International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Eighteenth Meeting of the CAR/SAM Regional Planning and Implementation Group CAR/SAM (GREPECAS/18)
(Punta Cana, Dominican Republic, 9 to 14 April 2018)

Agenda Item 3: Air navigation activities at global, inter-regional and intra-regional level

3.2 Follow-up on the implementation of global, inter-regional and intra-regional activities

CAR/SAM INTER-REGIONAL ACTIVITIES

(Presented by the Secretariat)

SUMMARY

This working paper presents information on the inter-regional air navigation activities carried out between the CAR and SAM Regions since the PPRC/4 meeting, as well as on the activities foreseen for the near future.

REFERENCES

- Final report of the First MEVA III REDDIG II coordination meeting. (Oranjestad, Aruba, 25-26 April 2015).
- Report of the Fourth meeting of the Programmes and Projects Review Committee (PPRC/4) (Lima, Peru, 12-14 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, 15-17 August 2016)
- ICAO/IATA/CANSO Performance-based navigation (PBN) harmonisation, modernisation and implementation meeting for the Caribbean (CAR) Region, held in San Jose, Costa Rica, on 7-9 December 2016.
- NAM/CAR/SAM automatic dependent surveillance – Broadcast (ADS-B) implementation meeting/workshop (Lima, Peru, 13-16 November 2017)

ICAO strategic objectives:	*A – Safety* *E- Environmental protection*

1. Introduction

1.1 Global airspace interoperability and harmonisation is a global need and the main objective of the global air navigation plan. Therefore, inter-regional coordination is of great importance when planning the implementation of services, procedures and equipment.

1.2 The CAR and SAM Regions have developed and approved their own regional air navigation implementation plans, aligned with the ICAO ASBU methodology, and have defined regional implementation priorities, which are also reflected in the national priorities.

1.3 Follow-up to the implementation of CAR and SAM inter-regional air navigation services, equipment, and procedures is being performed through regional mechanisms such as meetings, seminars, workshops and teleconferences.

1.4 The PPRC/4 meeting took note of the CAR/SAM inter-regional activities related to the ATM and CNS areas carried out since the PPRC/3 meeting, as summarised below:

CNS

- Coordination between the focal points of Brazil and the United States for the implementation of the AMHS interconnection between the Brasilia MTA and the Atlanta MTA through the MEVA III-REDDIG II interconnection.
- Successful AIDC tests between the Panama ACC and CENAMER.
- Follow-up to the implementation of the requirements of the new circuits of the MEVA III and REDDIG II networks.
- Seminar/workshop on the implementation of advanced surveillance and automation systems, carried out in Lima, Peru, on 22-25 September 2015.
- NAM/CAR/SAM ATS data link implementation workshop, carried out in Philipsburg, Saint Maarten, on 18-21 April 2016.

ATM

- Assessment and analysis of large height deviations (LHDs) at the Fifteenth meeting of the GREPECAS Scrutiny Working Group (GTE/15) (Lima, 16-20 November 2015).
- Harmonisation of PBN routes: the meeting took note of the ICAO meeting held in collaboration with IATA and CANSO on the harmonisation, modernisation, and implementation of performance-based navigation (PBN) in the CAR Region, held at Embraer facilities in Fort Lauderdale, United States, on 28 March to 1 April 2016.

2. Discussion

CNS inter-regional aspects

Implementation of services in the MEVA-REDDIG interconnection

2.1 An ATS direct speech circuit (hot line) between the Maiquetía ACC and the San Juan ACC became operational in late August 2016. Similarly, AMHS operational tests were conducted between the Bogota MTA and the Panama MTA in August 2017. The MEVA III service provider configured the Panama and Bogota nodes for the test period at no cost. The commissioning is scheduled for the end of the first quarter of 2018, when the contractual aspects between Colombia and Panama and the MEVA III provider are to be completed.

2.2 Brazil and Peru started coordinating with the FAA for the migration of the Lima-Atlanta and Brasilia-Atlanta AFTN circuits to AMHS through the MEVA III/REDDIG II interconnection. This activity is to be completed by the second half of 2018.

