Satellite Navigation Program

IRNSS

Presentation by Indian delegation at STSC-UNCOPUOS, Vienna Feb, 2012

GAGAN-FOP Configuration
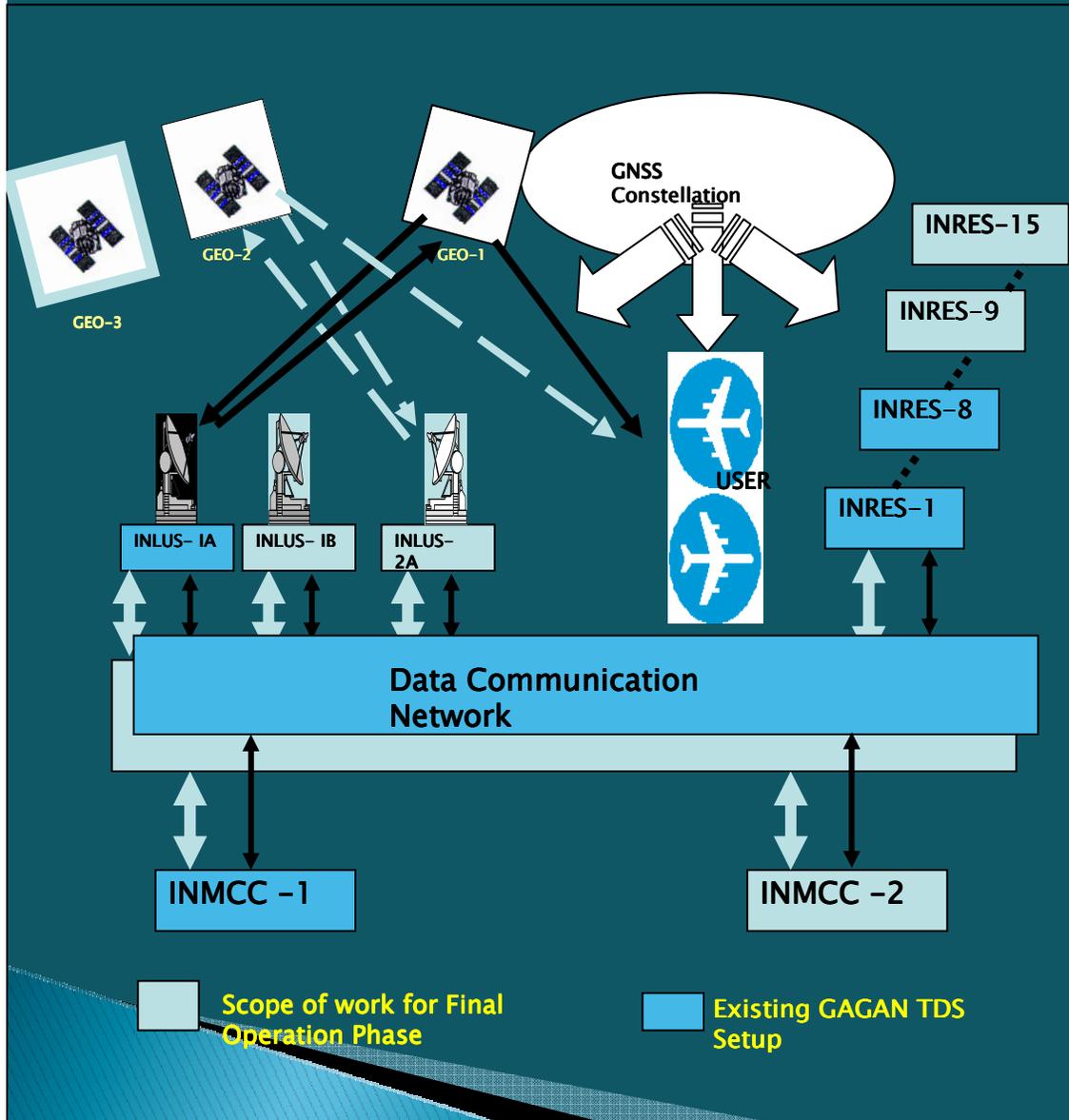
System	FOP
INRES	15 (3 chains)
INMCC	2
INLUS-SG	2
O&M	2
Iono Model (Equatorial)	IGM-MLDF
GEO	1 (GSAT-8)
INLUS-RF	1
COM Links	2

System/Activities Planned

System	FOP
INLUS-RF	2
GEO	GSAT-10, 15
Comm. Links	1

GAGAN payload on GSAT–8: Completion of ground and in orbit test

- GSAT-8 carrying GAGAN Payload launched on 21 May 2011
- INLUS RFU Subsystem Tested and Evaluated
- GSAT-8 GAGAN Payload IOT Completed

