INTERNATIONAL CIVIL AVIATION ORGANIZATION
Seventh Meeting of the Civil Aviation Authorities of the SAM Region
(RAAC/7)

(Salvador, Bahia, Brazil, 01 - 03 July 2002)

Agenda Item 4d: Transition to the CNS/ATM System – CSTB (CAR/SAM Test Bed)

DEVELOPMENT OF A GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) REGIONAL AUGMENTATION TEST BED CAPABILITY

(Presented by the United States of America)

INFORMATION PAPER

SUMMARY

This information paper provides a general overview of ICAO Regional Work Project RLA/00/009 for Latin America whereby the United States Federal Aviation Administration (FAA), International Civil Aviation Organization (ICAO) and the member States of the ICAO Regional Planning and Implementation Group for the Caribbean and South American (CAR/SAM) Region (GREPECAS) are cooperating to implement a Global Navigation Satellite System (GNSS) Augmentation Test Bed (CSTB) to support a regional transition to a satellite-based air navigation infrastructure.

1. Introduction

1.1 The transition from the current, aging, ground-based navigation infrastructure to the future satellite-based technologies has been adopted as a high priority by the International Civil Aviation Organization (ICAO).

1.2 The Caribbean and South American (CAR/SAM) Region has, through its Global Navigation Satellite System (GNSS) Task Force, taken the initial steps in this transition by adopting Regional Project RLA/00/009. This project establishes a GNSS Augmentation Test Bed, called the CSTB, throughout the region to support and facilitate research, development, acquisition, and implementation efforts associated with a operational transition to satellite navigation.

2. Project Objectives

2.1 Before States can transition to the operational use of satellite navigation technologies, many questions need to be answered. Some questions needing attention are:

- Can GNSS (and its augmentations) meet existing aviation requirements?
- What mix of GNSS technologies are needed to economically satisfy all requirements?
- How many TRSs will be needed to meet operational needs and where do these TRSs need to be situated for optimal service availability?

- How to achieve GNSS benefits by modifying existing route structures and procedures?
- What are the ionosphere conditions and other sources of system error in the region, and how to solve for these using GNSS?

2.2 These are just a few of the many questions and issues that need to be addressed in a test bed environment prior to making a large monetary investment in new technologies. The CSTB provides the platform for each State, and the region as a whole, to analyze what an operational GNSS architecture should look like to meet existing aviation requirements.

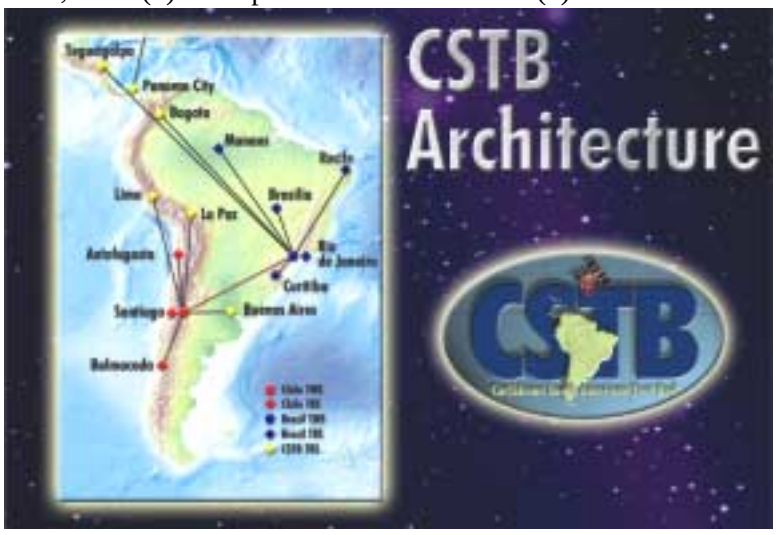
2.3 In addition to the regional analyses, each State is also encouraged to use the CSTB to take a more in-depth look into its specific requirements and how State solutions fit into the overall CAR/SAM regional solution.

2.4 Through the course of this project, a cadre of expertise will be developed within the region that empowers all States to confidently design, plan for, implement and operate satellite navigation technologies in their airspace.

3. **Project Overview**

3.1 The CSTB consists of an initial wide area test bed capability based on Wide Area Augmentation System (WAAS) prototype technology. A network of CSTB Reference Stations (TRSs) are being installed throughout the region to monitor Global Positioning System (GPS) satellite signals and determine the health and accuracy of the GPS data.

3.2 The U.S. Federal Aviation Administration (FAA) has contributed five (5) TRSs to the project, and they are located in the following States: Argentina, Bolivia, Peru, Colombia, and Honduras (COCESNA). In addition to these stations, three (3) FAA-provided TRSs and one (1) CSTB Master Station (TMS) are already installed in Chile.



