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GAGAN–Extension to the Gulf Region

Joint ACAC/ICAO MID Workshop on GNSS

7th & 8th November 2017

P.N.S. KUSHWAHA
EXECUTIVE DIRECTOR (CNS-P)

Airports Authority of India
New Delhi

Topics covered :

1. GAGAN program Implantation schedule.
2. GAGAN Architecture.
3. GAGAN Services & status.
4. GAGAN Performance & Ongoing Activities.
5. Extension GAGAN services to neighbouring regions.
6. Additional Services planned to be offered through GAGAN

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GAGAN Program Implementation Schedule

- Jointly developed by AAI and ISRO.

- Implemented in two phases:
  - Phase I : Technology Demonstration of System (TDS)
    Aug 2004 to August 2007.

  - Phase II : Final Operation Phase (FOP)
    June 2009 to June 2013.

- Certification: Certified by DGCA, India for
  - RNP 0.1 on 30th December 2013
  - APV-I on 21st April 2015

GOVERNMENT OF INDIA
OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION
DGCA COMPLEX, OPP. SAFDARJUNG AIRPORT, NEW DELHI-110 003

CERTIFICATE
Air Navigation Services Provider Certificate

No. ANS 2015/001

In exercise of the powers delegated under SO-727 E and part XII-A of the Aircraft Rules, 1937 notified on 14th January, 2015, this certificate is hereby issued to ***Airports Authority of India*** *by* ***The Director General of Civil Aviation***

Certifying the

GPS Aided GEO Augmented Navigation (GAGAN) System

for

Navigation Performance level of Approach with Vertical Guidance (APV-1) over India
&
Required Navigation Performance (RNP 0.1) within Indian Flight Information Regions

for a period not exceeding 60 months from the date of issue. This authorizes the certificate holder to provide the facility to operate as navigational aids to support air traffic services to all users on equal terms and conditions.

The certificate is liable to be suspended/ modified/ withdrawn or subject to any limitations or conditions, if any violation of the provisions of the Aircraft Act 1934 & the Aircraft Rules 1937, or any order/ direction/ requirements issued under the said Act/ Rules is observed.

This certificate is non-transferable.

Place : *New Delhi*
Date of Issue: 21.04.2015

Director General Civil Aviation

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GAGAN Elements

A. Ground segment

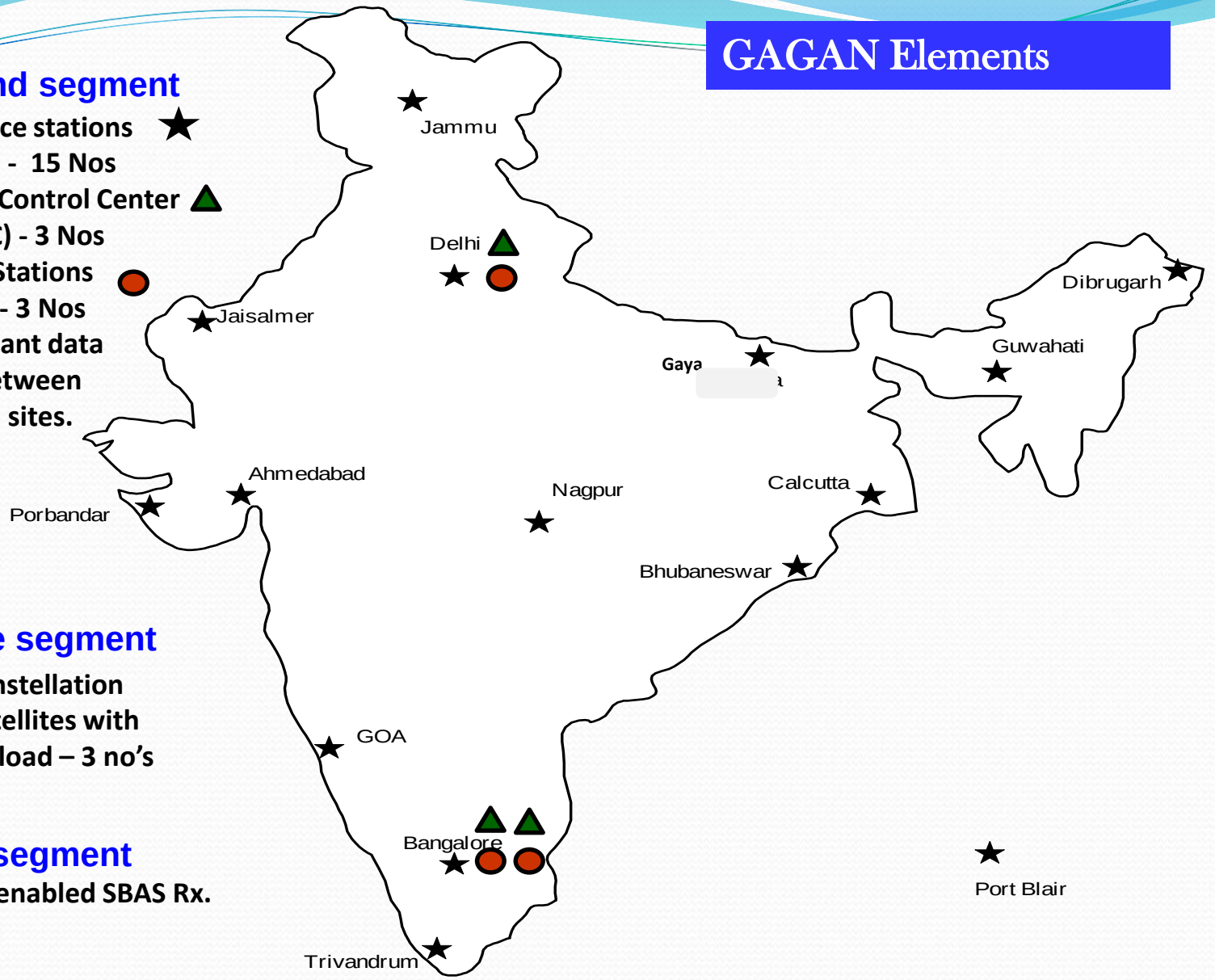
1. Reference stations (INRES) - 15 Nos
2. Master Control Center (INMCC) - 3 Nos
3. Uplink Stations (INLUS)- 3 Nos
4. Redundant data links between GAGAN sites.

