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ASSEMBLY — 36TH SESSION

TECHNICAL COMMISSION

Agenda Item 37: Other air navigation matters

GPS AIDED GEO AUGMENTED NAVIGATION (GAGAN) — INDIA

(Presented by India)

EXECUTIVE SUMMARY

In the 35th Assembly of ICAO, India had informed about the GAGAN project and its configuration. At that time, the project was at initial stage. Since then, Technology Demonstration System (TDS) phase has been completed and preliminary site acceptance test results are as per pre-requisite set envisaged for this project. GAGAN — TDS has been integrated with the INMARSAT — 4F1 navigation transponder and Signal-In-Space (SIS) is available for testing and validation since May 2007 onwards. This paper is an update on the GAGAN Project that has taken place since the last Assembly.

<i>Strategic Objectives:</i>	This working paper relates to Strategic Objectives A and D in support of safety, regularity and efficiency of international civil aviation.
<i>Financial implications:</i>	None.
<i>References:</i>	

1. INTRODUCTION

1.1 GPS aided GEO augmented navigation (GAGAN) will provide augmented information for satellite navigation to the aircraft flying within Indian FIR.

1.2 India is responsible for providing ATS over designated airspace of 6 million square km. Majority of the Indian airspace falls in oceanic region where it is difficult to provide navigation signal through conventional navigational aids.

1.3 India is situated in the vicinity of equator. In the equatorial region, the ionospheric variations are very predominant which affect the GPS as well GEO signals. It has therefore been decided to go for Iono -Tropo modelling over Indian airspace after collecting TEC data over an extended period of time from 20 TEC stations, which have been established for the purpose.

2. IMPLEMENTATION PLAN

2.1 **Technology Demonstration System:** This phase requires implementation of a minimum configuration system, which would demonstrate the capability of the system to support up to precision approach over limited region of the Indian airspace and will serve as proof of concept. The performance objective of this system is to meet the ICAO SARPs requirements. TDS phase has been completed.

2.2 **Final Operational Phase (FOP):** During this phase, the GAGAN program will be matured. Extensive tests would be carried out to establish the system stability of various elements of the system as a whole. The system will be put to extensive use for its evaluation with respect to ICAO SARPs. Certification and validation of the system will be completed before declaring the system operational by end of the year 2010.

3. CURRENT STATUS OF GAGAN

3.1 Infrastructure for installation of INRES at Delhi, Collate, Guwahati, Port Blair, Ahmedabad, Banglore, Jammu and Trivanthapuram is in place.

3.2 Twenty GPS-TEC stations are functional at 5° x 5° grid size architecture. Ionospheric data for last three years from 20 TEC stations is being analyzed.

3.3 As per current analysis of data, 5 more TEC stations are recommended for equatorial anomaly region which will form 2° x 2° grid size, to achieve better IONO model for Indian airspace.

3.4 INMCC and INLUS at Banglore are functional and ground segment of GAGAN equipment are integrated.

3.5 GAGAN ground segment integration and connectivity test with eight INRES with INMCC is completed. The INRES data is being received through fiber optic cable and Vast at INMCC Banglore for corrections and validation checks of the erroneous data.

3.6 PSAT of GAGAN ground element was conducted in May 2006 with help of satellite emulator.

3.7 The INMARSAT 4F1 navigation transponder has been hired by ISRO(Indian Space Research Organisation) in the month of January 2007 for integration of GAGAN ground segment, to complete Final Site Acceptance Test (FSAT) and also to conduct the user level testing of GAGAN SIS in September-2007.

3.8 Total cost of the GAGAN project is 140 million US\$.

4. TDS RESULTS

4.1 The TDS phase is to demonstrate the expected vertical and horizontal positional accuracies over 95 per cent of the time with the associated Time-to-alarm (TTA) capability.

4.2 Results were better than 7.6 meters accuracy in both vertical and horizontal over 95% of the time within the perimeter of the reference stations.

4.3 Using type 62 (test) message, the TTA was better than 6.2 seconds.

4.4 Results were well within the exit criteria of PSAT.

5. CERTIFICATION

5.1 **Flight trials:** Flight trials for TDS SIS validation are scheduled in the month of September 2007 for up linked GAGAN signals.

5.2 **Certification by regulatory authority:** DGCA (India) officials are involved in the process of certification and document preparation of the system.

5.3 Validation of SIS and certification of GAGAN is being done by AAI in association with FAA.

6. TECHNOLOGY SUPPORT OF DEVELOPMENT AND MAINTENANCE OF GAGAN

6.1 ISRO in association with the AAI (Airports Authority of India) will be developing the entire system through all the stages of TDS, and FOP. ISRO will continue to provide technology support, maintenance and replenishment of the space segment of the system to maintain it as a robust system. AAI will operate and maintain the ground segment and also periodically check the validity of the SIS of system.

7. **CONCLUSION**

7.1 GAGAN has capability to provide the augmentation service within GSAT-4 footprint, which covers a large portion of the Asia-Pacific region.

7.2 Necessary Ionospheric and Troposphere (IONO-TROPO) models for GAGAN are under development and testing. The model will also take into account the equatorial ionosphere spatial and temporal variability during equatorial high magnetic conditions. Therefore this model will be more suitable for this region.

7.3 GAGAN would be developed to meet the ICAO GNSS SARPs.

7.4 The Assembly is requested to take note of the information.

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