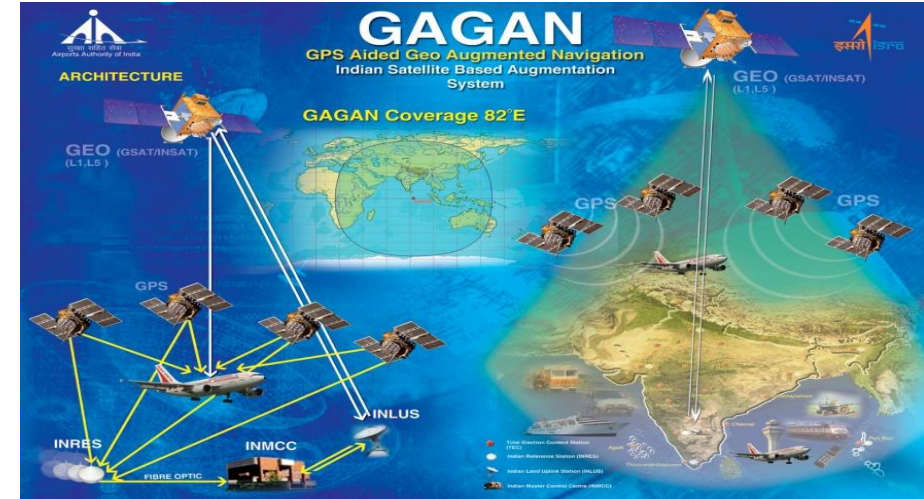
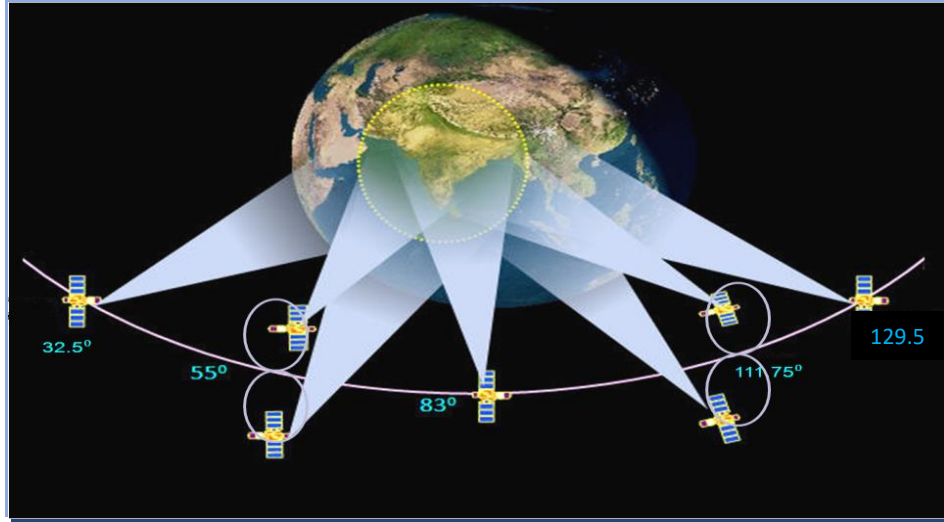




