The GNSS newsletter is produced by the GNSS-GAGAN team of the ISRO and AAI. This newsletter provides information on the Global Navigation Satellite Systems GNSS; GPS aided Geo Augmented Navigation GAGAN and its use for aviation, Indian Navigation programs IRNSS, Adoption of GAGAN and IRNSS in the Non-Aviation sectors. It will include Ground Based Augmentation Systems implementation for Aviation in India, GNSS & Performance Based Navigation for Indian Aviation.

**ISRO & AAI make GAGAN happen for India**

GAGAN – GPS Aided GEO Augmented Navigation is an Indian SBAS (Satellite Based Augmentation System) Programme jointly developed by Indian Space Research Organization (ISRO) and Airports Authority of India (AAI) to implement SBAS over Indian airspace. From concept to operationalization, ISRO, AAI and DGCA worked in tandem planning, technical demonstration, ground installation, satellite launches followed by integration with GAGAN payload to provide Indian airspace a space based augmentation system aptly called “GAGAN”, the SKY. GAGAN is India’s contribution to the Global Navigation Satellite System – GNSS.

**GAGAN is India’s Next Gen Infrastructure for transition from Ground Based to Space Based Navigation.**

GAGAN enhances accuracy of GPS derived position many times over while ensuring integrity of information, availability and continuity to users anywhere within its service volume.

**Director General of Civil Aviation Certifies GAGAN for Approach with Vertical Guidance**

On 21st April 2015 GAGAN became the first SBAS in the world to be certified for Approach with Vertical Guidance (APV1) operating in the Equatorial Ionospheric Region and the third SBAS to have achieved this feat after WAAS of USA and EGNOS of Europe. MSAS of Japan is currently certified for RNP0.3 Non Precision levels.
I wish to highlight and flag the vision which has been envisaged for AAI. It stipulates that "Organization to be a world class organization providing leadership in Air Traffic Services and Airport Management and making India a major hub in the Asia Pacific Region by 2016". This can only be achieved if all of us combine our efforts to chart out a road map with an annual milestone; in this direction an Action Plan for the year 2015-16 has been developed.

AAI as an organization is predominantly a service provider in Aviation Sector. With the changing time and emerging global trends, the AAI is now expected to work as a commercial enterprise. While doing this, it has to keep the overall welfare of the passengers paramount in the mind. It calls for a paradigm shift in the approach to address the requirement and demands of various stake-holders in the Aviation Sector. AAI therefore needs to work even more pro-actively in achieving this objective.

Mr. V. Somasundaram, Member (Air Navigation Services) observed, "It is a moment of pride and happiness for AAI that our ANS achievements have deservedly won us various ATC Global recognitions. We are committed to take Air Navigation Services to greater heights and forge ahead as a world leader among ANSPs."
A Brief Introduction About GAGAN

GAGAN is the acronym for GPS Aided GEO Augmented Navigation. The GAGAN uses a system of ground stations to provide necessary augmentations to the GPS standard positioning service (SPS) navigation signal. A network of precisely surveyed ground reference stations (INdian REference Stations INRES) is strategically positioned across the country to collect GPS satellite data. Using this information, the master control centre (INdian Master Control Centre INMCC) generates messages to correct any signal errors. These correction messages are then up linked through (INdian Land Uplink Station INLUS) and broadcast through communication satellites (Geostationary) to receivers on board aircraft using the same frequency as GPS. The GAGAN is designed to provide the additional accuracy, availability, and integrity necessary to enable users to rely on GPS for all phases of flight, from en route through approach for all qualified airports within the GAGAN service volume. GAGAN will also provide the capability for increased accuracy in position reporting, allowing for more uniform and high-quality Air Traffic Management (ATM). In addition, GAGAN will provide benefits beyond aviation to all modes of transportation, including maritime, highways, and railways.

GAGAN Is Certified And Commissioned For RNP 0.1 And APV-1 Services

GAGAN has been certified by DGCA for the provision of RNP 0.1 and APV-1 services on 30 December 2013 and 21 April 2015 respectively.

Airports Authority of India has commissioned RNP 0.1 service on 14 February 2014 and APV-1 service on 19 May 2015.

GAGAN History

The Government of India, decided to incorporate state of art GNSS technology like SBAS primarily over the Indian Flight Information Region. Then the implementation plan has been assigned to Indian Space Research Organization (ISRO) and the Airports Authority of India (AAI) to work together to its realization and its implementation. The Satellite Based Augmentation System using GPS core constellation is used. The System is meant primarily for Civil Aviation navigation purpose and can be utilized for other usages as well.

