana.issac@ab.gov.ag
Shenneth Phillips Air Traffic Services Operations Officer	V.C. Bird Air Traffic Services	Tel. +1 268 562 0301 E-mail shennethp@yahoo.com
	Bahamas	
Colyn Brown Operations Officer/O.I.C. AIS	Bahamas/Civil Aviation Department	Tel. + 1 242 397 4713 E-mail colyn55@live.com
Bryan Wilson Operations Officer	Bahamas/Civil Aviation Department	Tel. +242 377 2004 E-mail northstar7s_8s@hotmail.com
	Barbados	
Shirley Ianthe Ford Chief Aeronautical Information Services Officer	Civil Aviation Department	Tel. +1 246 428 0952 E-mail shirley.ford@barbados.gov.bb
	Cuba	
Carlos Alberto Fornés Valdés Especialista en aeronavegación. Meteorología aeronáutica	IACC	Tel. +537 2664497 E-mail carlos.fornes@aeronav.avianet.cu
Joel Beltrán Archer Santos Jefe de unidad de navegación aérea y gestión operacional	IACC	Tel. +537 266 4497 E-mail joel.archer@aeronav.avianet.cu
	Curaçao / Curazao	
Natasha Leonora Belefanti Chief AIS/ARO	DC-ANSP	Tel. +5999 839 3550 EXT 514 E-mail N.LEONORA-BELEFANTI@DC-ANSP.ORG
	Dominican Republic / República Dominicana	
José Rafael Molina Paulino Especialista Principal de Tránsito Aéreo	IDAC	Tel. +809 274 4322 x.2162 E-mail Jmolina56@hotmail.com
Agustin Jose de los Santos Marte Inspector ATM	Inspector ATM	Tel. +809-796-5967 E-mail Agustin1967@hotmail.com
	Guatemala	
Silvia Jeaneth Herrera Meléndez Jefe AIM	DGAC	Tel. +502 2321-5021 E-mail

Name / Position Nombre / Puesto	Administration / Organization Administración / Organización	Telephone / E-mail Teléfono / Correo-e
Julio Roberto Carpio Castellanos Controlador de Transito Aereo	DGAC	Tel. +502 2321-5021 E-mail roberto.carpio@dgac.gob.gt
	Guatemala	
Romeo Marco Tulio Garcia Chavarria Inspector Meteorológico Aeronáutico	DGAC	Tel. +502 2321 5062 E-mail marco.garcia@dgac.gob.gt
	Haiti / Haití	
Reginald Guignard Chief of ATS Division	OFNAC	Tel. +509 2910 226 E-mail pioleroc@yahoo.com
Jacques Boursiquot Director of Air Navigation	OFNAC	Tel. +509 2910 2226 E-mail jacboursiquot@yahoo.com
	Mexico / México	
Joaquín Humberto Rodríguez Hernández Encargado de Dirección de meteorología y telecomunicaciones aeronáuticas	SENEAM	Tel. +52 55 5786 5516 E-mail joaquin.rodriguez@sct.gob.mx
Rodrigo Bruce Magallón de la Teja Encargado de la Dirección de Tránsito Aéreo	SENEAM	Tel. + 52 55 5786 5513 E-mail dta_seneam@sct.gob.mx
Enrique Camarillo Cruz Meteorologo Aeronáutico	SENEAM	Tel. +5786 5518 E-mail camarillo_enrique@yahoo.com.mx
José Antonio Villanueva Solis Encargado de la Dirección de Navegación e Información Aeronáutica	SENEAM	Tel. ++52 55 57865519 E-mail jvillanus@sct.gob.mx
Jesús Carlos Reynoso Sandoval Inspector Verificador Aeronáutico	DGAC	Tel. +52 55 5723 9300 x.18257 E-mail jreynoss@sct.gob.mx
Sergio González Chávez Inspector Verificador Aeronáutico	DGAC	Tel. + 52 55 5723 9300 x.18071 E-mail egonz310@sct.gob.mx
Manuel Rodríguez Santiesteban Inspector Verificador Aeronáutico	DGAC	Tel. +52 55 5723 9300 x.18259 E-mail mrodsant@sct.gob.mx
Oscar Vargas Antonio Subdirector de Área	Dirección General de Aeronáutica Civil (DGAC)	Tel. +57239300 Ext. 18074 E-mail ovargasa@sct.gob.mx

Name / Position Nombre / Puesto	Administration / Organization Administración / Organización	Telephone / E-mail Teléfono / Correo-e
Maria Aleli Barrera Cruz OOA/Meteoróloga Auxiliar	Aeropuerto Internacional de Querétaro	Tel. +442 314 2005 E-mail aleli_barrera@hotmail.com
Matilde Nava Tadeo OAA/MET	Aeropuerto Internacional de Guadalajara	Tel. +33 1513 2526 E-mail matigatito@hotmail.com
Luciano Arturo Pérez García Seguridad operacional	Aeropuerto Internacional de la Ciudad de México	Tel. +52 55 5802-8740 E-mail lperezioa@hotmail.com
David Villaseñor Millán Asesor	SAR- Mexico	Tel. E-mail cuellarsar@gmail.com
Beatriz Delgado Sanchez Odontóloga Forense	SAR	Tel. 01 (55) 5220-4652 E-mail bettysar@yahoo.com.mx
José Eduardo Ávila Razo Investigador	IPN	Tel. +57296000 x.56057 E-mail jeavilar@ipn.mx
José Antonio Villanueva Solis Encargado de la Dirección de Navegación e Información Aeronáutica	SENEAM	Tel. ++52 55 57865519 E-mail jvillanus@sct.gob.mx
José Carlos Jiménez Escalona Investigador	IPN	Tel. +5255 5729 6000 ext 56103 E-mail jjimeneze@ipn.mx
	Trinidad and Tobago / Trinidad y Tabago	
Ricky Bissessar Unit Chief-AIM Operations	TTCAA	Tel. + 868 669 4128 E-mail rbissessar@caa.gov.tt
Robert Ricardo Rooplal Air Traffic Management officer	Trinidad and Tobago Civil Aviation Authority	Tel. +1 868 766 5633 E-mail rrooplal@caa.gov.tt
	United States / Estados Unidos	
Midori Tanino ATO International NextGen Lead	Federal Aviation Administration (FAA)	Tel. +1 202 267 0992 E-mail midori.tanino@faa.gov
Terry L. Rhea Aeronautical Information Specialist	FAA	Tel. +301 427 4773 E-mail terry.l.rhea@faa.gov
Leah Moebius ATO ICAO Global Lead	FAA	Tel. +1 202 267 0269 E-mail Leah.Moebius@faa.gov
Michael Murphy Meteorology specialist	FAA	Tel. +202 267 2788 E-mail michael.murphy@faa.gov
Thomas A. Nielson International Specialist	FAA	Tel. ++540 422 4554 E-mail tom.a.nielson@faa.gov

