

***INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM
(IRNSS)
AND
GPS-AIDED GEO AUGMENTED NAVIGATION SYSTEM
(GAGAN)***

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INDIAN SATELLITE NAVIGATION PROGRAM



GAGAN

(GPS Aided GEO Augmented Navigation)

OBJECTIVES

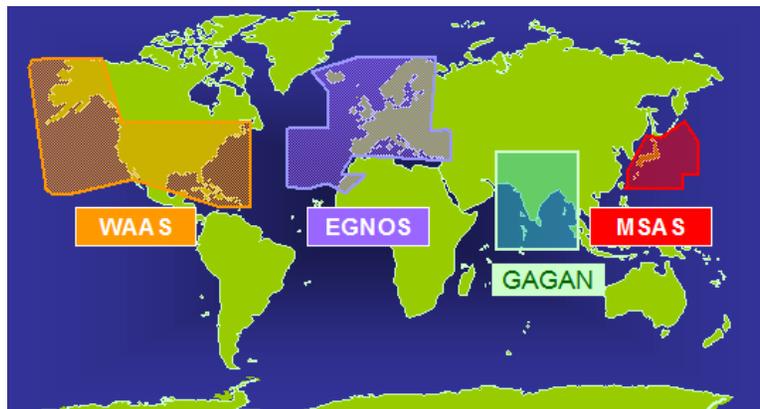
- *To provide Satellite-based Navigation services with accuracy and integrity required for civil aviation applications over Indian Air Space.*
- *Better Air Traffic Management over Indian Airspace.*

GAGAN

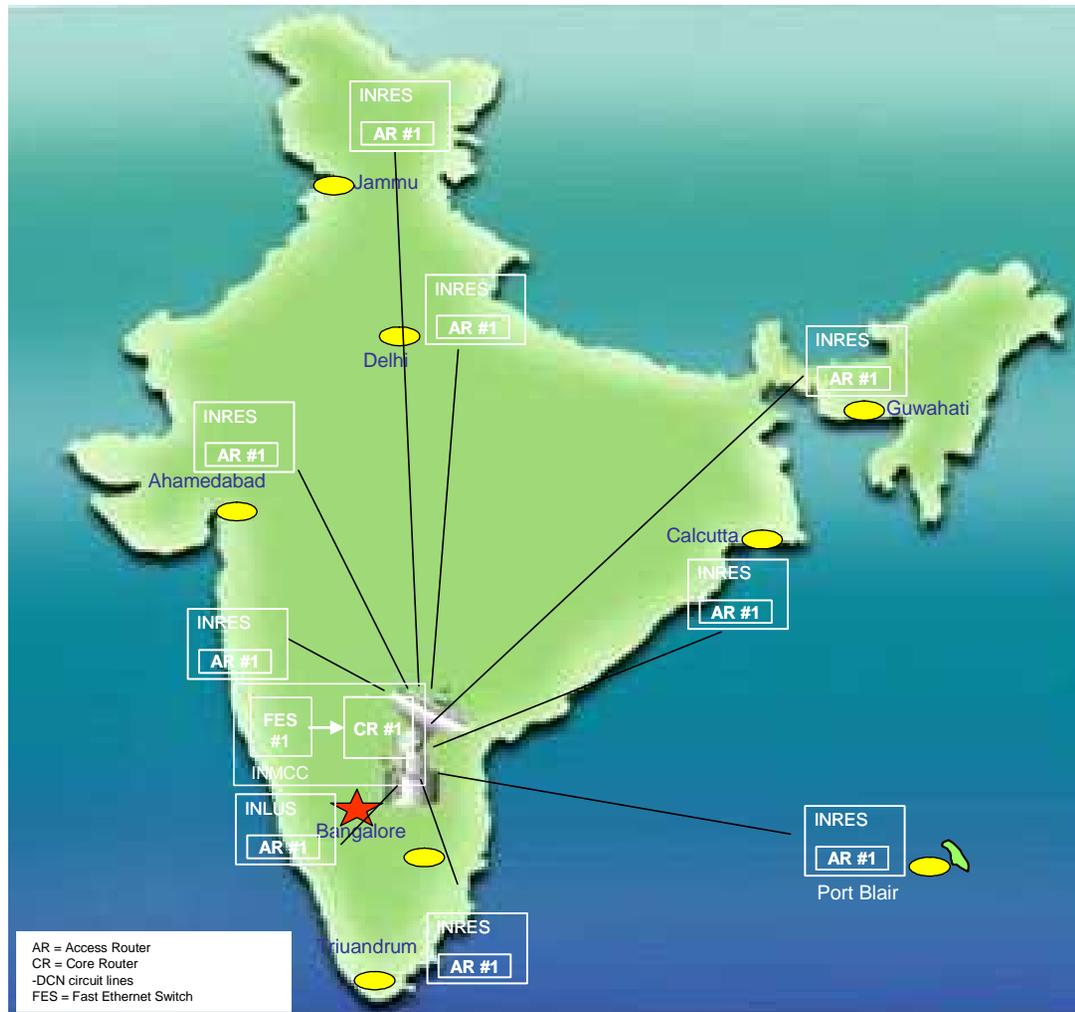
(GPS Aided GEO Augmented Navigation)



