



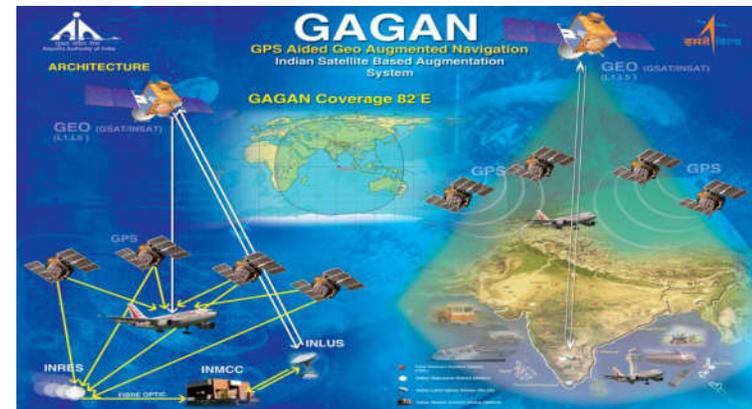
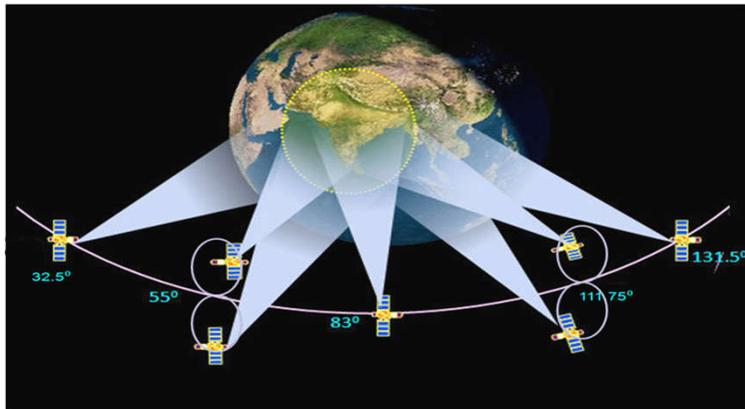
NavIC and GAGAN System Updates



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Satellite Navigation Programme - India



NavIC: Indian Regional Navigation Satellite System

- Provides SPS (civilian) and RS (Restricted) services in L5 and S band
- Service area: India and 1500km beyond its geo-political boundary.

GAGAN: GPS Aided GEO Augmented Navigation

- Provides Air Navigation services (Safety of Life) over Indian Flight Information Region (FIR)
- GAGAN certified for RNP 0.1 and APV 1.0

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
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 planned from NVS-01 satellite onwards



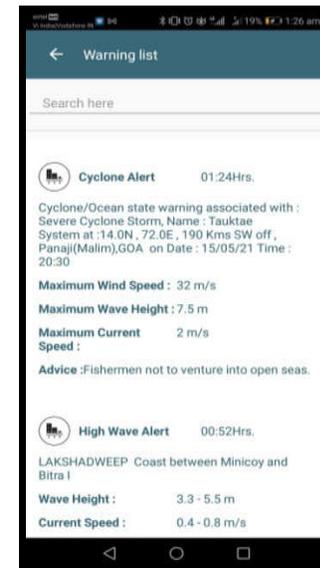
Current status Update



- NavIC constellation is operational and Follow-on satellites are under realization with indigenous atomic clocks. Next launch scheduled for Q4-2022.
- SPS service (civilian service) in L1 frequency band in the upcoming satellites (NVS-01 onwards) with SBOC modulation and IZ4 PRN codes.
- New SPS signal in the L1 is compatible and interoperable with other GNSS 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) 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).

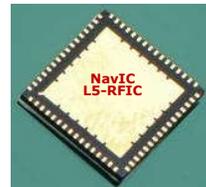
Current status Update – Contd..

- NavIC is offering short messaging service for users in Indian region through IRNSS-1A and 1E satellites. Web based interface for message submission through internet.
- Messaging service is presently used by INCOIS for broadcasting Potential Fishing Zone messages, Cyclone & High wave alerts etc. to fishermen across the country
- NavIC Service Advisory portal is planned to be launched by end 2022.
- Indigenous Time Scale system has been developed and made operational.
- Major smartphone chipset manufacturers (Qualcomm and Mediatek) have included NavIC in their SoC and NavIC services are available across different mobile handsets.



NavIC and Industry

ISRO Designs: NavIC-Only



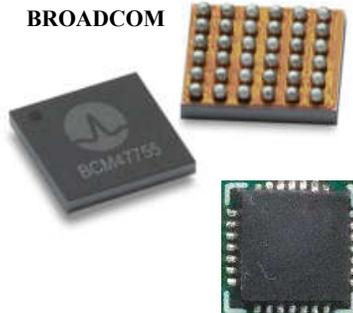
Pioneer- Sktraq NavIC-Only



NavIC+GAGAN/GPS : 2 Types



BROADCOM



GAGAN SBAS System

Joint development by ISRO and Airports Authority of India

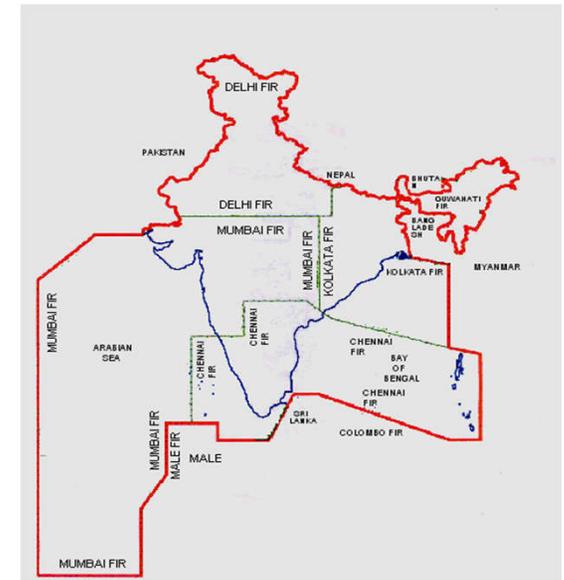
- To deploy and certify an operational SBAS for India
- To achieve an RNP0.1 capability over Indian FIR and
- To Provide APV-1 service over Indian land mass on nominal days

❖ 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 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,
providing Seamless navigation





GAGAN Status Update – Contd..



- AAI has developed 65 localizer performance with vertical guidance (LPV) procedures. GAGAN based LPV approach Procedure validation completed. Passenger aircrafts have started utilizing GAGAN based procedures for approach and landing.
- DGCA Mandated that all aircrafts being registered in India after July 1, 2021 shall be suitably equipped with GAGAN equipment.
- Demonstrated Automated Take-Off and Landing (ATOL) of Unmanned Aerial Vehicles (UAV) using GAGAN.



Thank You