CAR/SAM workshops/seminars

2.3 In order to provide technical and operational information to the States, air navigation service providers (ANSPs) and users, for effective implementation of air navigation infrastructure in support of PBN and GNSS precision approach operations, a *Seminar/workshop for the implementation of navigation infrastructure to support PBN and GNSS precision approach operations in the*

NAM/CAR/SAM Regions was carried out. The seminar was attended by 48 participants from 18 CAR/SAM States, one international organisation, and 11 industry representatives. There were 28 presentations delivered, which are posted on the following website: http://www2010.icao.int/SAM/Pages/MeetingsDocumentation.aspx?m=2016-PBNGNSS. **Appendix A** to this working paper contains the final recommendations of the event.

2.4 With a view to assisting States with the implementation of ADS-B in accordance with the goal established in the regional performance objectives (RPO) on situational awareness (modules B0-ASUR and B0-SURF) as set forth in the NAM/CAR Regional performance-based air navigation implementation plan (RPBANIP) and the Performance-based air navigation implementation plan (PBIP), a NAM/CAR/SAM Automatic dependent surveillance-Broadcast (ADS-B) implementation meeting/workshop was held. The event was attended by 51 representatives of 19 NAM/CAR/SAM States, 1 international organisation, and 6 industry representatives. The workshop was divided into 5 work sessions with 33 presentations. All the presentations are posted on the following website: https://www.icao.int/SAM/Pages/ES/MeetingsDocumentation_ES.aspx?m=2017-ADSB. **Appendix B** to tis working paper contains the recommendations formulated by the meeting.

ATM CAR/SAM inter-regional aspects

2.5 ICAO, in collaboration with IATA and CANSO, organised a second performance-based navigation (PBN) harmonisation, modernisation and implementation meeting for the CAR Region in San José, Costa Rica, on 7-9 December 2016.

2.6 The purpose of this meeting was to continue the harmonisation of an efficient PBN route structure and start the implementation process. Based on the proposals of air navigation service providers attending the meeting, the ICAO CAR and SAM Regional Offices have coordinated the proposal for amendment (PfA) of Doc 8733 - CAR/SAM Air Navigation Plan, Serial N° NACC 17/01, for the implementation of a first set of optimised RNAV 5 routes and the removal of obsolete and inefficient conventional routes. The effective date of these ATS routes was set for the AIRAC dates of August and October 2017.

2.7 Another important development of this meeting was the coordination between adjacent FIRs of the two Regions for the reduction of the longitudinal distance applied between the same, agreeing reductions from 80 to 40 nautical miles for aircraft equipped with GNSS and, in some cases, to 20 nautical miles. These agreements avoid the use of different longitudinal separations between aircraft crossing from one FIR to another, which would affect efficiency and increase ATC workload.

2.8 A third NAM/CAR/SAM performance-based navigation (PBN) harmonisation, modernisation and implementation meeting has been convened to take place in Mexico City on 2-6 July 2018. The agenda of this meeting includes the continuation of inter-regional route optimisation activities for the formulation of a second PfA of Doc 8733, the standardisation of longitudinal separation minima, the review of letters of operational agreement between States of adjacent Regions, as well as the discussion of ATFM implementation aspects.

AGA inter-regional aspects

2.9 In the aerodromes (AGA) area, pursuant to Conclusion PPRC/4-5 *Assessment of CAR/SAM projects F1 and F2*, a meeting was held on 24-25 January 2017 at the NACC Regional Office, with the participation of Programme F coordinators of the CAR and SAM Regions, the FAA and ACI-LAC to re-assess AGA programmes and projects (more information can be found in working paper 12). A

CAR/SAM workshop on “Aerodrome certification for regulators and operators” was held on the fourth quarter of 2017, with the support of the civil aviation authority of Panama.

MET inter-regional aspects

2.10 Regarding CAR/SAM activities in the MET area, the volcanic ash SIGMET trial was conducted in December 2016. Furthermore, the meeting on GREPECAS MET programme projects was held in September 2017.

Coordination mechanism for the implementation of CAR/SAM inter-regional air navigation activities

2.11 In recent years, CAR/SAM inter-regional aspects have been reported at the annual coordination meetings of the programmes and projects review committee (PPRC) and at GREPECAS meetings. Activities reported are mainly the result of teleconferences and events such as work meetings, seminars or workshops.