Name / Position **Nombre / Puesto**	**Administration / Organization** **Administración / Organización**	**Telephone / E-mail** **Teléfono / Correo-e**
	CANSO	
Javier Alejandro Vanegas Director para Latinoamérica y el Caribe	CANSO	Tel. + 52 55 5786 5517 E-mail lamcar@canso.org; javier.vanegas@canso.org
	COCESNA	
Alexis Mauricio Pérez Controlador Ejecutivo	COCESNA	Tel. +504 2233 9094 E-mail alexisovni@yahoo.com
Rawling Padilla Especialista AIM	COCESNA	Tel. E-mail rawling.padilla@cocesna.org
	IFALPA	
Alfonso Sierra Candela Regional Vice President CAR/West	IFALPA	Tel. +52 55 5091 5954 E-mail Alfonso.sierra@aspa.org.mx
	ICAO/OACI	
Víctor Hernández Especialista Regional en Gestión del Tránsito Aéreo y Búsqueda y Salvamento	North American, Central American and Caribbean Office / Oficina para Norteamérica, Centroamérica y Caribe (NACC)	Tel. + 52 55 5250 3211 E-mail vhernández@icao.int
Raúl Martínez Regional Officer, Aeronautical Information Management	North American, Central American and Caribbean Office / Oficina para Norteamérica, Centroamérica y Caribe (NACC)	Tel. + 52 55 5250 3211 E-mail rmartinez@icao.int
Eduardo Chacin Especialista Regional, Seguridad Operacional en Vuelo	North American, Central American and Caribbean Office / Oficina para Norteamérica, Centroamérica y Caribe (NACC)	Tel. + 52 55 5250 3211 E-mail echacin@icao.int
Luis Sánchez Regional Officer, Aeronautical Meteorology	North American, Central American and Caribbean Office / Oficina para Norteamérica, Centroamérica y Caribe (NACC)	Tel. +52 55 52503211 E-mail lsanchez@icao.int

INTERNATIONAL CIVIL AVIATION ORGANIZATION
South American Regional Office

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

SUMMARY

Lima, Peru, from 15 to 17 August 2016

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of ICAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

TABLE OF CONTENTS

HISTORY

ii-1 PLACE AND DURATION

The Workshop/Seminar for the Implementation of Navigation Infrastructure to Support PBN and GNSS Precision Approach Operations in the NAM/CAR/SAM Regions was held at the ICAO South American Regional Office, Lima, Peru, from 15 to 17 August 2016.

ii-2 OPENING CEREMONY AND OTHER MATTERS

Mr. Franklin Hoyer, Regional Director of the ICAO South American Office, greeted the participants and acknowledged their continuous support to the regional activities undertaken by the South American Regional Office, as well as the continuous support of civil aviation authorities of the South American Region.

ii-3 SCHEDULE, ORGANIZATION, WORKING METHODS, OFFICERS AND SECRETARIAT

The Workshop/Seminar was conducted from 08:30 to 15:00 hours.

The Meeting had two Secretaries: Mr. Onofrio Smarrelli, Regional CNS Officer of the Lima Regional Office, and Miss Mie Utsunomiya, Regional CNS Officer of the Mexico Regional Office.

ii-4 WORKING LANGUAGES

The working languages of the event were Spanish and English, with simultaneous interpretation services.

ii-5 AGENDA

The agenda is contained in Appendix A to this summary.

ii-6 ATTENDANCE

The event was attended by 48 participants from 18 CAR/SAM States (Argentina, Aruba, Bolivia, Brazil, Chile, Colombia, Cuba, United States, France, Jamaica, Mexico, Panama, Peru, Dominican Republic, Suriname, Uruguay, and Venezuela), one International Organization (COCESNA), as well as representatives from AERODATA AG, AEROLINEAS ARGENTINAS, BOEING, INVAP, HONEYWELL, MIRUS TECHNOLOGY, NAVBLUE, THALES ALENIA SPACE, and Universidad de la Plata (Argentina), in addition to ICAO Officers. The list of participants appears in **Appendix B.**

1 SUMMARY OF THE WORKSHOP

1.1 Objective

1.1.1 The objective of the workshop was to provide technical and operational information to the States, air navigation service providers (ANSPs), and users for the effective implementation of air navigation infrastructure to support PBN and GNSS precision approach operations.

1.1.2 The workshop was designed to support the implementation of Aviation System Block Upgrade (ASBU) B0 modules, mainly: B065/APTA-Optimization of approach procedures including vertical guidance, B0-10/ FRTO Improved operations through enhanced en-route trajectories, B0-05/CDO: Improved flexibility and efficiency in descent profiles, and B0-20/CCO Improved flexibility and efficiency in departure profiles - Continuous climb operations.

1.2 Introduction

1.2.1 The workshop was conducted in six sessions, as follows:

- Session 1: Global and regional implementation considerations of the navigation infrastructure to support PBN and GNSS precision approach operations in the NAM/CAR/SAM Regions
- Session 2: ICAO standards and recommended practices (SARPS) and documentation on the navigation infrastructure to support PBN and GNSS precision approach operations
- Session 3: Current status and evolution of GNSS
- Session 4: Ionospheric and tropospheric effects on GNSS
- Session 5: Ground and flight testing considerations
- Session 6: Final recommendations and conclusions

1.2.2 Twenty eight presentations were made and posted on the following website: http://www2010.icao.int/SAM/Pages/MeetingsDocumentation.aspx?m=2016-PBNGNSS

1.3 Global and regional implementation considerations of the navigation infrastructure to support PBN and GNSS precision approach operations in the NAM/CAR/SAM Regions.

1.3.1 In this session, two presentations were made: P/02, in which ICAO reported on Global Air Navigation Plan considerations on the navigation infrastructure to support PBN, including an explanation of the benefits of PBN implementation, the global status of PBN implementation and the way forward. This presentation focused on the global perspective of PBN, but also provided information on regional coordination and support, which would expedite PBN implementation in the CAR/SAM Regions.

1.3.2 In the other presentation (P/03), ICAO informed on regional planning, strategies and implementation of navigation infrastructure to support PBN and GNSS precision approach operations in the NAM/CAR/SAM Regions, according to the requirements of the Regional Air Navigation Plan (Document 8733 eANP), GREPECAS, and the Performance-based Implementation Plan.

1.4 ICAO standards and recommended practices (SARPS) and documentation on the navigation infrastructure to support PBN and GNSS precision approach operations

1.4.1 In this session, two presentations were made: P/04, in which ICAO presented its SARPs and the documentation on navigation infrastructure to support PBN. This presentation introduced ICAO SARPs and guidance materials related to PBN operations and navigation aid infrastructure to support PBN. Focusing on the performance-based approach and following the ASBU framework that assigns top priority to PBN, these documents are useful guidance for PBN planning, implementation and validation.

1.4.2 In the second presentation (P/05), ICAO shared some considerations regarding the frequency spectrum for navigation use, such as frequency registration and coordination, radio navigation frequency allocation, separation criteria, ICAO documents and results of the WRC 15.

1.5 Current status and evolution of GNSS

1.5.1 In this session, 12 presentations were made, 6 of them related to the ground-based augmentation system (GBAS), 4 on the satellite-based augmentation system (SBAS), and two on RAIM availability prediction.

