WORKING PAPER

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PLENARY

Agenda Item 2: Statements by delegations of Contracting States and of Observers

A BRIEF ON GAGAN

(Presented by India)

INFORMATION PAPER

Satellite Navigation is one of the key elements of Global CNS/ATM Plan adopted by the International Civil Aviation Organisation (ICAO) for global implementation. The new System offers substantial advantages over terrestrial navigational aids.

The core constellation of Global Positioning System (GPS) of Dept. of Defence, USA and Global Orbiting Navigation Satellite System (GLONASS) of Russian Federation are in place and are being used for providing navigation services in many parts of the world. GLONASS has over the years dwindled with only 7 or 8 operational satellites left against the full constellation of 23 satellites thus seriously affecting its usefulness. The current level of accuracy, integrity and availability offered by GPS does not meet the more demanding Air Navigation requirement particularly during the critical phases of flight like non-precision and precision approaches. To overcome these deficiencies of GPS and to use it for all phases of flight , Augmentation systems have been developed. Satellite Based Augmentation System (SBAS) has been developed more as regional systems to provide augmentation of GPS signal over wide geographical area.

Airports Authority of India (AAI) and Indian Space Research Organisation (ISRO) have jointly undertaken a programme for implementation of a Satellite Based Augmentation System for enhancing GPS signal accuracy and integrity for meeting civil aviation requirement for various phases of a flight. The proposed System, named, 'GAGAN' (GPS & Geo Augmented Navigation) would be implemented in three phases and is expected to be operational by 2008. The programme envisages establishment of a network of ground stations together with a Navigation Transponder carried on a Geo Stationary Satellite. 'GAGAN' will provide augmentation service for GPS over India and could be extended to cover much beyond the Indian airspace. The footprint of the Geo Satellite would, however, extend from Australia to Africa. When operationalised, 'GAGAN' is expected to fill the gap between European EGNOS and Japanese MSAS to provide seamless navigation.

'GAGAN' will be implemented in three phases. In the first phase, a Technology Demonstration System with 8 Reference Stations (INRES), a Master Control Centre (INMCC), an uplink station (INLUS) with necessary communication links to interconnect the ground elements would be established. A navigation payload on GSAT-4 satellite will be placed in a Geosynchronous orbit. The system will be upgraded through an Initial Experimental Phase (IEP) by adding redundancies to the space segment,

INMCC, INLUS and validating over the entire Indian airspace to the Final Operational Phase by augmenting the INMCC, INLUS & INRES with operational hardware and establishing additional INRES as may be required.

Geographical location of India in the equatorial region with high level of ionospheric activity and their effect on GPS signals is a significant issue. To adequately assess the effect of ionosphere on GPS signals and introduce necessary correction Iono-Tropo modeling and scintillation studies in the L band will be carried out over the entire Indian airspace as an integral part in Phase I. Twenty Total Electron Content (TEC) stations are being established at 5 x 5 degree Ionospheric grid points spread over the whole country. Sixteen out of the proposed twenty TEC Stations have already been established and data collection & analysis commenced. Ionospheric Scientists from universities and R&D establishments have been involved in development of ionospheric model.

A navigation payload compatible with GPS L1 frequency & GPS L5 frequency on an Indian Satellite will be positioned in the Indian Ocean Region at orbital arc of 82 degree E longitude to relay geo stationary overlay signal compatible with GPS L1 and L5 frequencies for use by modified GPS receivers. The transmitted signals will give an 33.0 dBW EIRP over Indian Airspace to cater to future plan of adding Q channel to L1 & increasing L5 data rate. Final design review for the payload has been completed and work on fabrication commenced. Advance Publication of Information (API) has already been filed for frequency allocation for the L band transponder with ITU. GPS code allocations have also been received for L1 frequency.

A contract has been awarded for implementation of the ground elements of 'GAGAN' for the TDS phase. ISRO has already completed detailed design review of the INLUS RF section, which will be done inhouse by ISRO. A Service Volume Simulation Package has also been developed in-house. TDS phase is expected to be implemented by end 2005.

While action for development and provision for Augmentation System is in hand, parallel action is also being taken to develop GPS procedure. Training on GPS procedure designing has already been imparted to the procedure specialist and in the first stage, development of overlay procedure for existing non-precision approaches excluding localizer based approaches are being undertaken. GPS overlay procedure for VOR/DME approaches for Delhi and some other airports have already been developed and sent to DGCA for approval before these are promulgated. These GPS overlay approaches will provide pilots with operational experience by flying GPS approaches while monitoring traditional navigational aids. This will also provide experience to the procedure specialists before designing GPS standalone approaches in the second stage.

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