1st Signal In Space from GAGAN payload received on 13-Sep-2011

Major Activities

Completed	Planned Activities
Ground Elements	
INLUS–2 at Bangalore: Completed	Test & Evaluation
Proto M&C system for INLUS RFU	Development in DO–178B
DELHI (Nangloi) INLUS–3 FMA: Civil works initiated	Commissioning by Apr'12
Ionosphere Algorithm	
ISRO developed IGM–MLDF model	Incorporation into operational system
Agreed by AAI, DGCA, RTN	Review by TRT for Certification
Space Segment	
GSAT–8 launch, IOT & integration	GSAT –10,15 launch & integration
System Acceptance Test	
Preliminary Completed in Dec'10	Final during Jun'12
Certification by DGCA	
Work Initiated	Completion by Jun'13

APV–1 Performance using IGM–MLDF

- = 100% (53.8%)
- 99% (77.45%)
- 98% (89.52%)
- 97% (91.65%)
- 96% (93.51%)
- 95% (96.42%)
- 80% (100%)
- 70% (100%)
- 60% (100%)
- 50% (100%)
- < 50% (100%)
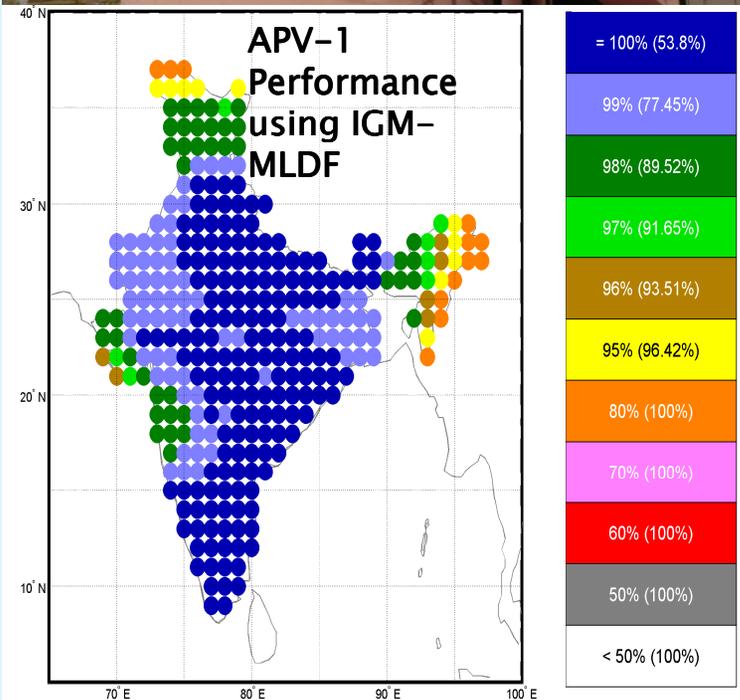
Preliminary Performance using SBAS Receiver

GAGAN versus GPS scatter plot and position uncertainties (15–Sep–2011)

ANT POSITION SCATTER PLOT
From 2011-9-15 0300hrs   To 2011-9-16 0200hrs
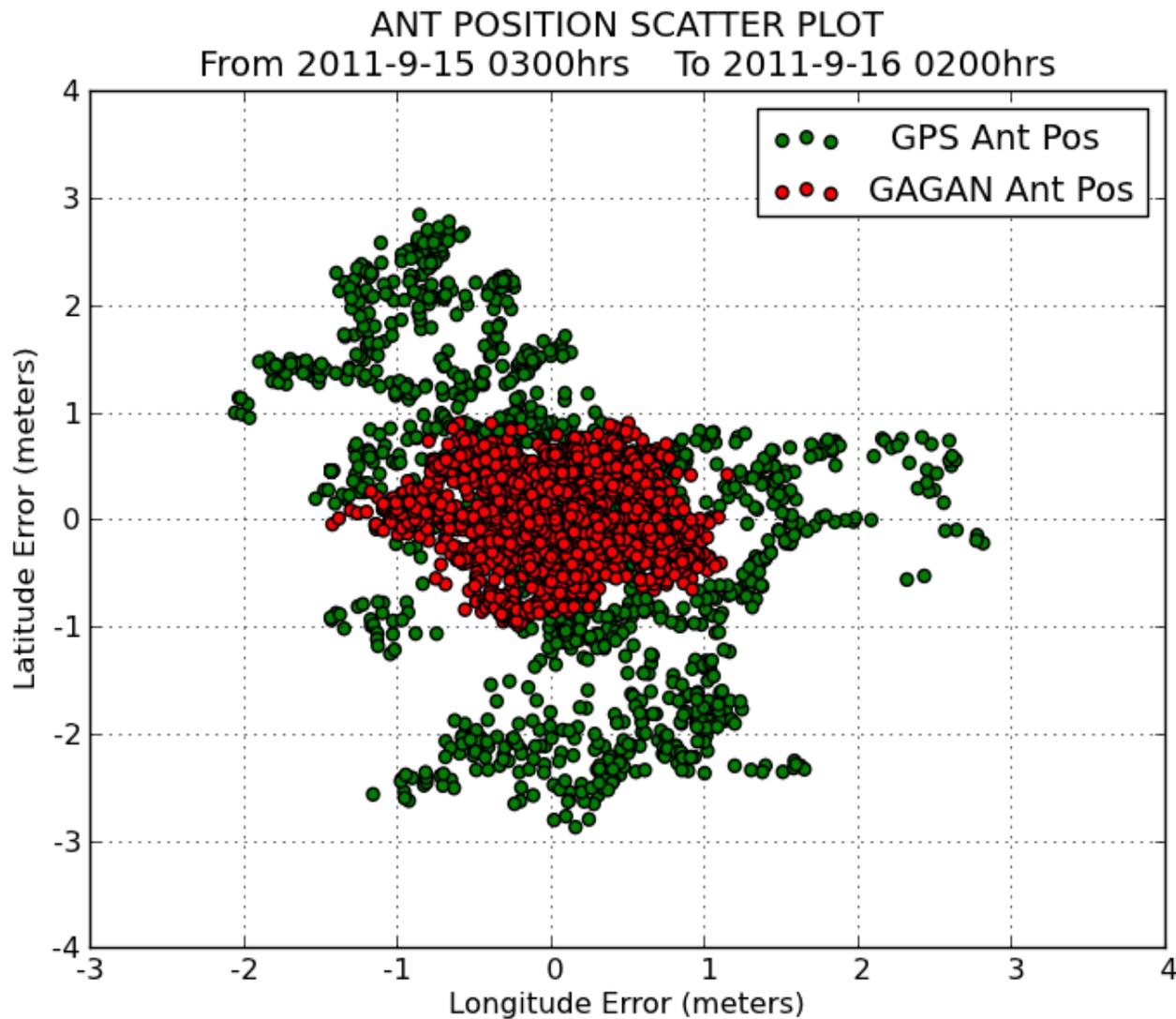
Application of SBAS Receiver