Ground-Based Augmentation System (GBAS) presentations

1.5.2 Presentation P/06, by Benoit Roturier, of DSNA from France, dealt with the status of GBAS Cat I station deployment worldwide and the complexity of implementing Cat I GNSS procedures, compared to basic GPS approach procedures. The presentation reported that a small number of GBAS certified stations had been deployed so far (less than 10) and that the number was not expected to increase significantly in the near future (with the possible exception of Russia) due to: 1) current deployments of ILS systems in potential GBAS airports, and 2) additional GBAS infrastructure costs. On the other hand, major aircraft manufacturers have made huge efforts to equip different types of aircraft with GBAS, which has led to about 1200 users of GBAS-enabled avionics today.

1.5.3 Presentation P06 also introduced the new GBAS Cat II/III SARPs being developed by ICAO, and the regional efforts being made, such as SESAR in Europe. The ICAO Navigation System Panel (NSP) has been finalizing the first generation of Cat II/III standards based on the GPS L1 signal alone. To increase the robustness and availability of GBAS, especially in equatorial regions, consideration has been given to the possibility and need for a second generation of Cat II/III standards, based on dual frequency (L1/L5) and multi-constellation.

1.5.4 The presentation also showed a study conducted by France to assess the operational benefits of GBAS Cat II/III at Paris CDG, where currently 8 ILS units support A/L operations. The aim is to increase airport capacity under ILS operations using low visibility procedures and/or to reduce ILS infrastructure costs. Several scenarios were investigated, such as a segregated GBAS runway, or the need for specific approach sequencing tools, but the study could not quantify the benefits of introducing GBAS, since the level of fleet mix (ILS- *vs* GBAS-equipped) to be managed by still inexistent ATM tools played a major role there. CDG operational teams did not support the notion of a GBAS specialized runway due to its complexity, nor of removing ILS, until the fleet was 100% GBAS.

1.5.5 In P/07, Carlos Rodriguez from the FAA informed that GBAS CAT I had been implemented at Newark and Houston and was used on a daily basis by domestic and international air carriers. FAA was working closely with the international community to complete the validation of GAST-D (CAT III) standards, and with Honeywell on the design approval of their GAST-D system. In addition, FAA was reviewing the benefits of advanced GBAS capabilities (extended service volume, reduced RVR, RNP to GLS, variable glide path/displaced threshold operations). He noted that the FAA maintained a close relationship with international service providers and the user community by co-chairing the International GBAS Working Group with Eurocontrol.

1.5.6 Alessander Santoro from Brazil presented P/08, on the Brazilian experience with GBAS. He began by discussing the emergence of PBN as a way of addressing global air traffic growth, along with GNSS technologies, given that conventional navaids had limitations to accompany this growth. He then explained the complexity and size of the Brazilian airspace, and described the evolution of GPS in Brazil, starting with the testing of the Honeywell SLS-2000 SCAT-I station up to the testing of the SBAS system within the context of ICAO project RLA/00/009. These tests revealed the severe behavior of the ionosphere around the geomagnetic equator and demonstrated that SBAS implementation did not have a favorable cost/benefit ratio.

1.5.7 In 2013, through an agreement with the FAA, DECEA (Airspace Control Department) installed a GBAS prototype station in SBGL (Rio de Janeiro) and equipped GEIV aircraft (Brazilian Flight Inspection Group) to test GBAS procedures. The flights showed the capacity, flexibility, and stability of GBAS for curved approaches, but data analysis was inconclusive due to data acquisition issues and the possible influence of the ionosphere. To eliminate variables, a Honeywell SmartPath SLS-4000 (certified by FAA) was installed in SBGL (Rio de Janeiro) to collect data during the peak of solar cycle 24 and check the behavior of the station. Since its installation, the availability of the station has been below the required level, forcing the disabling of monitors to allow for constant data collection.

1.5.8 Data collected from 180 GPS L1/L2 receivers installed throughout Brazilian territory and analyzed by a group of experts from DECEA, ICEA, FAATC, USTDA, Mirus Technology, SDTP, Stanford University, INPE, Boston College, UNESP, and KAIST, who measured S4, Kp and Dst indexes, revealed the occurrence of 127 severe ionospheric events. The result was a report submitted in March 2015, which concluded that the SLS-4000 station, at low latitudes, did not meet ICAO integrity and availability requirements. The report is posted in the ICAO website, together with all the presentations of the event.

1.5.9 He also reported on new technologies and procedures concurrent with GBAS GAST C, such as: GAST D (GBAS CAT II/III), GBAS MF/MC (multi-frequency, multi-constellation), LPV200 SBAS, SBAS MF, BARO VNAV and RNP-AR procedures. Finally, he noted that GBAS GAST C was operational in a few countries in mid-latitudes but was still a challenge in low latitudes. In 2003, Brazil tested GBAS stations in SBGL and the technology did not meet ICAO SARPs for availability and integrity. Brazil continues making efforts to set SLS-4000 operational at SBGL for public use, and new technologies were emerging to challenge GBAS GAST C.

1.5.10 Ricardo Abregu and Manuel Alvarez from ANAC (Argentina) informed in presentation P/09 that, in accordance with the ICAO strategy set forth in the Global Air Navigation Plan, ANAC opted for PBN implementation and GBAS as the best future option for CAT 1 precision approaches to replace ILS systems.

1.5.11 The presentation also described the CAT I GBAS implementation schedule, starting with the design, manufacture, implementation, and approval of a GBAS system at the San Carlos de Bariloche international airport in January 2014, the technical assessment conducted in the laboratory in 2014-2015, the on-site technical assessment model (2016), the certification and approval process (2016), and after that, the test period and initial manufacturing of 6 CAT 1 GBAS units. It also described the technical configuration of the GBAS and the test bench implemented for the correction algorithm.

1.5.12 Presentation P/10 by INVAP supplemented presentation P/09, providing more detailed technical information about the CAT 1 GBAS hardware and software and service provisions.

1.5.13 Patrick J. Reines from Honeywell presented P/17 on avionics support for GBAS and performance-based navigation. This presentation showed the cost-effectiveness of GBAS, since it could provide 48 possible approaches from a single ground station and enabled advanced PBN approach procedures. He also explained that GLS (GBAS avionics) equipage by airlines was being expedited and confirmed that GBAS and GLS were ICAO-compliant systems, in accordance with the following data: a. Formal approvals in multiple nations, b. In use on revenue passenger flights in IMC weather, c. GLS equipped airlines are already flying in the CAR/SAM Regions. In addition, he provided additional information, including that GBAS Cat I growth path to Cat II and Cat III was underway, that Brazil was leading the GBAS low latitude safety case, that the regional GBAS approval and implementation was an optimal approach, and that, so far, only the Honeywell GBAS was ICAO-compliant and was being used in revenue passenger service.

Satellite-Based Augmentation System (SBAS) presentations

1.5.14 Presentation P/11 by Benoit Roturier of France described the status of SBAS worldwide (EGNOS/Europe, MSAS/Japan, GAGAN/India, and WAAS). The vertical navigation service (LPV) is deployed over three regions, but not yet in Japan. Since SBAS does not involve local airport infrastructure costs, it is frequently considered a government-based multimodal infrastructure serving different user communities. SBAS represents a very low-cost infrastructure opportunity for aviation and supports a high rate of implementation of Cat I (LPV 200) or near-Cat I (LPV 250) approach procedures.

