Agenda Item 4: Assessment of operational requirements to determine the implementation of improvements in communications, navigation and surveillance (CNS) capabilities for operations in route and terminal area

Follow-Up to activities of Regional Project RLA/03/902 Augmentation Solution for the Caribbean, Central and South America (SACCSA)

(Presented by the Secretariat)

SUMMARY

This working paper presents information on the results of the activities of project RLA/03/902 Augmentation Solution for the Caribbean, Central and South America (SACCSA) which activities were completed in February 2015 in the Tenth Coordination Meeting (closing meeting).

REFERENCES:

- Final report of the Tenth Coordination Meeting of project RLA/03/902 Augmentation Solution for the Caribbean, Central and South America (SACCSA) Bogota, Colombia, 9 to 13 February 2015.
- Final report of the Eighth Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/8) Santo Domingo, Dominican Republic, 9 to 17 November 1998.

ICAO strategic objectives:	*A – Safety* *B – Air navigation capacity and efficiency*

1 Introduction

1.1 Trials in the CAR/SAM regions to verify the possibility of implementing a SBAS began in 1998 with the approval of GREPECAS Meeting of Conclusion 8/36 *Trials of SBAS systems in CAR/SAM regions* resulting from the offer of the European Tripartite Group (ETG) and the Federal Aviation Administration (FAA) of the United States to carry out trials of the EGNOS and WAAS systems.

1.2 To perform trials type SBAS the PNUD/ICAO technical cooperation Project RLA/00/009 was established in year 2000, called CAR/SAM trial platform by Satellite (CSTB) CAR/SAM Test Bed, to carry out trials SBAS type WAAS.

1.3 With the support of the ICAO Regional Project for Latin America (RLA/00/009), the tests and trials SBAS type WAAS were carried out from 2002 to 2006. As a result of them and in view of the severe ionospheric conditions in the geomagnetic Equator region (and +/- 20° around the Equator) the project recommended that the CAR/SAM Regions only consider the possible implementation of SBAS

for the Lateral Navigation (LNAV) or for Non Precision Approximations (NPA). The final report of the project is published in the following ICAO SAM Office website: http://www.icao.int/SAM/Pages/eDocumentsDisplay.aspx?area=CNS.

1.4 Through this project, in addition to the implementation of a platform of SBAS WAAS type tests and the collection of data during a period of four years which served as the basis for the conclusion stated in the previous paragraph, courses and seminars were conducted which were very useful in the Region in the understanding of the SBAS system and the ionosphere problem.

1.5 In the year 2003 was implemented in the CAR/SAM regions another ICAO technical cooperation project the RLA/03/902 (Augmentation Solution for the Caribbean, Central and South America (SACCSA)). The objective of this project was to make a study of technical feasibility, cost-benefit and financial of a SBAS system for the CAR/SAM regions.

2. Analysis

2.1 The project RLA/03/902 concluded its activities after almost eleven years of operability. The closing was carried out during the Tenth Coordination Committee Meeting of project RLA/03/902, *Augmentation Solution for the Caribbean, Central and South America (SACCSA)* (RCC/10) held at the premises of the Unidad Administrativa Especial de Aeronautica Civil in Bogota, Colombia, from 9 to 13 February 2015.

2.2 Over the years, the project has been emphasized in important activities, being the more important the following:

- Ionospheric studies for CAR/SAM Regions.
- Ionospheric algorithms were defined to the implementation of SACCSA.
- A complete design of the SBAS solution for SACCSA, applicable to the CAR/SAM region.
- SBAS approaches in Havana, Tegucigalpa, Bogota, Cartagena de Indias and San Andres were performed during EDISA tests.
- A real-time platform for GMV is available, where SACCSA services are been analyzed using the GMV magicSBAS and MagicGemini tools (http://magicgnss.gmv.com/sam/).
- A real SBAS signal was broadcast with SACCSA algorithms in the CAR/SAM regions, using the GMV magicSBAS platform and the Inmarsat Geostationary satellite.

2.3 During the project closing meeting (RCC/10) member States proceeded to the evaluation of the Project and concluded that through the project the viability of a SBAS for CAR/SAM Region has been proved, that more States from CAR/SAM Regions should have participated in the project and that in order to complete all project remaining work packages, it should be given continuity to the implementation of the test-bed, financial viability and cost benefit analysis. An executive summary of the project closure, the activities carried out by the project and final considerations is presented as **Appendix** to this working paper. More information about the project is available at the following WEB site www.rlasaccsa.com.

