NavIC and GAGAN System Update

P.S. Sura
Programme Director
Satellite Navigation Programme
Indian Space Research Organization (ISRO) /India

ICG-15, Vienna, Austria
Satellite based Navigation Systems

**IRNSS-NavIC – A Self Reliant Navigation**

Indian Regional Navigation Satellite System- Navigation with Indian Constellation
- Provides Standard Positioning Service (SPS) and Restricted Service (RS) in L5 and S band
- Service area is Indian region bounded by Latitude 5°S to 50°N and Longitude 55°E to 110°E

**GAGAN-Indian SBAS**

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 1.0
NavIC Architecture

<table>
<thead>
<tr>
<th>Space Segment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Constellation</td>
<td>7 satellites (3 GSO, 4 IGSO)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Ground Segment</th>
<th></th>
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<tbody>
<tr>
<td>Navigation Centres</td>
<td>2</td>
</tr>
<tr>
<td>One way ranging stations</td>
<td>17</td>
</tr>
<tr>
<td>Two way ranging stations</td>
<td>4</td>
</tr>
<tr>
<td>Network Timing Centre</td>
<td>2</td>
</tr>
<tr>
<td>Spacecraft Control Centre</td>
<td>2</td>
</tr>
<tr>
<td>Frequency band</td>
<td>L5, S and L1*</td>
</tr>
<tr>
<td>Service</td>
<td>SPS and RS</td>
</tr>
</tbody>
</table>

*Civil signal in L1 band planned from upcoming NVS-01 satellite onwards*
Current Status and Update

- NavIC constellation is operational. Follow-on satellite is under realization with indigenous atomic clocks and satellite launch is expected by the first quarter 2022.
- SPS service (civilian service) in L1 frequency band in the upcoming satellites (NVS-01 onwards).
- NavIC L1 civilian signal, with SBOC modulation and IZ4 PRN codes, has been designed as an interoperable signal with other GNSS MBOC signals.
Current Status and Update

- NavIC is offering short messaging service for users in Indian region. Web based interface for message submission through internet.

- Messaging service is being used presently used by INCOIS for broadcasting Potential Fishing Zone (PFZ) messages, Cyclone & High wave alerts, etc to fishermen across the country.

- NavIC Service Advisory system is planned to be launched in 2021.

- Major smartphone chipset manufacturers (Qualcomm, Mediatek etc.) have included NavIC L5 SPS signal in the SoC.
Current Status and Update

- NavIC has been adopted for assisted-GNSS by Global standards body 3rd Generation Partnership Project (3GPP). NavIC SPS signals in L5 and S are included in the Release-16 LTE specification.

- NavIC is incorporated into the Automotive Industry Standard (AIS 140) of India.

- NavIC has been incorporated in the National Marine Electronics Association (NMEA) 0183 standard.

- NavIC has been incorporated in the Radio Technical Commission for Maritime services (RTCM) 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 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 AAI

- 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 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 operational since the month of May 2015

Three GEO satellites carry GAGAN payload

<table>
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<tr>
<th>Satellite</th>
<th>Inclination</th>
<th>GAGAN Signal with PRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSAT-8</td>
<td>55°</td>
<td>127</td>
</tr>
<tr>
<td>GSAT-10</td>
<td>83°</td>
<td>128</td>
</tr>
<tr>
<td>GSAT-15</td>
<td>93.5°</td>
<td>132</td>
</tr>
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</table>

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).
- AAI has developed 65 localizer performance with vertical guidance (LPV) procedures and flight validation in progress.

Mandate by Civil Aviation

- All Aircrafts being registered in India after July 1, 2021 shall be suitably equipped with GAGAN equipment.
Thank You