1.5.15 Using WAAS, more than 4000 approach procedures with vertical guidance were implemented during the last decade, and 440 were expected in Europe by 2018. The number of equipped aircraft is also increasing on a regular basis, with more than 80,000 SBAS users registered in North America. GAGAN has developed a specific ionospheric model that provides good availability of LPV in the equatorial region.

1.5.16 France showed how PBN was improving significantly the performance of its approach and landing national network, while also reducing infrastructure costs through an ILS phase out program. The second part of the presentation introduced 4 new SBAS programs: SDCM/Russia, SBAS/ASECNA, BDSBAS/China and KASS/South Korea. It was also developing new ionospheric algorithms for EGNOS in the equatorial region, with the support of the ASECNA ABAS program (see the Thales presentation).

1.5.17 Finally, the evolution of SBAS toward a dual frequency, multi-constellation system was described, showing long-term potential to cover all the land masses of the world with Cat I signals when current SBAS evolved to this technology and additional networks were deployed in the Southern hemisphere.

1.5.18 In P/12, Carlos Rodriguez from the FAA presented the status and evolution of SBAS. Related FAA activities included investments by the FAA in upgrades to the WAAS network to address obsolescence issues and to prepare the system for the implementation of the L5 (dual) frequency. The FAA continues to manage the acquisition of GEO satellite services to maintain optimum coverage and service level for the WAAS. The WAAS system provides the service required to meet ADS-B positioning requirements and to support PBN implementation. The FAA continues to support the development and publication of WAAS supported procedures and user equipage. The GPS follows the program for the development of the next generation of satellites and control segments and the FAA maintains close coordination for the implementation of aviation requirements in the GPS system.

1.5.19 In P/13, ICAO showed the results of the SBAS-type WAAS test bed trials conducted under technical cooperation project RLA/00/009 between 2001 and 2007 in the CAR/SAM Regions. Project activities were described, together with the recommendations made as a result of the trials.

1.5.20 In presentation P/14, COCESNA (Central American Corporation for Air Navigation Services) provided information about project RLA/03/902 SACCSA, in which several CAR/SAM States and agencies participated under the leadership of ICAO, and which consisted of three phases.

1.5.21 Its objective was to study the ionospheric behavior in the CAR/SAM Regions in order to find an SBAS solution for the development of an GNSS applicable to the CAR/SAM Regions, where ionospheric behavior is different from other regions that already have SBAS.

1.5.22 It was noted that phase III contemplated studies on the operation of the monitoring network and the Central Processing Unit, as well as a comparison of complementary solutions in areas of poor or limited performance. In addition, the meeting was informed that the project contractor, GMV, had enabled the link http://magicgnss.gmv.com/sam/, as a platform to analyze SACCSA benefits using its magic SBAS and MagicGemini tools.

1.5.23 In order to meet APV-I horizontal and vertical accuracy requirements, the system should take advantage of the multi-constellation of satellites (GPS/GLONASS and others) and dual frequency to minimize the impact of solar activity on the ionosphere, and particularly on the SBAS signal.

RAIM availability

1.5.24 Two presentations were made on this item: P/15, by ICAO, describing the reasons why the SAM Region had implemented a regional RAIM availability service called SATDIS, and its functionality in approach and terminal areas.

1.5.25 In P/16, NAV BLUE presented an overview of GPS operation and the errors and key parameters that affected RAIM (*e.g.*, geometry), a brief description of SATDIS, the SAM RAIM prediction tool, an overview of other regional solutions provided by NAVBLUE to AeroThai, CAAS and EUROCONTROL, and finally an overview of additional functionalities that could be added to SATDIS, including ADS-B, NOTAMs, and mapping capabilities.

1.6 Ionospheric and tropospheric effects on GNSS

1.6.1 Francisco Azpilcueta, from the University of La Plata, Argentina, presented P/18, on the ionospheric and tropospheric effects on GNSS. He showed a method to characterize the behavior of the nominal ionosphere in Bariloche, which had favorable ionospheric conditions. The method was applied to characterize the behavior of the ionosphere in Argentinian territory and identify the different ionospheric regions of Argentina. In summary, University of La Plata is expecting to obtain results and conduct a statistical analysis based on the infrastructure installed at the Bariloche airport. At present, the first phase has been completed. The next step will be to characterize the irregular behavior of the ionosphere over Argentina, in order to define the parameters typical of an ionospheric threat model, and implement the management module.

1.6.2 In presentation P/19, Rich Cole (Mirus Technology) provided information on the effects of the troposphere and ionosphere on GNSS and an overview of the upcoming GBAS safety case project. He also summarized the findings of the low-latitude threat model project, comparing three ionospheric threat models from the U.S., St. Helena's Island (UK), and Brazil. The results of the Brazil threat model were dramatic compared to the U.S. and St. Helena. Then, a short description was given of the project sponsored by the U.S. Trade Development Agency (US TDA) for the development of a safety case for low-latitude GBAS operations. The safety case will provide the foundation for system design approval and allow DECEA to complete the commissioning of the GIG installation. It will also provide other nations in low-latitude regions the information required to approve GBAS in their respective airspace.

1.6.3 In P/20, Thales Alenia reported that the ionosphere was one of the main concerns in South America, where many low-latitude countries underwent the worst gradients and scintillation effects. Activities have been carried out in the past to deploy a test bed with an old version of “mid-latitude” WAAS algorithms (more than 10 years old). These studies did not lead to any conclusion as to the feasibility of conducting precise approaches with vertical guidance over South America. In addition, GBAS was facing the same kind of issue, as it was not able to separate ionosphere delays from other sources of GNSS ranging error, contrary to SBAS. Furthermore, the qualified GBAS threat model used for binding errors caused by the non-separation of ionosphere delay was not suitable to ensure integrity in low latitudes.

1.6.4 Other studies like SACCSA have been performed with new algorithms but fed by GLONASS, which unfortunately cannot be used today for safety purposes. (This is the reason why EGNOS does not provide GLONASS augmentation.) Thales Alenia Space, the prime contractor of the European SBAS - EGNOS, performed studies in low-latitude regions (in mid Africa – ASECNA countries) for several years. These studies allowed to understand ionosphere behavior in low latitudes (high gradients, depletion, bubbles, and scintillation) and to design a new generation of algorithms capable of operating even in severe equatorial ionosphere conditions. The results obtained in Africa during test campaigns showed that these algorithms were capable of providing at least APV-1 precision approaches (with vertical guidance, almost Cat 1 service) in Africa, even during geomagnetic storms, with the availability level required by ICAO SARPs (>99%).

1.6.5 These algorithms have also been run on the EGNOS network during severe geomagnetic storms, showing that they were not affected, contrary to current operational EGNOS and WAAS. These results show the huge improvement provided by Thales Alenia Space equatorial algorithms. Finally, preliminary studies have been performed in Brazil thanks to INPE and DECEA/ICEA, confirming the feasibility of APV-1 service, just as in Africa. To conclude, Thales Alenia Space invited South American countries to participate in new SBAS test bed campaigns, which will now use Thales equatorial algorithms. It will be a first step to support a future SBAS deployment over the South American region.