B. Space segment

1. GPS Constellation
2. GEO Satellites with nav payload – 3 no's

C. User segment

GAGAN enabled SBAS Rx.



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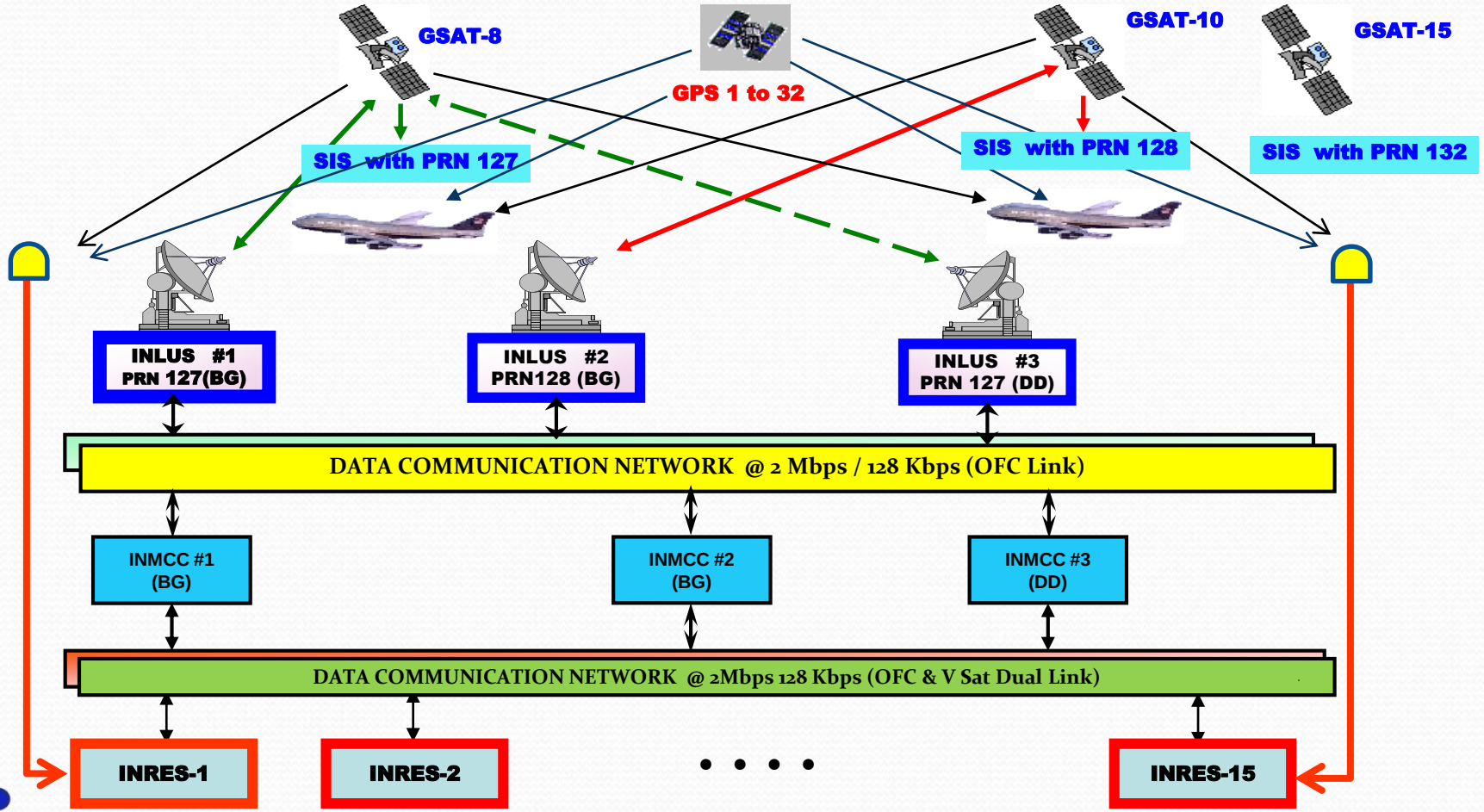
GAGAN Architecture



