

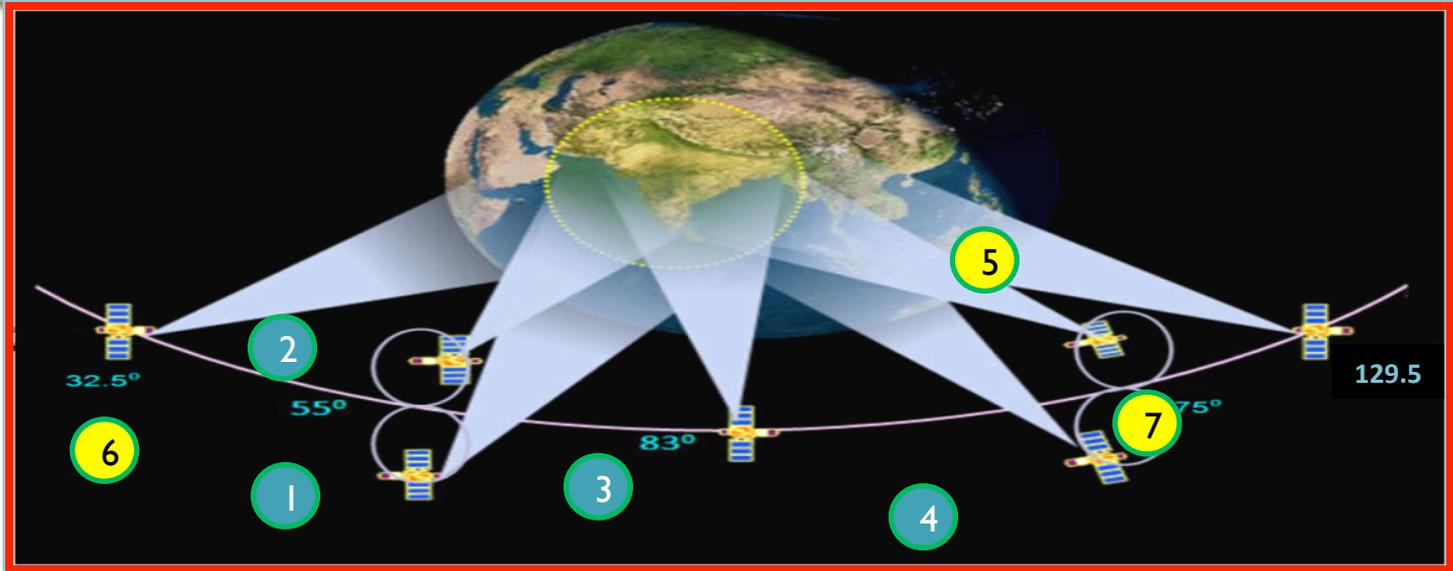


Update on
Indian Regional Navigation Satellite System (IRNSS)
and
GPS Aided Geo Augmented Navigation (GAGAN)

K S Parikh
Deputy Director,
Indian Space Research Organization (ISRO)
INDIA

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Indian Regional Navigation Satellite System (IRNSS)