1.7 Ground- and flight-testing considerations

1.7.1 In P/21, Bob Stuckert, from the United States, presented GNSS flight inspections. GNSS flight inspections validate the data used in procedure design and ensure that the procedure delivers the aircraft to the correct position for landing. Valid data depends on compliance with up-to-date survey standards developed for GNSS application. The United States performs Preflight Coding Validation. This is a comprehensive check of the procedure data and ARINC 424 coding. Once completed, flight inspection validates the procedure design, insures obstacle clearance, and confirms communications with air traffic control. An FAA program of flight inspection courses for international students scheduled for 2017 was also presented.

1.7.2 In P/22, Beniot Roturier reported on the status of PBN flight inspections in France. The presentation showed ICAO material applicable to PBN procedure design and validation, the logic behind it, and how this has been incorporated into French regulations. States should follow this process for procedure commissioning and when changes are made to the procedure. A description was then provided of the flight inspection structure in France, aircraft systems and teams, also showing several cases of interference on PBN procedures, which were detected thanks to the flight inspection teams and systems. This experience highlights the need for proper spectrum management and aviation tools to maintain high availability of PBN procedures.

1.7.3 In P/24, P26, P27, and P28, Argentina, Bolivia, Cuba, and COCESNA presented respectively the current status and expectations in terms of flight inspection of navigation infrastructure to support PBN. Additionally, Aerolineas Argentinas presented P/25, describing PBN flight validation procedures in Argentina.

1.7.4 In P/23, Frank Musmann, from AERODATA, provided information on Avionic Navigation Infrastructure to support PBN. When designing Instrument Flight Procedures (IFP), consideration should be given to many limiting factors, such as: terrain, obstacles, environmental constraints, and suitability for air traffic management. Accordingly, instrument flight procedures are increasingly based on area navigation (RNAV) or performance-based navigation (PBN), which permits the definition of a complex flight path. The capabilities of modern flight management systems (FMS) enable procedure designers to use new elements for the definition of the procedure path. Typical elements are radius-to-fix (RF) segments for the definition of arcs, and the final approach segment (FAS) for the definition of precision approaches with vertical guidance. This presentation highlighted some typical undesired effects that could be observed during flight validation of procedures based on RF and FAS. In order to simplify the validation process, software tools and functions have been developed. Based on case examples, it has been shown how such effects could be easily identified through an automated process.

2 FINAL RECOMMENDATIONS AND CONCLUSIONS

2.1 Based on the presentations and discussion, the participants agreed on the following conclusions and recommendations:

General aspects and development of SARPs

a) PBN is the foundation for safety, operational and environmental improvements as described in the Global Air Navigation Plan, its technological roadmaps, and the ICAO ASBU methodology.

b) The PBN framework is well established and there are a lot of SARPs and guidance materials related to PBN procedures to assist States in the: 1) implementation, including technical requirements of the navigation infrastructure to support PBN and GNSS operations, 2) validation, and 3) operation. Furthermore, ICAO is now providing more assistance to States in their planning and implementation, by providing guidance materials, offering CBT training, and conducting workshop and seminars.

c) Follow-up activities are needed to allow the PBN concept to further mature and to provide adequate procedures and technical requirements to enable PBN-related ASBU modules B1 and B2.

d) This includes assessment activities and the development of SARPs for GBAS Cat II/III operations by the Navigation System Panel (NSP). The development of GBAS Cat II /III SARPs is nearly complete, and the amendment of Annex 10 Volume I to introduce GBAS Cat II/III is scheduled to become effective in November 2018.

e) It was noted that the NAM/CAR/SAM Regions had enough DME-DME coverage to support PBN procedures, but there were areas that were not yet covered and required the implementation of additional DME.

f) In order to avoid the interruption of GNSS signals and interference, States should:

- prohibit all actions leading to the interruption of GNSS signals;
- develop and implement a strong regulatory framework governing the use of intentional in-band diffusers, including GNSS repeaters, pseudolites, spoofers, and jammers;
- have particular care with off-band diffusers that are in a harmonically GNSS-related frequency, such as some television broadcast channels and other industrial applications;
- support the position of ICAO at the ITU WRC;
- protect the frequency spectrum for aeronautical use; and
- coordinate frequency allocation with the respective ICAO Regional Offices

Ground-Based Augmentation System (GBAS)

g) GBAS is being used as a satellite-based alternative to the Instrument Landing System (ILS) for precision approach and landing, providing differential corrections and integrity monitoring of global navigation satellite systems (GNSS), which are fundamental for PBN operation as described in ASBU modules.

h) The implementation of GBAS CAT-I is underway worldwide and is already operational at several airports in mid-latitude States.

i) These operations and assessments confirmed various benefits of GBAS operations, including the high accuracy, availability, and integrity required for CAT I and, eventually, Cat II/III precision approaches. In addition, some assessments showed robustness under severe snow conditions and a good cost/benefit ratio, since a GBAS covers multiple runway ends, and provides up to 48 approaches per system.

j) However, it is important to note that these GBAS operations were conducted mainly in mid-latitude States and it is still a big challenge to operate GBAS in low latitudes because of the ionospheric effect.

k) Brazil was leading a low-latitude GBAS safety case, and it was recognized that the lessons learnt would provide great guidance for States interested in deploying GBAS in their States and who were facing the same challenges in their GBAS development and assessment projects.

l) It was also noted that several promising technical improvements were under development, such as multi-constellation and dual frequency GBAS, which was expected to provide enhanced robustness with respect to ionosphere anomalies and radio frequency interference.

m) Since many CAR/SAM States were located in equatorial regions, safety case assessments should be conducted if they intended to implement and operate GBAS in their States.

n) It was also recognized that the implementation of GBAS CAT II/III had to be carefully considered and assessed so that each State could decide whether the use of GBAS would allow them to achieve their particular goals and meet their operational needs, since those operations could depend on market demand, maturity of standards/regulatory requirements, availability of infrastructure and other business factors.

o) A cost-benefit analysis based on the operational demand of each State was needed to identify those airports suited for the installation of GBAS CAT I stations.

p) For each eligible airport, a GBAS ionosphere threat model would be required for certification and commissioning purposes.

SBAS

q) States were encouraged to continue assessing the technical, operational, and financial feasibility of SBAS systems in a multi-constellation and dual frequency environment. But it was noted that an ionospheric model that supported a good availability of LPV in the equatorial region (low latitude) had been developed through GAGAN, the African SBAS test campaigns, and SACCSA in the CAR/SAM Regions.

r) Studies conducted under the SACCSA project have shown that an augmentation solution for the CAR/SAM Regions is feasible and its interoperability with other systems is based on the SARPs/MOPS. In addition, the use of multi-constellation (GPS+GLONASS+Others) and multi-frequency (dual frequency) is recommended to minimize the impact of solar activity on the ionosphere and the SBAS signal.

s) SACCSA studies are consistent with recommendations 6/5 and 6/9 of the 12th Air Navigation Conference.

t) As a result of the SBAS-type WAAS test bed developed in the CAR/SAM Regions, the following recommendations were made:

i) The SBAS-type WAAS tests carried out in the CAR/SAM Regions between 2001 and 2007 concluded that, because of the severe ionosphere conditions in the geomagnetic equatorial region (+/- 20° degrees around the equatorial line), it was recommended that the CAR/SAM Regions consider the possible implementation of an SBAS only for lateral navigation (LNAV) or non-precision approach (NPA).

ii) In the future, GNSS-based precision approach services in the region should be provided only after a Cat I capable ground-based augmentation system (GBAS) that can account for ionosphere error as recorded at/near the geomagnetic equator, or a global second civil GPS signal at L5, is available.