Time Line from Inception

GAGAN Project was conceived between AAI and ISRO in the year 2001 and planned in two phases

Phase I: Technology Demonstration System (TDS) from year 2001 to 2007. TDS phase was having three objectives. First, to demonstrate feasibility of SBAS implementation over Indian region with minimum set of elements. Second, It also requires to achieve horizontal and vertical accuracy of 7.6mtrs, 95% of the time over the selected area of Indian land mass with 6.2 seconds time to alarm. Final one, to study the ionosphere over the Indian region & to collect data for system development and necessary modifications for the Indian region for the Final Operational Phase. TDS phase was successfully completed in August 2007.

Phase II: Final Operation Phase (FOP) from year 2007 to 2014. Objective of FOP was to establish a final operational SBAS with redundancies, suitable region specific IONO model, safety certification for the system for the Civil Aviation use.
GAGAN System Elements

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Two INMCC
GBM, Bangalore GBC, Bangalore

Three INLUS
GBL Bangalore, Integrated with GSAT-8
GLL Bangalore, Integrated with GSAT-10
GDL Delhi, Integrated with GSAT-8

Two GEO Satellite
GSAT-8, Located at 55° E GSAT-10, Located at 83° E

DCN
2 Networks, Two data links (Terrestrial & Space Based) in each Network

System Configuration of GAGAN
GAGAN Coverage (GEO Foot-print)

Above image displays the foot-print of GSAT-8 and GSAT-10 GEOs. Coverage of RNP 0.1 and APV-1 services are displayed in images shown right side. RNP 0.1 service is available over entire Indian FIRs for en-route phase of flights and APV-1 service is available over entire Indian land-mass for approach phase of flights.
**GAGAN Website**

Current status of RNP 0.1 service and prediction of RNP 0.3 service for next 24 hours is available for monitoring on GAGAN Website which can be accessed through following link:

http://59.144.72.85/gagan

All GAGAN related NOTAMs and AIP Supplements can be referred on this website.

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**GAGAN Interoperability**

GAGAN is interoperable with other Satellite Based Augmentation Systems (SBAS) namely the Wide Area Augmentation System (WAAS) in USA, the multi-functional transport satellite (MTSAT) satellite-based augmentation system (MSAS), in Japan or the EGNOS system in Europe. Although all SBAS are currently defined as regional systems, it is commonly recognized the need to establish adequate co-operation/co-ordination among the different systems, so that their implementation becomes more effective and part of a seamless world-wide navigation system.

The service providers of the GAGAN, EGNOS, WAAS and MSAS systems are regularly meeting through the *interoperability working group (IWG)* to identify and resolve interface issues.

India conducted IWG-26 on February 3rd & 4th of 2014 at New Delhi.

Recent IWG-28 mainly engaged in developing Dual Frequency Multi Constellation - Interface Control Document which will pave the way for future advanced multi frequency SBAS.

The combination of SBAS Interoperability and SBAS expansion concepts will provide a true global world-wide navigation seamless service.
GAGAN benefits in Aviation

GAGAN provides the additional accuracy, availability, and integrity necessary to enable users to rely on GPS for all phases of flight, from en-route through approach for all qualified airports within the GAGAN service volume.

GAGAN also provides the capability for increased accuracy in position reporting, thereby making possible high-quality Air Traffic Management (ATM).

GAGAN signal is accurate enough to permit use of GPS as primary means of navigation.

Requirement of RAIM prediction is eliminated thus reducing flight dispatch and pilot workload.

Unlike Baro-VNAV, vertical path is not affected by temperature extremes.

Provides a cost-efficient opportunity for airports to gain ILS-like approach capability without any ground infrastructure requirements

Eliminates siting constraints of navigation facility, maintenance and associated restrictions on airport development.

GAGAN will increase safety by using a three-dimensional approach operation with course guidance to the runway, which will reduce the risk of controlled flight into terrain i.e, an accident whereby an airworthy aircraft, under pilot control, inadvertently flies into terrain, an obstacle, or water.

GAGAN is capable of providing precision approach at airports where it is impossible to install terrestrial Navigational aids because of terrain conditions like hill tops, valleys, etc.