- *GAGAN is a Satellite Based Augmentation System being implemented by India based on GPS*
- *GAGAN jointly implemented by ISRO and Airports Authority of India (AAI)*
- *Compatible and Interoperable with other SBAS*
- *Provides Seamless navigation*
- *GAGAN implementation in two phases:
GAGAN – TDS (Technology Demonstration System)
GAGAN – FOP (Final Operation Phase)*



GAGAN Configuration in TDS



Ground Segment

- 8 INRES: 2 INREEs
- 1 INMCC
- 1 INLUS
- 1 ring of OFC (7 INRES)
- 1 VSAT link (GPB)

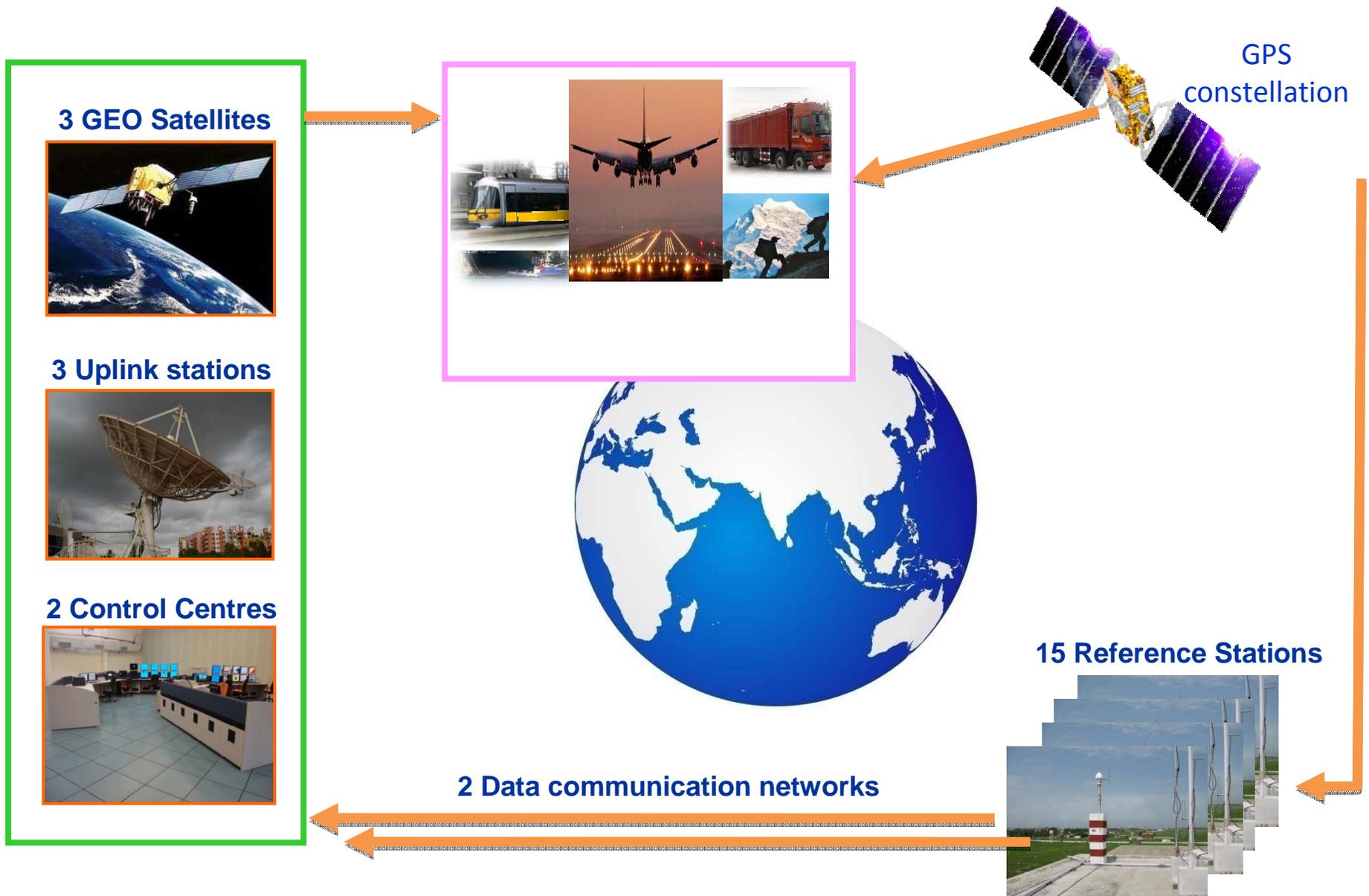
Space Segment

- INMARSAT-4F1

GAGAN Signal-In-Space Verified and validated through flight-trail from Hyderabad to Bangalore.

On-board GAGAN Receiver position compared with DGPS position to demonstrate SBAS capability.

