



International Civil Aviation Organization

THE SIXTH MEETING OF IONOSPHERIC STUDIES TASK FORCE (ISTF/6)

Bangkok, Thailand, 19 – 21 January 2016

Agenda Item 3: Review of status of States' activities

STATUS UPDATE OF GNSS ACTIVITIES IN INDIA

(Presented by India)

SUMMARY

Indian airspace and airports are GAGAN capable. GPS Aided Geo Augmentation Navigation (GAGAN) – the Indian Satellite Based Navigation System (SBAS) is now certified for Approach with Vertical Guidance (APV1) service over Indian Landmass and is developing LPV approaches for select runways within India.

The GAGAN service volume is susceptible to the ionospheric variations that are very predominant and affect the GPS as well GEO signals. In order to meet the set objective of APV1.0 over the Indian land mass, India has developed an appropriate region specific ionosphere model for GAGAN.

This paper presents the current status of GNSS (SBAS and GBAS) activities in India and also urges the SBAS service providers in the world to encourage aircraft operators for utilization of SBAS technology.

1. INTRODUCTION

1.1 With the certification of GAGAN for approach and landing operations (APV 1) on 21st April 2015, India has become the third country in the world to have such capabilities. GAGAN is the first system in the world to have implemented in the equatorial Ionospheric region.

1.2 GAGAN was already certified for RNP0.1 enroute services on 30th December 2013. GAGAN Signal-in-space is available on 24x7 basis through two satellites GSAT-8 (PRN-127) and GSAT-10(PRN-128).

1.3 GAGAN – the Indian Satellite Based Augmentation System (SBAS) Programme is unique because of the implementation of ISRO-MLDF IONOSPHERIC ALGORITHM (IGM-MLDF 1.4) to meet the ionospheric challenges posed in Indian sub-continent and other Equatorial Ionospheric Anomaly regions.

1.4 Implementation of GAGAN has provided the required momentum to India's PBN implementation programs. In line CANSO Seamless ANS, Airports Authority of India has been working continuously to upgrade the CNS and ATM services consistent with ICAO global ATM concept.

1.5 GAGAN has made India's Flight Information Region capable of RNP0.1 services to suitably equipped aircraft. The seamless airspace concept needs uniform systems and aircraft capabilities to derive maximum flexibility, capacity utilization, reduced fuel burns and lowering Carbon footprints.

1.6 With Indian Landmass capable of Approach with vertical guidance, ANS can plan their investments prudently encouraging regional players to forward fit / retro fit their aircraft appropriately with GAGAN capabilities.

1.7 Honeywell Smartpath SLS4000 has been installed at Chennai airport for Cat-1 operation. System has been upgraded to Block-II software and is under performance evaluation.

2. DISCUSSION

2.1 Continued work for mitigating identified hazards and fine tuning unique Ionospheric algorithm developed by ISRO team along with AAI, DGCA members assisted by MITRE Corp USA with experts from Stanford University, Raytheon Inc USA culminated in achieving APV 1 certification by India on 21st April 2015 and making available the certified GAGAN signal from 19th May 2015 to both civil Aviation and Non-Aviation Users.

2.2 With this, India became the first country in the world to establish Satellite Based augmentation system that can provide Approach with Vertical Guidance services namely, APV1 for landing at qualified runway ends in equatorial ionospheric anomaly region with its unique ISRO – MLDF Iono-Model for the region developed and validated for GAGAN.

2.3 In order to provide in-orbit redundancy in space segment, third Geostationary Satellite GSAT-15 (PRN 132) carrying GAGAN payload was launched on 10th November 2015.

2.4 Performance of GAGAN Signal-in-space is being continuously monitored using in-house developed Operation Test and Evaluation (OT&E) Tools meeting SARPS requirements. Same tools are serving the purpose for Offline monitoring of GAGAN (Reference Attached Annexure-I).

2.5 India is in the process of development of LPV procedures for select airports, for which the initial GNSS based Aeronautical Survey is completed and the procedures for six airports are ready. These procedures will be available for ground validation by the end of March 2016.

