Indian Satellite Navigation Programme: An Update

By

P. K. Jain
ISRO HQ, India

45th Session of S&T Subcommittee of UN-COPUOS

Vienna; Feb 11-22, 2008

Four Decades of Indian Space Programme

इसरो isro

TODAY, Feb 2008

25 Launch Vehicle Missions

November 21, 1963

SLV-3 ASLV

Self reliance in launching

PSLV GSLV

12 5

ONE AMONG THE SIX NATIONS

48 + 8 Spacecraft Missions

Self reliance in building satellites

LAUNCH VEHICLE

SATELLITE

APPLICATIONS

INSAT-3E
28.09.03

KALPANA-1
12.09.02

ARYABHATA
19.04.75

INSAT-3C
24.01.02

INSAT-2E
03.04.99

INSAT-3B
22.03.00

INSAT-3A
10.04.03

EDUSAT
20.09.04

GSAT-2
08.05.03

INSAT 4A/4B/4CR
2005/2007/2007

HAMSAT
05.05.05

IRS-P3
21.03.96

IRS-1D
29.09.97

IRS-P4
26.05.99

TES
22.10.01

RESOURCESAT-1
17.10.03

CARTOSAT-1& 2
05.05.05 10-01-07

GAGAN

IRNSS

Space Based Augmentation System

Indian Regional Navigational Satellite System

GAGAN

(GPS Aided GEO Augmented Satellite Navigation)

An Overlay system built around the GPS

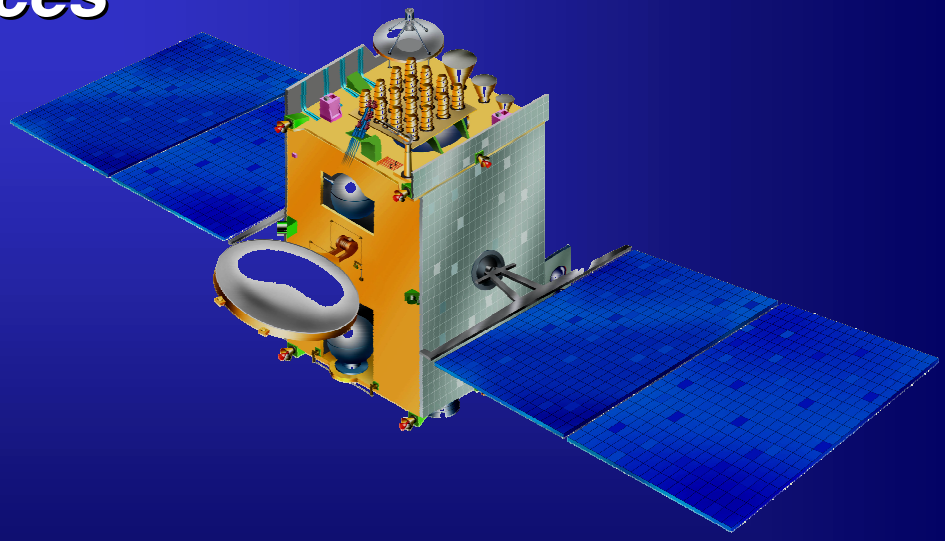
Objective

Satellite Based Augmentation System

To provide for --

- Satellite-based Navigation services
- Air Traffic Management

over Indian Airspace

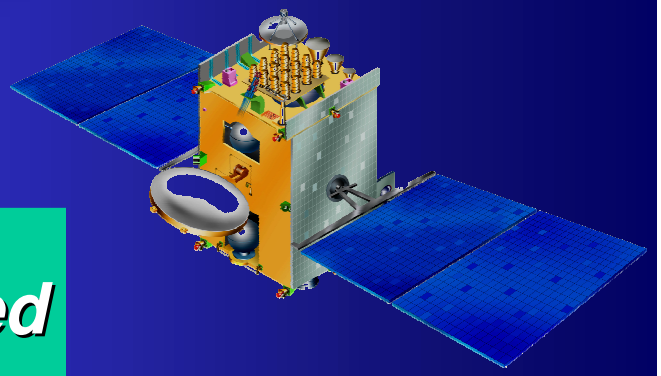


GAGAN- Implementation Plan

Two Phases

GAGAN-TDS (Technology Demonstration System)

