

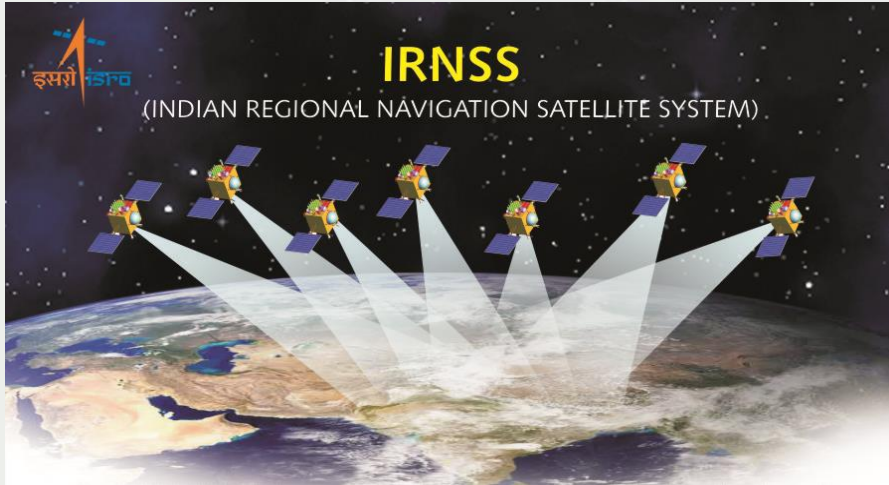


NavIC and GAGAN System Update

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NavIC – A Self Reliant Navigation

Indian Regional Navigation Satellite System (IRNSS (NavIC))

- Provides SPS (civilian) and RS (Restricted) services in L5 and S band
- Service area is India and its island and area bounded by Latitude 5°S to 50°N and Longitude 55°E to 110°E



GAGAN-Redefining Navigation

GAGAN (GPS Aided GEO Augmented Navigation)

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

NavIC Architecture

| Space Segment | |
|-----------------------------|------------|
| Satellites in Constellation | 7 |
| Ground Segment | |
| ISRO Navigation Centre | 2 |
| Reference Stations | 17 |
| CDMA Ranging Stations | 4 |
| Network Timing Centre | 2 |
| Spacecraft Control Centre | 2 |
| Frequency band | L5 and S |
| Service | SPS and RS |



Current status and Update

- Constellation operational. Follow on satellite is under realization with indigenous Atomic clock and is expected by third quarter 2020.
- Proposal to introduce SPS service (civilian service) in L1 frequency band in the up coming satellites (IRNSS 1J onwards).
- Service area is the “Primary service area” (area bounded by Latitude 5°S to 50°N and Longitude 55°E to 110°E).
- To have Compatibility and Interoperability with new L1C signal of GNSS providers.