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GAGAN Infrastructure - INRES

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GAGAN Infrastructure- INMCC & INLUS Equipment

INMCC

CVSS and DCSS

INLUS

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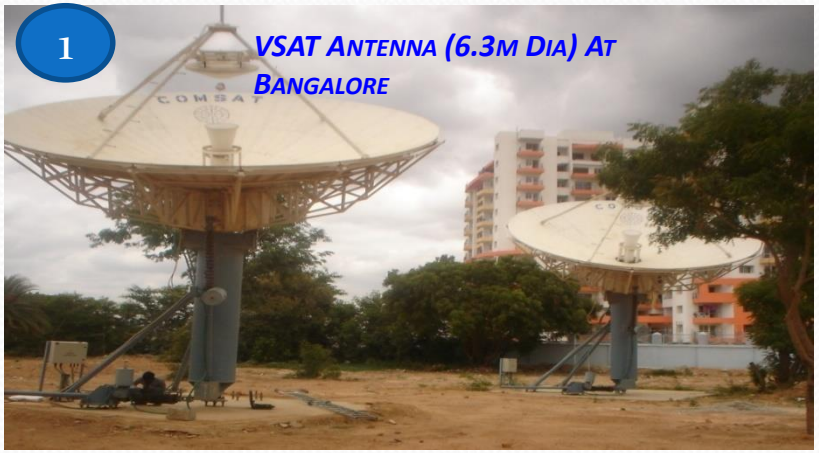
GAGAN Infrastructure – Building & Antenna Structures



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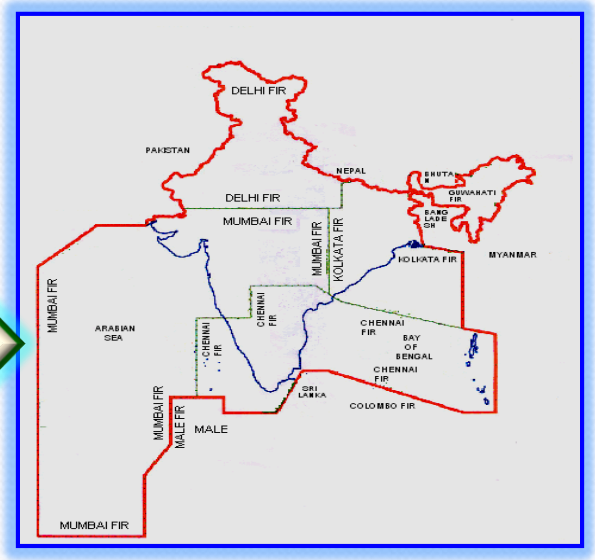
GAGAN Services & Status

GAGAN provides the following air navigation services meeting ICAO SARPS.

- RNP 0.1 within India FIR
- APV-1 in the landmass of Indian FIR.
  (Due to impact of ionosphere behavior over the equatorial regions, availability of GAGAN APV -1 service is better than 76% of landmass on nominal iono days .



