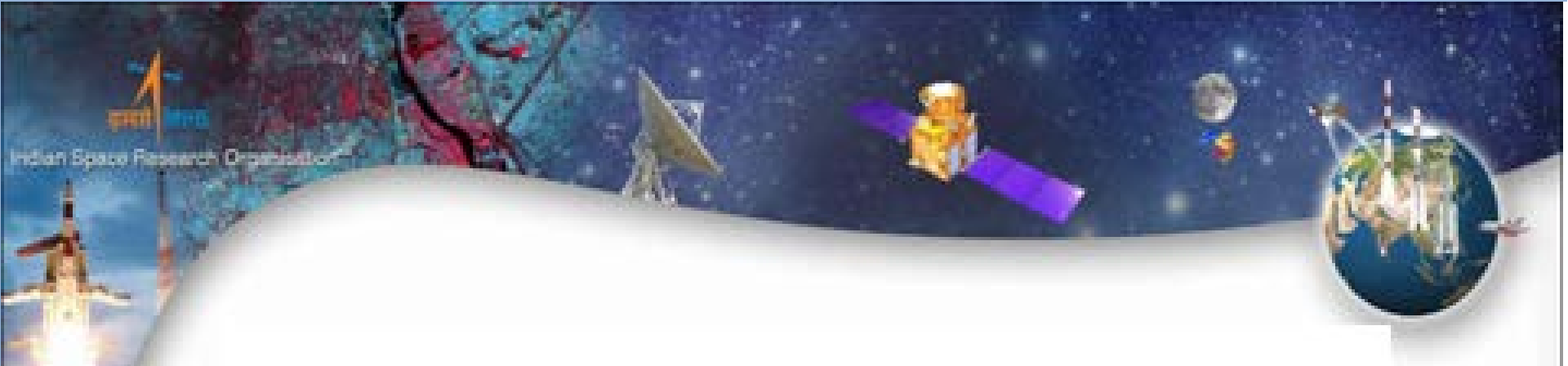
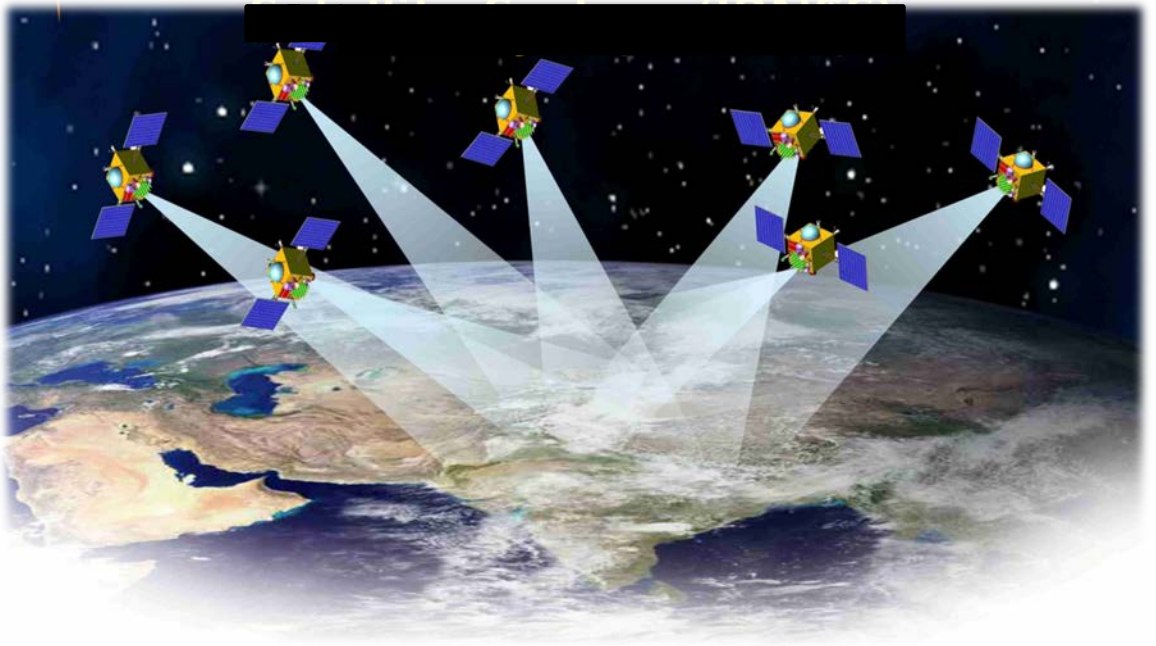