GAGAN has capability to enhance reliability and reduce delays by defining more precise terminal area procedures that feature parallel routes and environmentally optimized airspace corridors.

LPV approaches are very similar to ILS approaches, from the pilot's perspective.

WAAS provides consistent service to users throughout the service area for all phases of flight. The system delivers an accurate position solution, typically one to two meters, no matter where the user is in the WAAS service area. This accuracy is a significant improvement over the typical accuracy obtained using GPS alone. WAAS also provides Integrity parameters that ensure that WAAS accuracy is within integrity bounds. With very high probability, the user is assured the information WAAS is transmitting will result in a safe and accurate position.

WAAS offers many benefits in approach operations. GPS alone does not meet the aviation requirements for availability, accuracy, and integrity for different phases of flight, such as timely integrity for the GPS signal. If a GPS satellite unexpectedly provides erroneous signals, the WAAS will detect this failure and mark that satellite as “not usable” within six seconds. The WAAS also provides final approach. WAAS allows pilots to use satellite navigation to perform a precision approach down to a 200-foot decision height with a one-half mile visibility.

WAAS has opened up thousands of runways to aviators who previously did not have access to a precision approach capability. The FAA has published 3,498 Localizer Performance with Vertical guidance (LPV) approaches, 2,321 to runways with no ILS capability, by November 13, 2014. LPV approaches are very similar to ILS approaches, from the pilot’s perspective.

GAGAN, being on similar platform will provide SBAS service comparable to WAAS.
ISRO-MLDF Algorithm - Making GAGAN unique for equatorial Ionospheric Region

Need for a Region Specific model for GAGAN

The ionospheric phenomena typically observed at the equatorial latitudes remains a challenge to SBAS to precision approaches. The ionospheric behaviour over the low-latitude (India) regions is characterized by various phenomena like: Large scale features (Large gradients in the total electron content (TEC), especially during the peak of the solar cycle, common between +/- 10 to 20 degrees magnetic latitude), Scintillation (Rapid change in amplitude and phase of the GPS signal as it passes through the small scale irregularities of the ionosphere, which can even result in a complete loss of lock of a Satellite), Depletion (A local phenomena, causing sharp gradients in the ionospheric delay over fairly small baselines occurring during the evening hours (sunset to midnight)).

The grid ionosphere model developed for mid-latitude regions are not valid for GAGAN, since they do not capture the above mentioned irregularities, which are specific to low-latitude regions. To meet the required GAGAN performance, it was necessary to develop and implement a best suitable ionosphere model, applicable over the Indian region. Moreover, it is preferred that the selected algorithm may not call for changes in the existing message structure, since, any changes in the MOPS requires agreement between all member states and to get the GAGAN system certified with MOPS changes is a very time consuming process. Moreover, the confidences(GIVE) must bind the errors not only at the grid locations, but for all interpolated regions between the grid points. In addition, the error bound must be valid for both the nominal and the disturbed ionosphere. In order to capture the large scale features of the equatorial ionosphere anomaly, the model must provide an approach to overcome the inadequacy of the thin shell model over equatorial region and must capture the complex 3 dimensional nature of the equatorial ionosphere.

IGM-MLDF: Brief Description

Hence a region-specific ionosphere model, named ISRO GIVE Model - Multi Layer Data Fusion (IGM-MLDF) has been developed and implemented for GAGAN, supporting the APV1/1.5 service. IGM-MLDF model has been selected after studying the adequacy of various models over Indian region. IGM-MLDF employs an innovative approach for computing the ionosphere corrections and confidences at pre-defined grid points at 350 Km shell height. IGM-MLDF consists of computing ionosphere delays at 250 and 450 km shell heights in order to capture the vertical movement and large scale irregularity of the Indian ionosphere and then employing data fusion for fusing the delays and confidences at 350 km shell height. Ionosphere storm detection algorithm utilizes goodness of fit test to protect the user from irregular behaviour of ionosphere. Moreover, IGM-MLDF models the associated uncertainties to protect a GAGAN user from ionosphere abnormalities. Another important feature of this algorithm is that, it does not require any changes in the user message structure, resulting in ease of GAGAN message usage by all the users, including the legacy users.
GAGAN Realization Strategy And Challenges

In realizing GAGAN system, a lot of indigenous efforts have been put in to establish, test and integrate the ground and space segment elements. Suitable sites were selected for the establishment of various ground elements such as INRES, INMCC and INLUS through study and analysis of RF interference survey, multipath survey, elevation profile study in addition to assessing the availability of adequate communication link and other logistical requirements. On selection of suitable site, all necessary civil and electrical infrastructures were developed to install the procured equipments.