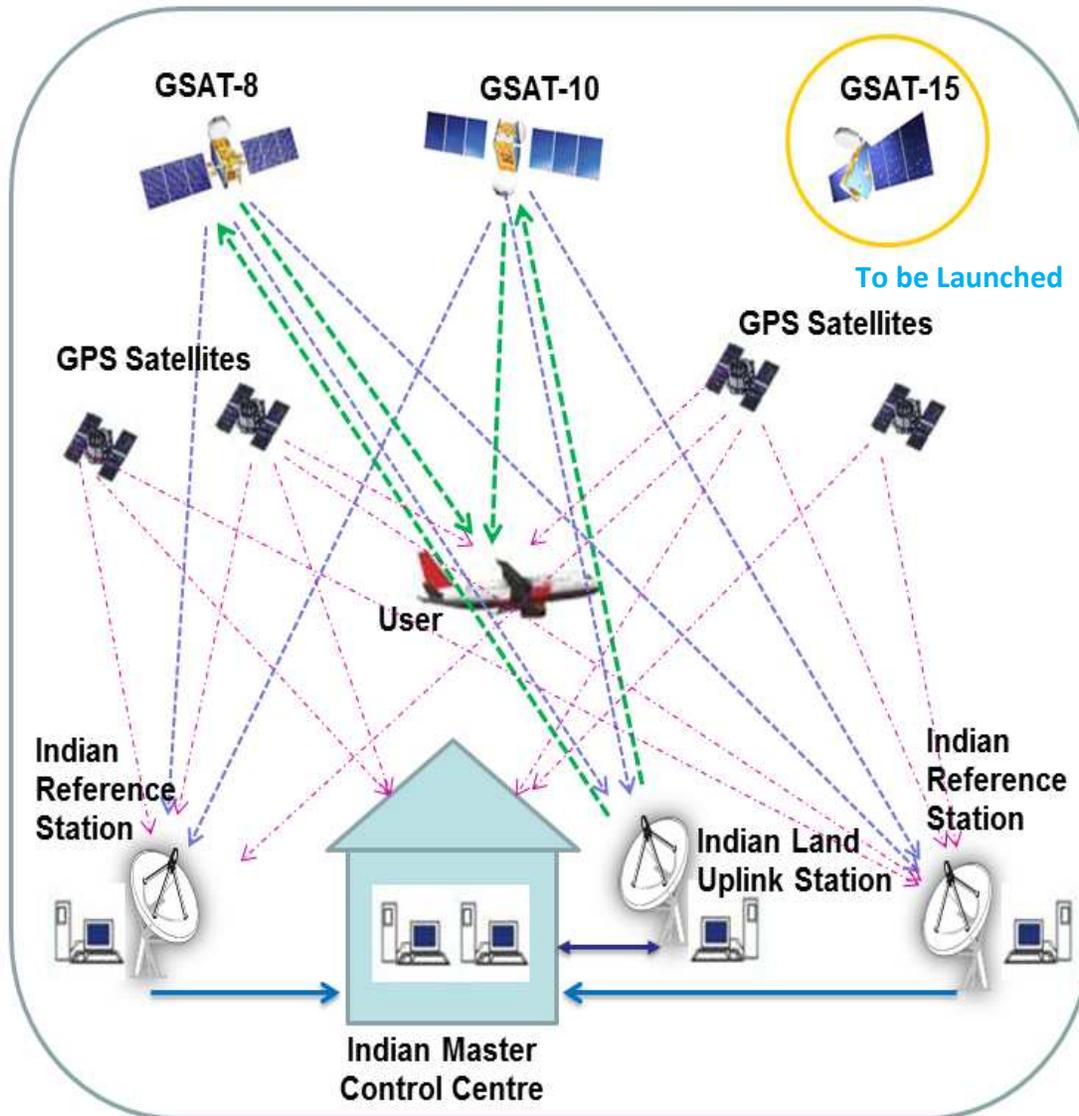
GAGAN Operational System



GAGAN – Intended Services

- ***High position accuracies with integrity (APV- 1/1.5 and RNP 0.1) over a wide geographical area such as the Indian Airspace.***
- ***These position accuracies to be simultaneously made available to all airports and air fields in Indian FIR, enabling satellite based landing of aircraft fitted with SBAS receivers.***
- ***To provide fuel efficient air corridors.***
- ***Better upper Air-space management over India.***

GAGAN – Current Status



- ***The GAGAN Signal-in-Space is available through GSAT-8 and GSAT-10***
- ***GAGAN Stability tests were successfully completed***
- ***The certification process for GAGAN signals by Directorate General of Civil Aviation is under progress***

Indian Regional Navigation Satellite System (IRNSS)