NAVIC

(NAVigation with Indian Constellation)

The Indian Regional Navigation Satellite System (IRNSS)

Outline

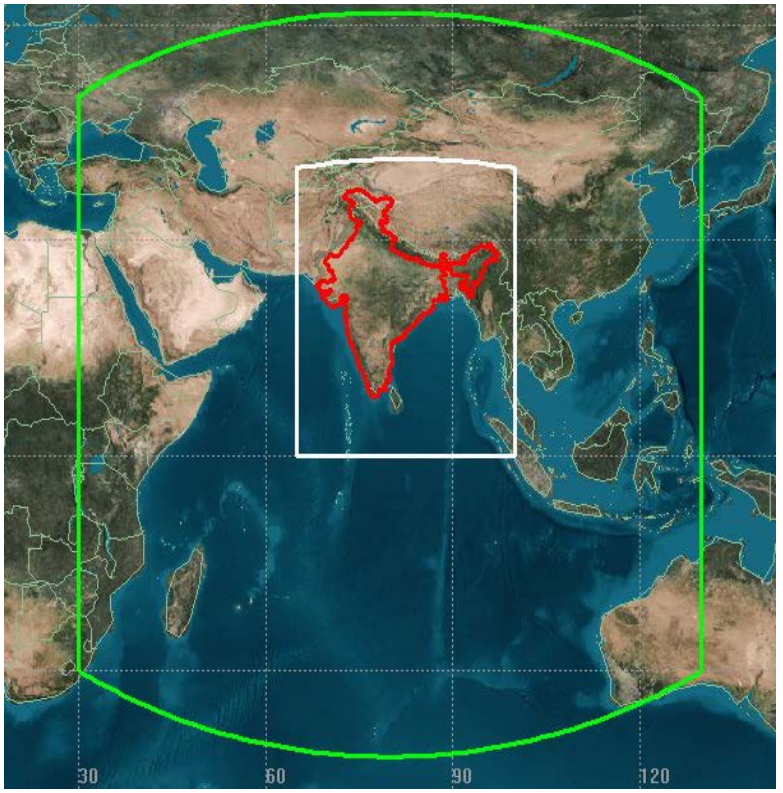


- Objectives
- Constellation
- Space Segment
- Ground Segment
- Performance & Applications

NAVIC - Objectives

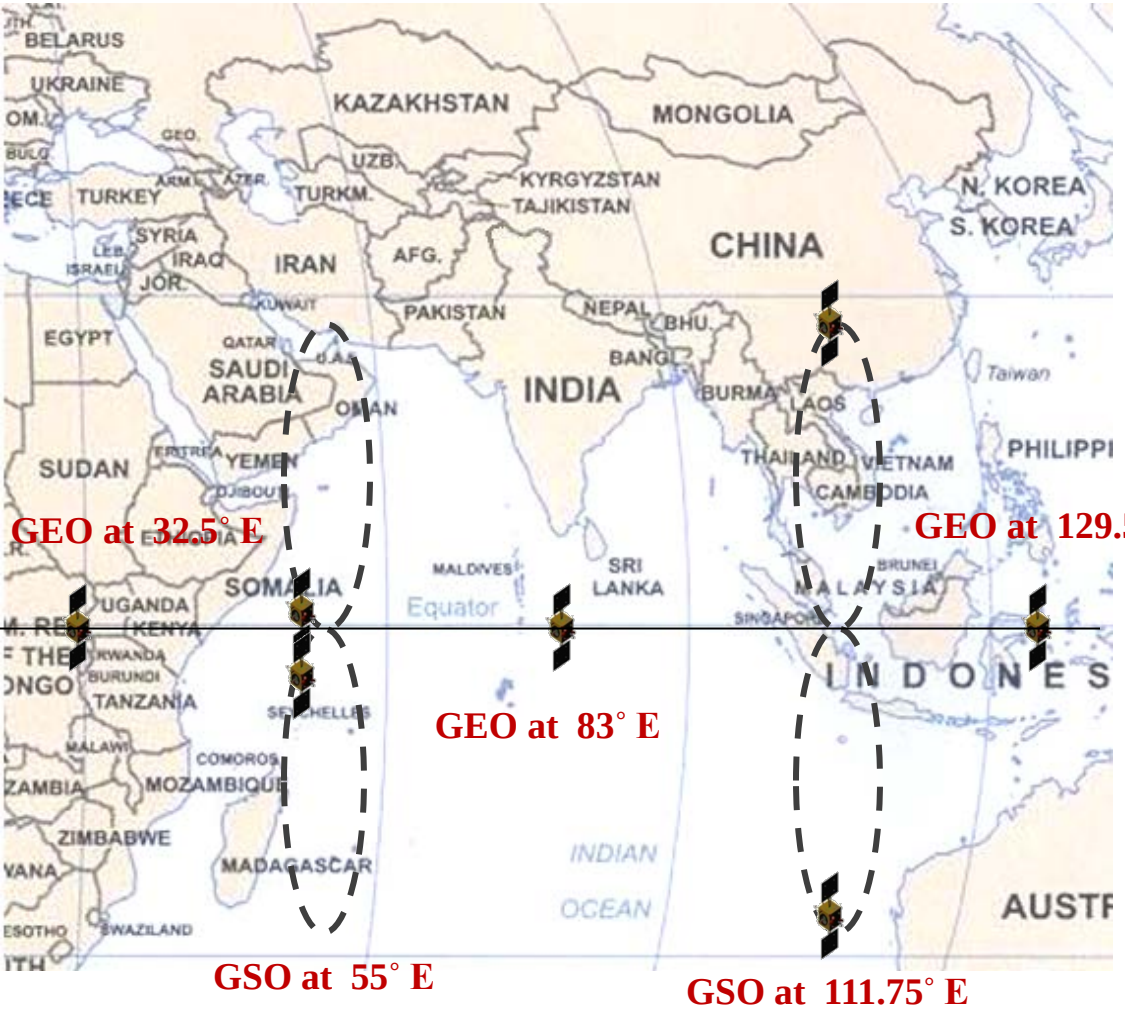
- **NAVIC, is an ISRO initiative to build independent satellite-based navigation system to provide precise Position, Velocity and Time over the Indian Region.**