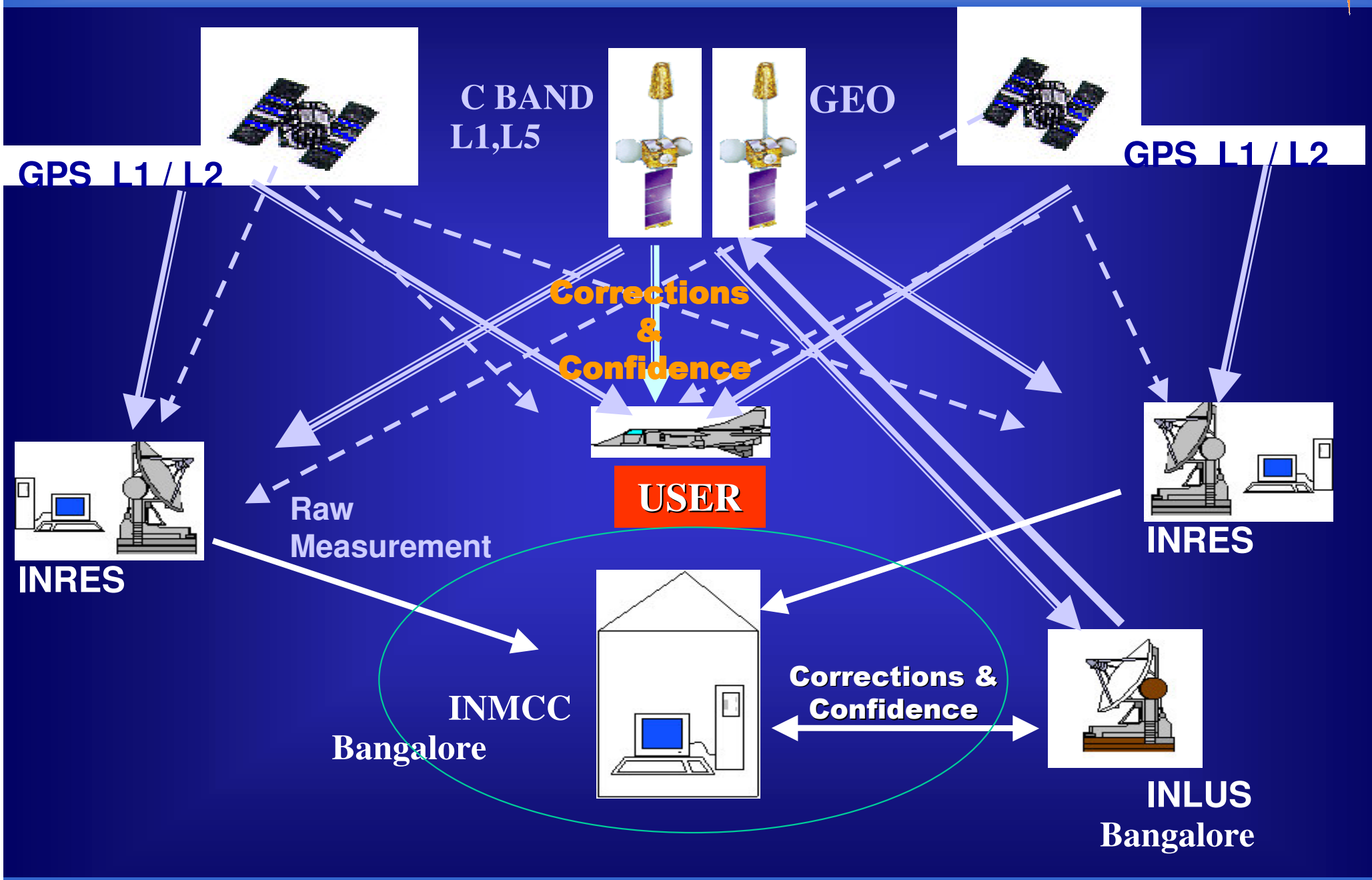
GAGAN-FOP (Final Operational Phase)



