

Agenda Item 3: CNS/ATM Implementation and Related Activities

GPS AND GEO AUGMENTED NAVIGATION IN INDIA (GAGAN)

(Presented by India)

1. Introduction

1.1 India has presented an Information Paper during APANPIRG/13 meeting on the subject. This is an update and also future roadmap of the project. GAGAN will provide augmented information for satellite navigation to the aircraft flying within Indian FIRs which consist of seven boundaries.

1.2 India is situated near 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 and tropo modeling over Indian Airspace after collecting TEC data over an extended period of time from twenty TEC stations being established for the purpose.

2. Implementation Timescale

2.1 **Technology Demonstration Systems (TDS):** This phase requires implementation of a minimum configuration system which would demonstrate the capability of the system to support up to precision approach Category-I over a 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. The TDS will broadly consist of about eight Indian Reference Stations (INRES), an Indian Mission Control Center (INMCC), one Indian Land Uplink System (INLUS), space segment, required communication links and necessary software for navigation and communication during the TDS phase. The TDS will be completed in the year 2005.

2.2 **Initial Experimental Phase (IEP):** In this phase, TDS will be expanded to cover the entire Indian airspace and requisite redundancies will be added to the system. The system will be available for trial operations and the data collected by Airports Authority of India (AAI) during such trial operations would be analyzed to further improve the system, wherever considered necessary, to achieve compliance of ICAO SARPS. The IEP will be completed in a period of one year after the development of TDS.

2.3 **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 in extensive use for its evaluation with respect to ICAO SARPs before declaring the system operational. The FOP will be completed in a period of one year after the successful implementation of IEP.

3. Current status of GAGAN:

3.1 Places for INRES and Ionospheric Grid Stations (IGS) are finalized for installation of the requisite equipments.

3.2 The installation of GPS-TEC at IGS has been completed at four places i.e. Ahmedabad, Bhopal, Jodhpur and Delhi Airport and the installation of the remaining GPS-TEC receivers will be completed during current year i.e. 2003.

3.3 Agreements have been signed with universities and R&D institutions involved in ionospheric studies for their participation in data collection ,analysis and modeling.

4. Technology support of development and maintenance of GAGAN

4.1 ISRO in association with the AAI, will be developing the entire system through all the stages of TDS, IEP and FOP. ISRO will continue to provide technology support, maintenance and replenishment of the space segment of the system, as and when required, to maintain the system as a robust system.

5. Conclusion:

5.1 GAGAN has a capability to provide the augmentation service within GSAT-4 foot-print, which covers a large portion of the Asia/Pacific region

5.2 Necessary Ionospheric and Tropospheric (IONO-TROPO) models for GAGAN are under development. GAGAN system takes into account the fact that in the equatorial ionosphere the spatial and temporal variability is much greater, even during quiet magnetic conditions and therefore a model specifically for this region has to be developed to take care of the variations.

5.3 GAGAN would be developed to meet the ICAO GNSS SARPs and it would be interoperable with WAAS, EGNOS and MSAS.

6. Action taken by the meeting

The meeting is requested to take note of the information.