Indian Regional Navigation Satellite System (NavIC)

GROUND SEGMENT

Presentation to ICG-13 WG-D

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ISRO
IRNSS (NAVIC)

- Independent Navigation Satellite System providing navigation services in the Indian region
- Provides the user with a targeted position accuracy over India extending to about 1500 km around India
IRNSS: Indian Regional Navigation Satellite System
Civilian Services in IRNSS

• Standard Positioning Services (SPS)

Frequency

1. L5: 1176.45 MHz
2. S: 2492.028 MHz
Navigation message broadcast by IRNSS satellites

- The IRNSS Master frame comprises of four Sub-frames. Each Sub-frame is 600 symbols transmitted at 50 sps.

<table>
<thead>
<tr>
<th>Sync code</th>
<th>Subframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>584 symbols</td>
</tr>
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</table>

- Data rate is 25 bps (50 sps)
- The IRNSS System Time is given as 27-bit binary number composed of two parameters: Week Number and Time of week Count.
- The transmission timing of the navigation message provided through the TOWC is synchronized to IRNSS System Time.
Navigation Data

Primary navigation parameters:
- Satellite Ephemeris
- Satellite clock correction model parameters
- Satellite & signal health status
- Total group delay

Secondary Navigation parameters:
- Satellite almanac
- Atmospheric (Ionospheric) correction model
- IRNSS Time Offsets w.r.t to UTC & GNSS
- Constellation status
- Ionospheric grid delays
- Differential corrections
- Earth orientation parameters

All these parameters are generated using the Ground segment network.
- Available in Published ICD
IRNSS Ground Segment

- House-keeping of IRNSS satellites
- Carry out precise orbit determination of all IRNSS Satellites
  - one-way and two way CDMA ranging
  - Laser ranging (Limited Measurements)
- Generate maintain and disseminate IRNSS network time using an ensemble of highly stable atomic clocks
- Estimate
  - onboard satellite clock bias and drift rate
  - Ionospheric delay
- Have dedicated uplink facility for each satellite for housekeeping and navigation uplinks
- Enable 24X7 automated operation of the IRNSS Ground Segment
Overview of IRNSS Ground Segment Architecture

IRNSS CDMA RANGING STATIONS (IRCDRs)

ISRO NAVIGATION CENTRE (INC)

SATELLITE CONTROL FACILITY (IRSCF)

SUPPORT FROM LASER RANGING

LINK INFRASTRUCTURE (IRDCN)

IRNSS RANGE AND INTEGRITY MONITORING STATIONS (IRIMS)
ISRO NAVIGATION CENTER

- Orbit Determination
- Navigation Parameter Generation
- Timing Synchronisation
IRNSS Network Timing (IRNWT)

- IRNWT serves as the reference timescale for the IRNSS system.
- IRNWT is responsible for the generation, dissemination and maintenance of a precise and stable system time of IRNSS.
- Ensemble of Active Hydrogen Masers, Passive Hydrogen Masers and Cesium atomic clocks
- Timescale output is steered to a desired reference
IRNSS two-way CDMA Ranging stations

- A network of IRCDR Stations have been established across India.
- Two-way CDMA ranging carried out to IRNSS satellites in C-band
IRNSS Range & Integrity Monitoring Stations

- A network of IRIM Stations have been established across India.
- Carry out one-way CDMA ranging to IRNSS satellites continuously.
- New Reference Stations are Planned Outside India.
Conclusion

All the elements of the ground segment is realized and fully functional, supporting NAVIC constellation
Thank You!