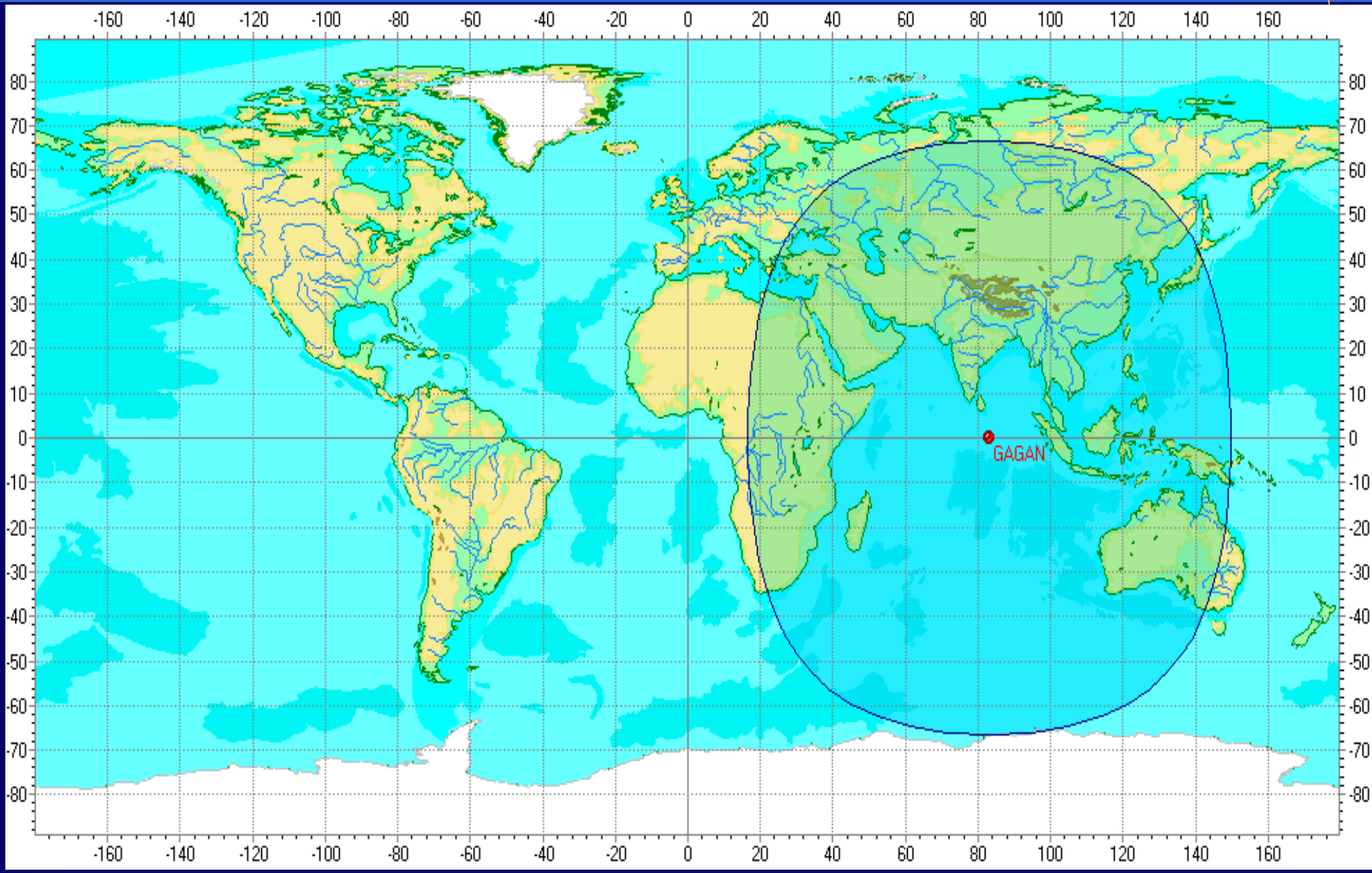
GAGAN-TDS has recently been completed

GAGAN once implemented will offer required position accuracies with integrity which is important for civil aviation application

