





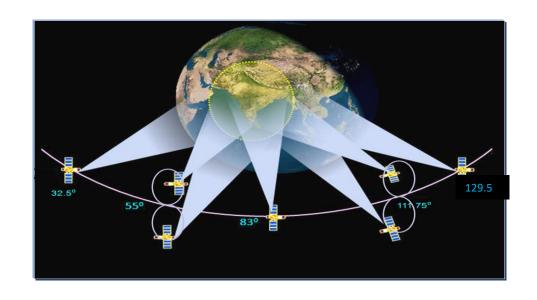
NavIC and GAGAN System Update

Satellite Navigation Programme
Indian Space Research Organization (ISRO) /India



Satellite Navigation Programme







NavIC – the Indian Regional Navigation Satellite System

- Provides SPS (civilian) and RS (Restricted) services in L5 and S band
- Service area is India and 1500 km beyond its Indian Landmass.

GAGAN- GPS Aided GEO Augmented Navigation

- Provides Air Navigation service (Safety of Life) over Indian Flight Information Region (FIR)
- GAGAN certified for RNP 0.1 and APV 1



NavIC Architecture



Space Segment	
Nominal Constellation	7 satellites (3 GSO, 4 IGSO)
Ground Segment	
Navigation Centres	2
One way ranging stations	17
Two way ranging stations	5 (+ 1 upcoming)
Network Timing Centre	2 (upgraded with in-house timescale)
Spacecraft Control Centre	2
Frequency band	L5, S and L1*
Service	SPS and RS





Current status and Update



- NavIC constellation is functional and 1st of the Follow-on satellites NVS 01 with indigenous atomic clocks is launched on 29th May 2023.
- SPS service (civilian service) in L1 frequency band (NVS-01 onwards) with SBOC modulation and IZ4 PRN codes.
- New SPS signal in the L1 band is compatible and interoperable with other GNSS civilian signals in L1 band.
- NavIC adopted for assisted-GNSS by Global standards body 3GPP. NavIC is included in the Release-16 LTE specification.
- NavIC is incorporated into the AIS 140 (Automotive Industry Standard) standard of India.
- NavIC has been incorporated in the NMEA 0183 standard.
- NavIC has been incorporated in the RTCM (Radio Technical Commission for Maritime services) 10403.3 standard.
- NavIC has been accepted as a component of the World Wide Radio Navigation System (WWRNS) for operation in the Indian Ocean Region by the International Maritime Organization (IMO).
- NavIC receiver standard for maritime equipments IEC 61108-6 has been released in 2023



Current status and Update



- New Iono algorithm NeQuick has been introduced in newly released SIS L1 ICD
- NavIC provides one way broadcast messages for users in Indian region through IRNSS-1A and 1E satellites. Web based interface for message submission through internet.
- One-way broadcasts are being used presently by INCOIS for providing Potential Fishing Zone messages, Cyclone & High wave alerts etc. to fishermen across the country
- NavIC Service Advisory portal is planned to be launched in 2023.
- Indigenous Time Scale system has been developed and is operational.
- Major smartphone chipset manufacturers (Qualcomm, and Mediatek) have included NavIC in their SoC and NavIC services are available across different mobile handsets.
- NavIC Message Authentication service is planned and system level testing is going ON
- Impact of continuous UTC is being studied by NavIC.