- **Current Transmission is on GSAT-8 (PRN-127) & GSAT-10 (PRN-128)**
- **Integrations activities with third GEO satellite GSAT-15 (PRN 132) are in progress. Expected to be completed by July 2018.**

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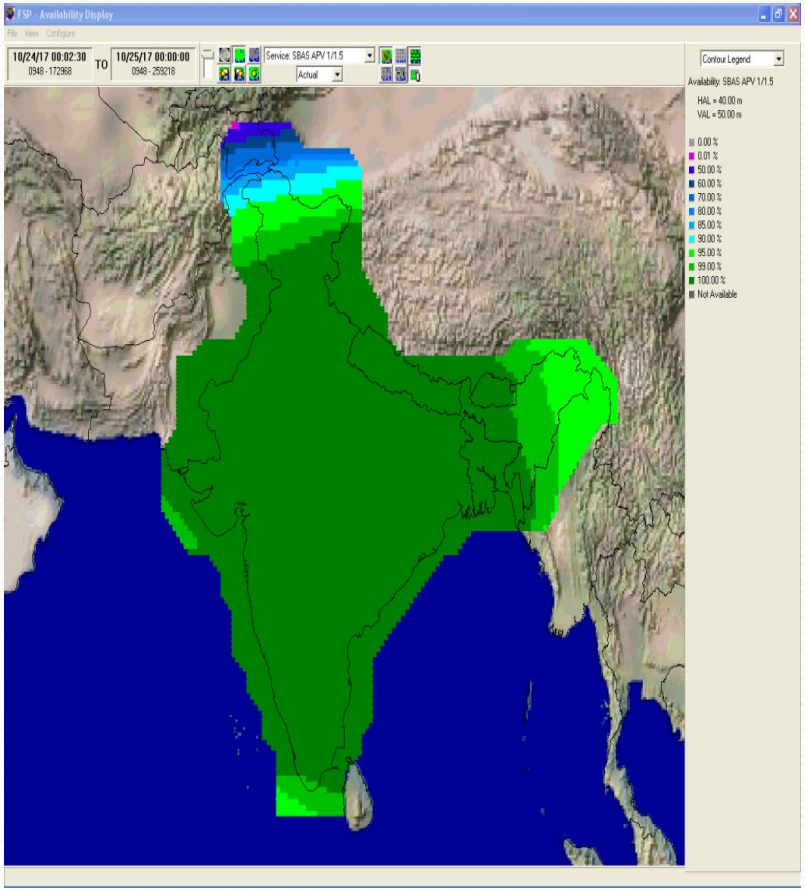
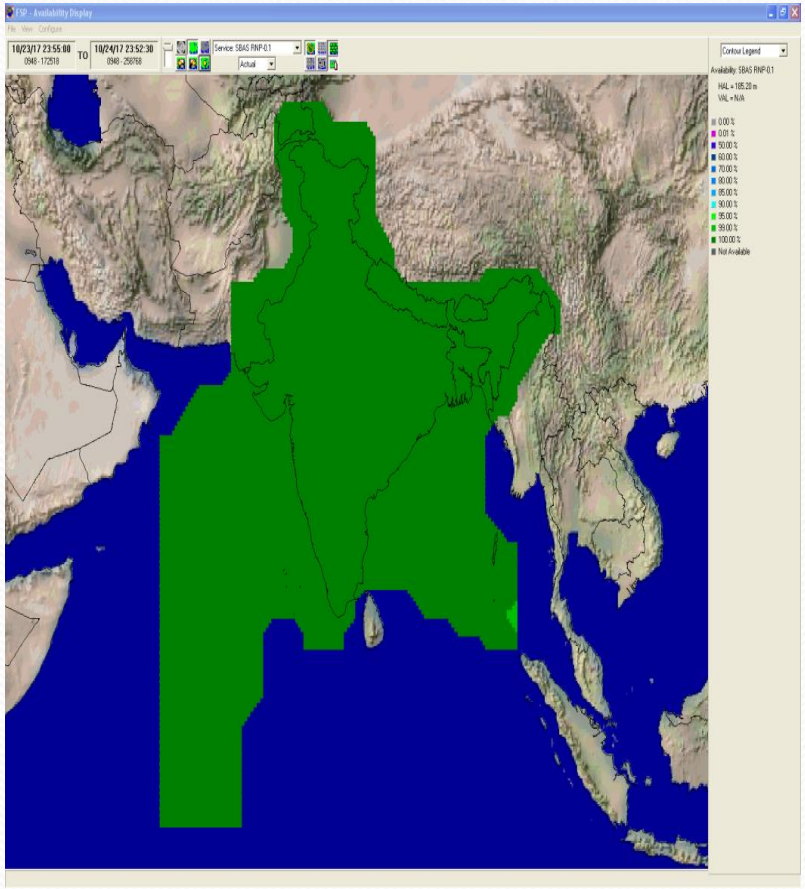
24 hours Service Availability plot (24th Oct. 2017, 00:00 to 23:59 UTC)