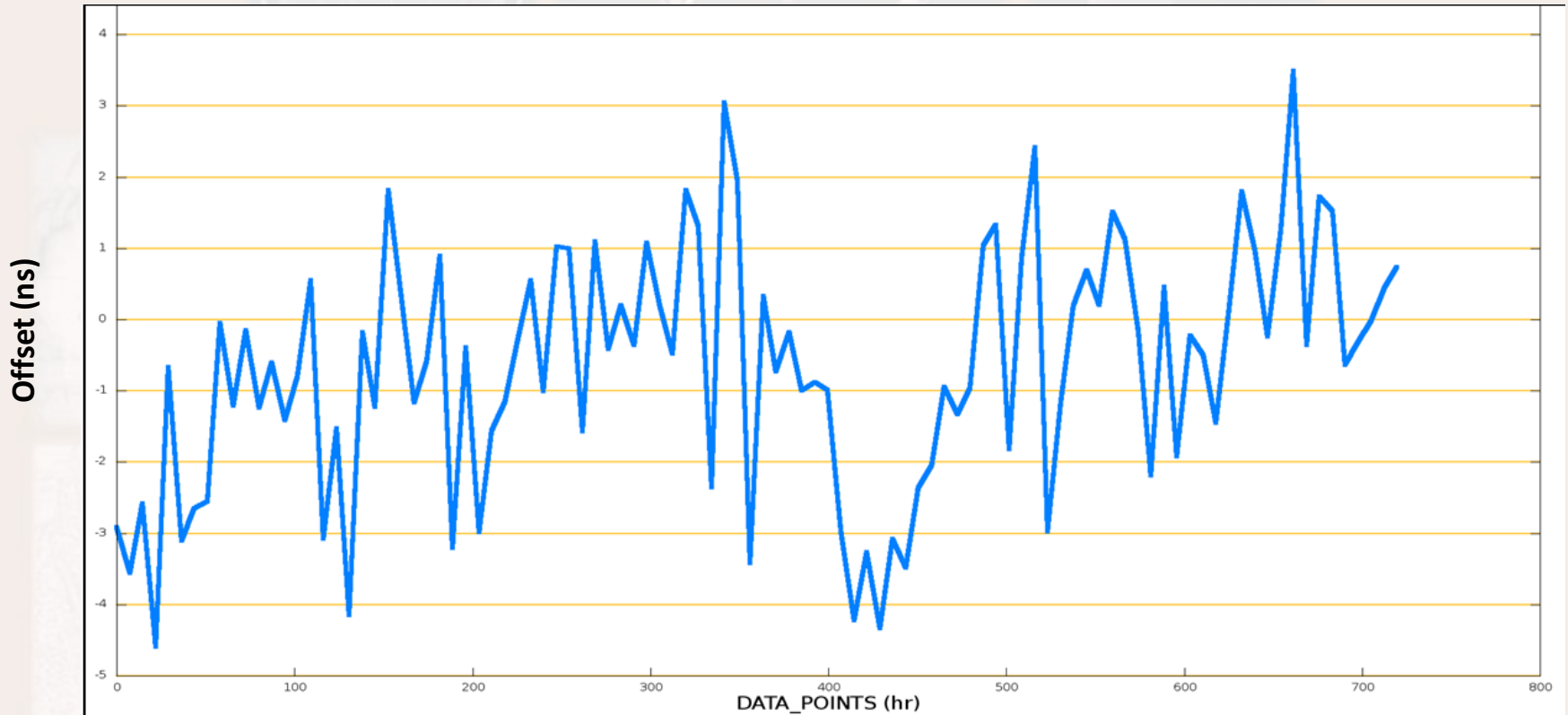
Current status and Update

- Two–Way Satellite Time and Frequency Transfer (TWSTFT) between NavIC (IRNSS) system time and National Physical Lab. (NPL), New Delhi (IST) for Traceability.
- NavIC is offering short messaging service for users in Indian region through IRNSS-1A spacecraft. Web based interface for message submission through internet.

Current status and Update

- NavIC is incorporated into the AIS 140 (Automotive Industry Standard). As per the Indian government mandate all public transport vehicles in India shall be equipped with vehicle tracking devices adhering to AIS 140.
- NavIC has been incorporated in the NMEA 0183 standard developed by National Maritime Electronics Association.
- Global standards body 3GPP, which develops protocols for mobile telephony has included NavIC for assisted GNSS support. NavIC will be included in the Release-16 LTE specification.

NavIC (IRNSS) System Time

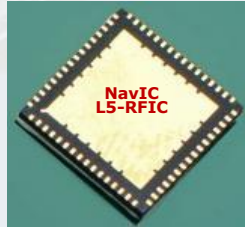


UTC(NPLI) - IRNWT

Mean: -1 ns; Standard Deviation: 2 ns

NavIC and Industry

ISRO Designs: NavIC-Only



Pioneer- Sketra NavIC-Only

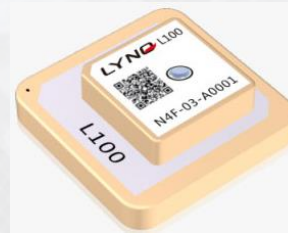


NavIC+GAGAN/GPS : 2 Types

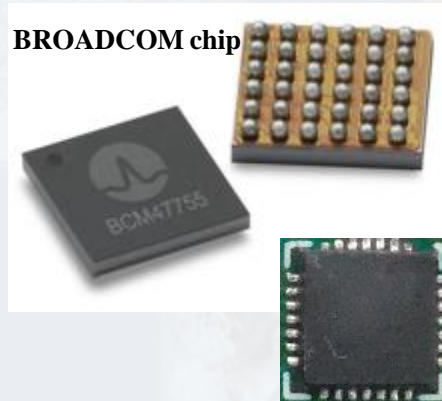
NavIC-Only



NavIC+GAGAN/GPS : 2 Types



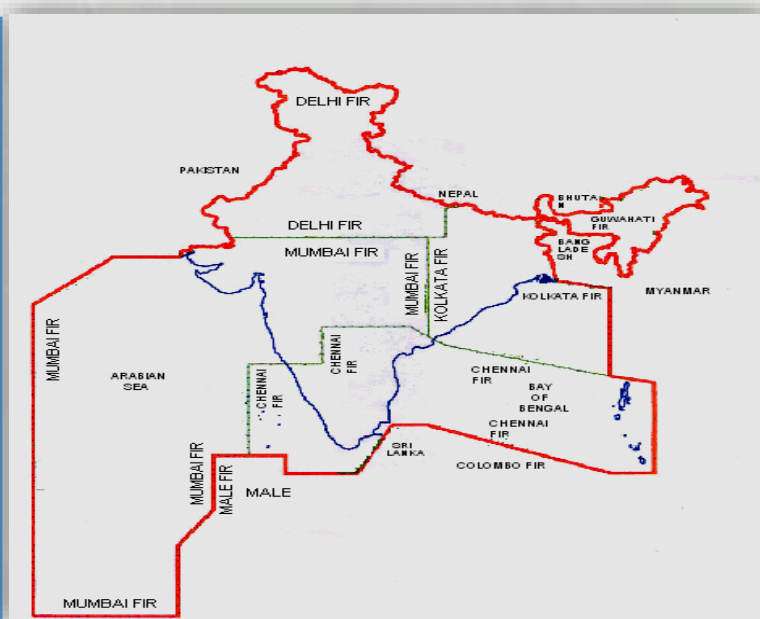
BROADCOM chip



Joint development by ISRO and AAI

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

- ❖ GAGAN – TDS
 - Minimum set of ground and space elements implemented to demonstrate the proof of concept
- ❖ GAGAN – FOP
 - Certiifiable SBAS built over the TDS elements with additional ground and space elements



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

GAGAN system Infrastructure

- Establishment of Delhi INMCC (Third Control Centre).
- Integration of GSAT 15 with GAGAN system completed. GAGAN signal with PRN 132 is being transmitted from GSAT 15.
- Integration of GSAT 15 GAGAN Payload and third INMCC at Delhi into GAGAN System has been certified and is operational.

Mandate on GAGAN

- All Aircrafts being registered in India after June, 2020 shall be suitably equipped with GAGAN equipment.

GAGAN Architecture (current)