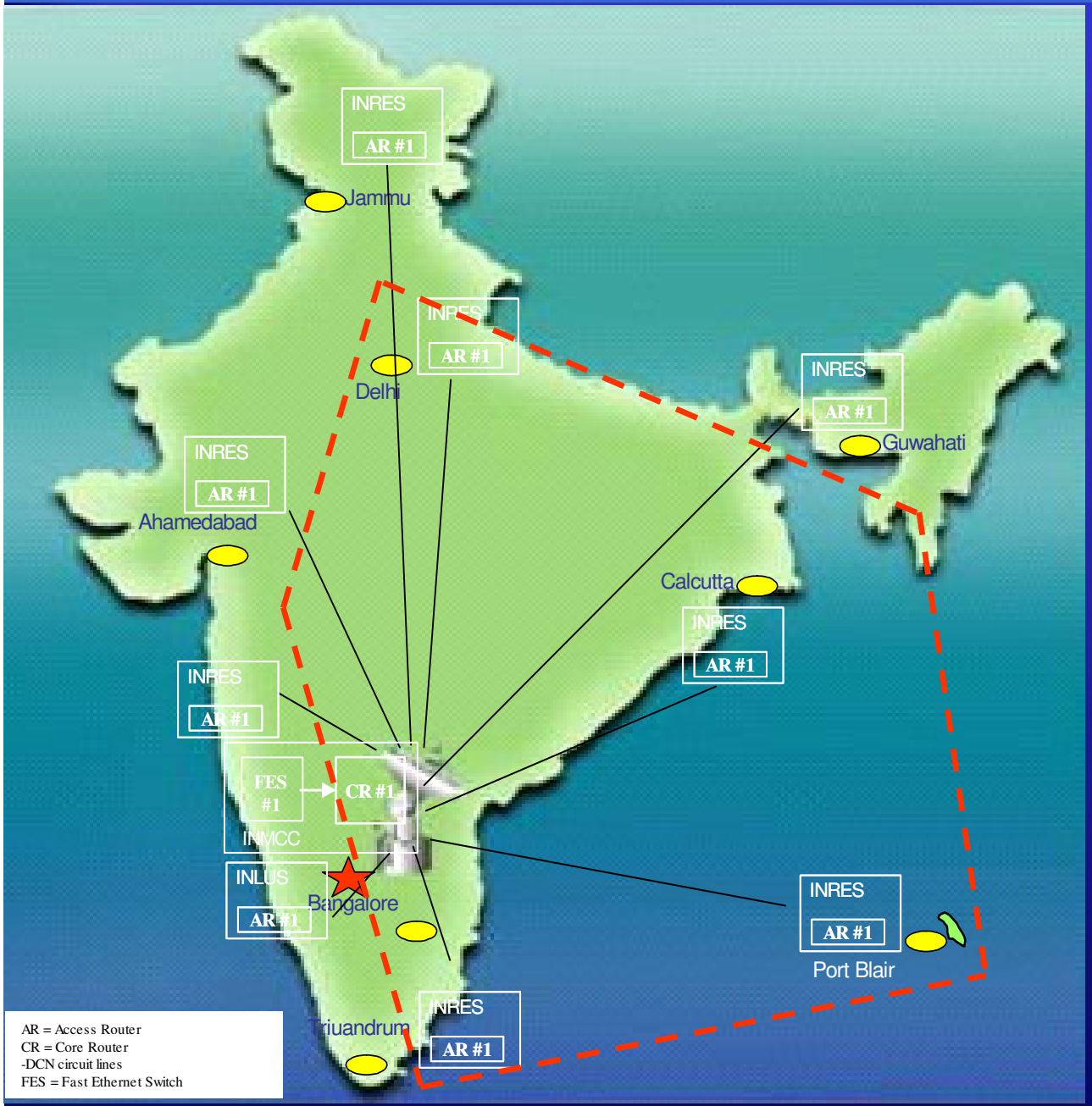
GAGAN ARCHITECTURE



GAGAN Coverage



GAGAN-TDS CONFIGURATION



Ground Segment

- 8 INRES
- 1 INMCC
- 1 INLUS
- OFC link (7 INRES)
- 1 VSAT link (GPB)