- **The primary service area includes the Indian landmass and 1500 km from the Indian geo-political boundaries**



Extended Service Area: Area between primary service area and area enclosed by the rectangle of Lat 30˚S to 50˚ N, Long 30˚ E to 130˚E.

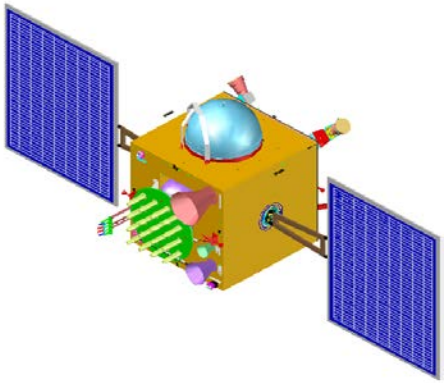
CONSTELLATION



NAVIC Constellation Footprint

- IRNSS constellation consists of 7 satellites
- Three satellites in Geo-stationary orbit at 32.5°E, 83°E and 129.5°E
- Four satellites in Geo-synchronous orbit placed at inclination of 29° with Longitude crossings 55°E and 111.75°E
- IRNSS Satellites are launched by the Indian launcher PSLV.

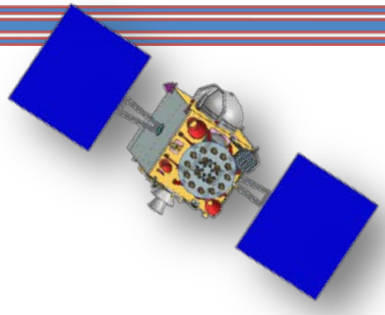
SATELLITES



- IRNSS Satellites are built around I-1K bus.
- Dry mass of 600 Kg & Lift off mass of 1425 Kg
- Power generation capability is1600 W
- Navigation P/L Transmits SPS and RS signals in both L5 and S Bands
- Highly stable Rubidium Atomic Frequency Standards (RAFS) for generation of Navigation Signals.
- Three Axis control of the satellite with Yaw steering capability to generate optimum power and to support thermal control of the satellite.