To interconnect all the ground elements spread across the country, dedicated data communication network was established with multiple redundant circuits to meet the stringent availability requirements of 99.999.

ISTRAC, ISRO designed and developed 3 Indian Land Up-Link Stations (INLUS) with RF equipments to uplink GAGAN messages to the GEO satellite for broadcast to users along with state of the art Antenna Tracking System with 11m dish antenna. Necessary navigation payload on-board the GEO satellites were also designed developed by ISRO-SAC, Ahmadabad. The Monitoring & Controlling Interface for the INLUS RFU was developed by ISTRAC and the M&C software coding was done as per the DO-178 process. A complicated task of Integrating INLUS with GEO satellites GSAT8 and GSAT10 was carried out by team of experts within ISRO and AAI. A software tool called Operation, Test & Evaluation tool was developed for continuous system performance analysis to fulfill certification requirements.

Development of region-specific ionosphere model for GAGAN to overcome the limitations of existing SBAS models over equatorial region. Several candidate algorithms were examined and IGM-MLDF was down selected as the region specific ionospheric model for GAGAN. Several challenges in realization of GAGAN APV1 service over the Indian region is addressed in the algorithm. Currently the expected availability of GAGAN APV1 service on nominal days is 76% of the Indian land mass excluding the period of solar storms.

The certification of the developed GAGAN system posed a great challenge as the system was meant for safety of life civil aviation applications. Tremendous effort was put in by DGCA, AAI and ISRO to evolve a system to analyze system performance, safety issues, hazard records and recommend suitable mitigation methods. Expertise of external agencies such as MITRE, Raytheon and FAA of USA was used in certifying the GAGAN system.

Coordination with multiple organizations with diversified domain knowledge was another challenge in realizing the project of this magnitude and it was achieved effectively with regular meetings, technical interchange sessions, tele conferences and other follow up activities. Performance demonstration by deploying SBAS receivers at various locations over the service area.

Challenges:

1. GAGAN system certified and commissioned for Precision navigation
2. Realization of the project within the schedule and stipulated time with limited resources
3. Directing the project with many organizational stake holders, cross functional communication
4. Drawing up of various contingency plans for budget, resource and manpower utilization
5. Planning and executing the GAGAN complex program flawlessly
6. Firm leadership to deliver the work packages on time
7. Resolution of all project related dependency conflicts
8. Meeting each program milestone like FSAT, stability test, GEO Integration on dot
9. System under testing for APV 1/1.5 service levels
IRNSS: Indian Regional Navigation Satellite System Program

Highlights

IRNSS, the Indian Regional Navigation Satellite System, is an ISRO initiative to design and develop an independent satellite-based navigation system to provide positioning, navigation and timing services for users over Indian region. The system is designed with a constellation of 7 spacecraft and a vast network of ground systems operating 24 x 7. Three satellites of the constellation placed in geostationary orbit, at 32.5°E, 83°E and 131.5° E respectively, and four satellites in inclined geosynchronous orbit with an equatorial crossing at 55°E and 111.75°E, respectively, with an inclination of 29°(two in each plane). The constellation provides continuous regional coverage for positioning, navigation and timing services.

IRNSS Architecture

The ground segment is responsible for the maintenance and operation of the IRNSS constellation. The system is supported by vast ground segment consisting of 17 IRIMS (1-way ranging stations), 4 IRCDR (2-way CDMA raging stations), 2 IRNWT (Timing Centre), 2 INC (ISRO Navigation Centre) and 2 SCF (Spacecraft Control Facility) located at various parts of the country.

The IRNSS constellation transmits navigation signals in L5 and S bands. The basic services offered by IRNSS are Standard Position Service (SPS) and Restricted Service (RS) that use encryption technologies. IRNSS would provide services to the area covering India and 1500 Km around Indian land mass defined as its Primary service area.
Three satellite IRNSS-1A, 1B and 1C were launched during 2013-14. IRNSS-1D, the fourth satellite of IRNSS constellation was launched on March 28 '15 on board PSLV-C27 and has joined the family of IRNSS space segment. With the addition of fourth spacecraft the minimum satellite requirement is met and independent position solution is demonstrated for the first time using an Indian satellite-based navigation system. The unique Geostationary Earth Orbit (GEO) /Geo Synchronous Orbit (GSO) constellation design provides a position accuracy of better than 15 m for 18 hours in a day even with 4 satellites.