RAIM availability prediction

u) In the SAM Region, where a RAIM availability prediction tool has been implemented, the following recommendations were made:

- The aeronautical community should be aware of SATDIS functions in support to the GNSS-based navigation (basically GNSS - ABAS). In this respect, an AIC should be issued.
- For the approval of PBN by the aeronautical authority, users must be required to implement an availability prediction system (RAIM) (SATDIS is a service that meets the requirement, as stated in the advisory circulars issued in the Region, for the approval of PBN operations).
- Any State that has published in its AIP the PBN procedures at an aerodrome should also publish a NOTAM in case availability prediction for that aerodrome is not available (SATDIS makes 24-, 48-, and 72-hour predictions).
- Additional functionalities that can be added to SATDIS include ADS-B, NOTAMs, and mapping capabilities.

Ionospheric and tropospheric effects on GNSS

a) GBAS operations in low latitude cannot meet ICAO integrity requirements using the mid-latitude threat model.

b) To support GBAS operations in low-latitude regions, a safety case is required to ensure compliance with ICAO Annex 10 and overall system safety criteria. The safety case is a critical part of the certification process and requires rigor, structure, and a process to make sure that the highest level of safety is maintained.

Ground and Flight Testing Consideration

a) The validation process and the flight testing experience of States have underlined the need for proper spectrum management to avoid interference and for aviation tools to maintain high availability of PBN procedures.

b) It is recognized that GNSS flight testing is important for validating the data used in PBN procedure design and making sure that the procedure delivers the aircraft to the correct position during operations.

b) Instead of only validating the signal-in-space, States should take into account the validation process described in the PBN Manual and in Doc 9906, which highlight the importance of a full validation process, including validating the data used in the PBN procedure design.

d) The PBN Manual, the Quality Assurance Manual for Flight Procedure Design (Doc 9906) and the Manual on Testing of Radio Navigation Aids (Doc 8071), Volume II, Testing of Satellite-based Radio, should be referred to when performing PBN procedure validations.

e) It was confirmed that the technical requirements and specifications for the GNSS flight testing were described in the Manual on Testing of Radio Navigation Aids (Doc 8071), Volume II, Testing of Satellite-based Radio Navigation Systems.

APPENDIX A

AGENDA
WORKSHOP/SEMINAR FOR THE IMPLEMENTATION OF NAVIGATION INFRASTRUCTURE TO SUPPORT PBN AND GNSS PRECISION APPROACH OPERATIONS IN THE NAM/CAR/SAM REGIONS
(Lima, Peru, 15 to 17 August 2016)

MONDAY, 15 AUGUST 2016		
HOUR	**SUBJECT**	**EXPOSITOR**
08:30-09:00	Registration	
09:00-09:150	Opening ceremony	SAM ICAO RD Franklin Hoyer
09:15-09:30	Introduction workshop/seminar	ICAO Onofrio Smarrelli
SESSION 1: GLOBAL AND REGIONAL IMPLEMENTATION CONSIDERATION OF NAVIGATION INFRASTRUCTURE TO SUPPORT PBN AND GNSS PRECISION APPROACH OPERATIONS IN THE NAM/CAR/SAM REGIONS		
09:30-10:00	Global air navigation plan consideration on navigation infrastructure to support PBN	ICAO Mie Utsunomiya
10:00-10:30	Regional air navigation plans implementation consideration on navigation infrastructure to support PBN in the NAM/CAR and SAM Regions	ICAO Onofrio Smarrelli Mie Utsunomiya
10:30-11:00	***Coffee break***	
11:00-11:30	*Questions / Session 1 summary*	
SESSION 2: ICAO SARPS AND DOCUMENTATION OF NAVIGATION INFRASTRUCTURE TO SUPPORT PBN AND GNSS PRECISION APPROACH OPERATIONS		
11:30-12:00	ICAO SARPS and documentation on navigation infrastructure to support PBN	ICAO Mie Utsunomiya
12:00-12:30	Spectrum consideration of navigation infrastructure	ICAO Onofrio Smarrelli
12:30-13:30	***Lunch break***	
13:30-14:00	*Questions / Session 2 summary*	
SESSION 3: CURRENT GNSS SITUATION AND EVOLUTION		
14:00-14:30	GBAS world implementation and France GBAS Cat III opportunities and challenges at Paris Charles de Gaulle experience	France Benoit Roturier
14:30-15:00	GBAS current situation and evolution	United States FAA Carlos Rodriguez

TUESDAY, 16 AUGUST 2016		
HOUR	**SUBJECT**	**EXPOSITOR**
SESSION 3: CURRENT GNSS SITUATION AND EVOLUTION		
9:00-10:00	Brazilian GBAS experience	Brazil Alessander de Andrade Santoro
10:00-10:30	GBAS future vision and other CNS development	Argentina (ANAC) Ricardo Abregu and Manuel Álvarez
10:30-11:00	***Coffee Break***	
11:00-11:30	GBAS development in Argentina	INVAP Isidoro Vaquilla and Oscar Bria
11:30-12:00	PBN and EGNOS implementation status in France and other SBAS world implementation (Current situation and evolution)	France Benoit Roturier
12:00-12:30	SBAS current situation and evolution	Estados Unidos FAA Carlos Rodriguez
12:30-13:30	***Lunch break***	
13:30-14:00	SBAS type WAAS test bed Project in CAR/SAM Region	ICAO Onofrio Smarrelli
14:00-14:30	SBAS NAM CAR SAM experience SACCSA Project	COCESNA Rony Montenegro
14:30-14:45	RAIM availability prediction tool in SAM Region SATDIS	ICAO Onofrio Smarrelli
14:45-15:15	GNSS integrity	NAVBLUE John Wilde
15:15-15:45	Avionic navigation infrastructure to support PBN	Honeywell Patrick Reines
15:45-16:15	*Questions / Session 3 summary*	

WEDNESDAY, 17 AUGUST 2016		
HOUR	**SUBJECT**	**EXPOSITOR**
SESSION 4: IONOSPHERIC AND TROPOSPHERIC EFFECTS ON GNSS		
09:00-09:30	Ionospheric and tropospheric effects on GNSS	Universidad La Plata (Argentina) Francisco Azpilcueta
09:30-10:00	Regional ionospheric update and low-latitude GBAS threat model synopsis	United States Rich Cole
10:00-10:30	Latest SBAS performances under severe and equatorial ionosphere conditions	Thales Alenia Space Franck Haddad
10:30-11:00	***Coffee Break***	
11:00-11:30	*Questions / Session 4 summary*	
SESSION 5: GROUND AND FLIGHT TESTING CONSIDERATION		
11:30-12:30	GNSS Flight Inspection	United States Bob Stuckert
12:30-13:30	***Lunch break***	
13:30-14:00	PBN flight inspection status in France	France Beniot Roturier
14:00-15:00	CAR/SAM GNSS flight inspection	ARGENTINA BOLIVIA COCESNA CUBA
15.00-15:30	Avionic navigation infrastructure to support PBN	AERODATA Frank Musmann
15:30-16:00	*Questions / Session 5 summary*	
SESSION 6: FINAL RECOMMENDATIONS AND CONCLUSION		
16:00-16:30	Workshop/Seminar final recommendation and conclusion	ICAO/STATES
16:30	Closing ceremony and delivery of certificate	