Space Segment

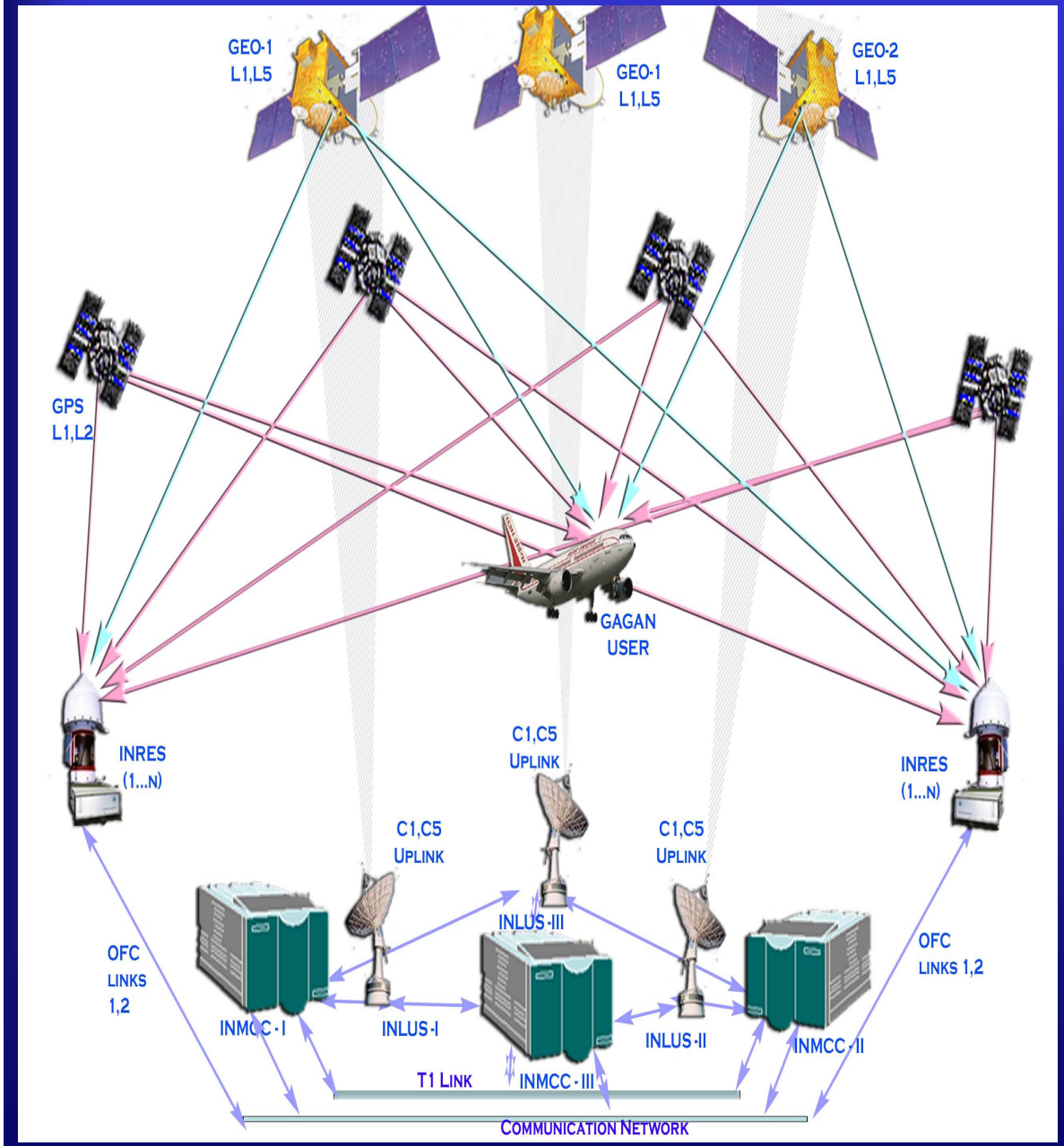
- INMARSAT-4F1

Status: GAGAN-TDS

- The GAGAN TDS ground system has been integrated with the INMARSAT 4F1 Navigation Transponder

- **Results Achieved:**
  - 7.6 meter vertical and horizontal accuracy 95% of the time within the perimeter of the GAGAN-TDS INRES stations
  - Demonstrated time to alarm not to exceed 6.2 seconds.

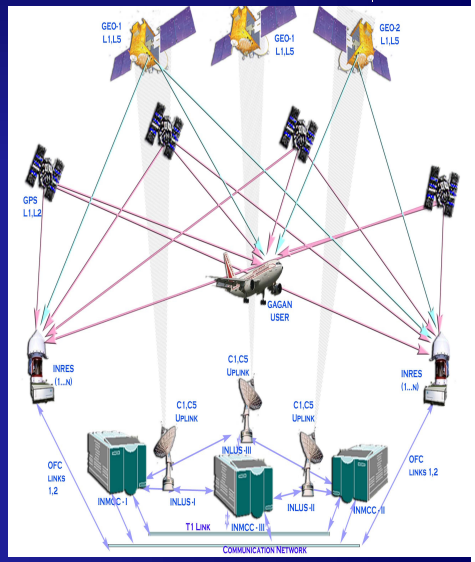
GAGAN FOP CONFIGURATION



- *Additional Indian Reference Stations (INRES)*
- *Redundant Indian Master Control Centre (INMCC)*
- *Additional Indian Navigation Land Uplink Station (INLUS)*
- ***Two operational Navigation Payloads on Indian GEOs and one on-orbit spare***
- *Additional Communication links*

APPROACH TO GAGAN-FOP

- *Installation of the FOP system*
- *Development of User Receiver*
- *Certification*