Applications

- ### For Aviation
  - High Accuracy, Global Coverage, Direct En-route, Reduced and Simplified equipment on-board & ground
- ### Other Potential Users
  - Survey, Land Management Scientific Research, Business solutions, Geodynamics etc.,

Tasks Ahead

- Signal In Space tests including air-borne receivers
- Production of SBAS Receivers
- User Meet

Indian Regional Navigational Satellite System
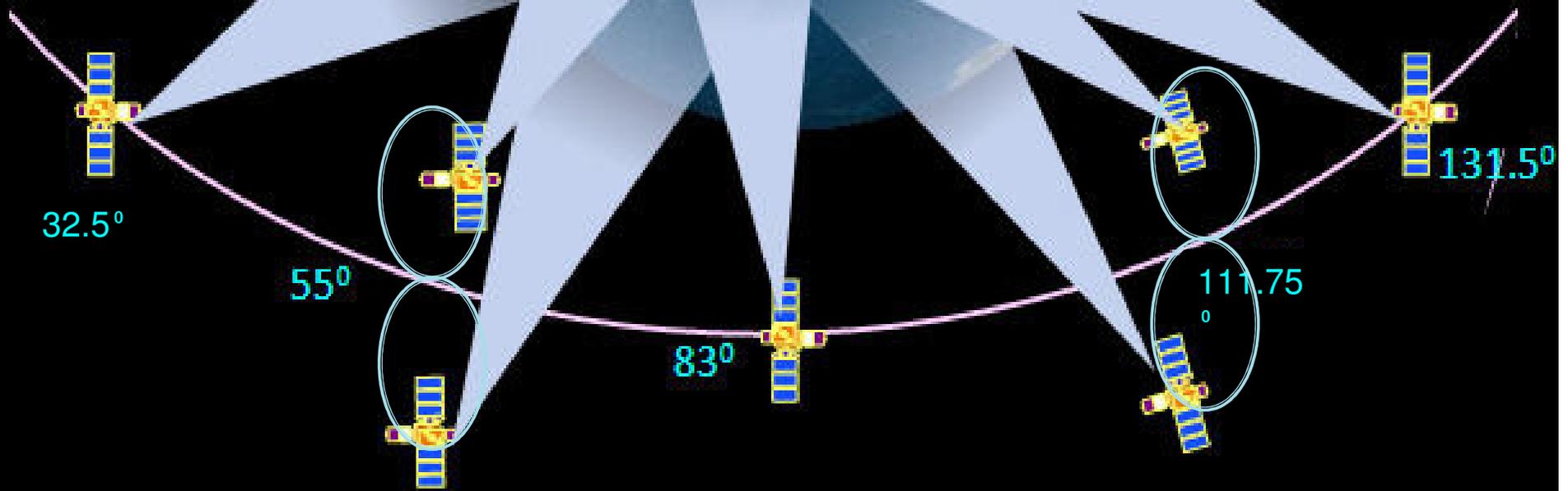
IRNSS SERVICE AREA DEFINITION