APÉNDICE B / APPENDIX B

Seminario/Taller para la Implementación de infraestructura de navegación para soportar PBN y las operaciones de aproximación de precisión GNSS en las regiones NAM/CAR/SAM

Workshop/Seminar for the implementation of navigation infrastructure to support PBN and GNSSS precision approach operations in the NAN/CAR/SAM Regions

LISTA DE PARTICIPANTES / LIST OF PARTICIPANTS

ARGENTINA

Ana Carolina Toloza Especialista ATM y Ambiental Administración Nacional de Aviación Civil ANAC Azopardo 1405 C.A. Buenos Aires, Argentina	Tel: +54 11 5941-3000 E-mail: atoloza@anac.gob.ar
Manuel Alvarez Jefe Departamento Planes Programas y proyectos Unidad de Planificacióny Control de Gestión Administración Nacional de Aviación Civil ANAC Azopardo 1405 C.A. Buenos Aires, Argentina	Tel: +54 11 5941-3000 E-mail: malvarez@anac.gob.ar
Ricardo Abregu Asesor Especializado Administración Nacional de Aviación Civil ANAC Azopardo 1405 C.A. Buenos Aires, Argentina	Tel: +54 11 5941-3098 E-mail: rabregu@anac.gob.ar
Diego Martín Frigerio Inspector de Navegación Aérea - ANAC Azopardo 1405 Buenos Aires, Argentina	Tel: +54 11 5941 3000 – int. 69744 E-mail: dfrigerio@anac.gob.ar
Andrés Espina Inspector de Navegación Aérea - ANAC Azopardo 1405, piso 3 Buenos Aires, Argentina	Tel: +54 11 5941 3000 – int. 69212 E-mail: aespina@anac.gob.ar
Federico Giorno Director CNS Dirección General de Control de Tránsito Aéreo (DGCTA) Junín 1060, C.A.B.A. Buenos Aires, Argentina	Tel: +54 11 68940640 E-mail: fgiorno@faa.mil.ar

Gustavo Romo
Jefe Laboratorio
Dirección General de Control de Tránsito Aéreo (DGCTA)
Junín 1060, C.A.B.A.
Buenos Aires, Argentina
Tel: +54 11 47511612
E-mail: gromo7318@hotmail.com

Oscar Alberto Muñoz
Jefe Comunicaciones Aeropuerto Ezeiza
Buenos Aires, Argentina
Tel: +54 11 1530374269
E-mail: ocomeze@gmail.com

ARUBA

Joselito Correia de Andrade
Manager CNS/ATM Systems
Air Navigation Services Aruba
Tel: +297 528 2700
+297 593 2923
E-mail: joselito.coreiadeandrade@ansa.aw

BOLIVIA

Jaime Yuri Alvarez Miranda
Jefe Unidad CNS
DGAC
Av. Arce # 2631 Edif. Multicine Piso 9
La Paz, Bolivia
Tel: +5912 2444450
E-mail: jalvarez@dgac.gob.bo

BRASIL/BRAZIL

Alessander de Andrade Santoro
Departamento de Control del Espacio Aéreo (DECEA)
Av. General Justo 160 – 4º Andar, Centro
Rio de Janeiro 20.010-130, Brasil
Tel.: +55 21 2101-6105
E-mail: santoroaas@decea.gov.br

CHILE

Luis Ignacio Silva Montoya
Piloto Inspector
Dirección General Aeronáutica Civil (DGAC)
Miguel Claro 1314, Providencia
Santiago, Chile
Tel: +56 2 24363 629
E-mail: lisilva@dgac.gob.cl

COLOMBIA

John Ferrer
Jefe Navegación Aérea / CAP A320
Diagonal 25G/95A85
CEO, Piso 6
Bogotá, Colombia
Tel: + 571 3816000 ext. 3368
E-mail: john.ferrer@avianca.com

CUBA

Efren Cruz Julve
Ingeniero Navegación Aérea - IACC
Calle 369 – 178 y 184 Edif. 17820 Apto. 13 Reparto, Mulgoba
La Habana, Cuba
Tel: + 537 2664424
E-mail: efren.cruz@aeronav.avianet.cu

Franciscoo Javier Fernández Padiz
Jefe Unidad CNS - ECASA
Calle Canal # 2717 – Rto. Antonio Maceo
La Habana, Cuba
Tel: + 537 266 4826
E-mail: francisco.padiz@aeronav.avianet.cu

ESTADOS UNIDOS

Raúl G. Chong
International Program Officer of South America & Panama
Federal Aviation Administration (FAA)
600 Independenca Ave. Sw.
Washington, DC 20597,USA
Tel: +1 202 267 0999
E-mail: raul.chong@faa.gov

Robert Stuckert
Manager, Technical Service
Federal Aviation Administration (FAA)
PO Box 25082
Oklahoma City, OK 73125, USA
Tel: +1 4059542856
E-mail: bob.stuckert@faa.gov

Carlos Rodríguez
Federal Aviation Administration (FAA)
800 Independence Ave, SW
Washington, DC 20591
Tel: +1202 267-9975
E-mail: carlos.rodriguez@faa.gov

FRANCIA

Benoit Roturier
GNSS and PBN Programe Manager
DGAC/ DSNA
Francia
Tel: + 336 42833179
E-mail:benoit.roturier@aviation.civile.gouv.fr

JAMAICA

Christopher Chambers
Chief Procedures Specialist - JCAA
Jamaica
Tel: + 976 960 3948
E-mail: christopher.chambers@jcaa.gov.jm

MÉXICO

José Inés Gil Jiménez
Subdirector Navegación Aérea
DGAC
Tel: + 5255 57239300 ext. 18084
E-mail: jigiljim@stc.gob.mx

PANAMÁ

Enrique Antonio Brown
Jefe de Departamento Radar
Autoridad Aeronáutica Civil (AAC)
Ave. Demetrio Korsi, Calle Hector Conte Bermudez
Edificio 646, Albrook, Apartado 03073-03187
Panamá
Tel: +507 315-9863
E-mail: ebrown@aeronautica.gob.pa