3. Suggested actions

3.1 The Meeting is invited to:

a) Take note of the information provided; and

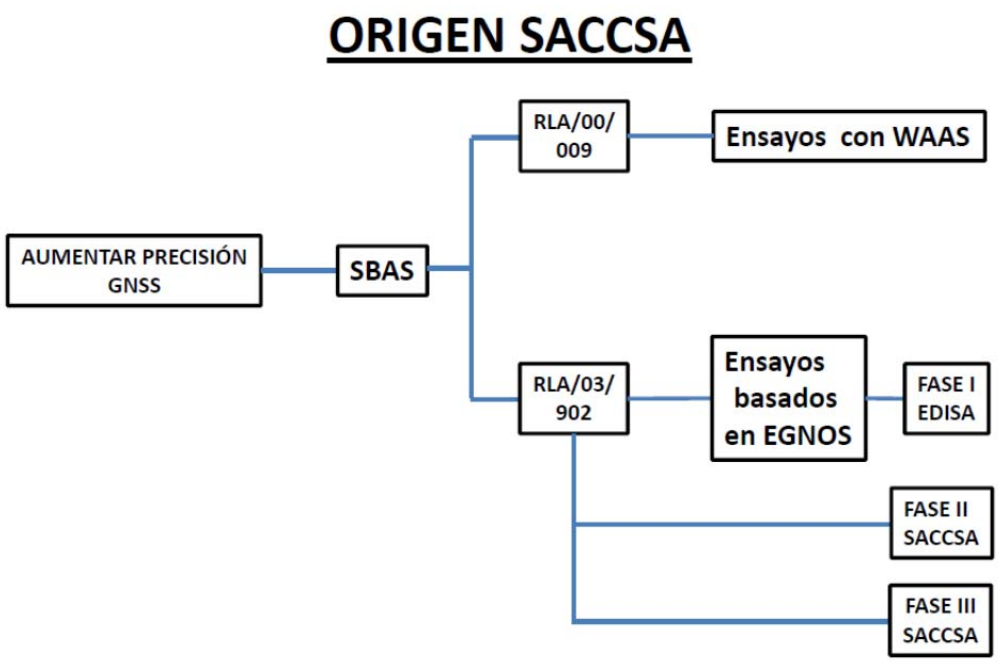
b) Analyse the results of the trails and studies obtained from the technical cooperation regional projects on SBAS, regarding the analysis of the infrastructure of the navigation systems in support of the PBN.

-END-

APPENDIX A

EXECUTIVE SUMMARY ON THE CLOSURE OF TECHNICAL COOPERATION PROJECT RLA/03/902 - SACCSA (AUGMENTATION SOLUTION FOR THE CARIBBEAN, CENTRAL AND SOUTH AMERICA)

1. Background



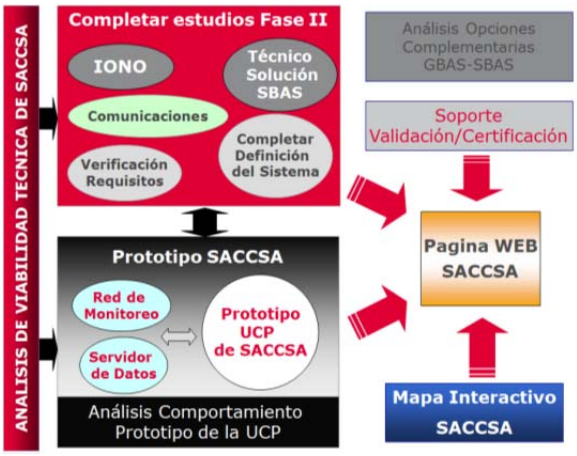
Based on trials conducted in the CAR/SAM Regions with WAAS (Wide Area Aumentation System) and EGNOS (European Geostationary Navigation Overlay Service) augmentation systems, it was determined that the extension of these systems was not feasible due to the particular ionospheric behaviour experienced in these regions. Accordingly, it was suggested that an SBAS system called "Augmentation solution for the Caribbean, Central and South America" – SACCSA be developed, with algorithms adapted to the needs of the CAR/SAM Regions.

Through the ICAO Technical Cooperation Bureau, project RLA/03/902 was launched with the participation of some CAR/SAM member States and AENA (Aeropuertos Españoles y Navegación Aérea) (currently ENAIRE) as contributor and Technical Coordinator of the project. This project has been developed in three phases, through which its technical feasibility has been demonstrated.

