

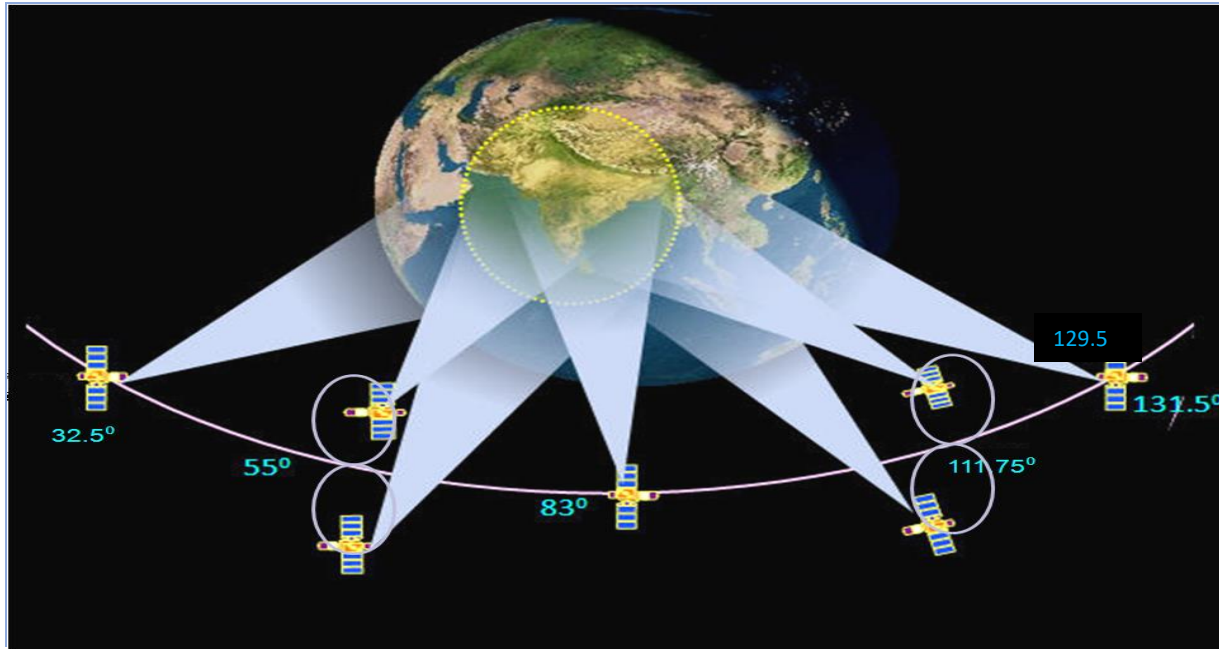


NavIC and GAGAN System Update

G Ramarao

Satellite Navigation Programme

Indian Space Research Organization (ISRO) /India



NavIC – the Indian Regional Navigation Satellite System

- Provides SPS (civilian) in L1, L5 and S bands and RS (Restricted) services in L5 and S bands.
- Service area is India and 1500 km beyond Indian main land.



GAGAN- GPS Aided GEO Augmented Navigation

- Provides Air Navigation service (Safety of Life) over Indian Flight Information Region (FIR).
- 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



* Civilian service in L1 band from the replacement NavIC satellite NVS-01 onwards

NavIC current status and update

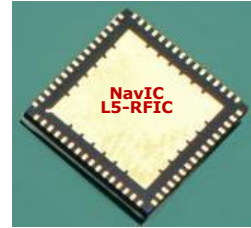


- NavIC constellation is functional. NVS 01 satellite with on-board indigenous RAFS launched on 29 May 23.
- Interoperable SPS civilian signal is incorporated in L1 band with SBOC modulation and IZ4 PRN codes.
- NavIC has been adopted for assisted-GNSS by global standards body 3GPP and included in the Release-16 LTE specifications.
- Incorporated into the AIS 140 standard of India.
- Incorporated in the NMEA 0183 standard.
- Incorporated in the RTCM 10403.3 standard.
- Accepted as a component of the WWRNS for operation in the Indian Ocean Region by IMO.
- NavIC receiver standard for maritime equipments IEC 61108-6 has been released in 2023.

- Ionospheric correction algorithm NeQuick incorporated in NavIC L1 SPS. SIS L1 ICD Released.
- NavIC provides one way broadcast messages for users in Indian region through IRNSS-1A and 1E satellites. Web based interface for message submission is through internet. One-way broadcasts are being used presently by INCOIS for providing Potential Fishing Zone messages, Cyclone & High wave alerts etc 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 (NMA) service is planned and is under system level testing.
- Impact of continuous UTC on GNSS is being studied.