2.6 GAGAN is becoming popular for many non-aviation applications. The data from the GAGAN reference stations and ionospheric monitoring stations have shown enormous potential in host of applications other than aviation use. The ionospheric corrections broadcast from GAGAN can be used to interpret the large scale variations of ionosphere over Indian Sub-continent facilitating the space weather research.

2.7 The experience gained during the implementation of GAGAN by Airports Authority of India (AAI) can be fully shared with all the states wherein GAGAN service volume is contiguous with Indian service volume, with the inclusion of a few reference stations using GAGAN GEOS and the capabilities of monitoring signal-in-space, GNSS augmented services can be extended. The benefit of such a system extends beyond aviation. The benefit of additional reference stations will in turn increase availability and continuity within the APV service volume.

2.8 AAI is in the process of implementation of GBAS system at Chennai as a pilot project. Installation of GBAS has been completed however issues related to the high ionospheric gradient in equatorial region and therefore requirement of developing ionospheric threat model for low latitude region remains the major concern related to performance of the system. The FAA approved version of Block-2 software has been incorporated in the system in December 2015. The System is expected to be certified by Director General of Civil Aviation (DGCA) by June 2016.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) Take note of the GAGAN developments as a viable SBAS solution within Equatorial Ionospheric Anomaly Region capable of providing RNP0.1 service and APV 1/LP services at selected airports and status of implementation of GBAS in India.
- b) to discuss any relevant matters as appropriate.

ANNEXURE-I

GAGAN – Performance Objective

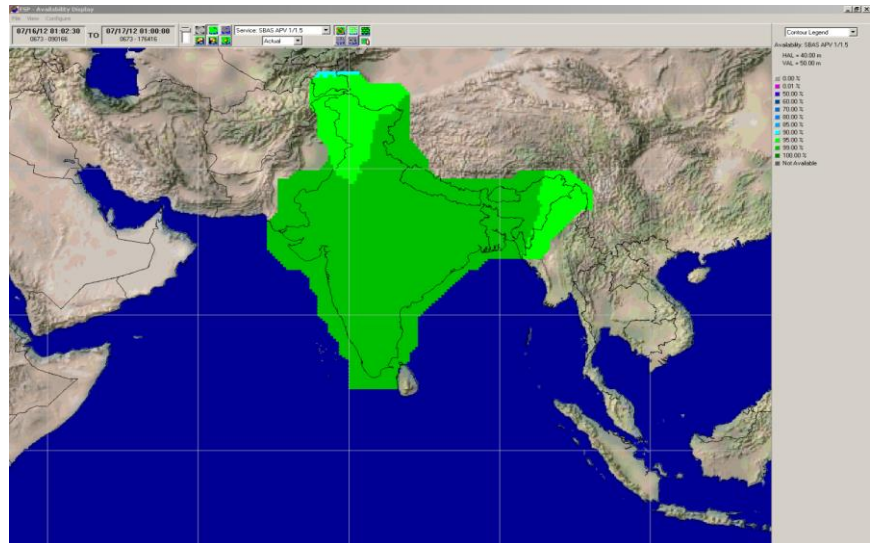
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Availability Coverage % at

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99% Contour: 86.57

100% Contour: 0.00



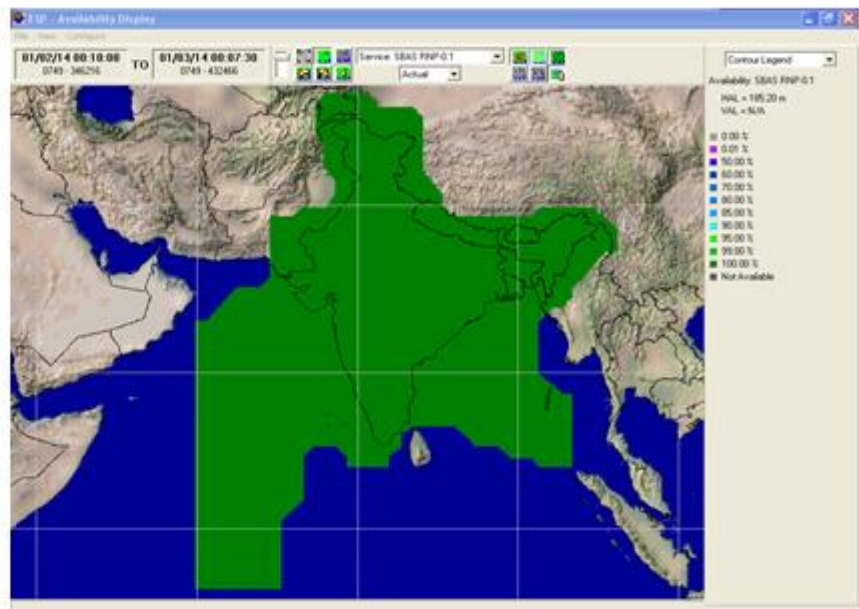
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Availability Coverage % at