PERÚ

Jorge García Villalobos Jefe Equipo Comunicaciones Corporación Peruana de Aeropuertos y Aviación Comercial S. A. (CORPAC) Aeropuerto Internacional "Jorge Chávez" Lima 1, Perú	Tel: Cel: E-mail:	+511 2301432 +51 950831446 jgarcia@corpac.gob.pe
Tony Boza Rodríguez Jefe Inspección en Vuelo Corporación Peruana de Aeropuertos y Aviación Comercial S. A. (CORPAC) Aeropuerto Internacional "Jorge Chávez" Lima 1, Perú	Tel: E-mail:	+511 2301147 tboza@corpac.gob.pe
Jorge Taramona Perea Inspector de Navegación Aérea Dirección General de Aeronáutica Civil (DGAC) Ministerio de Transportes y Comunicaciones Jr. Zorritos 1203 Lima 1, Perú	Tel: E-mail:	+51 1 615-7880 jtaramona@mtc.gob.pe
José Alberto Díaz Zegarra Ingeniero Corporación Peruana de Aeropuertos y Aviación Comercial S. A. (CORPAC) Aeropuerto Internacional "Jorge Chávez" Lima 1, Perú	Tel: Cel: E-mail:	+51 4141213 +51 969919533 jdiaz@corpac.gob.pe

REPÚBLICA DOMINICANA

Alexi Manuel Batista Ruiz Encargado Sección Gestión del Espacio Aéreo IDAC Av. Ruta 66, Cabo Caucedo Edificio Norge Botello, Santo Domingo	Tel: E-mail:	+1 809 272 4322 ext. 2303 alexismbr911@hotmail.com

SURINAM

Akloe Tjiettrawatie Air Traffic Controller Civil Aviation Department Suriname Coesewijnestraat 1 Paramaribo, Suriname	Tel: E-mail:	+597 875 4741 cheetra@hotmail.com
Maira J. Rozenblad Developmental ANS Inspector Civil Aviation Safety Authority Coesewijnestraat 1 Paramaribo, Suriname	Tel: E-mail:	+597 434286 ext 235 madamroos@hotmail.com mrozenblad@casas.sr

URUGUAY

Martín Ruiz
Inspector Navegación Aérea
Dirección Nacional de Aviación Civil e
Infraestructura Aeronáutica (DINACIA)
Av. Wilson Ferreira Aldunate 5519
Canelones, Uruguay
Tel: +589 2 6040408 Ext 4045
E-mail: mruiz@dinacia.gub.uy

Juan Garrido
Tec. Electrónico Aer. Nav. y Vigilancia (CNS)
Dirección Nacional de Aviación Civil e
Infraestructura Aeronáutica (DINACIA)
Av. Wilson Ferreira Aldunate 5519
Canelones, Uruguay
Tel: +598 2 698 7337
E-mail: juanga61@gmail.com

VENEZUELA

Emerson Aparicio La Grave
Operaciones Aproximación
Instituto Nacional de Aeronáutica Civil (INAC)
Aeropuerto Internacional Simón Boliviar Edo. Vargas
Venezuela
Tel: +58 212 355273
E-mail: e.apariciolg@gmail.com

AERODATA

José Yglesias
Director Business Development & Sales
AERODATA AG
Hermann-Blenk-Strasse 34-36, D-38108
Braunschweig, Germany
Tel: +49151 57131629
E-mail: yglesias@aerodata.de

Frank Musmann
Program Manager / Seminor System Engineer
AERODATA AG
Hermann-Blenk-Strasse 34-36, D-38108
Braunschweig, Germany
Tel: +49531 2359-341
E-mail: musmann@aerodata.de

AEROLINEAS ARGENTINAS

Eduardo Ravera
Gerente Documentación y Normas Operativas
Aeroparque Jorge Newbery
Rafael Obligado s/n Edificio Corporativo T4 – piso 5
Buenos Aires, Argentina
Tel: +5411 3723.8151
E-mail: eravera@aerolineas.com.ar

Rodrigo Devesa
Coordinador Diseño PBN
Aeroparque Jorge Newbery
Rafael Obligado s/n Edificio Corporativo T4 – piso 5
Buenos Aires, Argentina
Tel: + 5411 3723.8151
E-mail: rodrigo.devesa@aerolineas.com.ar

COCESNA

Rony Montenegro G.
Gerente de Estación Guatemala
Interior Aeropuerto La Aurora. Zona 13
Guatemala
Tel: + 502 2260 6422
E-mail: rony.montenegro@cocesna.org

BOEING

William Peterson
Engineer
BOEING
P.O.Box 3707 MCOR - 445
Seattle, WA 98024
Tel: + 1 206 427 0235
E-mail: william.j.peterson2@boeing.com

Glaucia Costa Baldevi
Researcher
BOEING
P.O.Box 3707 MCOR - 445
Seattle, WA 98024
Tel: +5512 99105 0533
E-mail: glaucia.c.baldevi@boeing.com

INVAP

Ricardo Sagarzazu
VP Strategic Development
Av. Piedrabuena 4950
Bariloche, Argentina
Tel: +54911 51100422
E-mail: peck@invap.com.ar

Julieta Llanes
GBAS Software Eng.
Av. Piedrabuena 4950
Bariloche, Argentina
Tel: +54911 51100422 int 1375
E-mail: jllanes@invap.com.ar

Danilo Giri
GBAS Project Manager
Av. Piedrabuena 4950
Bariloche, Argentina
Tel: +5492 94466 4735
E-mail: dgiri@invap.com.ar

Isidoro Vaquila
GBAS System Eng.
Av. Piedrabuena 4950
Bariloche, Argentina
Tel: +54929 4420 3332
E-mail: ivaquila@invap.com.ar

HONEYWELL

Patrick Reines
Senior Manager
7412 Argus Court
Gaithersburg, MD 20879-4555
USA
Tel: +1 240 447 1100
E-mail: pat.reines@honeywell.com

MIRUS TECHNOLOGY

Richard Cole
Principal
7005 Booker T Washington Hwy
Wirtz, Virginia 24184
USA

Tel: +1 540 912 0150 x 101
Tel: +1 703 626 5885
E-mail: rcole@miruscorp.com

NAVBLUE

John Wilde
Global Strategic Sales
Hersham Place Technology Park
Moseley Road
Walton-on-Thames

Tel: +44 7976 907152
E-mail: john.wilde@navblue.aero

THALES ALENIA SPACE

Franck Haddad
Egnos Algorithm and Peformance Engineer
Thales Alenia Space
26, Av. J.F. Champollion – B.P. 33787
Toulouse Cedex 1, France

Tel: +33 5 34357834
E-mail: franck.haddad@thalesaleniaspace.com

UNIVERSIDAD LA PLATA

Francisco Javier Azpilcueta
Investigador
Paseo del Bosque s/n
Fac. Cs. Astronómicas y Geof.
1900, La Plata, Argentina

Tel: + 54 221 4286593
E-mail: azpi@fcaglp.unlp.edu.ar

OACI / ICAO

Onofrio Smarrelli
Oficial Regional CNS
Oficina Regional Sudamericana (SAM)
Av. Víctor Andrés Belaúnde No.147
Centro Empresarial Real, Vía Principal No.102
Edificio Real 4, Piso 4, San Isidro
Lima 27, Perú

Tel: +511 611-8686, Ext. 107
E-mail: osmarrelli@icao.int

Mie Utsunomiya
Oficial Regional CNS (e.i.)
Oficina para Norteamérica, Centroamérica y
Caribe (NACC)
Av. Presidente Masaryk No. 29
Piso 3, Col. Chapultepec Morales
11570 México DF, México

Tel: +52 55 5250 3211
E-mail: mutsunomiya@icao.int