NavIC and GAGAN System Update

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



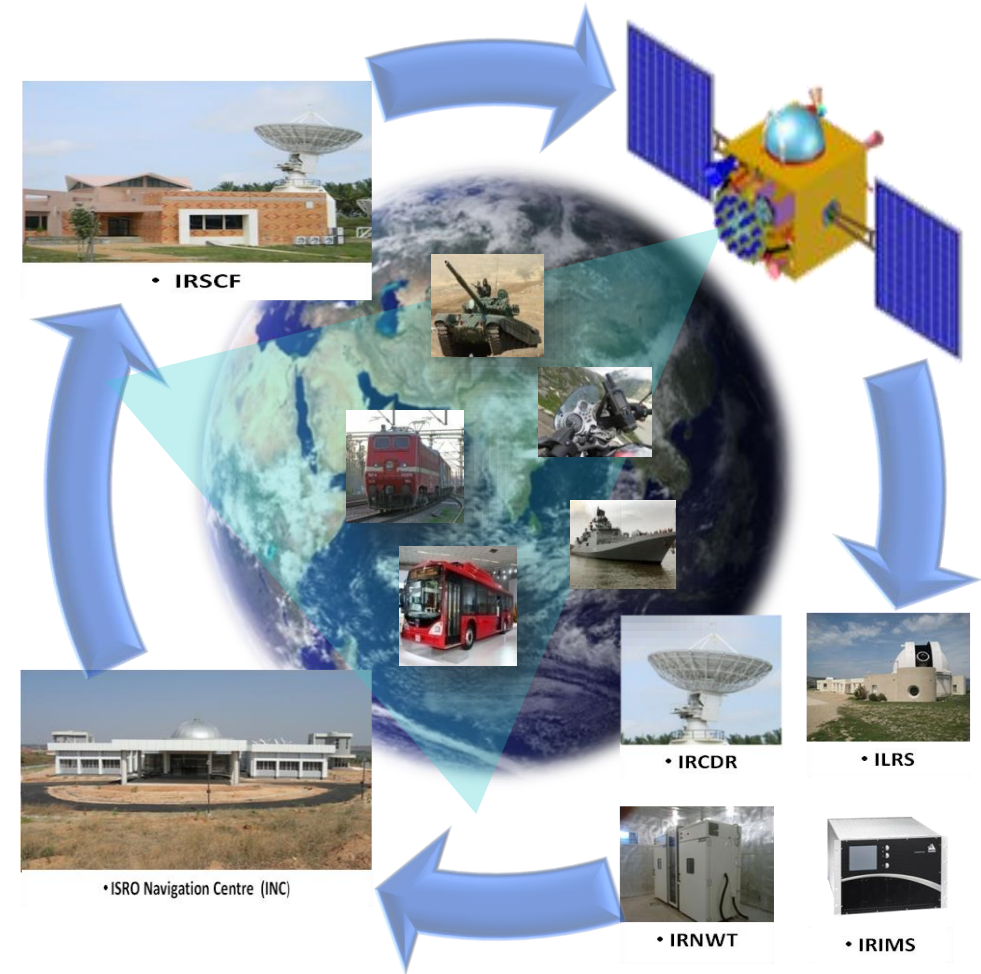
NavIC – the Indian Regional Navigation Satellite System

- 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

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



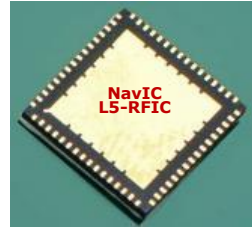
*Civil signals in L1 band from NVS-01 satellite onwards^{ISRO-India}

- 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

- New Ionosphere 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



Pioneer- Sktraq NavIC-Only



NavIC+GAGAN/GPS : 2 Types

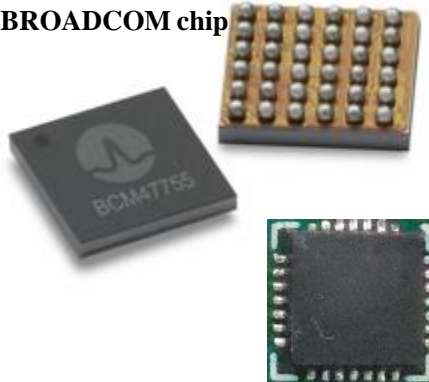
NavIC-Only



NavIC+GAGAN/GPS : 2 Types



BROADCOM chip



Joint development by ISRO and Airports Authority of India

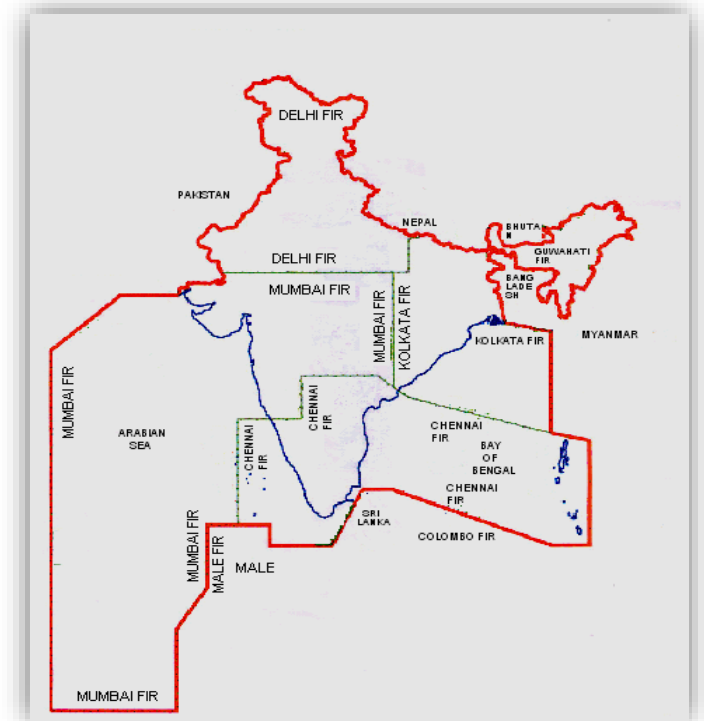
- To deploy and certify an operational SBAS for India
- To achieve an RNP0.1 capability over Indian FIR and
- To provide APV-1 service over Indian land mass on nominal days