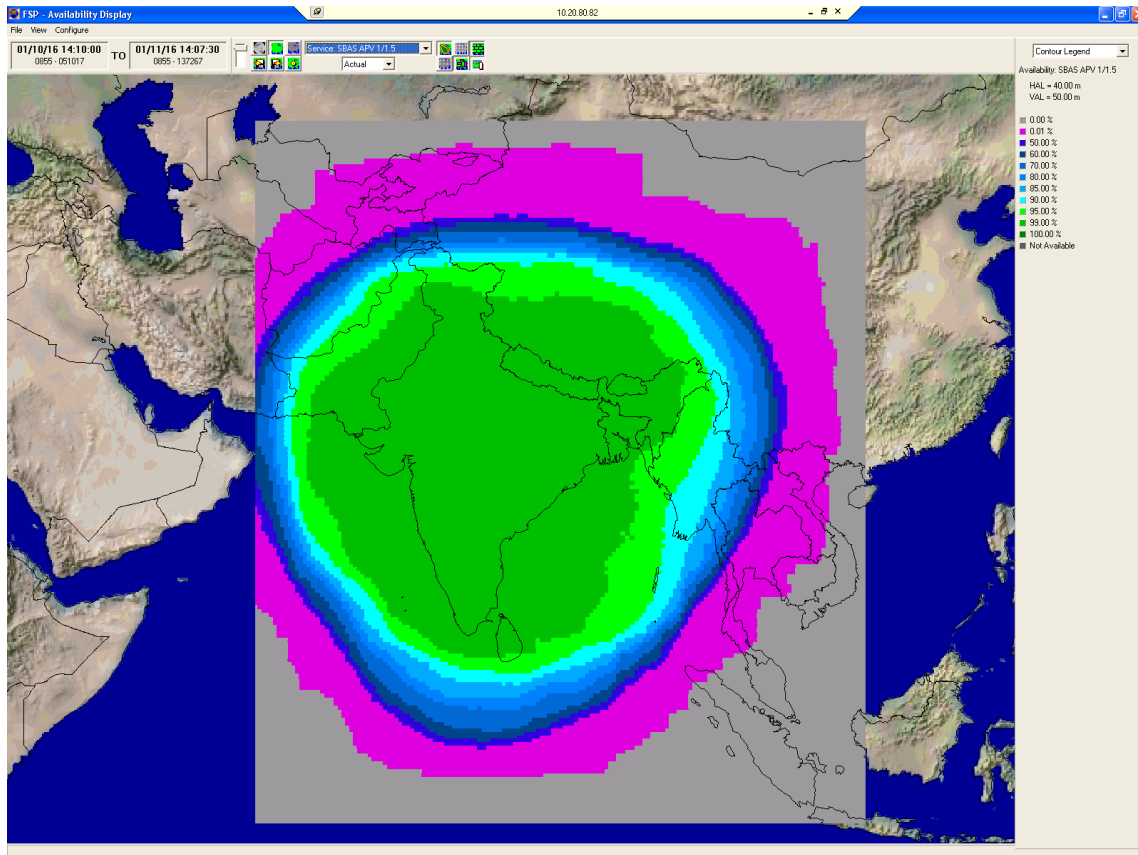
95% Contour: 100.00

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APV Availability



RNP Availability