FOP: EXPECTED BY EARLY 2010

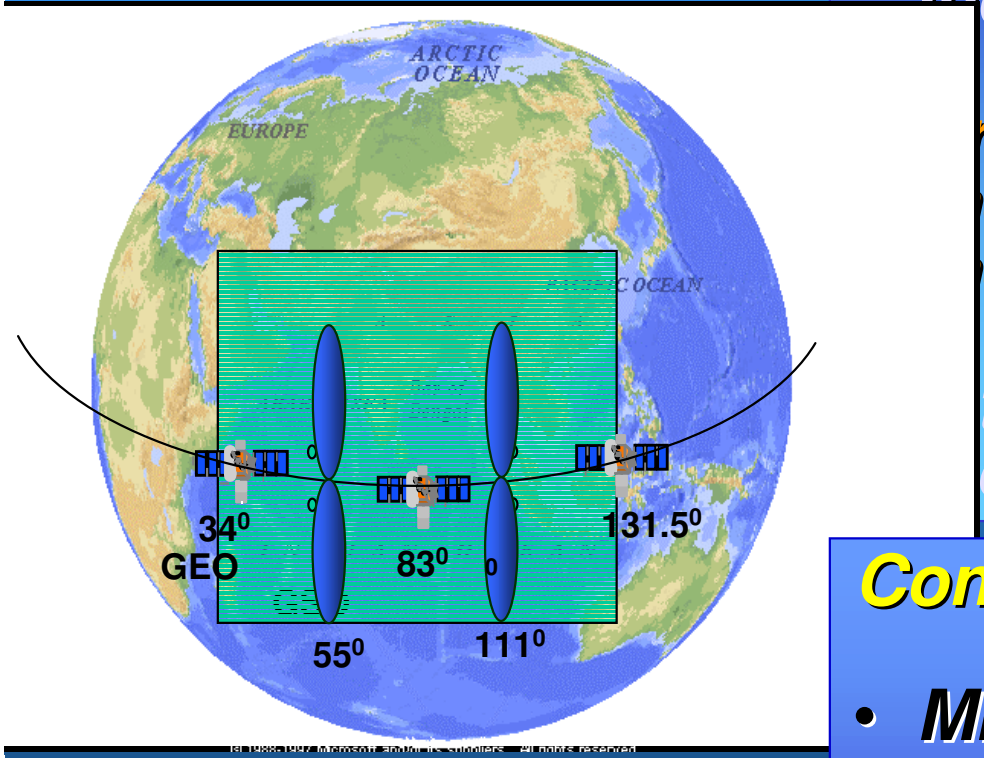
FUTURE SCOPE OF GAGAN

- *Interoperability with other GPS Augmented Systems in the World*
- *To provide SBAS service beyond the Indian FIR (within GEO coverage)*
  - *Deploying few INRES stations outside the country*
  - *Co-operation with other countries*

Indian Regional Navigation Satellite System

(IRNSS)

- An independent regional navigation system covering an area of about 1500 km around India



rovides fairly good accuracy and e whole constellation is seen all e time

tegrity & ionospheric correction essages to user

Constellation Design Considerations

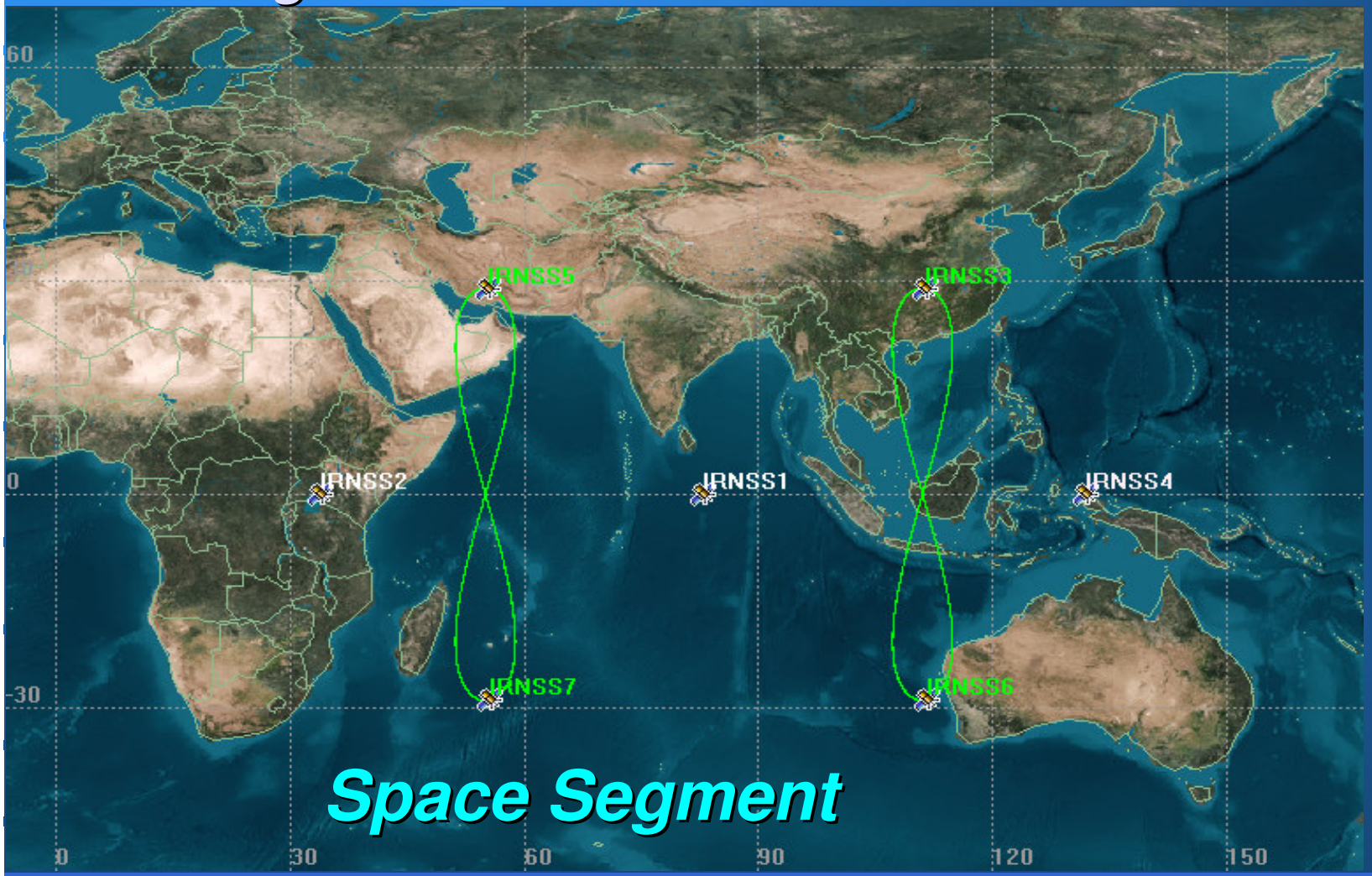
- Minimizing the Max DOP
- Min satellite constellation
- Orbital slots for India

