**INTERNATIONAL CIVIL AVIATION ORGANIZATION**
***South American Regional Office - Regional Project RLA/06/901***
*Assistance for the implementation of a Regional ATM System, taking into account the ATM operational concept and the corresponding CNS technological support*
**Eighth Workshop/Meeting of the SAM Implementation Group (SAM/IG/8)**
(Lima, Peru, 10-14 October 2011)

SAM/IG/8-WP/20
14/09/11

**Agenda Item 6: Assessment of the operational requirements to determine the implementation of improvements in communication, navigation and surveillance (CNS) capabilities for en-route and terminal area operations**

# IMPLEMENTATION OF A RAIM AVAILABILITY PREDICTION TOOL IN THE SAM REGION

(Presented by the Secretariat)

**SUMMARY**

This working paper presents the results of the activities carried out for the implementation of a RAIM availability prediction tool in the SAM Region to support the implementation of PBN for en-route, terminal area, and approach operations.

**References:**

- SAM/IG/5 meeting report (Lima, Peru, 10-14 May 2010);
- SAM/IG/7 meeting report (Lima, Peru, 23-27 May 2011); and
- Doc 9613 – Performance-based navigation manual

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| ***ICAO strategic objectives:*** | *A – Safety*<br>*C – Environmental protection and sustainable development of air transport* |

## 1. Background

1.1 Air navigation operations based on the global navigation satellite system (GNSS) require confirmation of the integrity of the signal-in-space of the global positioning system (GPS). In this regard, and in order to ensure the integrity parameters of the GPS signal-in-space for en-route air navigation operations, non-precision approaches, approaches with vertical guidance (APV) and terminal area supported by the aircraft-based augmentation system (ABAS), a GPS receiver with a receiver autonomous integrity monitoring (RAIM) system is available.

1.2 An aircraft equipped with GPS receivers with certified RAIM (TSO C129a, E/TSO-C146) complies with the precision, integrity and continuity monitoring parameters specified in Annex 10, Vol. I, Table 3.7.2.4.1 – *Signal-in-space performance requirements*, for en-route and terminal area operations and for non-precision approaches and approaches with vertical guidance.

1.3 In order to ensure RAIM operation, the GPS receiver must receive signals from at least five satellites of the GPS constellation. An enhanced version of RAIM is FDE (Fault Detection and Exclusion), whereby the GPS receiver can detect a failed satellite of the GPS constellation and exclude it from the calculation. To do this, the GPS receiver must receive signals from at least six GPS satellites.

1.4 The operator, before starting a flight in which ABAS will be used, should verify if the RAIM is available along the route, in the terminal area or in the approach phase, in accordance with the procedure approved to that end. RAIM operation is verified using a *RAIM availability prediction* software. The RAIM availability prediction programme is based on the operating status of the GPS constellation reported by the United States Coastguard through NANU (Notice Advisory to Navstar User) messages.

2. **Discussion**

2.1 The fifth workshop/meeting of the SAM Implementation Group (SAM/IG/5) (Lima, 10-14 May 2010), upon reviewing the background of RAIM availability prediction, noted that the operations in the Region did not have a RAIM availability prediction programme that was approved and applicable to the SAM Region, and that the aeronautical authorities lacked the regulations for approving a RAIM availability prediction programme.

2.2 Likewise, the SAM/IG/5 meeting informed that the RAIM prediction programmes that existed worldwide only operated in the geographical areas for which they were designed, such as the programme designed by VOLPE for the FAA, which operates properly, especially in the territory of the United States, and the AUGUR programme designed by DWI for Eurocontrol, which operates properly over Europe.

2.3 Furthermore, the meeting noted that AUGUR included airports and radio aids of the SAM Region, but the results of RAIM availability calculations were not reliable because the programme informs users that reliable results only encompass the European Region.

2.4 In this respect, the SAM/IG/5 meeting recognised that the Region did not have a RAIM prediction programme, and formulated Conclusion SAM /IG/5-5 – *FDE availability prediction programme*, in which the ICAO SAM Regional Office was requested to establish a process for the development of a RAIM availability prediction programme for the SAM Region, for use in all flight phases.

2.5 As a follow up to the process of development of a RAIM availability prediction programme for the SAM Region, a technical and financial solution was presented at the seventh workshop/meeting of the SAM Implementation Group (SAM/IG/7). Following an analysis, the meeting felt that another offer was required in order to compare the cost of the solutions.