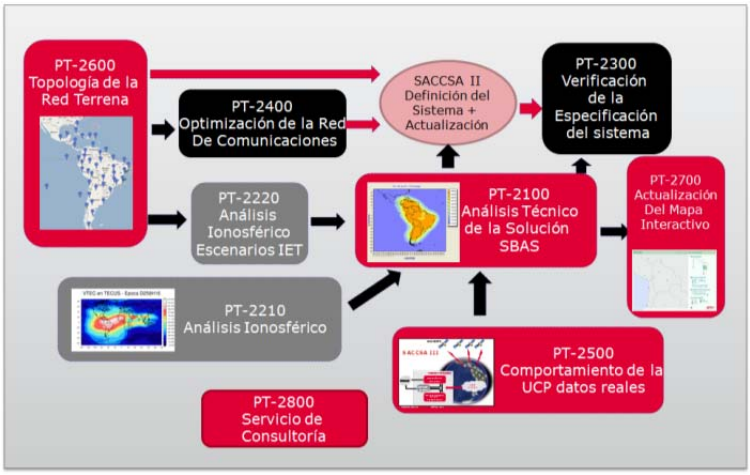
2. Purpose of the Project

The purpose of Project RLA/03/902 is to provide the technical, financial, operational and institutional studies related to the implementation of a satellite-based augmentation system (SBAS) for the CAR/SAM Regions.

To this end, several activities were proposed, as shown in the figure below:



These activities were carried out as work packages, as illustrated in the following figure:



3. SACCSA Participants

ICAO
ENAIRE (formerly AENA)
U.A.E. de Aeronáutica Civil Colombia
COCESNA
Autoridad Aeronáutica Civil de Panamá
Trinidad and Tobago Civil Aviation Authority
Instituto Nacional de Aeronáutica Civil de Venezuela

It should be noted that Cuba, Bolivia, Argentina, Guatemala and Costa Rica participated during phases I and II.

4. Project Development

a) PHASE I: EDISA

Project RLA/03/902 was initiated as a result of the launching of the EDISA Programme by the European Union, whose objective was to show the feasibility of implementing an SBAS system in the CAR/SAM Regions. To that end, three reference stations were installed in Havana, Tegucigalpa and Bogota, and an SBAS navigation message was generated based on the EGNOS test signal. At the same time, a series of flights were planned for receiving and analysing said signal, which were conducted at Havana, Tegucigalpa, Bogota, Cartagena de Indias and San Andrés. The trials demonstrated that it was possible to have an SBAS system in the CAR/SAM Regions, but that it had to be independent and autonomous from other SBAS systems (EGNOS or WAAS), since the need for ionospheric models and specific algorithms made it unfeasible to extend the coverage of existing systems. Subsequently, the FAA endorsed this decision with respect to WAAS.

b) PHASE II

Based on these conclusions, the so-called PHASE II was launched, where the system to be defined received the name of SACCSA (Augmentation Solution for the Caribbean, Central and South America). Its purpose was to perform the necessary studies and developments to confirm the feasibility of implementing an SBAS system in the CAR/SAM Regions, and develop the necessary algorithms to resolve problems in the ionosphere and conduct in-depth studies thereof. Furthermore, the different elements of the system were defined and work was done on financial, cost-benefit and operational issues, based on the following work packages:

PT 1000: Information on users and service providers.
PT 2000: Analysis of SACCSA services.
PT 3000: Study of an SBAS for the CAR/SAM Regions.
PT 4000: Ionospheric analyses.
PT 5000: SACCSA specifications.
PT 7000: Management/Operation.
PT 8000: Human resources and training.
PT 9000: Economic and financial feasibility.
PT 10000: Planning of project phases.

c) PHASE III

Based on the promising results of PHASE II, it was decided to launch PHASE III, in which the necessary adjustments and simulations would be carried out to define the system for its subsequent development and deployment, minimising risks and, thus, reducing development and implementation costs. Given the complexity of the tasks, a competitive international bidding process was established for this phase, in which the contract was awarded to a consortium led by GMV. This phase consisted of the following work packages:

PT 1000: Monitoring network and control thereof.
PT 2000: Completion of PHASE II studies.
PT 3000: SACCSA UCP prototype.
PT 4000: Definition of activities in support of system validation and certification.
PT 5000: Analysis of other supplementary options.

PT 6000: Website.

5. Project Management

The different phases have been financed through direct contributions by the States and in-kind contributions by States and enterprises.

Phase I was mainly funded by the European Union and the European Space Agency for a total of 178,052 USD, of which 35,000 USD were provided by Cuba, 35,000 USD by COCESNA, 35,000 USD by Colombia and 27,237 USD by AENA. This phase meant a total investment of 178,052 USD, to which we should add the in-kind contribution equivalent to 26,220 USD by AENA. The total for this phase was 207,272 USD.