IRNSS

IRNSS CONSTELLATION

3 GEO satellites at 34^0, 83^0, and 131.5^0 East

4 GSO satellites at 29^0 inclination with Longitude Crossing at 55^0 and 111^0



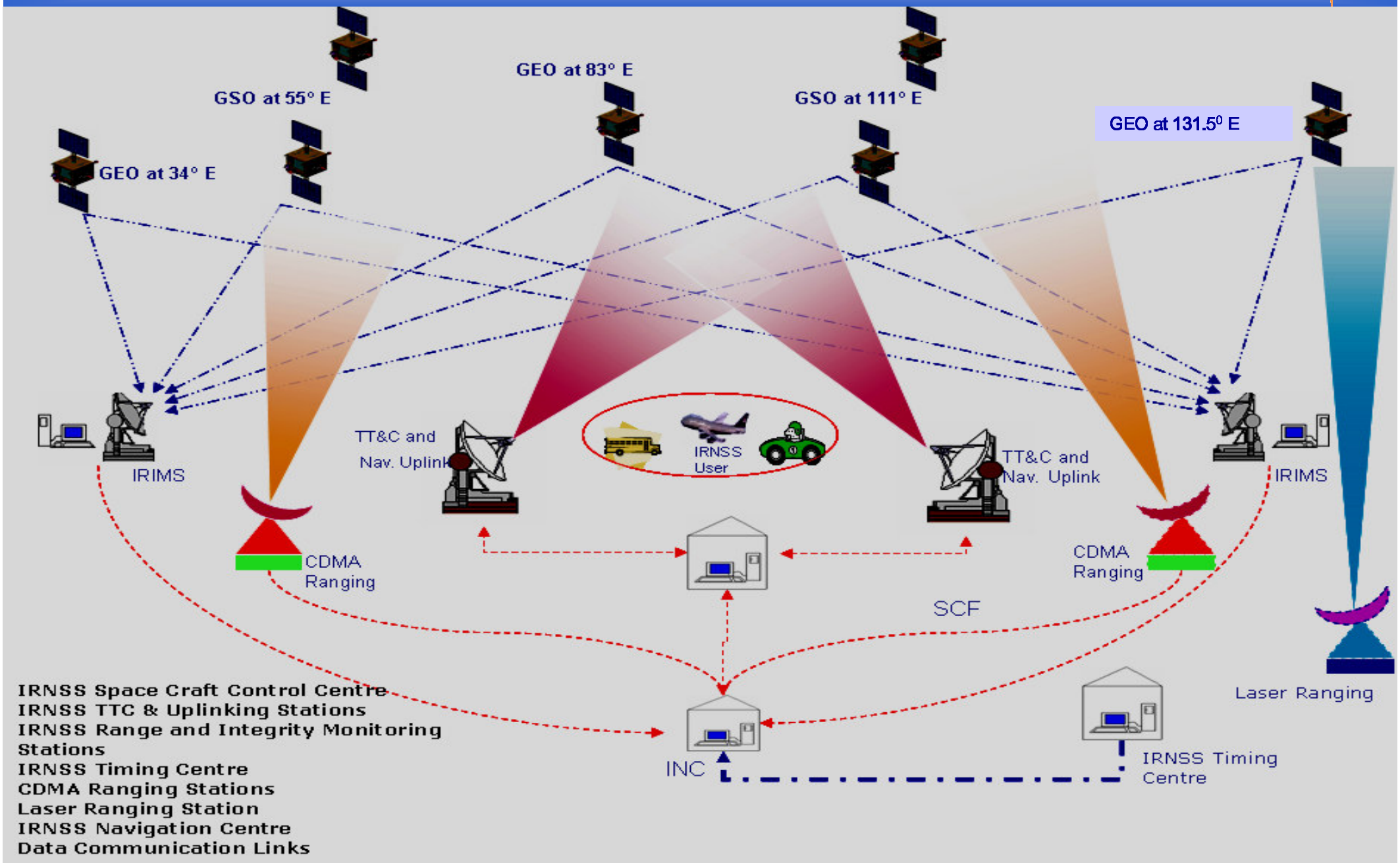
Space Segment

To be launched by Indian PSLV

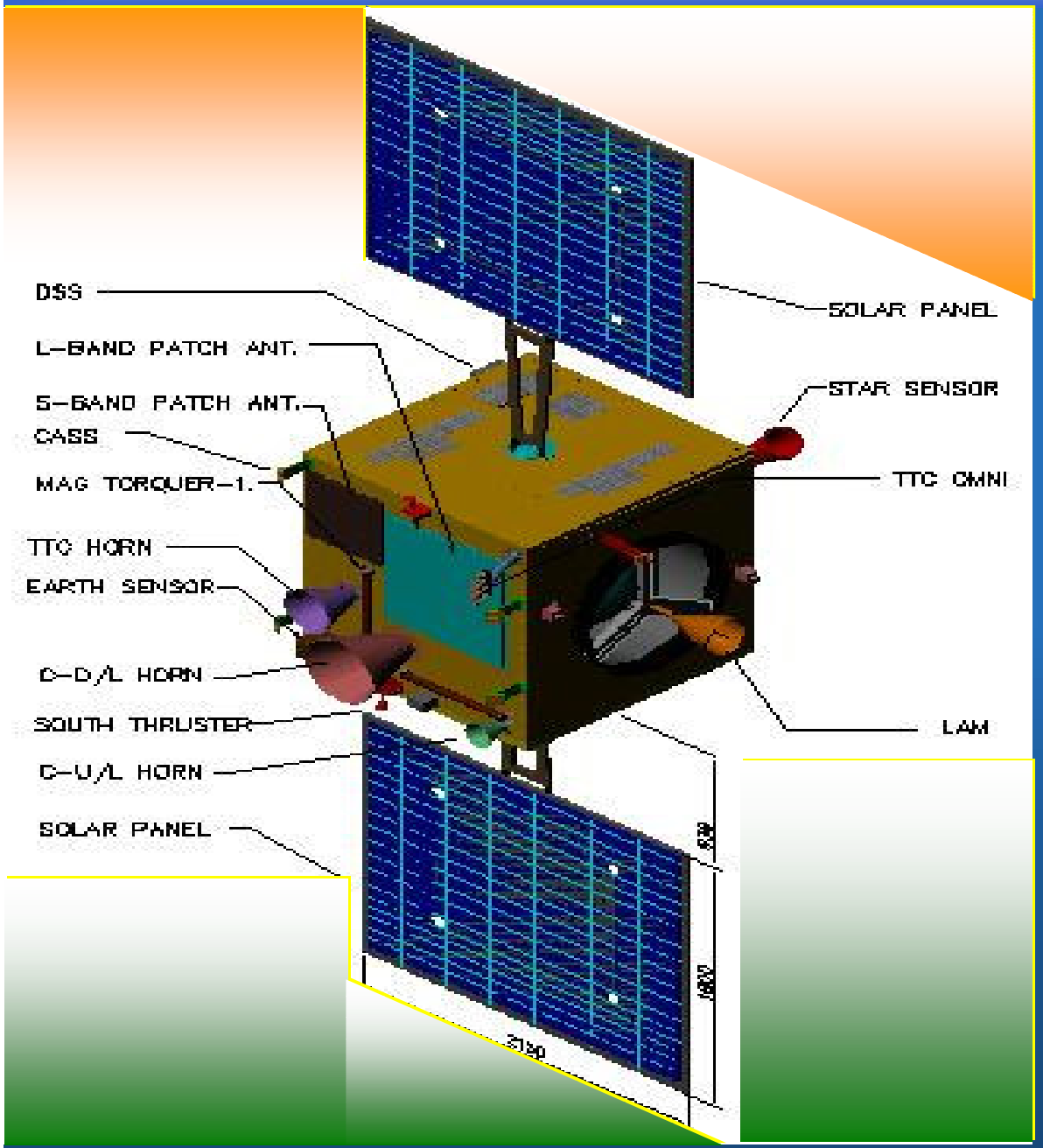
First satellite by second half of 2009

Entire constellation by 2011

IRNSS Configuration



IRNSS Spacecraft



- Satellite mass: 1425 Kg (PSLV Launch)
- Navigation Payload in L1, L5 and S-Bands.
- Navigational data uploaded through TTC link in C-band

USER Segment

- *Dual frequency receiver*
- *Single frequency receivers with capability to receive ionospheric corrections*
- *User receiver to receive other constellations in addition to IRNSS*
- *All the seven IRNSS satellites to be continuously tracked by the user receiver*
- *The user receiver will have minimum G/T of -27 dB/K*

Thank You

For Your Attention