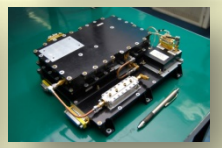
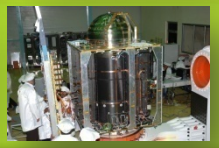
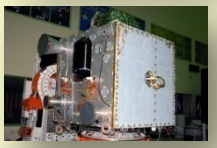
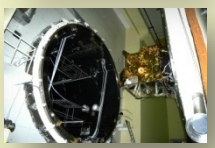
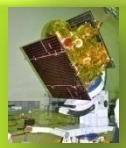
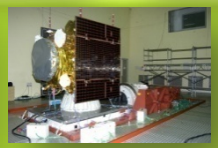
SATELLITES

Orbital Location	:	Geosynchronous / Geostationary
Bus	:	I-1K Bus
Payload	:	Navigation Payload in S and L5 bands Ranging Payload in C Band
Power	:	1600 Watts
Mass	:	1425 Kg
Mission Life	:	10 Years



Spacecraft	Launch Date
IRNSS -1A	1 July, '13
IRNSS -1B	4 April, '14
IRNSS -1C	15 October, '14
IRNSS -1D	28 March, '15
IRNSS -1E	20 January, '16
IRNSS -1F	10 March, '16
IRNSS -1G	28 April, '16

Spacecraft Realization

MONTH #1	Propulsion Integration and Thermal Implementation	  
MONTH #2	Payload and House Keeping Assembly and Integration	  
MONTH #3	Open Mode IST, Panel Closure and Closed Mode IST	  
MONTH #4	Closed Mode IST and Thermo-Vac Test	  
MONTH #5	Deployments, Physical Parameters, Dynamic and CATF Tests	   
MONTH #6	Transportation, Launch Campaign and Launch	  

Ground Systems

IRNSS Spacecraft Control Facility (IRSCF)

ISRO Navigation Centre (INC)

IRNSS Range and Integrity Monitoring Stations (IRIMS)

IRNSS Network Timing Facility (IRNWT)

IRNSS Data Communication Network (IRDCN)

IRNSS CDMA Ranging Stations (IRCDR)

Ground Segment

1. **IRNSS Spacecraft Control Facility (IRSCF)**
   - Monitors and controls the IRNSS spacecrafts.
   - Uplinks the navigation data to the satellite

IRSCF- MCF Hassan

2. **IRNSS Range and Integrity Monitoring Stations (IRIMS)**
   - Located at accurately known locations across the country.
   - Performs continuous one-way ranging.

3. **ISRO Navigation Centre (INC)**
   - Generation of navigation parameters.
   - Ionosphere modelling, precise clock and ephemeris estimation.

Naviagation Control Room.INC

Ground Segment

4. IRNSS Network Timing Facility (IRNWT)

- Maintains the precise IRNSS time .
- Uses an ensemble of Hydrogen Masers and Caesium clocks

H-MASER at IRNWT

5. IRNSS CDMA Ranging Stations (IRCDR)

- Precise orbit determination of the IRNSS satellites using CDMA technique.

6. IRNSS Laser Satellite Ranging (IRLSR)

- Accurate orbit determination of the IRNSS satellites using Laser technology..
- Corner Cube Retro Reflector (CCRR) on board spacecrafts.