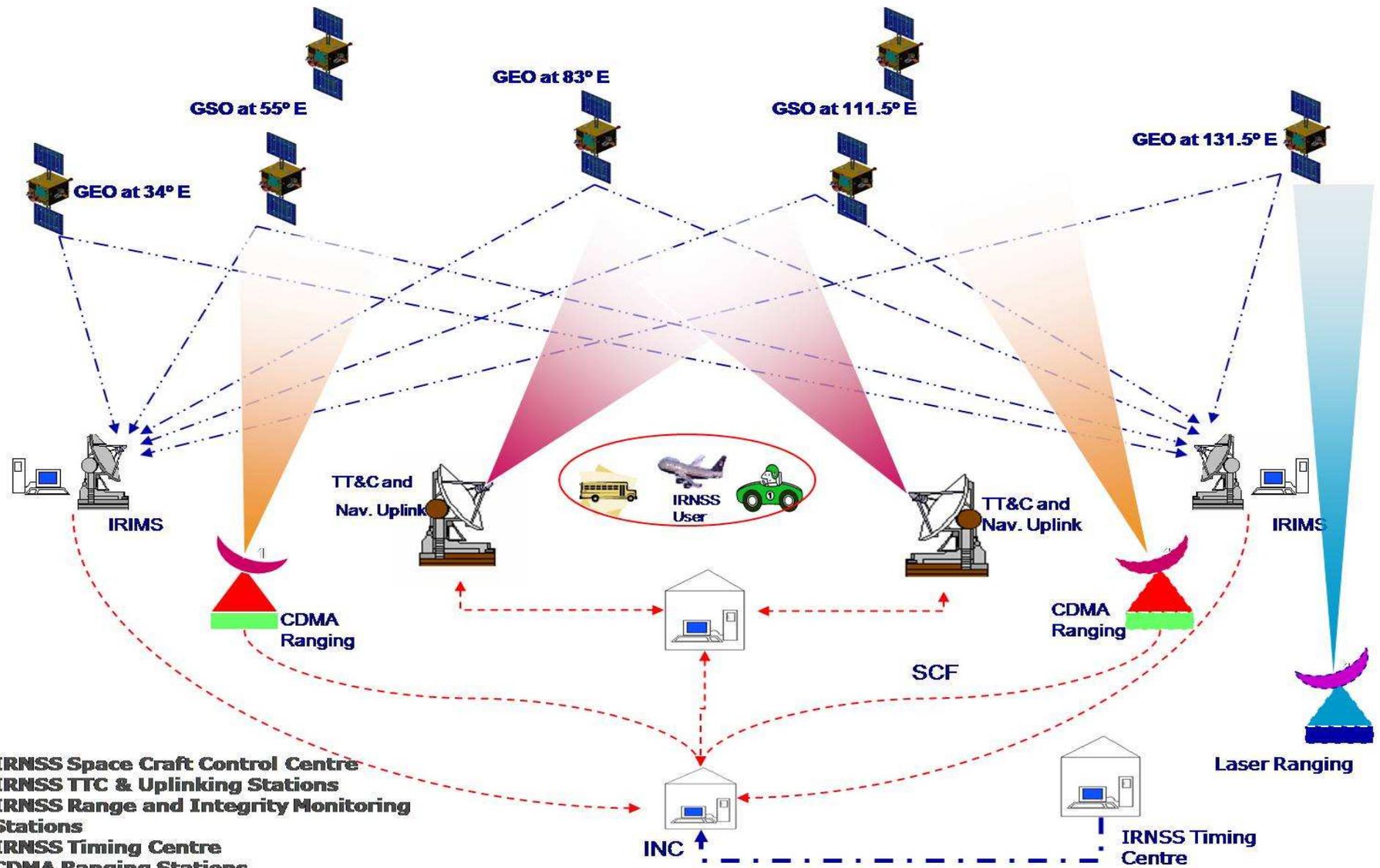


- *IRNSS is an independent regional navigation system.*
- *7 satellite constellation and ground segment.*
- *Coverage area is about 1500 km beyond Indian territory.*
- *Estimated horizontal position accuracy of 20m in over India and adjoining areas.*

IRNSS - Objectives

- ***Reliable Position, Navigation and Timing services over India and its neighbourhood***
- ***To provide fairly good accuracy to the user.***
- ***Most of the constellation is seen by user all the time.***
- ***Ionosphere correction messages to user.***