❖ 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

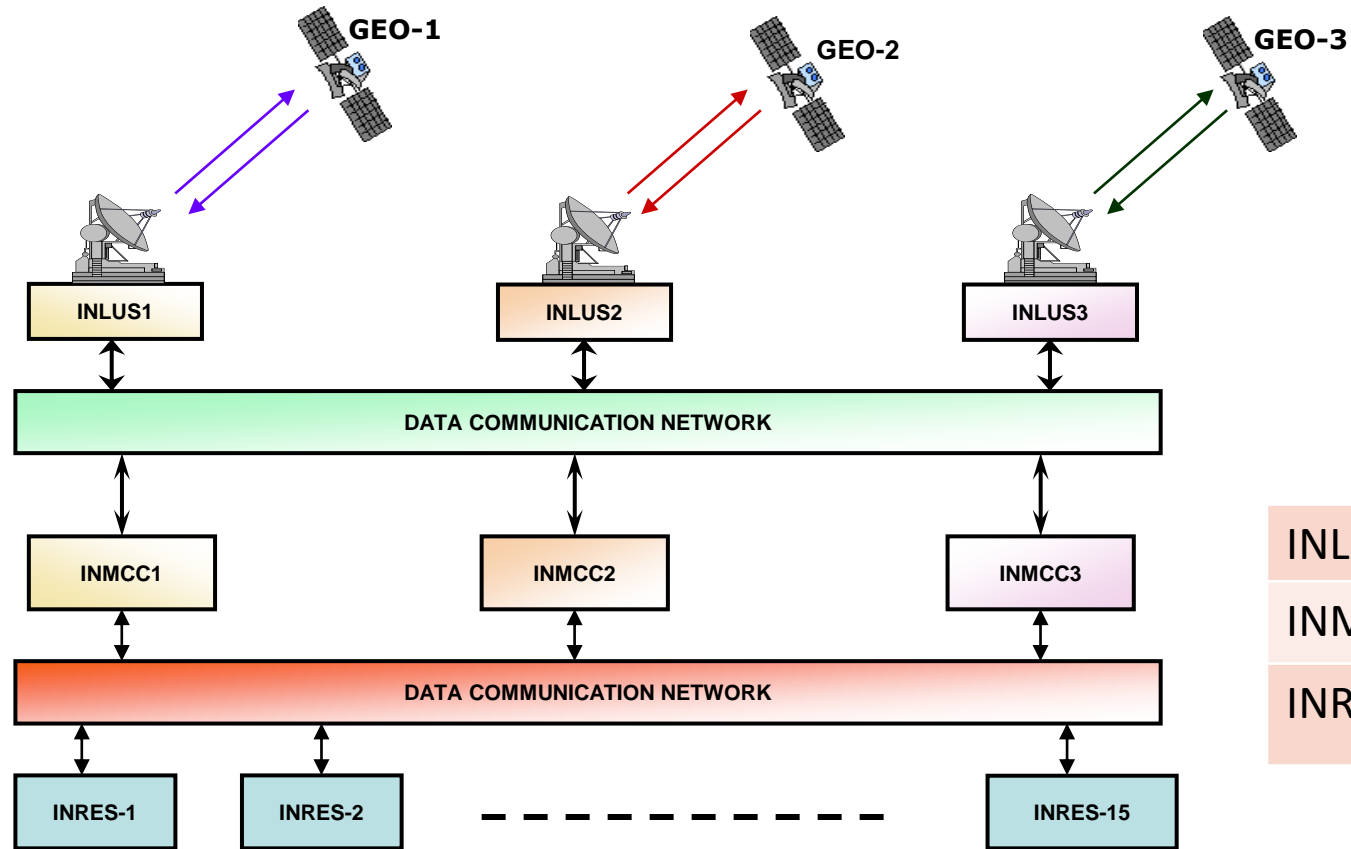
Three GEO S/C carry GAGAN payload

- 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





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

- 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



Thank You