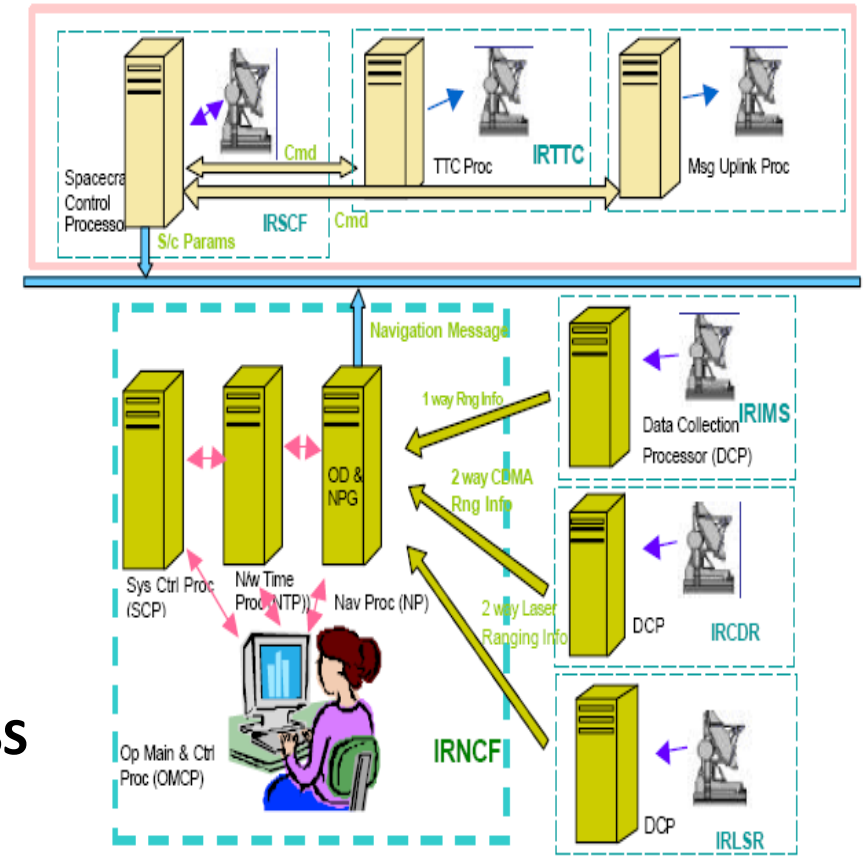
IRCDR Station

Navigation Software

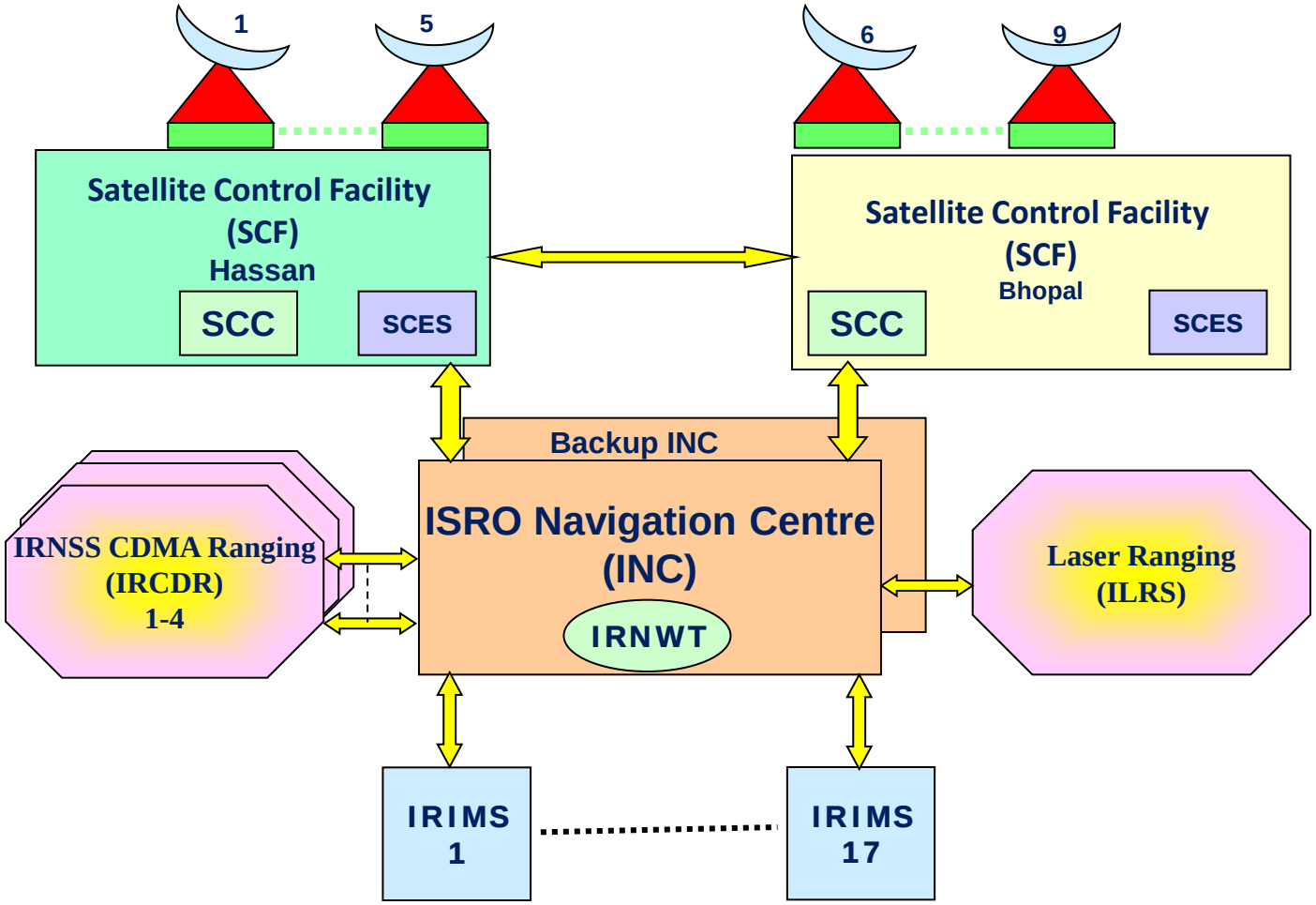
Navigation software deployed in ISRO Navigation Centre (INC)

The software modules interface with various subsystems of the ground segment and generate navigation parameters.