Enhanced Access To Airport Through GAGAN LPV Procedures

Widespread use of GPS in aviation has paved way for transition from terrestrial navigation aids to space-based/satellite navigation system. Satellite navigation is based on a global network of satellites in medium earth orbit that transmit signals, which are then received and processed by GPS receivers to compute position. Use of satellite-navigation for aviation received significant boost when ICAO recognized the benefits of this system and the 36th ICAO Assembly, 2007 resolved for global implementation of satellite navigation-based routes and flight procedures generically called Global Navigation Satellite System (GNSS) procedures, the resolve was further reiterated in the 37th ICAO Assembly in 2010. This led to the evolution of Performance Based Navigation (PBN) Concept consisting of Required Navigation Performance (RNP) and Area Navigation (RNAV) navigation specifications wherein GNSS is vital navigation sensor. In a major thrust towards global PBN implementation, ICAO encouraged every State to develop a PBN Implementation Roadmap and monitor progress to ensure its time-bound implementation. procedures is progressing. Till date, 10 airports have RNAV-1 SID & STAR, implementation at 6 airports is in progress. PBN procedures are also being implemented at Dabolim, Goa, first defense airport to have such procedures. 17 RNAV-5 ATS routes have been established connecting major city-pairs. RNP APCH development is ongoing. PBN implementation in India has provided noteworthy fuel savings and emission reduction. In continuation, AAI will be developing LPV procedure to derive benefit of GAGAN SBAS.

The Global Navigation Satellite System (GNSS) currently comprises of two constellations - GPS and GLONASS. GPS is being widely used for navigation for a decade now. Typically, the basic GPS service provides users with approximately 7.8 meter accuracy, 95% of the time anywhere on or near the surface of the earth. However, the basic technology does not assure acceptable precision, integrity, accuracy, continuity and availability to be permitted as a sole means of navigation. The accuracy and integrity of GPS can be significantly enhanced by providing augmentation/correction information. Satellite-based (SBAS) & Ground-based (GBAS) are the two types of augmentation systems being implemented globally. Several regional SBAS programs such as WAAS, MSAS, EGNOS & GAGAN have been/being implemented, each complying with a common global standard. Therefore, all SBAS systems are compatible and interoperable and do not interfere with each other. In future, with implementation of additional SBAS systems, it will be possible to have seamless SBAS global coverage. An operator with an SBAS-capable receiver can benefit from the same level of service and performance no matter the coverage area they are in. Satellite-Based Augmentation Systems (SBAS) will enable in reducing dependency on ground based infrastructure and leverage the precision and accuracy provided by satellite technologies. Suitably certified SBAS system can provide approach procedures to runway ends to a minima as low as 250 Ft close to ILS Category I.

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Localizer Performance with Vertical Guidance (LPV) Approach Procedure

An LPV (Localizer Performance with Vertical guidance) approach procedure is an RNAV (GNSS) approach with minima lower than LNAV or LNAV/VNAV approaches. LPV procedure combines FMS navigation database with GPS & SBAS signals and produce an approach that closely mimics an ILS approach. FMS navigation database in SBAS-capable aircraft contain additional information for each LPV approach procedure called the Final Approach Segment (FAS) Data block. The FAS data block contains the lateral and vertical approach path parameters that define the LPV approach. RNAV approach to LPV minimums combines information from FAS data block with highly accurate SBAS correction signals to produce an approach. This enhanced accuracy permits lower minimums of up to 250 Ft. Similar to ILS, when LPV functionality is active on an approach, the course deviations are angular instead of linear meaning that the sensitivity of the deviations are increased as the aircraft approaches the runway threshold. During LPV final approach the lateral and vertical deviations are not provided by FMS but set directly by GPS sensor. The sensitivities are similar to those of the ILS at same distances.

LPV procedures provide accuracy of an ILS without the limitations of localizer or glide slope interference. In order to enable such operations, aircraft needs to be equipped with a certified SBAS receiver and must be approved for the operations; the airport runway must qualify for such operations and associated LPV procedures must be approved.

GAGAN has been certified for APV I operations to LPV minimum of 250 Ft. Such procedures can provide significant benefits to the user.