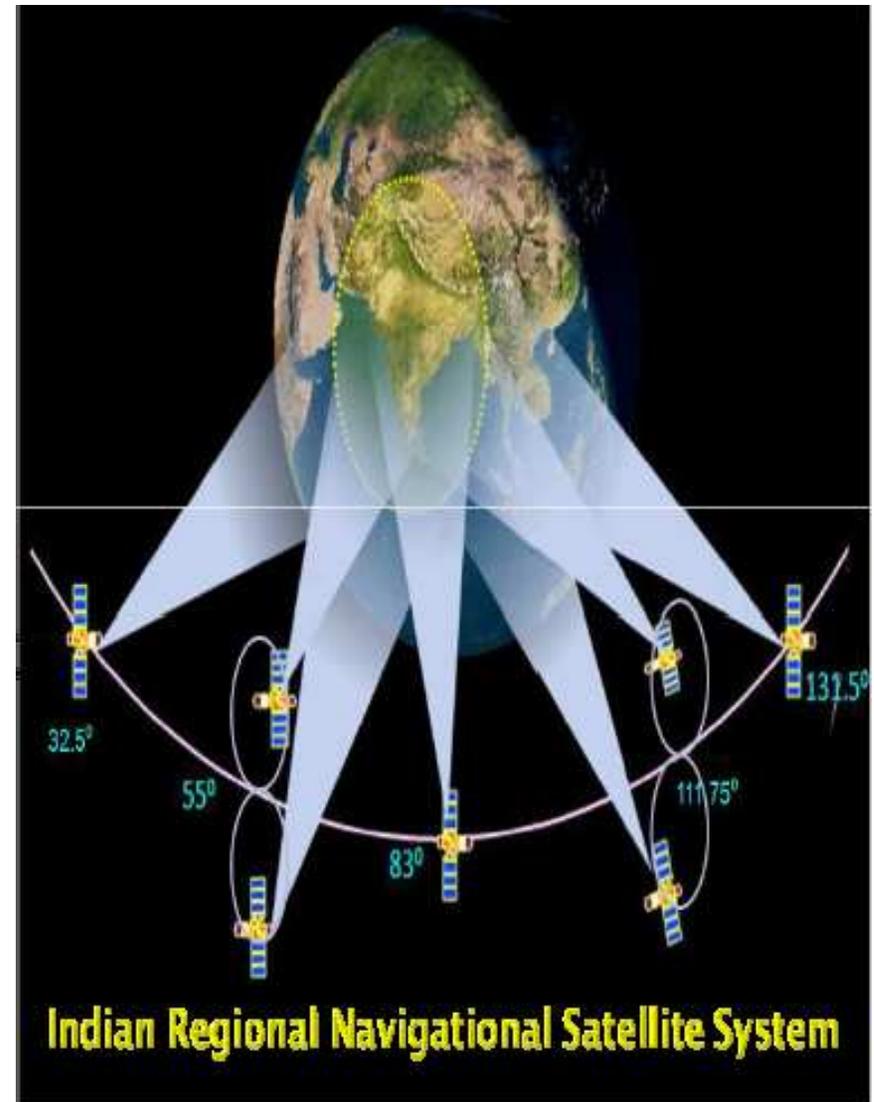
IRNSS CONFIGURATION



IRNSS Space Craft Control Centre
IRNSS TTC & Uplinking Stations
IRNSS Range and Integrity Monitoring Stations
IRNSS Timing Centre
CDMA Ranging Stations
Laser Ranging Station
IRNSS Navigation Centre
Data Communication Links

IRNSS SPACE SEGMENT

- **Consists of 7 Satellites, 3 in Geo-Stationary orbit at 32.5°, 83° and 131.5° East.**
- **4 Satellites in GEO Synchronous orbit at inclination of 29° with Longitude crossing at 55° and 111.75° East.**
- **IRNSS Satellites are to be launched by the Indian launcher PSLV.**
- **The first Satellite launched on 1st July 2013.**
- **The full constellation will be realized by the end of 2015.**



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)***

IRNSS USER SEGMENT

- *The user segment consists of IRNSS receivers operating in
 - *Single Frequency (L5 or S band)*
 - *Dual Frequency (L5 and S band)**
- *Single frequency and dual frequency receivers shall receive both SPS and RS signals. SPS is for civilian users. RS signal is meant for authorised users.*

IRNSS SIGNALS

- *IRNSS signals are transmitted using the following frequencies and modulations.*

L5 : 1176.45 MHz

S : 2492.028 MHz

- *Modulation schemes:*

BPSK(1) and BOC (5,2)

IRNSS STATUS

- *IRNSS-1A satellite was launched on 1st July 2013 and the satellite was positioned at 55°E with inclination of 27°.*
- *Subsequently the in-orbit Test was successfully completed.*
- *Navigation and Ranging Payload performance is normal.*
- *Phase 1 ground stations have been established.*
- *Realtime navigation operations started at INC.*

IRNSS STATUS

(Contd..)

- *CDMA ranging from all four IRCDR stations and one way ranging from eight IRM stations being carried out for orbit determination .*
- *Laser ranging has been successfully carried out from Yaragadee (Australia) Changchun (China), Wettzell (Germany), Grasse(France) Graz (Austria) & Zimmerwald (Switzerland) stations. ISRO acknowledges the laser ranging support provided by these stations with thanks and appreciation.*
- *Navigation signal performance is being monitored.*

***Thank you for your
Attention***