International Civil Aviation Organization
South American Regional Office - Project RLA/03/902
Transition to GNSS/SBAS in the CAR/SAM Regions – SACCSA – Phase III
Ninth Meeting of the Coordination Committee (RCC/9)
Lima, Peru, 1-4 July 2013

Agenda Item 4: Tentative programme of Project activities for the 2013-2014 period

Demonstration of magicSBAS

(Presented by the Secretariat)

SUMMARY	
This working paper presents the results obtained from the real-time demonstration of the GMV *magicSBAS* test bed with SACCSA algorithms.	
ICAO Strategic Objectives	*This working paper is related to Strategic Objectives:* *A. Safety* *C. Environmental protection and sustainable development of air transport*

1. Introduction

1.1 This working paper describes the results obtained with the SACCSA central processing unit (CPU) prototype, in real time and using real data, with input from the public stations located in the CAR/SAM Regions. The results are available in the web page http://magicgnss.gmv.com/sam/.

1.2 A real-time demonstration is scheduled for States attending the RCC/9 meeting to show the results obtained with the GMV magicSBAS test bed with the SACCSA solution.

1.3 As an example, this document shows the results obtained for 18/07/2012 with that test bed.

1.4 The results shown here were obtained through the GMV R+D+i activities related to the evolution of the *magicSBAS* product. It is a test bed, thus its availability cannot be ensured.

1.5 ***magicSBAS*** is a GMV product that builds upon the algorithmic experience in the GNSS field (SBAS in particular) and provides the aforementioned service at a low cost (http://www.gmv.com/*magicSBAS*/*magicSBAS*.html, http://magicgnss.gmv.com/sbas). *magicSBAS* (see the description in Annex 1) combines the existing satellite navigation and communication technology to provide an alternative to the preliminary development of an SBAS system (prototype) that fits the needs of the SACCSA programme and SACCSA III in particular.

2. Results of *magicSBAS*-SACCSA in the CAR/SAM Regions: 18/07/2012, 15:45:19 (GMT time)

2.1 Infrastructure used

2.1.1 The infrastructure used for generating the results shown in this document is as follows:

- **Public real-time stations** from different institutions, organisations, universities and entities of CAR/SAM States. Examples: IGS, RAMSAC, IBGE, UNESP, UPRM, etc.

- One **real-time station in Colombia** was also included thanks to arrangements made by AEROCIVIL and the geological service of Colombia.

- **Communications**: Internet

- **SACCSA CPU prototype** (***magicSBAS*** adapted to the Region). It is the core of the SBAS system and, based on data provided by reference stations (RS), it calculates SBAS messages that contain both GPS corrections to improve user precision, and parameters that provide integrity. These messages comply with the MOPS, SARPs and ICAO Annex 10.

  Visit http://www.gmv.com/en/space/*magicSBAS*/index.html for more information.

- **Support centre prototype**. ***magicgemini*** is a tool executed in real time that analyses services based on the SBAS messages calculated by *magicSBAS* (see description in Annex 2).

  Visit http://www.gmv.com/en/aeronautics/*magicgemini*/ for more information.

- **Web platform**. The web platform displays in real time the services analysed with *magicgemini*. Figures are updated every 30 seconds.

2.1.2 GMV wants to acknowledge the valuable collaboration with reference station data providers, in particular, IBGE (Brazil), RAMSAC (Argentina), UNESP (Brazil) and the Colombian Geological Service (*Servicio Geológico Colombiano* - GEORED).

2.1.3 The following figure shows the stations configured for real-time use by the CPU prototype. The orange colour indicates that data arrive in real time, in a correct and suited manner for use in the platform.