IRNSS Visibility

IRNSS Constellation Visibility for 95%, User Mask Angle 5deg
Constellation GEO(34,83,132), GSO(55(MA=305,125,inc=29),GSO(111(MA=1,181,inc=31))   FDD/ISAC
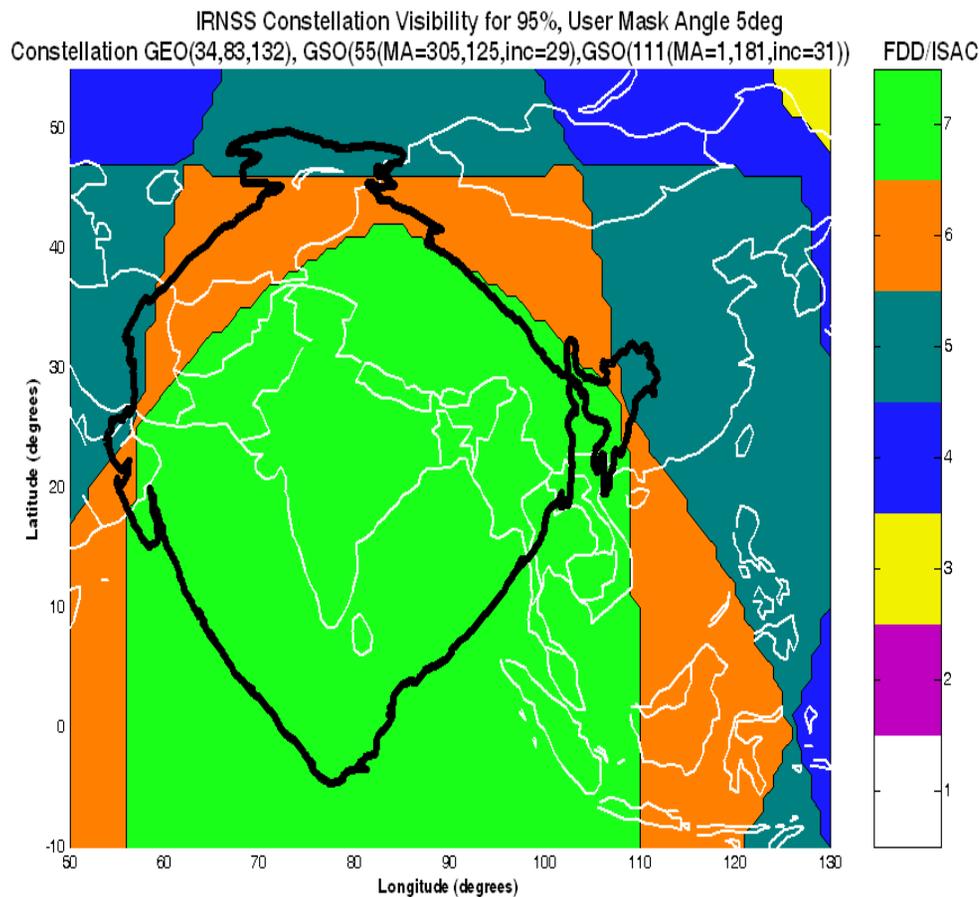
S. No	Service Area	Description of the service area
1	Primary Service Area	Indian land mass and 1500 km from Indian geopolitical boundry