2.6 At the SAM/IG/7 meeting, Colombia informed that it had implemented a RAIM availability prediction programme at its main airports at national level, and that it would study the possibility of extending the scope of the programme with a view to predicting RAIM availability all over the SAM Region, and advise the SAM Regional Office of its results. The programme is an application of the IDS SAPET tool.

2.7 In this regard, the Aeronautical Administration of Colombia informed that the tool it was using for determining RAIM prediction was in the phase of improvement and once the existing problems were resolved, they would study the possibility of using the tool for RAIM predition in the SAM Region.

2.8 The SAM Regional Office, continuing with the development of a RAIM availability prediction progamme for the SAM Region to be used in all flight phases, requested DWI to provide a technical and financial solution for a RAIM predition programme in the SAM Region.

2.9 The RAIM availability prediction programme for the SAM Region is a programme that would be placed on dual servers and would be accessed by users through the web, on an address to be determined. The application would be available 24x7, with an availability of 99.5%.

2.10 For the implementation of RAIM availability prediction, two modalities have been considered, one in which the programme would be installed and managed at the manufacturer's headquarters, and the other in which the programme, as well as the required hardware, would be installed at a site in the Region under the supervision of the manufacturer or service provider. In both modalities, the user would access the information through the Internet, at a website where the RAIM availability prediction programme would reside. **Appendix A** shows how the RAIM availability prediction system would be organised. **Appendix B** contains a table with the cost of the options submitted by the two main providers of RAIM prediction programmes.

2.11 The implementation of a regional RAIM prediction programme would allow all the States of the Region to have a single programme for consultation by all the operators to ensure en-route, terminal and approach PBN procedures. Therefore, in view of the need to implement a RAIM availablity prediction programme to support the growing number of en-route, terminal and approach air navigation PBN procedures to be implemented in the SAM Region in the short and medium term, the following draft conclusion is formulated:

**Conclusion SAM/IG/8-X Implementation of a RAIM prediction system in the SAM Region**

That, in order for the SAM Region to have a common programme for predicting RAIM and FDE availability to support en-route, terminal area, and approach PBN operations:

a) the fifth meeting of the Coordination Committee of Regional Project RLA/06/901 consider the purchase of the RAIM prediction service selected by this SAM implementation workshop/meeting; and
b) ICAO analyse the most convenient way for States that are not members of Regional Project RLA/06/901 to pay the corresponding fee for the RAIM prediction service.

## 3. Suggested action

3.1 The Meeting is invited to:

a) take note of the information presented herein;
b) analyse the aspects contemplated in section 2, Appendices A and B, and Conclusion AM/IG/8-X of this working paper regarding the implementation of a RAIM availability prediciton programme, and approve the process for its implementation; and
c) analyse any other related matters it may deem appropriate.