APV-1 Service



RNP 0.1 Service



GAGAN Real time system performance is available at

http://gagan.aai.aero

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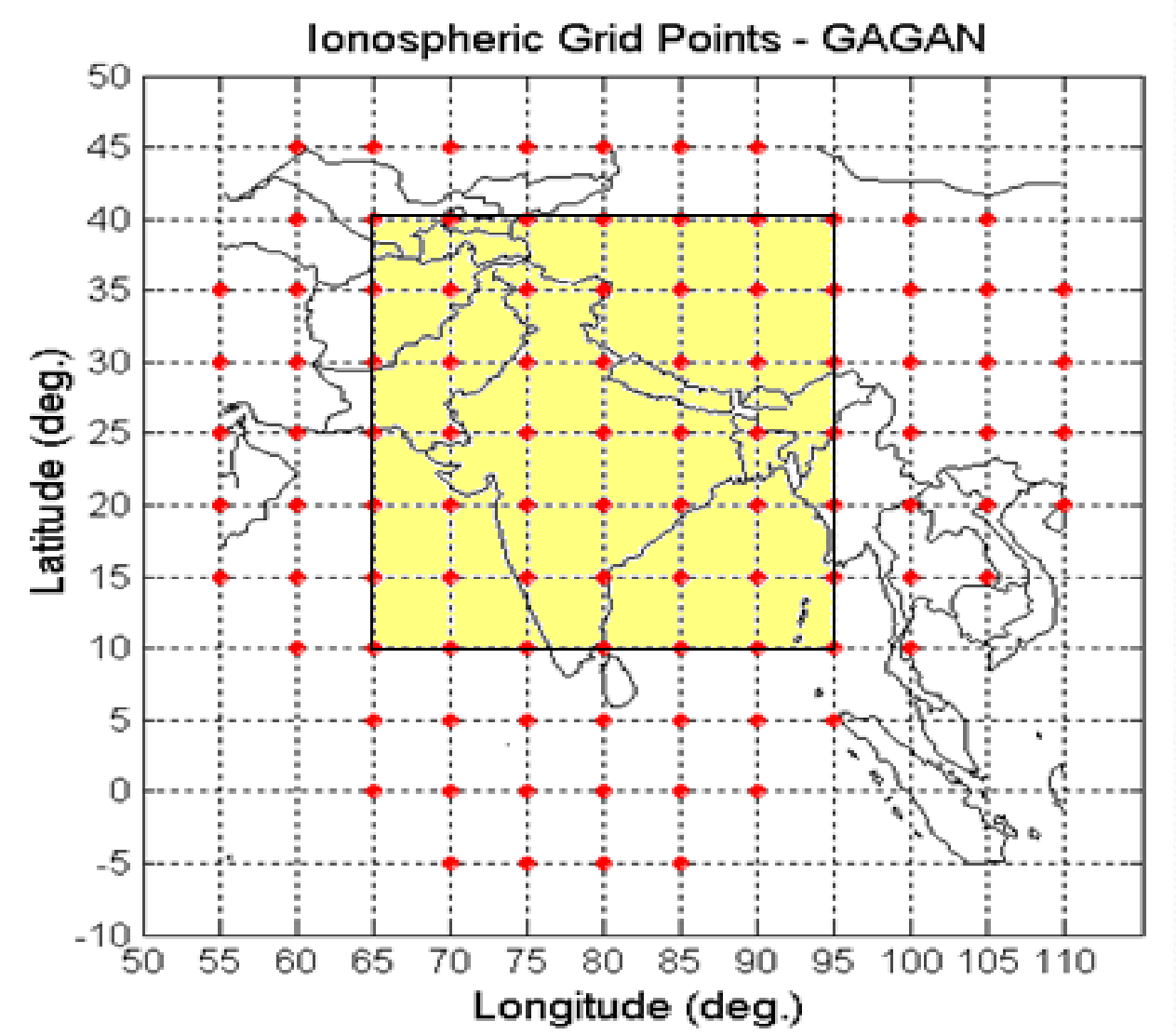
IGP's serviced in the existing GAGAN system