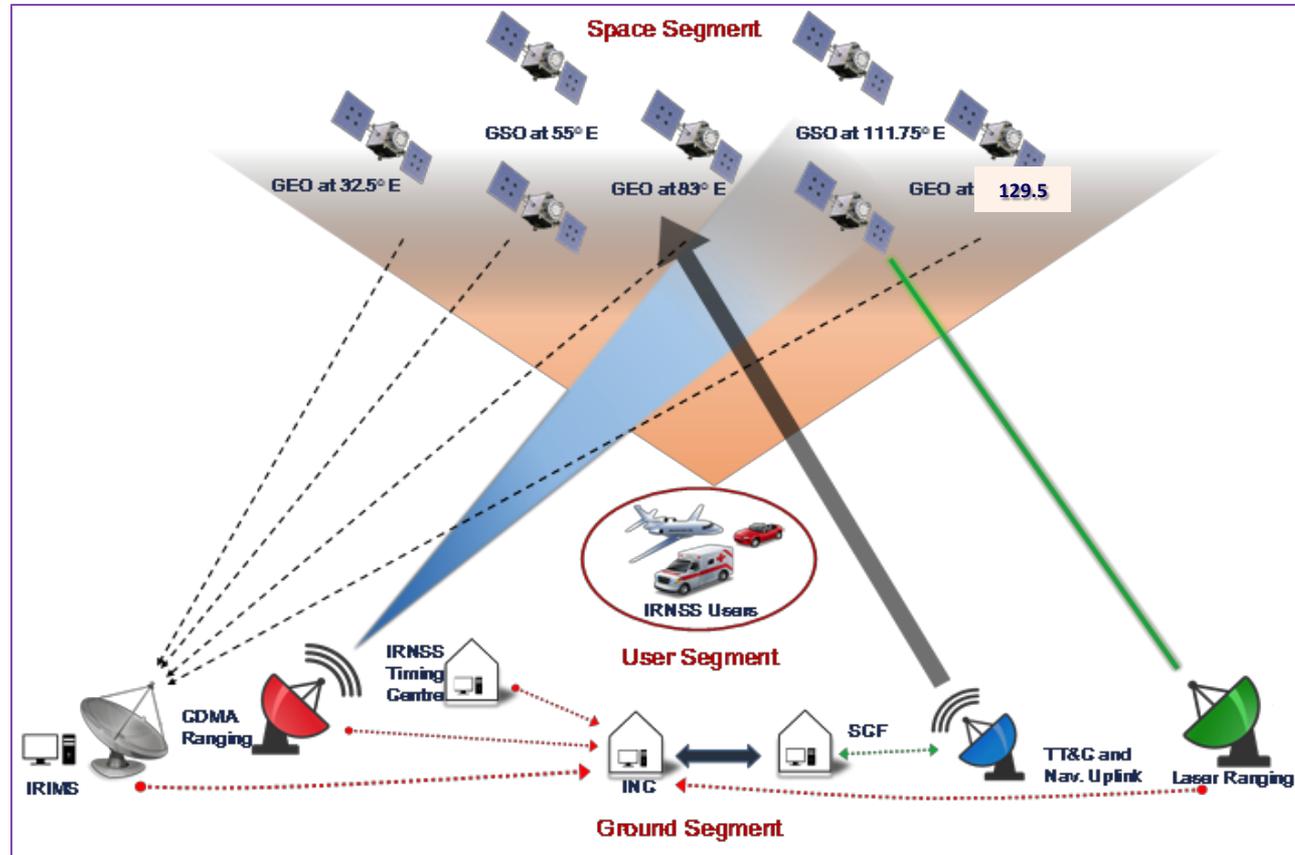
- IRNSS – Regional Navigation Satellite System
- IRNSS consists of 7 Satellites
 - 4 Geo Synchronous Orbit (GSO) satellites at 55° E and 111.75° E at an inclination of 29°
 - 3 Geo Stationary Satellites (GEO) at 32.5° E, 83° E and 129.5° E
- IRNSS transmits signals in L5 band (1176.45 MHz) and S band (2492.048 MHz)



Indian Regional Navigation Satellite System (IRNSS)

- IRNSS shall provide two types of services – Standard Positioning Services (SPS) and Restricted Services (RS)
- Four Satellites are successfully realized in orbit
 - IRNSS-IA (July 2013)
 - IRNSS-IB (Apr 2014)
 - IRNSS-IC (Oct 2014)
 - IRNSS-ID (Mar 2015)
- The remaining three satellites - IRNSS-IE, IRNSS-IF and IRNSS-IG are scheduled for launch in 2015-16 and the constellation will be completed by Q1-2016.
- Current constellation satellites are functional with navigation signals in L5 and S-band. Efforts to bring in L1 band in future satellites are under progress.

Indian Regional Navigation Satellite System (IRNSS)



• IRNSS Architecture:

- Ground Segment
- Space Segment
- User Segment



Indian Regional Navigation Satellite System (IRNSS)

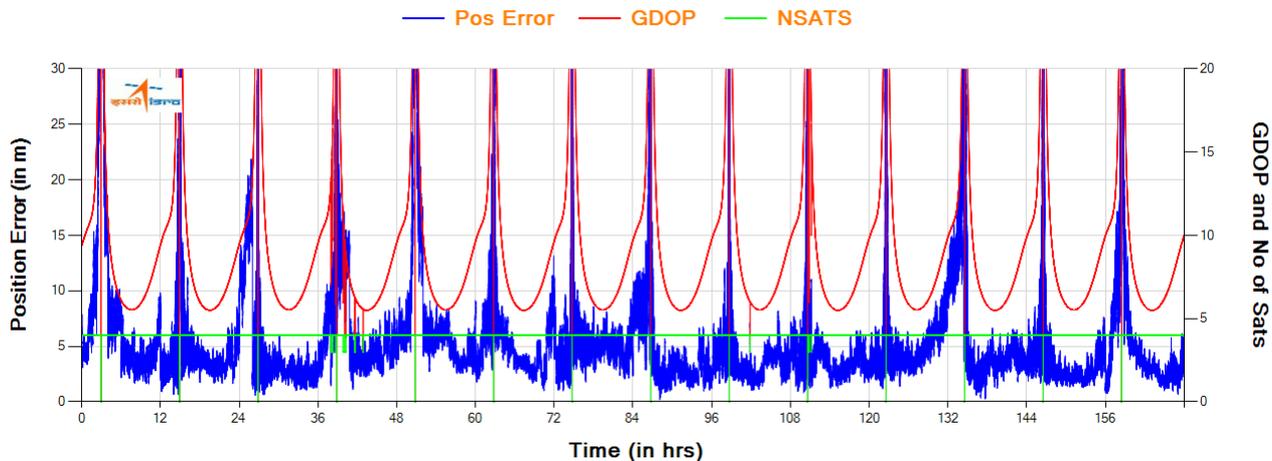
- **IRNSS Space Segment:**
- Navigation Payload
 - Rubidium Atomic Frequency Standard
 - Navigation Signal Generation Unit (NSGU) generates navigation signals in L5 and S band
- Ranging Payload
 - CDMA Ranging Payload in C band