• Targeted position accuracy better than 20 metres

IRNSS Architecture
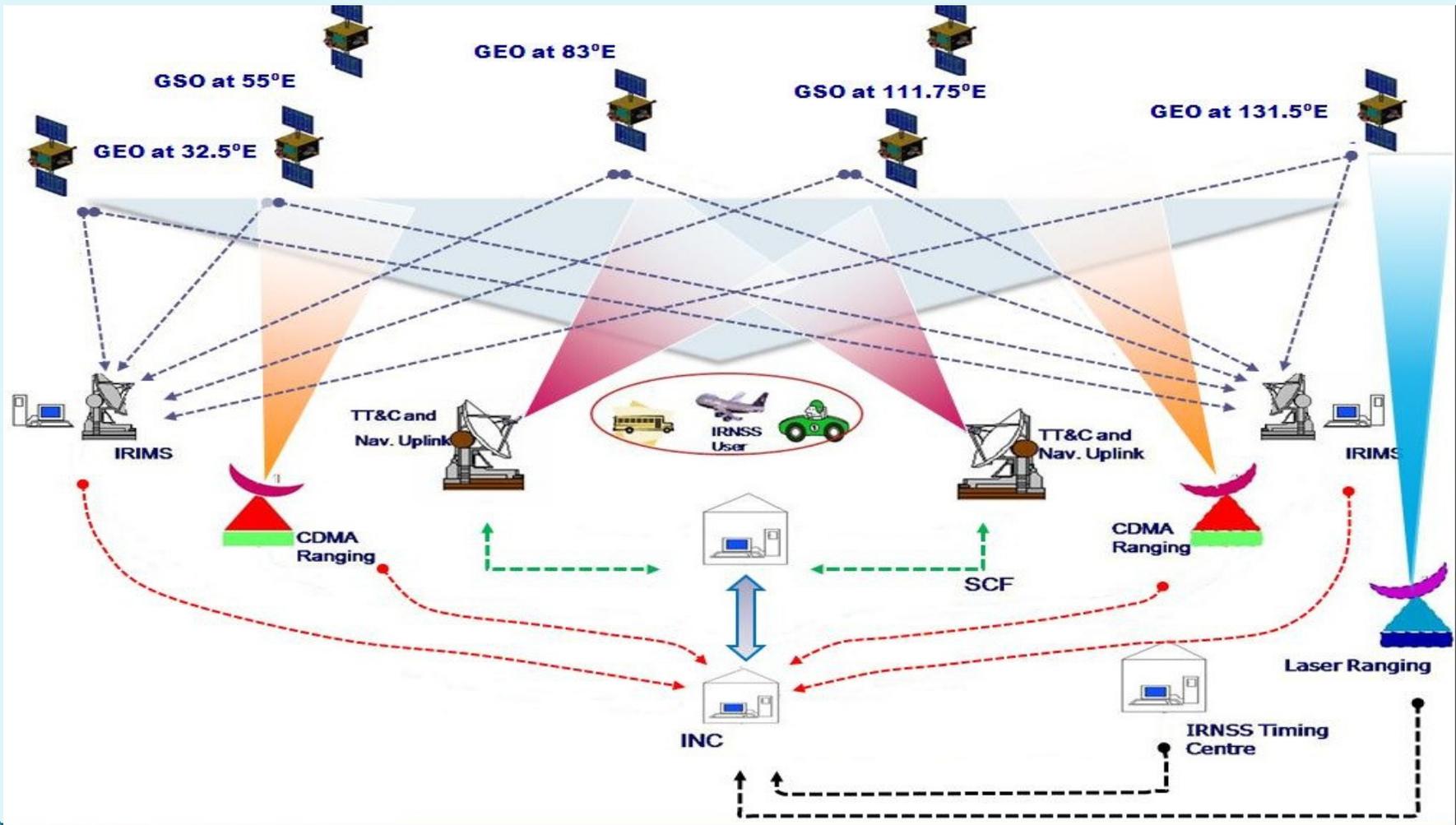
Space Segment

▸ Space Segment consists of Seven satellites

▸ 3 Satellites in Geo-Stationary orbit at 32.5°, 83° and 131.5° East.

▸ 4 Satellites in GEO Synchronous orbit placed at inclination of 29° with Longitude crossing at 55° and 111.75° East.

▸ Two spare satellite are also planned.

▸ The Satellites are specially configured for the Navigation. Same configuration for GEO and GSO which is desirable for the production of the satellites. Production plan & schedule are worked out.

▸ IRNSS Satellites are to be launched by the Indian launcher PSLV.

▸ The first Satellite will be launched in 2012.The subsequent launches are planned once in Six months. The full constellation will be operational by 2015.

IRNSS Constellation

3 geo–stationary satellites revolving in equatorial orbit
4 geo–synchronous satellites revolving in independent 29⁰ inclined orbits
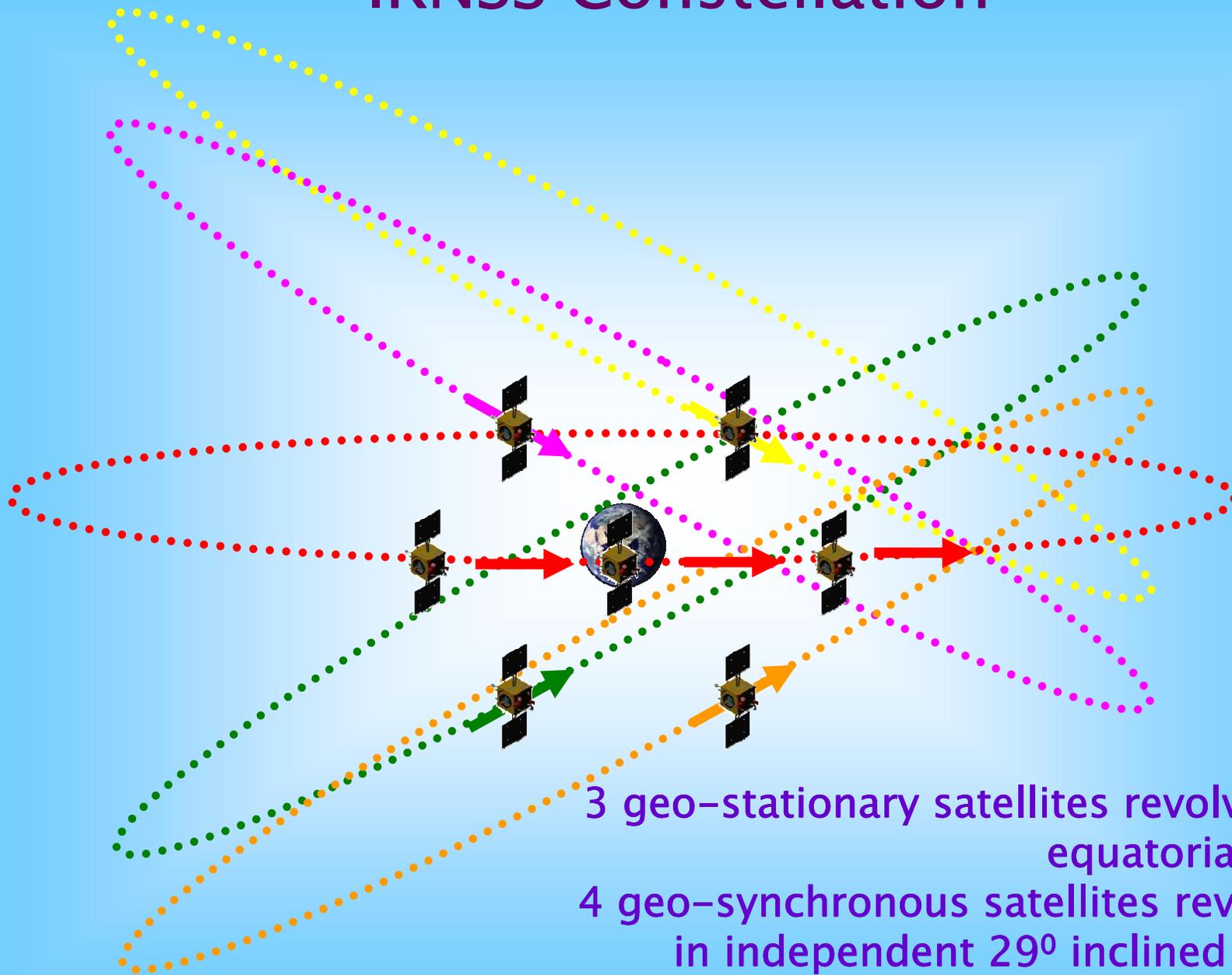
IRNSS Satellite