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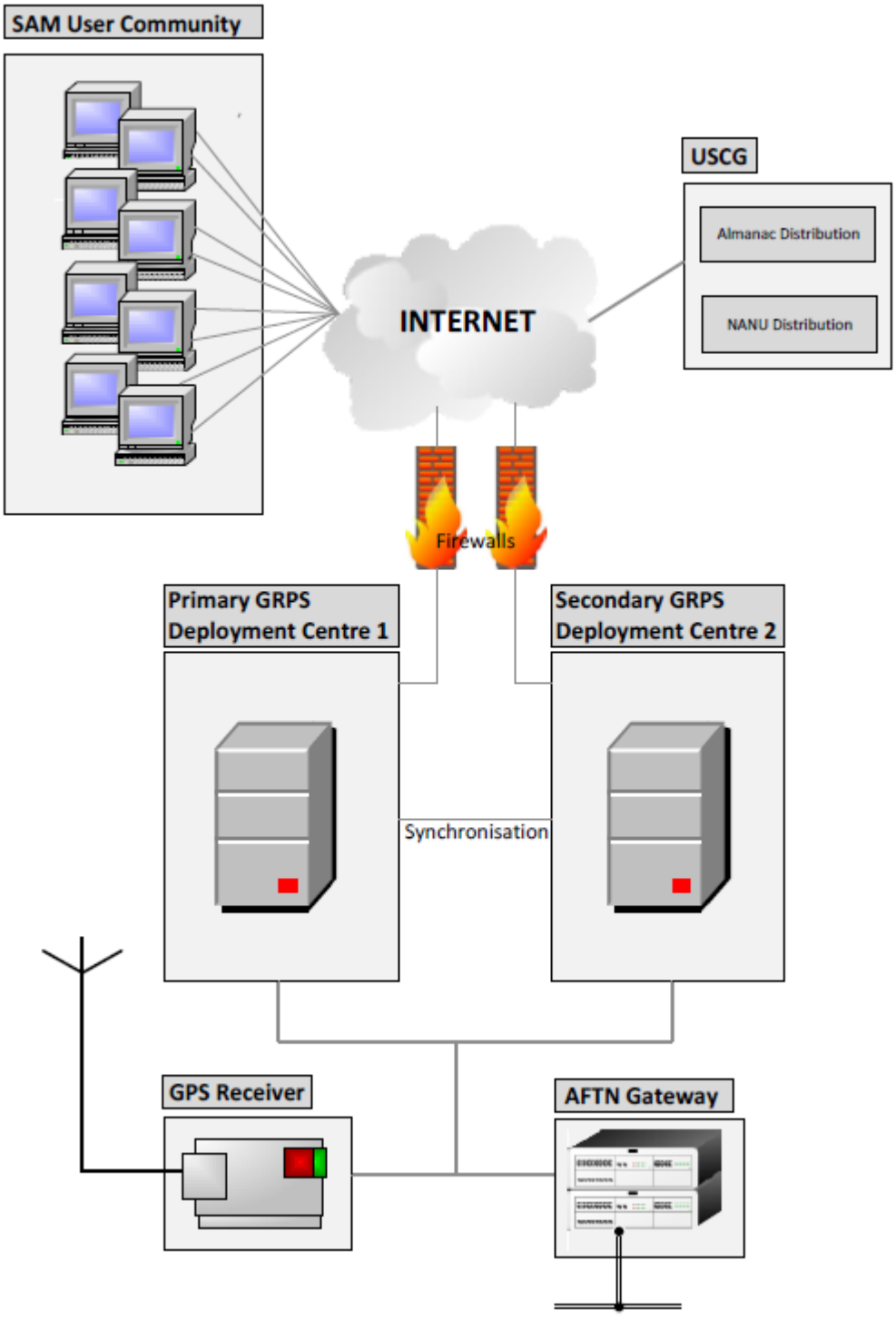
**APPENDIX A / APENDICE A**

**GRPS ARCHITECTURE / ARQUITECTURA GRPS**

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**APPENDIX B**

**OFFER PRESENTED BY RITA**
**(Research and Innovative Technology Administration --Volpe National Transportation System)**

| NO | ITEM | DESCRIPTION | COST US$ |
|---|---|---|---|
| 1 | Subtotal | 1. Operational Concept (CONOPS)<br>2. Verification and validation (V&V)<br>3. System architecture<br>4. Software implementation<br>5. Hardware specifications<br>6. Communications specifications | $358,000 |
| 2 | Labour | 1. Purchasing functions<br>2. Preparation of site and configuration<br>3. System installation | $85,000 |
| 3 | Hardware | 1. Computer system<br>2. Peripherals and screens<br>3. Storage devices<br>4. Network devices<br>5. Backup system<br>6. UPS<br>7. Operational system and software support | $175,000 |
| 4 | Operation | 1. Operation<br>2. Internet service communication<br>3. Utilities, services and maintenance<br>4. Technical support | $100,000 per year |
| | Total | | $618,000<br>+<br>$100,000 per year |

**PROPOSAL PRESENTED BY DWI**

| NO | ITEM | DESCRIPTION | COST US$ |
|---|---|---|---|
| 1 | | Web page design for GRPS (GNSS RAIM/RNP prediction service) | $96,000 the first year. US$80,000 as of the second year. |
| 2 | | Hosting of GRPS at the Web site for 12 months | |
| 3 | | Provision of data base with significant points of SAM airspace | |
| 4 | | Netbook for SAM to Access GRPS | |
| 5 | | Cost of a mission for three (3) people of the SAM Region for a three-day visit to DWI, England, to coordinate the design of the Web page | |
| 6 | | RNP AR prediction under 0.3 NM (maximum 1,500 RNP predictions) | |

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