3.3 Brazil has also made a strong commitment to the project and is providing five (5) TRSs and (1) TMS as its contribution to the establishment of the CSTB architecture. Brazil has also equipped a Hawker 800 aircraft to perform regional flight tests, and is investigating the acquisitions of a GEO uplink and broadcast capability to support the transmission of the CSTB correction signal throughout the CAR/SAM region.

3.4 A communications link between the Chile and Brazil TMSs is being coordinated to allow for data sharing throughout the region. A communications link is already operational between the Chile

and U.S. TMSs to provide the CSTB with access to more than eighteen (18) U.S. TRSs, one (1) Panama City, Panama TRS, three (3) Mexico TRSs, and three (3) Canadian TRSs.

3.5 The last component of this project is the addition of a Local Area Augmentation System (LAAS) Test Prototype, or LTP. Brazil is currently investigating the potential installation of an LTP in Rio de Janeiro. This LTP will allow the project to conduct regional integration testing for wide area and local area systems, as well as tests and data collection to support operational LAAS facility siting and installation, advanced procedure development (curved approaches), and research on extreme terrain and multi-path interference generated by having airports located in close proximity to mountains and bodies of water.

4. Project Status

4.1 The CSTB Project Plan document was approved in June 2001 and implementation has begun in earnest.

4.2 A TRS Installation and Operation Training Course was conducted in Buenos Aires, Argentina from December 5-7, 2001, where all attendees were given detailed instruction on installation procedures for a TRS, including equipment set-up and operation and GPS receiver antenna site survey, installation, and verification. At the conclusion of the training, the Argentina TRS installation was complete and operational. The communication line between Argentina and the Chile TMS was completed on February 5, 2002, thus initializing access to real-time Argentina TRS data.

4.3 In January 2002, Peru completed the installation its TRS and initialized a communication link to the Chile TMS. The Bolivia TRS was also installed in May 2002 and is awaiting initialization of the communications line to Chile (expected in June 2002). The Honduras (COCESNA) and Colombia TRS installations are in progress and investigations continue on securing final communications lines to the Brazil or U.S. TMSs.

4.4 The FAA and Brazil completed technical ionosphere flight tests from January 14-24, 2002 in the Rio de Janeiro area. The data collected, both from the Brazil TRSs and the FAA B727 aircraft, will be used to determine conclusions about the geographic ionosphere challenges that the CAR/SAM region has to address when planning for and implementing an operational GNSS. The flight test report is currently being finalized and should be available in mid 2002.

4.5 From February 18-22, 2002, the CSTB project hosted a training course at the FAA Technical Center to instruct States on the operation of the CSTB, how to collect and analyze data, and how to conduct flight testing in support of operational transition initiatives. This training provided the necessary instruction to complete the CSTB infrastructure set-up and initialization, and prepared all State representatives for the execution of regional data collection flight tests that would be performed in mid 2002.

5. Initial CSTB Flight Tests and Data Collection

5.1 The primary objective of the CSTB project, as agreed to and finalized in the August 1-3, 2001 GNSS Task Force Meeting, is to develop a wide area GNSS augmentation test bed to conduct research and development activities in support of an operational implementation of an SBAS in the region for enroute through non-precision approach (NPA) operations. It was agreed that the

individual States would then provide any precision approach (PA) operations at their airports requiring this level of service.

5.2 To support the development of an operational SBAS NPA service with high availability (0.99+), the CSTB project has to address the threat from the ionosphere and associated threats of scintillation and bubbles. This requires the collection and analysis of both "static or ground" and "airborne" data.

5.3 To support this project objective and collect the required airborne GPS data, the CSTB project executed airborne data collection flight tests from May 12-26, 2002. For this test, a Chilean Citation II aircraft recorded airborne GPS data (non-precision approach phase) in Chile, Argentina, Bolivia, and Peru. The aircraft also recorded enroute GPS and ionosphere data while flying between countries. Ground TRS data was also recorded at the TRSs in the same geographic area during this same timeframe.

5.4 Both airborne and ground TRS data logged during the flight timeline are currently being collected for post-processing to be analyzed specifically to determine several technical and operational parameters. Regional flight tests and data collection and analysis exercises will continue throughout 2002 and be summarized and reported at the next GNSS Task Force meeting in the August 2002 timeframe (tentative schedule). From late 2002 through 2003, the CSTB project will focus more on State flight tests and operational scenarios.

6.0 **Recommendation**

5.1 The meeting is requested to note the material presented in this information paper, and continue to support the activities within RLA/00/009 in the months and years to come.

5.2 For continued RLA/00/009 project success, it is important for each State to ensure that the appropriate technical points of contact are present and represented at all CSTB training, coordination, and flight test activities. This cooperation will help guarantee a continuity of regional expertise that will expedite the successful completion of project objectives.