Use of Equatorial orbit for Indian Satellite Navigation Programme

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COSPAR & IAF Workshop, 44th Session of S&T, 13th February 2007
Applications driven programme
Self reliance in building & launching satellites

ONE AMONG THE SIX NATIONS

INDIAN SPACE PROGRAMME - Achievements

November 21, 1963

22 LV Missions

46 + 6 S/C Missions

LAUNCH VEHICLE

SATELLITE

APPLICATIONS
GAGAN

IRNSS

Space Based Augmentation System

Indian Regional Navigational Satellite System
Global Navigation Satellite System (GNSS)

Core Constellations

- GPS – USA
- GLONASS – Russia
- GALILEO – European Union

Augmentation Systems

- Ground Based Augmentation System (GBAS)
- Aircraft Based Augmentation Systems (ABAS)
- Space Based Augmentation System (SBAS)
Objective

Satellite Based Augmentation System

To provide for --

- Satellite-based Communication, Navigation, Surveillance
- Air Traffic Management

over Indian Airspace

Need for augmentation

To meet the Civil Aviation Requirements for Navigation Performance in the terminal stage of flight
GPS Augmentation systems in the World

- WAAS
- EGNOS
- MSAS
- GAGAN
**Space Segment**
GPS compatible navigation payload, GSAT- 4

**Ground segment**
- **IRES**: 8 Reference Stations
- **IMCC**: 1 Indian Master Control Station
- **LUS**: Uplink Station
- **TEC collection stations**: 25

(Total Electron Content) with grid based ionospheric model using near real time TEC measurements from GPS dual frequency receivers over a number of locations
Present Service Coverage for WAAS, EGNOS, MSAS & Proposed INSAT Nav Payload Coverage

INSAT Coverage 74 & 93.5 E

3 Satellite Coverage
INDIAN REFERENCE STATIONS

INRESs

Future INRESs

Delhi
Ahemdabad
Bangalore
Thiruvananthapuram
Kolkata
Guwahati
Port Blair
Jammu

INRESs

Delhi
Ahemdabad
Bangalore
Thiruvananthapuram
Kolkata
Guwahati
Port Blair
Jammu

Future INRESs

Indore
Bhuj
Amritsar
Chennai
Nagpur
Lucknow
Visakhapatnam

Delhi
Ahemdabad
Thiruvananthapuram
Bangalore
Kolkata
Guwahati
Port Blair
Jammu

INRESs
The electron content (TEC) receivers shall be located over the Indian region to develop the grid based Ionospheric model.
GAGAN- Implementation Plan

- **Technology demonstration and Initial experimental phase**
- **Final operation phase**

1. **Technology Demonstration Phase**- 8 Indian Reference Stations (INRES) at widely separated geographical areas; Indian Master Control Centre (INMCC); Indian Land Uplink Station (INLUS); Navigation Payload in the Indian Ocean Region (48°E-100°E)

2. **Initial Experimental Phase**- with redundancies provided to the space segment, INMCC (configured with WAD technology), INLUS and System validation over the entire Indian Airspace [Conventional navigational aids in prime mode]

3. **Final Operational Phase** with additional INMCC, INLUS and INRES and communication system with operational hardware

GAGAN once implemented will offer better position accuracies with integrity which is important for civil aviation application
Indian Regional Navigation Satellite System (IRNSS)

- IRNSS is planned to be an independent regional navigation system covering an area of about 1500kms around India.
- IRNSS can provide dependable and accurate services for Critical National Applications.
- Extensive simulations indicate that with 7 satellites and a commensurate ground segment, an Indian system can be developed.
- Will provide 20 m accuracy over the Indian Ocean Region and <10 m accuracy over India and adjacent countries.
Proposed Constellation

- 7 Satellite Constellation
- GEO(3) + GSO(4)
- GEO Longitudes: 34, 83, 132° East
- GSO Equatorial Crossing: 55(2) & 111(2)
- Inclination: 29°
- Phasing of Orbital Planes: 180°
- In Plane Phasing: 180°
- Relative Phasing: 56°
The development and deployment of IRNSS constellation, the ground infrastructure, navigation, safety and certification, verification software is expected to be completed in about 5-6 years time frame.

Critical technologies –
Navigation software, space qualified atomic clocks, network timing and maintenance, Iono-topo models, Reference receiver, User receiver equipment
Thank you