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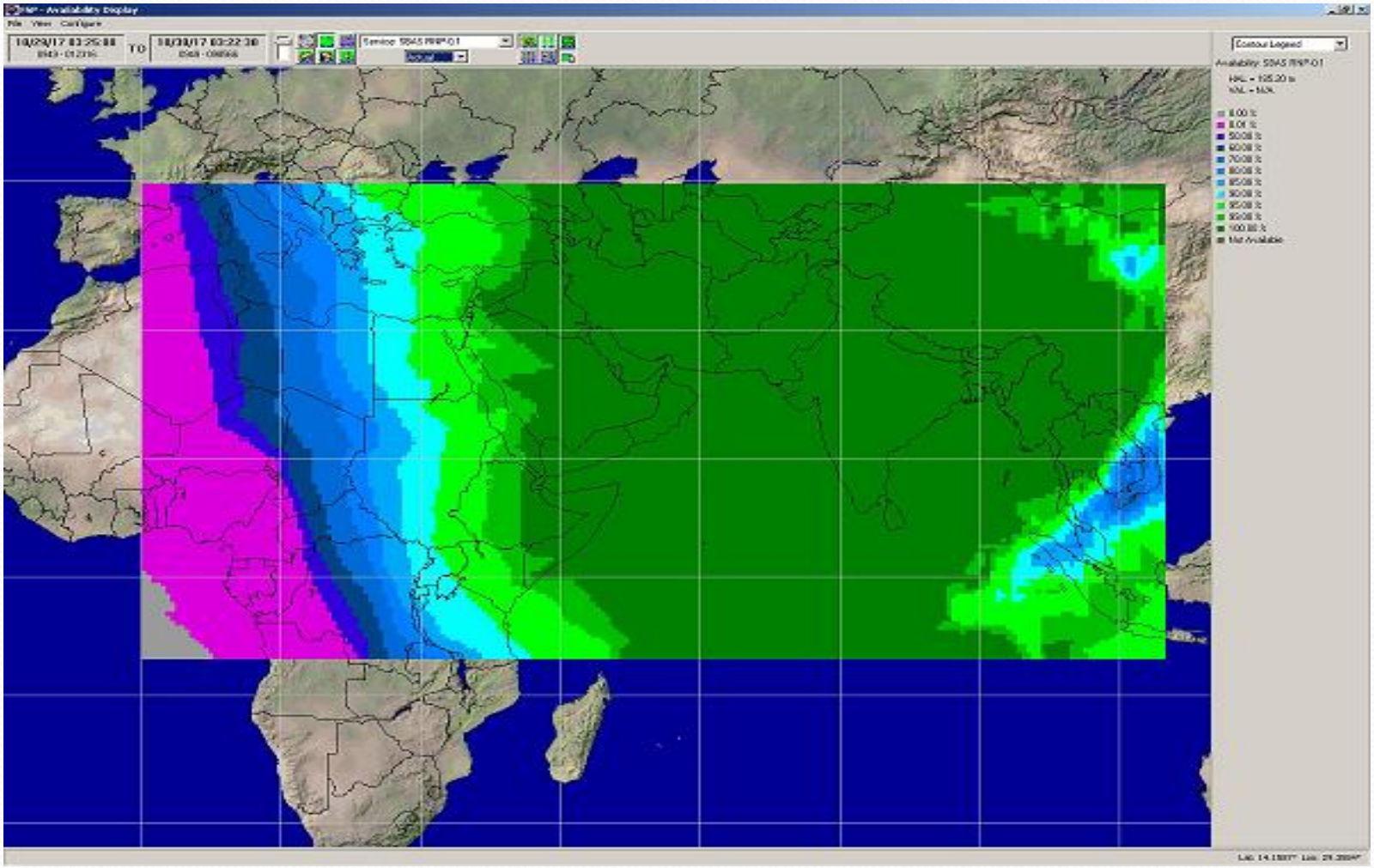
Existing GAGAN RNP 0.1 Coverage beyond the Indian Region



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GAGAN Performance during last one year

- **Average Availability value of RNP0.1 service is 100% of Indian FIRs.**

- **Average Availability value of APV 1.0 service is better than 76% of Indian Landmass during nominal days of ionosphere activity.**

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Promotional Activities in India – User Segment

- As per National Civil Aviation Policy (NCAP-2016), Ministry of Civil Aviation, India mandated that:
  - All new aircraft, registered in India to be GAGAN enabled from 1st January 2019. Forward fit notification by DGCA very soon, as per NCAP 2016
  - All aircraft, registered in India, to be GAGAN enabled from 01.01.2024
- DGCA, India to provide necessary amendments in CAR, CAP and Airworthiness Procedure Manual (APM)

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Works in Hand

- Development of APV procedures for 20 Airports are in the progress. The APV procedure for 3 airports i.e. Ahmedabad, Lucknow and Nagpur has been developed. Testing & validation of these procedures is being taken up shortly.

- In the next few years, GAGAN APV procedures development for almost all operational airports in India.

- GSAT 15 integration.

FURURE PLANS:

Expansion of GAGAN Services to Neighboring Countries having GAGAN GEO Foot prints.