PHASE II was financed by the participating States, at a rate of 25,000 USD by each State, and an extraordinary contribution by AENA for 464,760 USD. This Phase meant an investment of 589,760 USD. In this phase, AENA made an in-kind contribution for 306,498 USD, raising the total to 896,258 USD.

In Phase III, a contribution of 75,000 USD was set for each participating State, in addition to an additional fee of US$ 27,500, agreed at the eighth coordination meeting of the project (RCC8). AENA made an extraordinary contribution of 841,216 USD. In-kind contributions to date reach 163,444 USD from AENA and 310,000 USD from GMV. Accordingly, contributions for this phase total 1,687,955 USD so far.
The following table summarises monetary and in-kind contributions and executed funds:

FASE	I-EDISA	FASE II	FASE III	TOTAL
Aportación cada Estado participantes	$ 35,000.00	$ 25,000.00	$ 102,500.00	**$ 162,500.00**
Aportación AENA	$ 27,237.00	$ 464,760.00	$ 841,216.00	$ 1,333,213.00
Total dinerario aportado al proyecto hasta la fecha				$ 2,265,974.00
Aportación en especie AENA	$ 26,220.00	$ 306,498.00	$ 163,444.00	$ 496,162.00
Aportación en especie GMV			$ 310,000.00	$ 310,000.00
Total aportado en especie				**$ 806,162.00**
Total dineraria ejecutado hasta la fecha				**$ 2,116,336.00**
Total dineraria + especie ejecutado hasta la fecha				**$ 2,922,498.00**

6. Study of an SBAS solution for the CAR/SAM Regions

a) Description and results of work packages

In general, work packages were hired to establish the technical feasibility and operational benefits of an SBAS systems for the CAR/SAM Regions, including an analysis of SACCSA services, a study of an SBAS system for the CAR/SAM Regions, system design and architecture, ionospheric analyses, SACCSA specifications, management/operation, monitoring network and control thereof, SACCSA UCP prototype, definition of activities in support of system validation and certification, analysis of areas with poor service.

The services provided by the system prototype in the CAR/SAM Regions showed that APV-I procedures could be achieved, even after analysing scenarios degraded by solar disturbances. This was demonstrated by GMV from October 2012 in San Carlos de Bariloche, Argentina, to 12 February 2015, during the Workshop held at the premises of the *Centro de Estudios Aeronáuticos de la Aeronáutica Civil* in Bogota, Colombia.

The States that have participated in the three phases have contributed a total of US$ 162,500, totalling $2,922,498.00 in both money and in kind. This represents a ratio of 1:18 between payments made by the State to the project and total money and in-kind contributions executed to date by the project.

b) Project assessment and comments by Project members

- At the project closing meeting, Colombia, Spain, Panama, Trinidad and Tobago, and COCESNA made an assessment of the project, completing a survey on management indicators and project results (see attachment).
- Based on the assessment of the Project, the States felt that Project objectives had been met in all cases, highlighting the following:

    - The main achievement of the project was the confirmation that an SBAS system for the CAR/SAM Regions was feasible.
    - It was felt that more CAR/SAM States should have participated in order to complete all work packages.
    - The proposal was made to continue conducting the test-bed, the financial feasibility study and the cost-benefit analysis.
    - The results should be protected under intellectual property of the States and should not be used for commercial purposes and/or other developments by the contractor.
    - The significant contributions (both monetary and in-kind) made by AENA and Project members States were highlighted and acknowledged.

- It was also noted that the participants (financial institutions) should be aware of the terms of reference, contracts and all relevant information on the hiring of firms for the execution of this type of projects.
  Finally, mention was made of the need to disseminate the results of the project and to invite other countries of the Region to participate so as to strengthen the SBAS.

c) Final considerations

- Definitive closure of Project RLA/03/902 GNSS/SBAS – SACCSA
- Technological (hardware and software) evolution not related to ionospheric correction in the existing SBAS/WAAS and EGNOS systems, leading to the implementation of an operational SBAS in the Region or in the States that may deem it advisable.
- Based on this study, each State or group of States could consider the implementation of an SBAS system for the Region, after completing certain tasks required for validating and confirming its feasibility, namely:

    - ✓ Test bed
    - ✓ Cost-benefit analysis
    - ✓ Financial feasibility study

- Take into account the recommendation of the multiconstellation (GPS+GLONASS) and multifrequency (dual frequency) to minimise the impact of solar activity on the ionosphere and on SBAS signals, through the implementation of the aforementioned project, as proposed by GMV.

- Consider the possibility that ICAO through its technical cooperation projects undertake future action and activities for the implementation of an SBAS for the Region or for the States that deem it advisable.