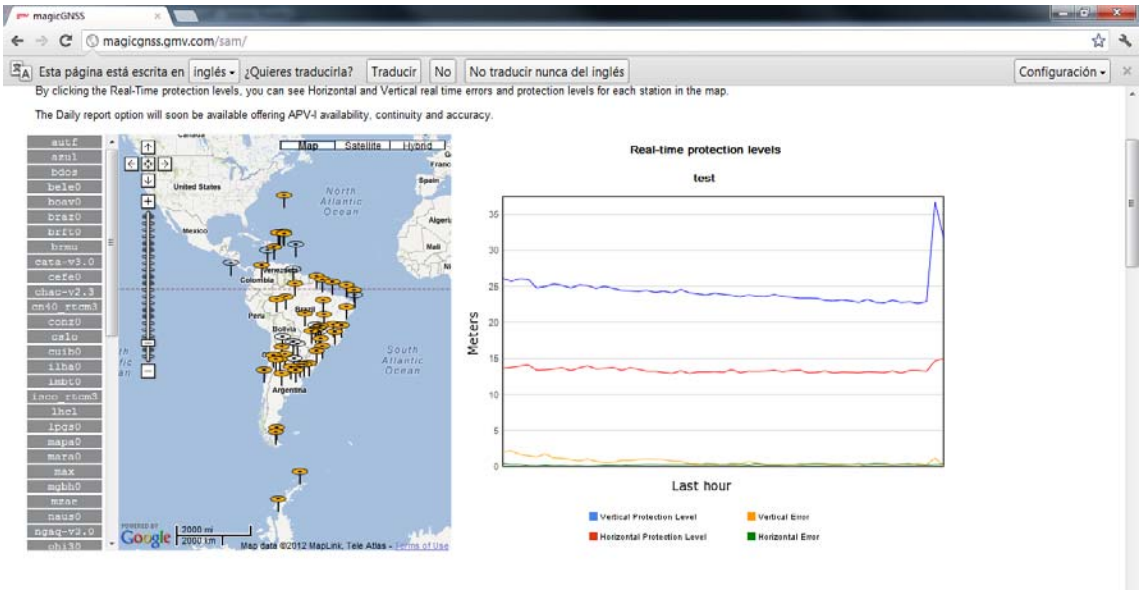

Figure 1. Image taken from the web platform (http://magicgnss.gmv.com/sam/) showing, in real time, the services provided by the SACCSA CPU prototype (adapted *magicSBAS*) in the CAR/SAM Regions as analysed by *magicgemini.* Left: Stations configured for real-time use by the CPU prototype. Right: Horizontal and vertical protection levels (xPLs) and navigation errors for the selected station.

2.2 Services by magicSBAS-SACCSA

2.2.1 Protection levels and navigation errors, by station

2.2.1.1 On the right side of the figure above are the horizontal and vertical protection levels (xPLs) as well as the navigation errors for the selected station. This error is calculated as the difference between the actual position of the reference station (known) and the position estimated using the information contained in the SBAS message (orbit/clock and ionosphere corrections). The so-called "Protection Levels" are calculated using both GPS corrections and integrity parameters (UDRE, GIVE) for such corrections, applying the MOPS and SARPs, and in accordance with ICAO Annex 10.

2.2.1.2 By clicking on each station in orange, the web platform will show, on the right-hand side, the graph corresponding to the selected station, showing the aforementioned parameters. As may be seen, the results show that **the integrity of the reference stations is met**, since the "Protection Level" is always greater than the error, both horizontal and vertical (VPL>VPE, HPL>HPE).

2.2.1.3 The figure mentioned in the previous paragraph reflects the services of the recently installed reference station of the Colombian Geological Service.

2.2.2 Maps of horizontal and vertical protection levels in the CAR/SAM Regions

2.2.2.1 In the central section of the web platform (below the aforementioned graphs) appear the horizontal (left HPL) and vertical (right VPL) protection levels. Both maps are shown in different colours. The following figure shows the results obtained on the cited day, as shown in the web platform.

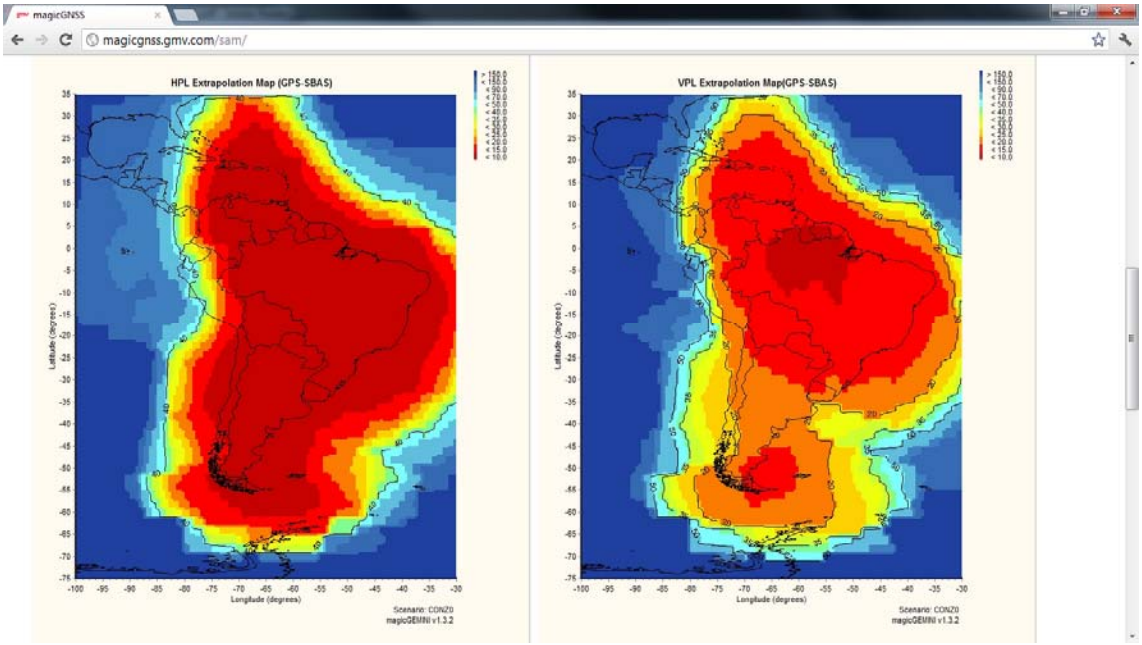

Figure 2. Image taken from the web platform (http://magicgnss.gmv.com/sam/). Horizontal (left, HPL) and vertical (right, VPL) protection levels.