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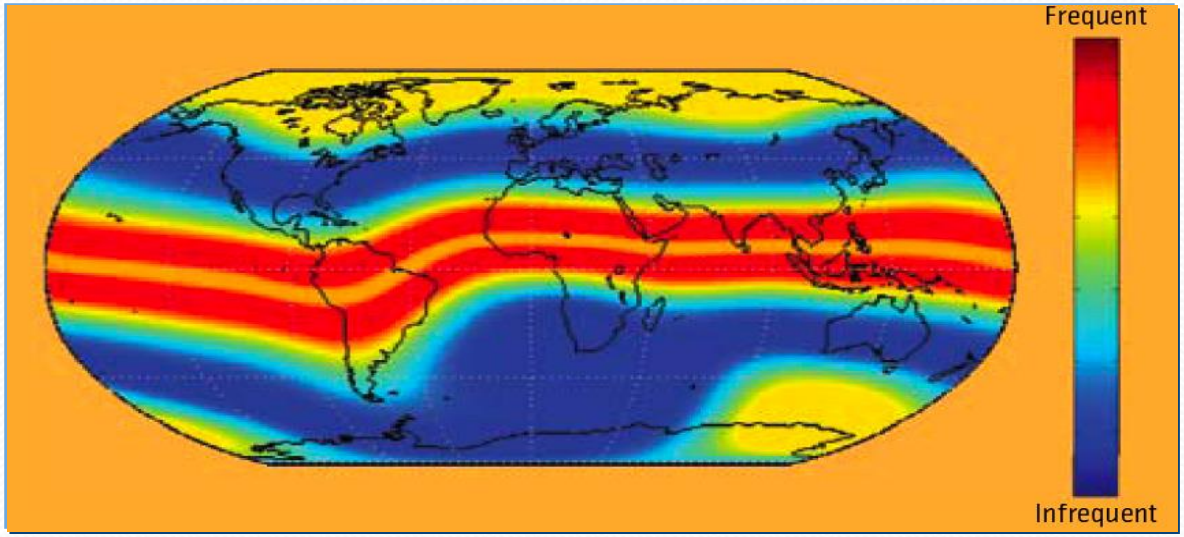
Suitability of GAGAN in the Gulf region

- Both India and Gulf regions are on equatorial anomaly region .
- Ionosphere Scintillation is most intense and most frequent in the equatorial region.



- Ionosphere Scintillation severely affects the performance of SBAS.
- An MLDF (Multi Layer Data Fusion) iono model suitable to serve the equatorial anomaly region was developed by ISRO and implemented in GAGAN system .
- Gulf region falls within the GAGAN GEO foot print.

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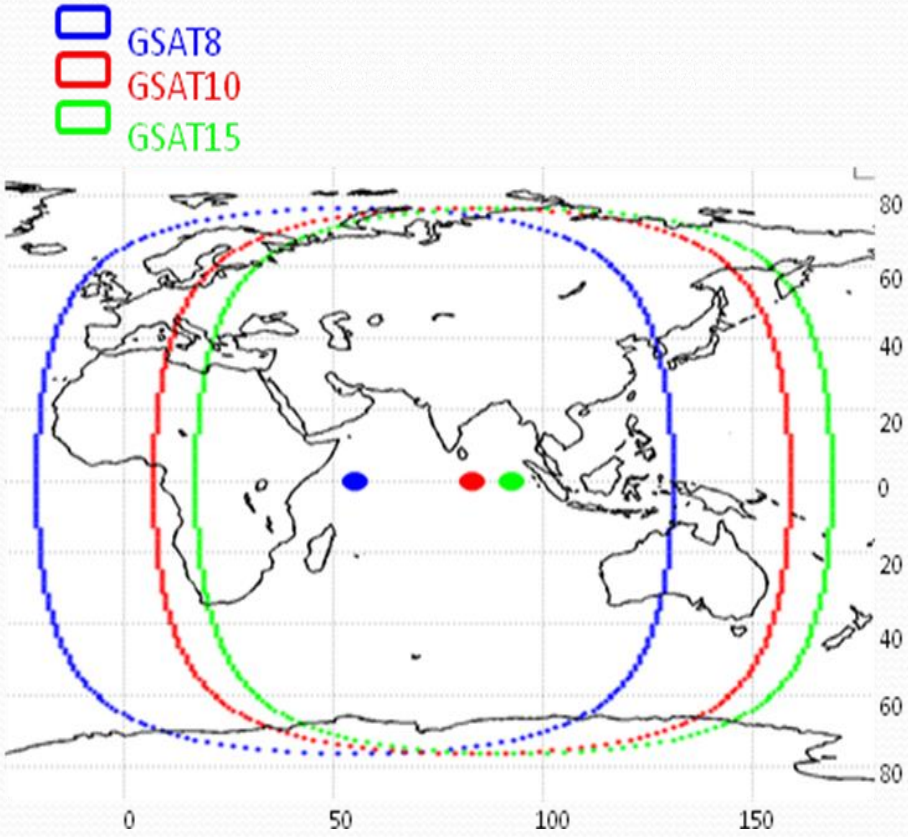
Extension of the GAGAN services to Gulf region

- GAGAN GEO footprint extends from Africa to Australia.
- In the existing GAGAN system 102 IGP's are serviced and RNP 0.1 coverage is available much beyond the Indian region.
- GAGAN system can support up to 45 reference stations.
- By installing additional reference stations at strategic locations in gulf region and forward the measurements data to GAGAN-INMCC, more IGP's can be serviced and RNP 0.1/APV 1 services can be extended to gulf region.