Indian Regional Navigation Satellite System (IRNSS)

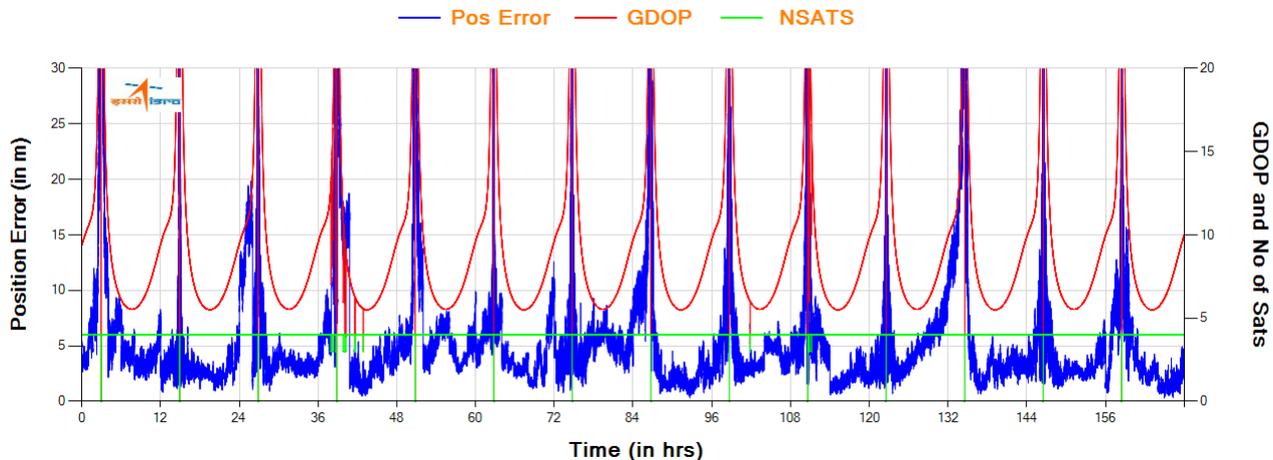
- **IRNSS User Segment:**
- Standard Positioning Service (SPS) for civilian users
- Restricted Services (RS) for authorized users
- Single Frequency Users (L5/S band)
 - Grid based Ionosphere related corrections for single frequency users
- Dual Frequency Users (L5 & S band)

NRSC HYDERABAD :IRNSS DF 3DRMS Position Error:6.22(m),Duration : 18/10/2015,0:0:0-24/10/2015,23:59:59UTC



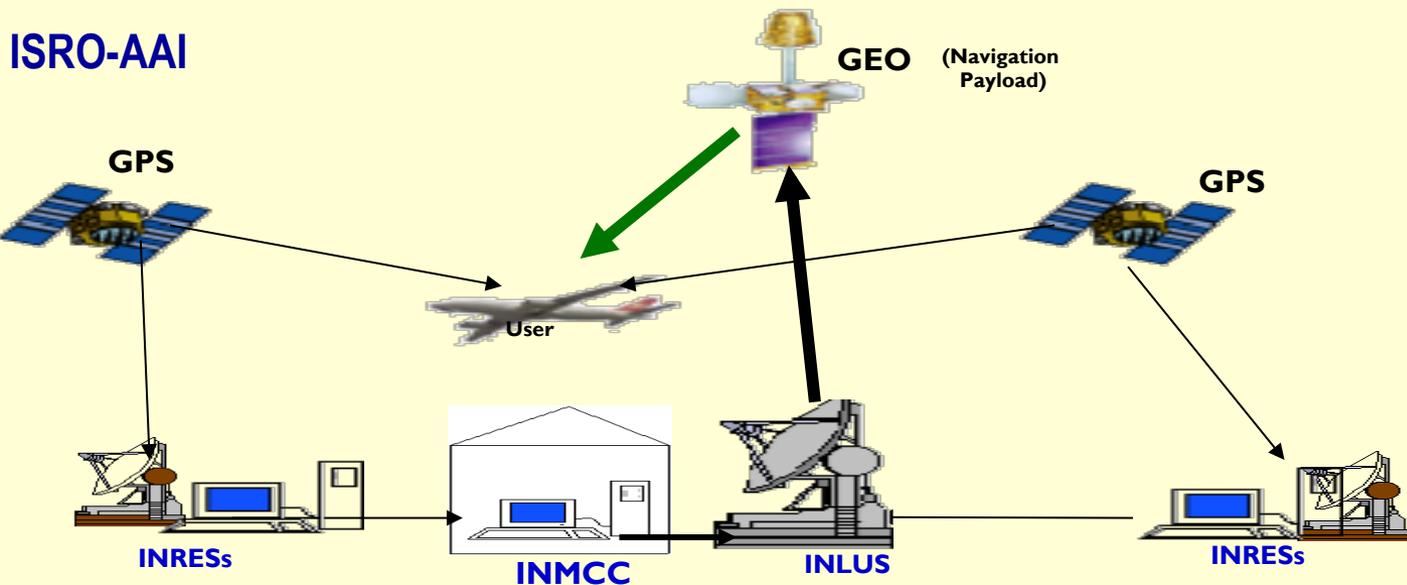
Position Error with Dual Frequency Receiver (L5 and S band)