NavIC and Industry

ISRO Designs: NavIC-Only



Pioneer- Skytraq NavIC-Only



NavIC+GAGAN/GPS : 2 Types



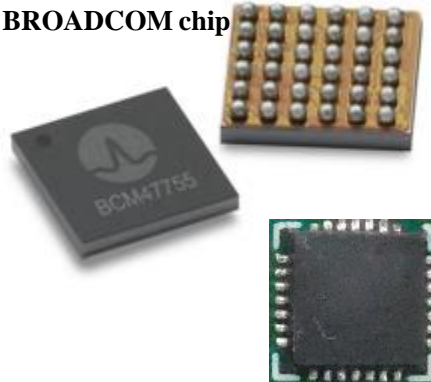
NavIC-Only



NavIC+GAGAN/GPS : 2 Types



BROADCOM chip



Objective

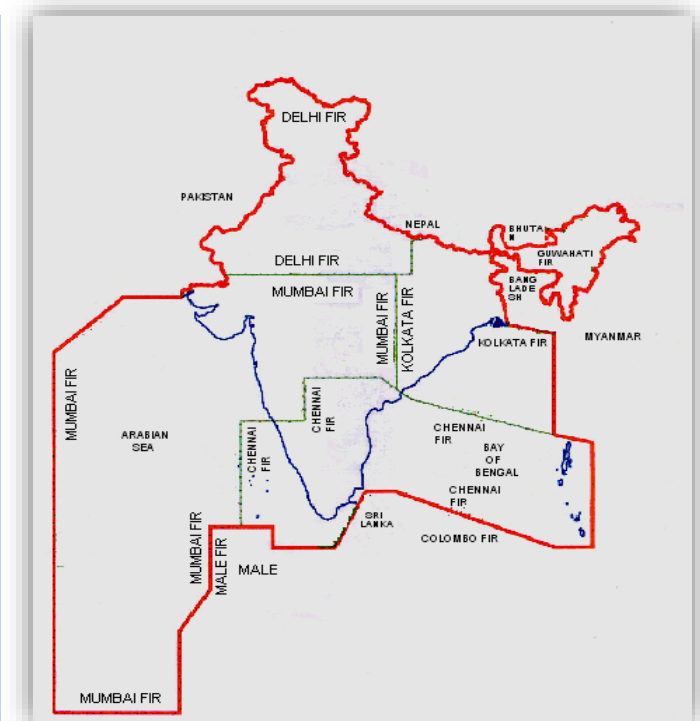
- To deploy and certify an operational SBAS for India
- To achieve RNP0.1 capability over Indian FIR
- To provide APV-1 service over Indian land mass on nominal days

❖ 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, India

- 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

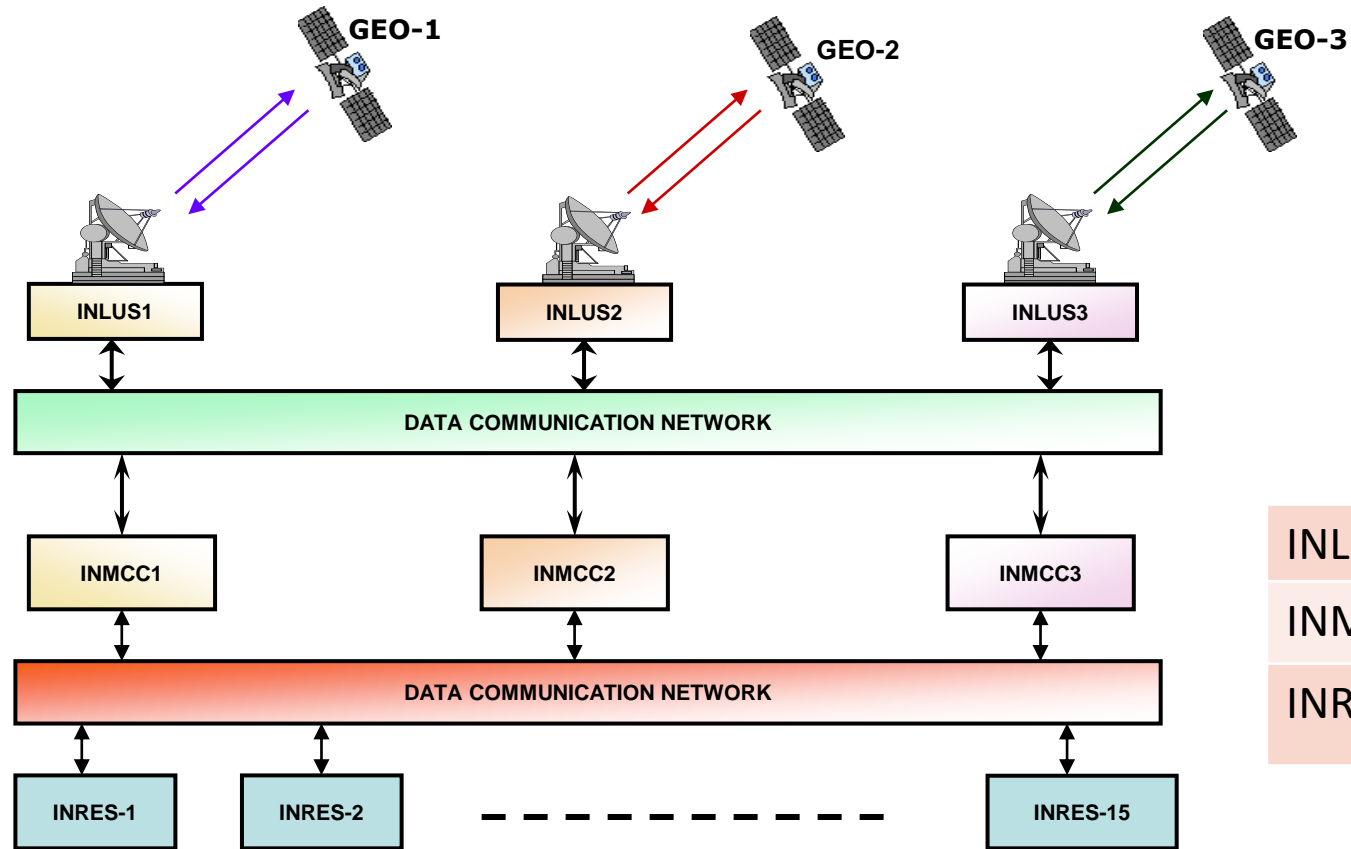
Three GEO S/C carry GAGAN payload

- 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





INLUS	Indian Land Uplink Station
INMCC	Indian Master Control Centre
INRES	Indian Reference Station

- LPV Procedure development activities in progress. 8 LPV Procedures for 5 Airports published. Further procedures covering more airports will be added soon.
- More than 250 aircraft 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+ locomotives.



Thank You