2.12 In this regard, the CAR and SAM implementation forums have identified the need to hold inter-regional face-to-face meetings to harmonise and proceed with the implementation of PBN, ATFM, the reduction of longitudinal separation, voice and data services, and, primarily, to update and sign ATS letters of operational agreements and memoranda of understanding between CNS facilities. At this Meeting, the participants, in addition to having knowledge and experience in this area, should be in a position to approve and sign agreements for effective implementation of operational improvements. This initiative does not foresee the establishment of new periodic meetings or a parallel programme. Inter-regional meetings will only be held as needed, through joint participation at meetings held in one of the two Regions, where State representatives from the other Region would be invited. Follow-up to implementation will continue through teleconferences and regional forums already established for that purpose.

3. Suggested action

3.1 The Meeting is invited to:

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

b) review CAR and SAM inter-regional activities shown in section 2 of this working paper; and

c) discuss any other related matter it may deem appropriate.

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APPENDIX A

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

Based on the presentations and discussions at the Seminar/workshop for the implementation of navigation infrastructure to support PBN and GNSS precision approach operations in the NAM/CAR/SAM Regions, the following conclusions and recommendations were formulated:

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 workshops 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 ionosphere effect.

k) Brazil was leading a low-latitude GBAS safety case, and it was recognised that the lessons learned 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 ionospheric 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 recognised 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 ionosphere 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 minimise 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° 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 of 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 rigour, 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 recognised 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.

c) Instead of 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 noted 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.

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APPENDIX B

FINAL RECOMMENDATIONS AND CONCLUSIONS OF THE NAM/CAR/SAM AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) IMPLEMENTATION MEETING/WORKSHOP

Based on the information presented at the meeting/workshop, the participants formulated the following recommendations:

ADS-B benefits: All the participants identified and agreed on the benefits derived from ADS-B implementation in terms of surveillance coverage and operation, and cost reduction, compared with the implementation of conventional and Mode-S radar systems. However, most CAR/SAM States have considered maintaining the conventional surveillance solutions currently in use as primary means of communication for the short and medium term.

Current use of ADS-B: Most CAR/SAM States that have implemented ADS-B or have plans to implement ADS-B in the short term are planning to use it as back-up to radar surveillance or as an alternative for areas currently lacking radar coverage.

Need for data on aircraft equipage: The participants felt the need to have data on aircraft equipage in terms of the avionics required for ADS-B, in accordance with the different interrogation protocols. Accordingly, the recommendation was to consult the possibility of obtaining fleet statistics from the FAA, NAV Canada, IATA, and Aireon. In this sense, ICAO will discuss with the FAA, Nav Canada, and Aireon the possibility of sharing this information with the States so as to have it available by the end of the first quarter of 2018.

List of activities required for ADS-B implementation: Taking into account the importance of consulting stakeholders and having comprehensive and strategic plans for ADS-B implementation, the meeting recommended that ICAO, through its NAM/CAR/SAM working groups, develop a checklist of stakeholders and a detailed outline of ADS-B implementation activities required to assist States in joint and consistent implementation planning. Each ICAO Office, both NAM/CAR and SAM, will fulfil the activity within their corresponding working groups. Upon completion, it will be integrated into a single regional version that will be available to all NAM/CAR/SAM States. This would be prepared during the first semester of 2018.

ADS-B implementation: The meeting identified the need for a long-term ADS-B vision that would allow States to update their short-, medium-, and long-term regional and national plans, taking into account the following factors:

a. The meeting noted the importance of planning specific safety, efficiency and capacity improvements based on the requirements of airspace users and air navigation service providers (ANSPs). Requirement-based planning ensures the selection of the appropriate technologies and that all stakeholders, including the regulator, understand and agree on the required performance for communication and ATS systems and on-board avionics.

b. It was recommended that CAR/SAM States follow the Global Air Navigation Plan (GANP), its technological roadmaps, the ICAO ASBU methodology, and the NAM/CAR and SAM regional performance-based plans, taking them into account when preparing their national air navigation plans.