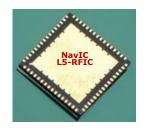


NavIC and Industry



ISRO Designs: NavIC-Only





NavIC+GAGAN/GPS: 2 Types

Pioneer- Sktraq NavIC-Only



NavIC+GAGAN/GPS: 2 Types





NavIC-Only























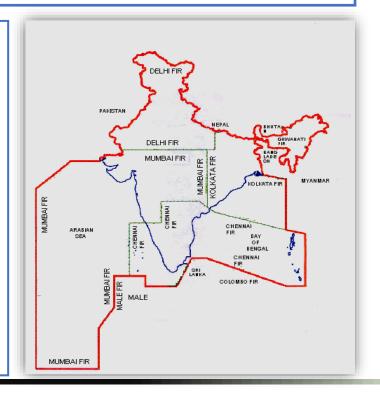


GAGAN SBAS System



Joint development by ISRO and Airports Authority of India

- > To deploy and certify an operational SBAS for India
- > To achieve an RNP0.1 capability over Indian FIR and
- > To provide APV-1 service over Indian land mass on nominal days
- GAGAN Technology Demonstration System (TDS)
 Minimum set of ground and space elements implemented to demonstrate the proof of concept
- GAGAN Final Operational Phase (FOP) Certifiable SBAS built over the TDS elements with additional ground and space elements





GAGAN Status and Update



GAGAN Certified by DGCA

- RNP 0.1 Operations over Indian FIR, 30th Dec 2013
- APV 1 Operations over Indian Landmass, 21st April 2015
- GAGAN is fully operation since the month of May 2015

Three GEO S/C carry GAGAN payload

GSAT-8 at 55° : GAGAN signal with PRN127

GSAT-10 at 83° : GAGAN signal with PRN128

GSAT-15 at 93.5° : GAGAN signal with PRN132

Compatible and Interoperable with other SBAS to provide Seamless navigation

First SBAS system to serve the equatorial anomaly region



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

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 axceeding 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 fable to be suspended/modified withdrawn or subject to any limitations or conditions, if may violation of the provisions of the Aircraft Act 1934 & the Aircraft Rules 1937, or any order/direction/ equivements issued under the said Act/Fulse is observed.

This certificate is non-transferable

Place

: New Delhi

Date of Issue: 21.04.2015



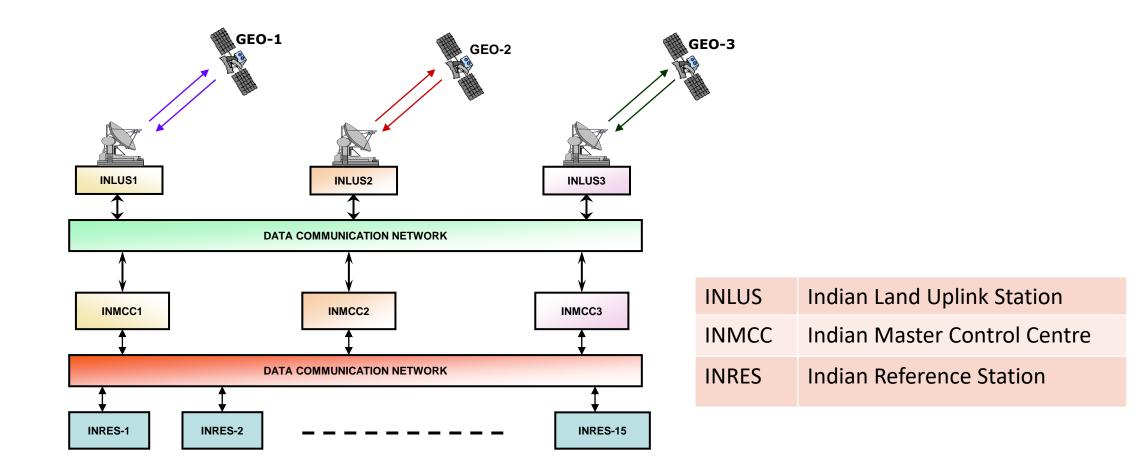
Battyawatt-Director General Civil Aviation

ISRO-India



GAGAN Architecture







GAGAN-Current Status & Update



- LPV Procedure development activities in progress.
- Eight LPV Procedures for 5 Airports published.
- More procedures will be added soon.
- More than 250 Aircrafts are equipped with GAGAN Receivers
- GAGAN Messaging Service (GMS) is used by INCOIS to broadcast alert messages to fishermen.
- 139 GMS receivers are installed on ships
- GMS is the part of Common Alert Protocol (CAP) project of NDMA for broadcasting Alert/Emergency messages.
- Real-Time Train Tracking Information System (RTIS) of Indian Railways.
- Installed in 2700+ LOCOs