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Major Activities Involved to add reference stations for extension of GAGAN services

- Indentify strategic locations and conduct a preliminary site survey.
- Carry out Multipath, RF Interference survey & elevation profile at the identified sites.
- Develop necessary Civil and electrical infrastructure at the selected site.
- Establish reliable data links between reference station and master control center. Conduct data links testing. One way latency of satellite links should be less than 500 msec.
- Procure the Reference station equipment.
- Install and Test the Reference equipment at site.
- Integrate with Master control center and conduct stability test.
- Safety analysis, Documentation.
- Certification by the regulator.

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Strengths of AAI-ISRO

- AAI, as GAGAN service provider has the capability of
  - Reference stations sites selection and identification of site infrastructure requirement.
  - Engineering Support for Site infrastructure development.
  - Installation & testing of reference stations and test reports generation.
  - Support to establish & test data communication links to Master Control Center.
  - Integrate reference station with Indian Master Control center
  - Carryout Stability test, test reports generation
  - Support for certification.
  - Train personnel for operation and maintenance.
  - Evaluation of SBAS SIS
- Neighboring states can take advantage of GAGAN infrastructure to implement the RNP 0.1 and APV 1 service in the respective states without having the full SBAS infrastructure in their country.
- GAGAN has become the third in the world to have such Precision Approach Capability.

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Additional Service Planned - GAGAN MESSAGE SERVICE (GAMES)

- Plan to utilize GAGAN signals for broadcasting short service messages with suitable changes in the message structure via GEO satellites.
- Early Warning messages on the occurrence of natural disasters, calamities, dangers for the safety of life within GAGAN coverage area :
    - Search and Rescue Messages
    - Relief and mitigation related messages
    - Meteorological information
- Users having the possibility to process the messages can extract the enclosed information and use it in the way they need.

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Feasibility of GAGAN Message Service (GAMES)

- RTCA DO229C MOPS standard defines the minimum update rate that needs to be respected by SBAS to comply with the safety of life requirements

- SBAS has to respect minimum update rate of corrections and integrity messages to comply with safety-of-life requirements (primary mission)
- - About 35% of bandwidth 75 bits out of 250 bits is still available

- Plan to utilize Message Type 63 for transmission of GAMES

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Advantages of GAMES

- Free Service
- Users equipped with GAGAN receivers know their position along with alert
- Confirmation of transmission and timely delivery of message is guaranteed as GAGAN is basically a SoL system
- Service availability ensured all the time
- Wider coverage area
- GNSS positioning functionality already embedded in many smart phones and personal devices
- Better control over message service as the system is controlled by government agencies
- No additional requirement for local infrastructure
- Resilience to terrestrial disturbances
- Low operational cost
- Capability to support different type of alerts simultaneously

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GAGAN Service to Neighbouring Nations

- **Service to all neighbouring countries such as Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Myanmar, Sri Lanka etc. is possible.**

- **Countries of South East Asia, such as Thailand, Indonesia, Malaysia, Singapore and others over Australia and Africa falling within GEO footprint subject to installing Indian Reference Stations (INRES).**

- **Aviation in the region will be greatly enhanced with the use of GAGAN as it is an enabler for transition to seamless satellite navigation based on the ICAO framework for Aviation System Block Upgrades (ASBU).**

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Assistance by India to other countries

- **Support in RFP Preparation & Evaluation**
- **Assistance for Site Selection for Reference Stations, Up link Stations & Master Control Stations**
- **Engineering Support for Site infrastructure development**
- **Engineering Support in establishing data communication Network**
- **Evaluation of Vendor Supplied Technical Documents**
- **Support for Equipment FAT/Installation/SAT/System Integration & Testing**

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Assistance by India to other countries

- **System Performance Evaluation/System Anomaly analysis & Resolution.**
- **Operational Test & Evaluation using S/W Tools**
- **Support for Certification Activities**
- **Training for Operation & Maintenance personnel**
- **Support for SBAS procedures design and development**

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Thank you

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