2.2.2.2 It should be noted that results (alarm limits) are different for the various service levels:

- APV-I , HAL=40m, VAL=50m
- LPV-200, HAL=40m, VAL=35m
- APV-II, HAL=40m, VAL=20m
- Cat-I, HAL=40m, VAL=35 a 10m

2.2.2.3 As may be noted, the **results are really good for availability (of APV-I and LPV-200) and coverage** (practically all the SAM Region is covered).

2.2.2.4 These maps can also give an idea of the precision (1 sigma) obtained, which would be equivalent (rough estimate) to the value that appears divided by 8 or 9 (approximately, based on experience). The precision obtained can also be seen by clicking on each station (vertical and horizontal position error). Based on extrapolation, **horizontal errors are less than 1m and vertical errors between 1 and 1.5m**.

2.2.2.5 In addition to the system's capability of providing integrity parameters (Protection Levels), the excellent results obtained in horizontal precision (equivalent to sub-metric service) practically throughout the region are noteworthy, and of special interest is the possibility of providing this technology off-shore, where other technologies provide a very poor service. This is of special interest for aeronautical and especially multimodal users.

2.3 Availability and continuity in the CAR/SAM Regions

2.3.1 Almost at the end of the web page, there is an availability map to the left and a continuity map to the right.

2.3.2 The instant availability map shows, in real time, the areas where both the vertical and horizontal protection levels are below the alarm limit (horizontal and vertical), in this case, for the APV-I service level. As may be noted, and as previously stated, **practically all the CAR/SAM Regions** are covered**.**

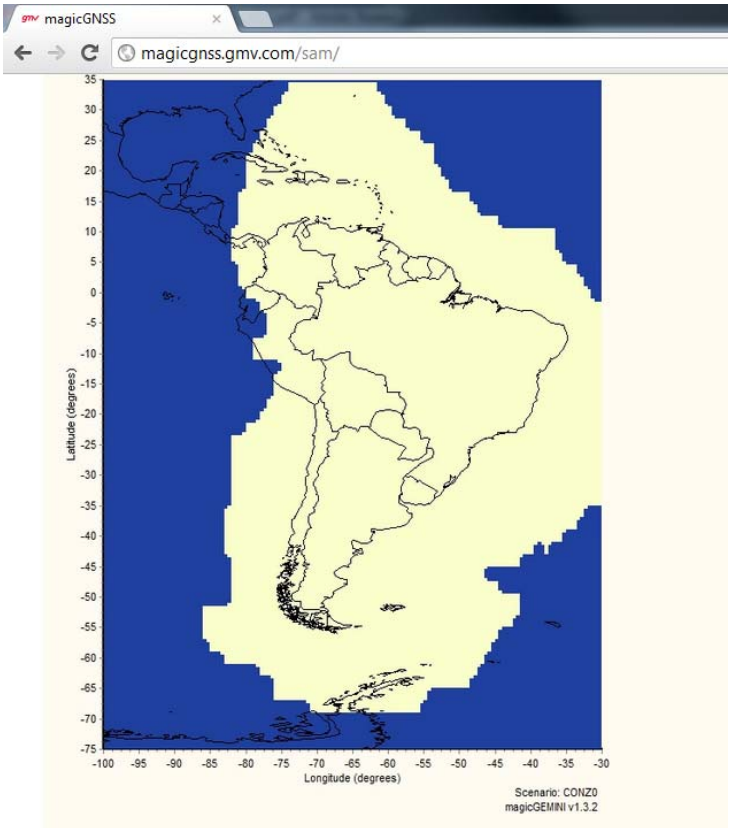

Figure 3. Image taken from the web platform (http://magicgnss.gmv.com/sam/). Instant availability map.

2.3.3 Obviously, availability and coverage will depend on the reference stations available.

3. Conclusions

3.1 This working paper shows the foreseeable results of a SACCSA test bed, based on the results obtained with the GMV magicSBAS test bed.

4. Suggested action

4.1 States are invited to:

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

b) investigate the real-time GNSS platforms (ntrip) available in their States and activate mechanisms for using the GNSS receivers that might exist in the SACCSA platform.

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