NRSC HYDERABAD :IRNSS S 3DRMS Position Error:6.31(m),Duration : 18/10/2015,0:0:0 to 24/10/2015,23:59:59UTC



Position Error with Single Frequency Receiver (S-band with Grid Model for Iono Correction)

GAGAN (GPS Aided Geo Augmented Navigation)



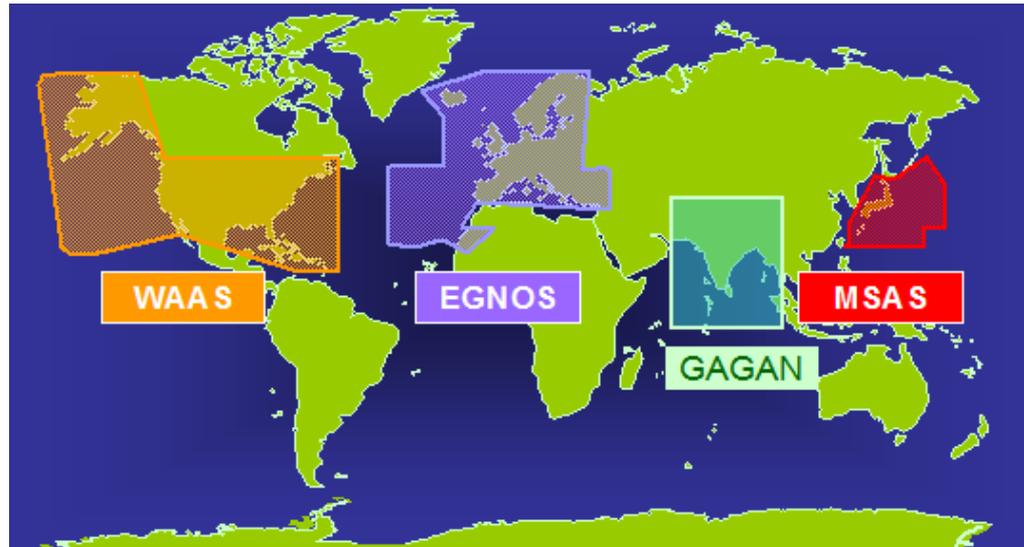
- Two Satellites GSAT-8 (PRN127) & GSAT-10 (PRN128) carrying GAGAN payload are already operational. Third satellite GSAT-15 carrying on-orbit spare GAGAN payload is scheduled for launch in Nov 2015.
- GAGAN is the first SBAS system in the world to have the capability of vertical guidance in the Equatorial Anomaly Regions, i.e. India

GAGAN (GPS Aided Geo Augmented Navigation)



- GAGAN operations are fully certified for en-route Navigation (RNP 0.1) in Indian Flight Information Region (FIR) since Dec 30, 2013
- GAGAN operation are also certified for Precision Approach with Vertical guidance APV 1 since April 21, 2015

IRNSS and GAGAN



- ISRO is in liaison with different National agencies for the adoption of IRNSS & GAGAN receivers.
- India is actively engaged in dialogue with other GNSS operators in establishing the compatibility.
- India continues to work with international forum like ICG, ITU RES-609 for addressing compatibility and interoperability matters.

IRNSS Ground Systems



***IRNSS CDMA Ranging
Stations (IRCDR)***



***ISRO Navigation Centre
(INC)***



***IRNSS Range & Integrity
Monitoring Stations (IRIMS)***



***IRNSS Network Timing Facility
(IRNWT)***



***IRNSS Data Communication
Network (IRDCN)***



***IRNSS Spacecraft Control
Facility (IRSCF)***



Thank You for Your Attention

Indian Regional Navigation Satellite System (IRNSS)