- IRNSS Satellites are designed around I-1K bus.
- Dry mass of around 600 kgs and lift off mass of 1425 kgs
- Power generation capability of 1600 W and payload power requirement of 901 W
- Navigation Payload Transmits SPS and RS signals in L5 and S Bands.
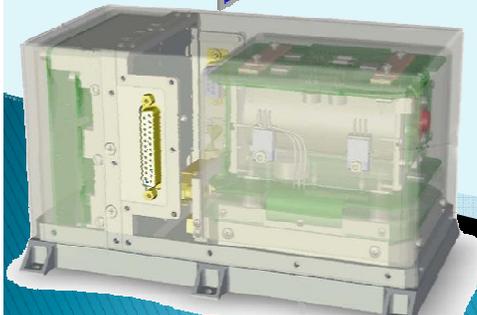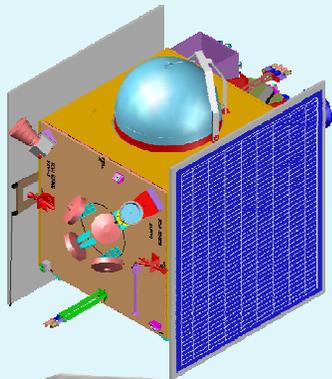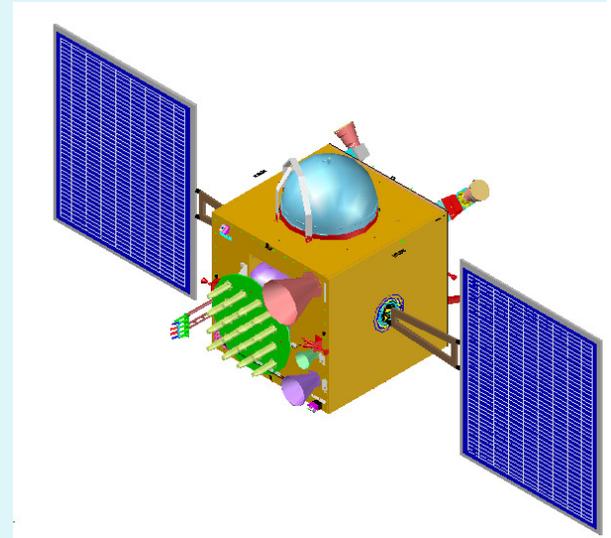
- Payload utilizes highly stable Atomic Frequency Standards for generation of Navigation Signals.