c. When implementing ADS-B, the States should consult and ensure the participation of all stakeholders as a priority to obtain the benefits of implementation.

d. When implementing management project, States should include in their feasibility and risk analyses the aeronautical infrastructure and operations with each of the adjacent FIRs, in order to ensure standard, harmonised and efficient coordination.

e. In their strategic planning, States should define surveillance data requirements (speed, precision, Pd, routes/levels, etc.) in order to define minimum technical/operational requirements to be met, and subsequently define the surveillance technology best suited to meet their needs (radar, ground-based ADS-B, space-based ADS-B, multilateration). This information would support the decision whether or not to eliminate radars and determine future investments in technology.

f. It is recommended that, when conducting the risk analysis for selecting a new technology, States include the risk analysis of both its implementation and lack of implementation to ensure that projects to be executed include all risk factors when selecting new surveillance technologies.

g. It is recommended that, based on the ATM operational concept of achieving seamless paths, and in order to meet the regional goals of ASBU Block 0, and taking into account the mandatory use of ADS-B in North America as of 1 January 2020, States make the necessary efforts to plan for the implementation of ADS-B and define whether mandatory actions should be established.

h. In order to obtain the benefits of ADS-B technology, all aircraft in designated airspace should be equipped with the ADS-B OUT system. To this end, States should analyse whether a mandate would be required to ensure fleet uniformity.

i. States should make sure that the investments to be made in subsequent years contemplate current and future requirements, minimising the risk of having to make unexpected investments in the short term.

j. The meeting/workshop deemed it advisable for CAR/SAM States to study the possibility of co-locating ADS-B station(s) with existing radar surveillance systems that are reaching the end of their lifecycle, so that they may be used as back-up to the latter. Likewise, to analyse the status of implementation of ADS-B in the aircraft fleet. At the end of the radar lifecycle, and based on the experience gained with ADS B during this period, a more informed analysis can be made whether to continue with radar or replace it with ADS-B.

For data exchange, the meeting recommended: that each State share information on surveillance systems with adjacent States in order to analyse the coverage and overlap of surveillance data to serve as back-up in air traffic control coordination areas between FIRs. States that have not yet delivered their updated data to ICAO, in accordance with attachment C to the invitation, must do so by January 30 2018.

Improved situational awareness in the Region: Taking into account the importance of having common situational awareness information, which is obtained by sharing surveillance data, CAR/SAM States/Territories were urged to continue making efforts to complete data sharing both at radar and ADS-B system level.

ATS infrastructure: States must conduct an analysis of their ATS infrastructure and determine whether it is capable of ADS-B management, directly integrated into the ATS system, without the need for conversion of surveillance protocols, thus offering optimum surveillance data management to operational personnel.

Commitment by system and equipment providers: The participants noted that the commitment of system providers (Thales, Indra, etc.) was required for the implementation of solutions that ensured compatibility and easy integration of ADS-B systems. In this sense, providers were requested, when implementing new projects in the Region, to assist States in ensuring standardisation, harmonisation and integration of systems.

Assessment of space-based ADS-B: The participants pointed out the need for an integrated and cooperative assessment to determine the correct use of space-based ADS-B. In this regard, the SAM Region will include this activity among the actions to be carried out by the working group that is currently validating the use of the communication infrastructure for this purpose. The NAM/CAR Region will include this task within the activities of NAM/CAR Surveillance Working Group, to be carried out during the first semester of 2018.

Development by the State of regulations for ADS-B implementation: The regulator may need to change the wording of ATS regulations to allow for the use of both ADS-B and radar. The regulator will need to certify aircraft and operators. The technical and maintenance personnel of operators and ANSPs will need to learn new systems and procedures. Coordination and operational arrangements with neighbouring ANSPs may need to be updated. Taking into account the experiences shared at the meeting, the participants concluded that States should start developing legislation/regulations on the use of ADS-B in each State.

Regional meeting: The participants agreed on the need to hold a NAM/CAR/SAM regional meeting on the second half of 2018 in order to follow up on ADS-B implementation. The meeting would analyse, *inter alia*, aspects related to operational and airworthiness requirements for ADS-B implementation and the lessons learned by States that have already implemented ADS-B in the NAM/CAR/SAM Regions.