LPV procedure provide reduced minimums ensuring enhanced access to runway resulting in more successful landings and reduced holding delays or diversions due to visibility. This will also mean airline can manage their fleet scheduling efficiently and optimally.

AAI is focused towards implementing LPV procedures at medium and small airports in order to provide enhanced access to such airports. In the role of ANSP, AAI is striving to reduce the service provision charges, one of the major cost component of ANSP is creation and upkeep of ground-based navigational aid infrastructure which includes onetime cost of equipment procurement and recurring cost of maintenance, manpower and land use. Also the indirect cost of restricted usage of land due to obstacle free zones around navigational aid Implementing LPV procedure will enable in eliminating the requirement of ground aid leading to reduced cost thereby translating to reduced ANS charges for operators. However, for this change to occur, suitably equipped and certified aircraft are vital for the success. General aviation operators and airlines have a better choice for airport access and need to take up the opportunity by upgrading cockpit avionics that support LPV procedures.
GAGAN News

Inter-Ministerial Group under Secretary MOCA to examine the potential of GAGAN applications for non Aviation with participation from Ministry of Agriculture, Director General Light Houses of Light Ships, Ministry of Mines, Ministry of Defence, Ministry of Science & Technology, Ministry of Urban Development, SCNP, ISRO HQ, Ministry of Road Transport & Highways, Ministry of Railways, Ministry of Power

GAGAN for Surveys: Surveyor General of India, SOI stressed that 90% of general surveys could be carried out at the accuracy level offered by GAGAN and advised organizations to adopt to GAGAN based surveys except where very high degree of accuracies are demanded such as cadastral surveys which would require local DGPS.

Karnataka forest department presented the use of GAGAN dongle (a low end receiver devised to receive and process GAGAN) has changed the way forest surveys were carried out and has saved on both time and money. AAI is planning to use GAGAN based surveys for verification requirements. Most of the DGPS now coming into market are receiving GAGAN.

GAGAN for Railways: NRSC (National Remote Sensing Centre) along with Indian Railways are experimenting on various GAGAN based applications, particularly in providing unmanned level crossing warning to drivers using GAGAN – BHUVAN applications. NRSC is doing some work on Train tracking using GPS-GAGAN.

GAGAN for Road Transportation: Receiver industries are keen on developing IRNSS – GAGAN solutions for road transportation and are working on the chipset that can harness both the systems capabilities.

GAGAN for Agriculture: The representative from MOA informed that applications based on GAGAN for precision farming is being considered.

GAGAN for Marine: DGLL is in the process of assessing GAGAN for marine operations and are coordinating for the same.

GAGAN for Space Weather Studies: GAGAN data is being used for space weather studies by SAC and has also been used for developing regional IONO model for Asia Pacific region.

GAGAN for Defence: Many applications have been considered by DRDO and defence for use of GAGAN in their position, Navigation and timing applications.

GAGAN as Scientific Research: NRSC and SAC Ahmadabad are developing applications using GAGAN signal in space.

Development of Indian Receiver Industry: Launch of GAGAN and IRNSS will encourage develop more number of receiver manufacturers in India and bringing multiple applications for use of general public. Receiver industry is showing keen interest.

Meeting with receiver industry representatives: Most of the receiver manufacturers have informed that SBAS based applications are operational in Europe and USA and have different set of receivers for different applications. Indian receiver manufacturers have developed GPS/GAGAN based timing devices.

User Group meetings conducted by ISRO/AAI: Multiple user group meetings were conducted by ISRO /AAI to promote awareness of GAGAN to the industry for the past three years.

Events And Upcoming GNSS Forums

- Technical Review Team (TRT) -11 is scheduled on 16th-17th July 2015.
- Bay of Bengal, Arabian Sea and Indian Ocean (BOBASIO) meeting is scheduled from 31st Aug 2015 to 4th Sep 2015.
We’re collecting testimonials about the benefits of GAGAN navigation from users. If you are a pilot, passenger, airport manager, controller, dispatcher, airline employee, or involved in aviation in any capacity - whether you fly fixed-wing or vertical flight aircraft - we want to hear from you! Please send your experience, thoughts and contact information to sv satish at svsatish@aai.aero
Domestic & International Airports

Development through connectivity
### Golden Peacock Innovative Product/Service Award-2015

For technology up-gradation for World Class Air Traffic Control

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