- 3 Axis control of the satellite with Yaw steering capability to optimize the use of Solar Panels and to support the thermal control of the satellite

Ground Segment Subsystems

- IRNSS Satellite Control Earth Stations – 9 Nos

- IRNSS Satellite Control Centre (IRSCC) – 2 Nos

- IRNSS Range and Integrity Monitoring Stations (IRIMS) – 17 Nos

- IRNSS Navigation Centre (INC) – 2 Nos

- IRNSS Network Time (IRNWT) – 2 Nos

- IRNSS CDMA Ranging Stations (IRCDR) – 4 Nos

- IRNSS Data Communication Network (IRDCN) – 2 Nos

Ground Segment Architecture
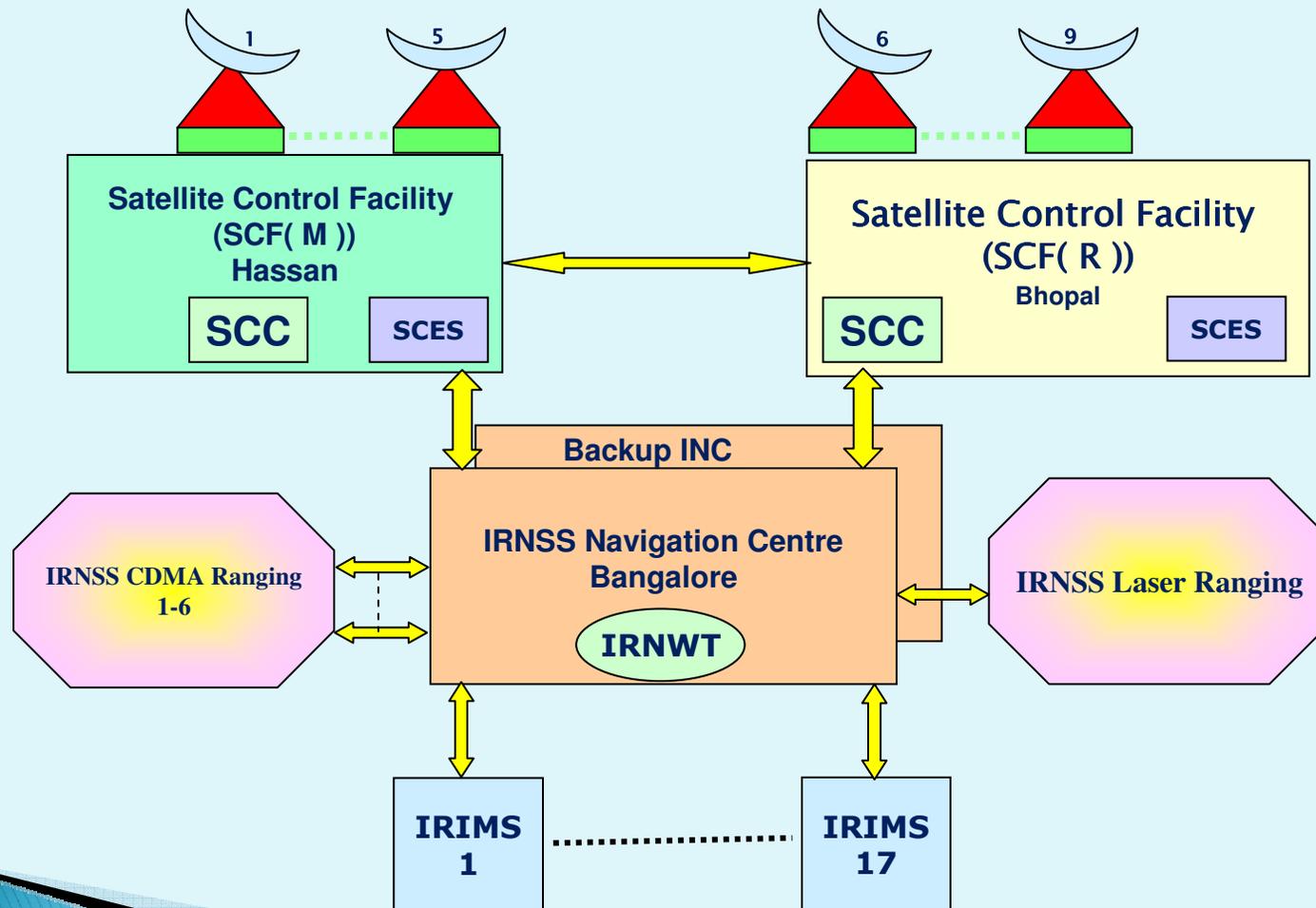
Major Elements Of Navigation Software

Navigation software will be deployed in the IRNSS Navigation Centre. The software modules interface with various subsystems of the ground segment and generate navigation parameters, required for broadcast from spacecraft.

Navigation software generates the following in 4 sub-frames:

- Primary Parameters
    - Satellite ephemeris , clock
    - Satellite health status & accuracy
- Secondary Parameters
    - Satellite almanac
    - Ionospheric corrections-coefficients
    - IRNSS time difference w.r.t UTC /GNSS
    - Ionospheric gird delay parameters
    - Encryption keys
    - Text messages
    - Differential corrections
    - Earth orientation parameters
    - Auto Nav Parameters
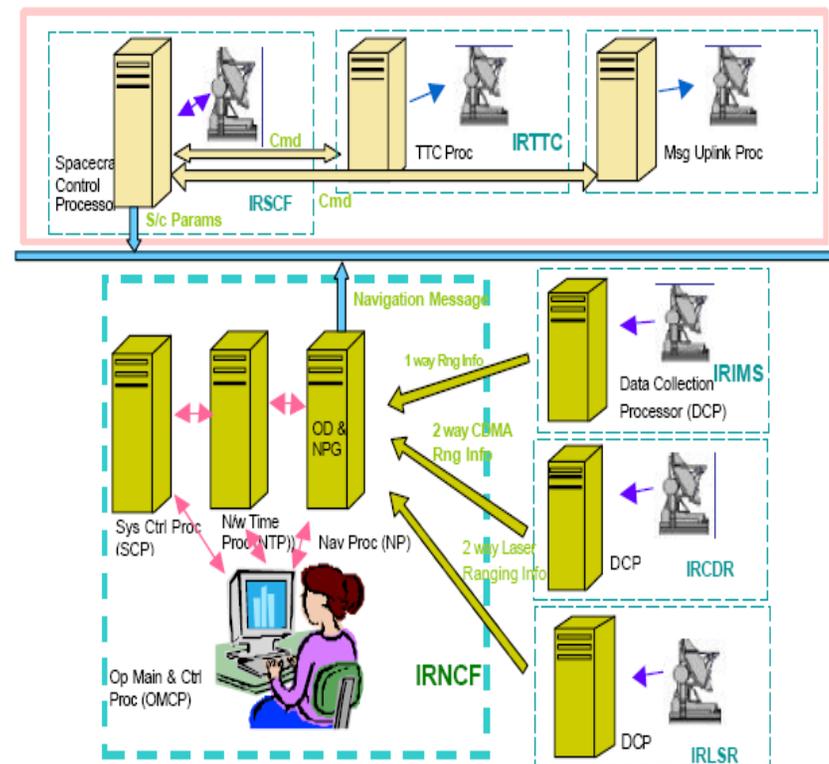
User Segment

▸ 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.

Satellite Navigation Application

➢ Avionic navigation and precise landing system

➢ Mapping and GIS data capture

➢ Automated logistics in factories, construction sites and mines

➢ Vehicle tracking and fleet management.

➢ Terrestrial navigation aid for hikers and travelers

➢ Visual and voice navigation for drivers

➢ Integration with mobile phones.
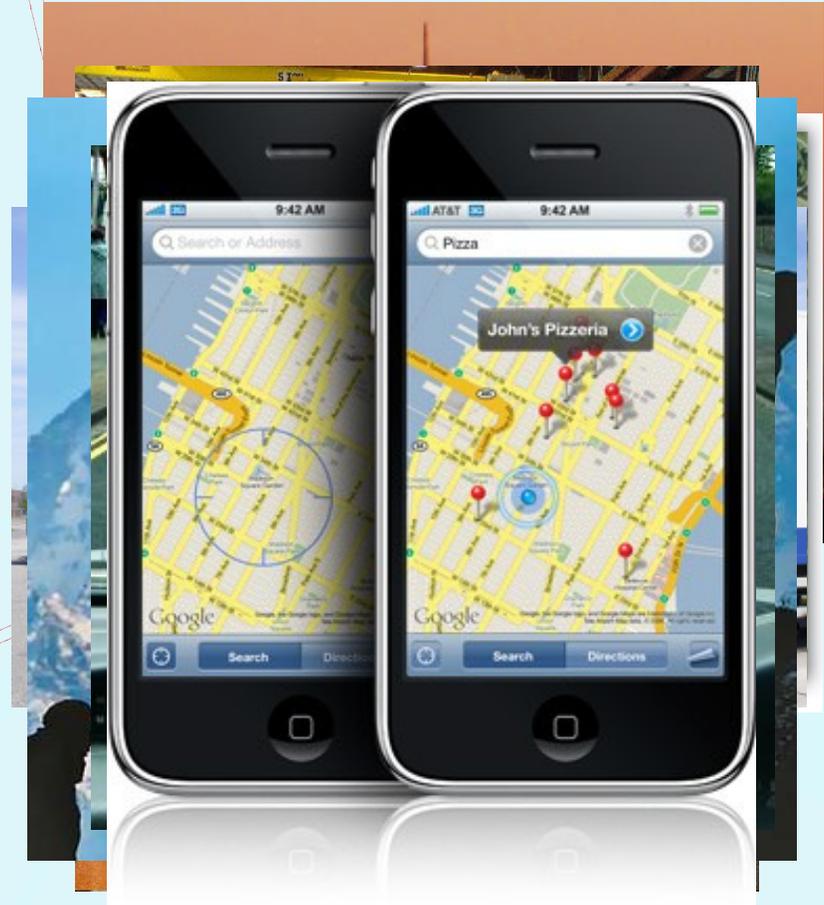
ISRO Participation to International GNSS Forum

- ISRO is an active member of International Committee of GNSS (ICG).
- ISRO participated in many bilateral discussions with GPS, GALILEO etc. on Interoperable and compatible signal structure.
- ISRO is hosting a QZSS Monitoring Station site in ISTRAC.

Thank You