- **Primary Parameters**
  - Satellite ephemeris and clock
- **Secondary Parameters**
  - Satellite almanac
  - Differential corrections
  - Ionospheric gird delay parameters
  - Ionospheric corrections-coefficients
  - IRNSS time difference w.r.t UTC /GNSS
  - Auto-Nav Parameters etc.

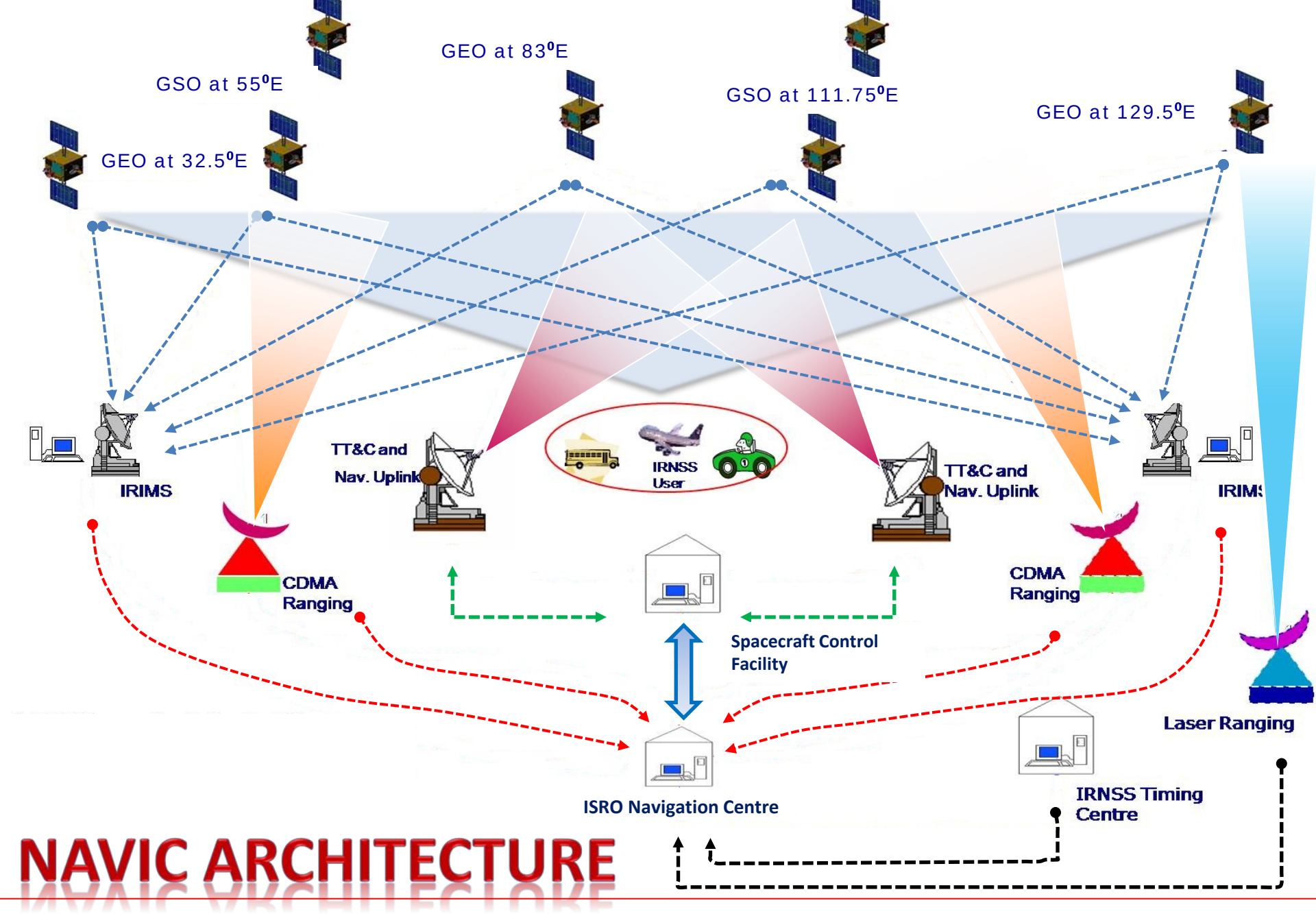


Ground Segment Architecture



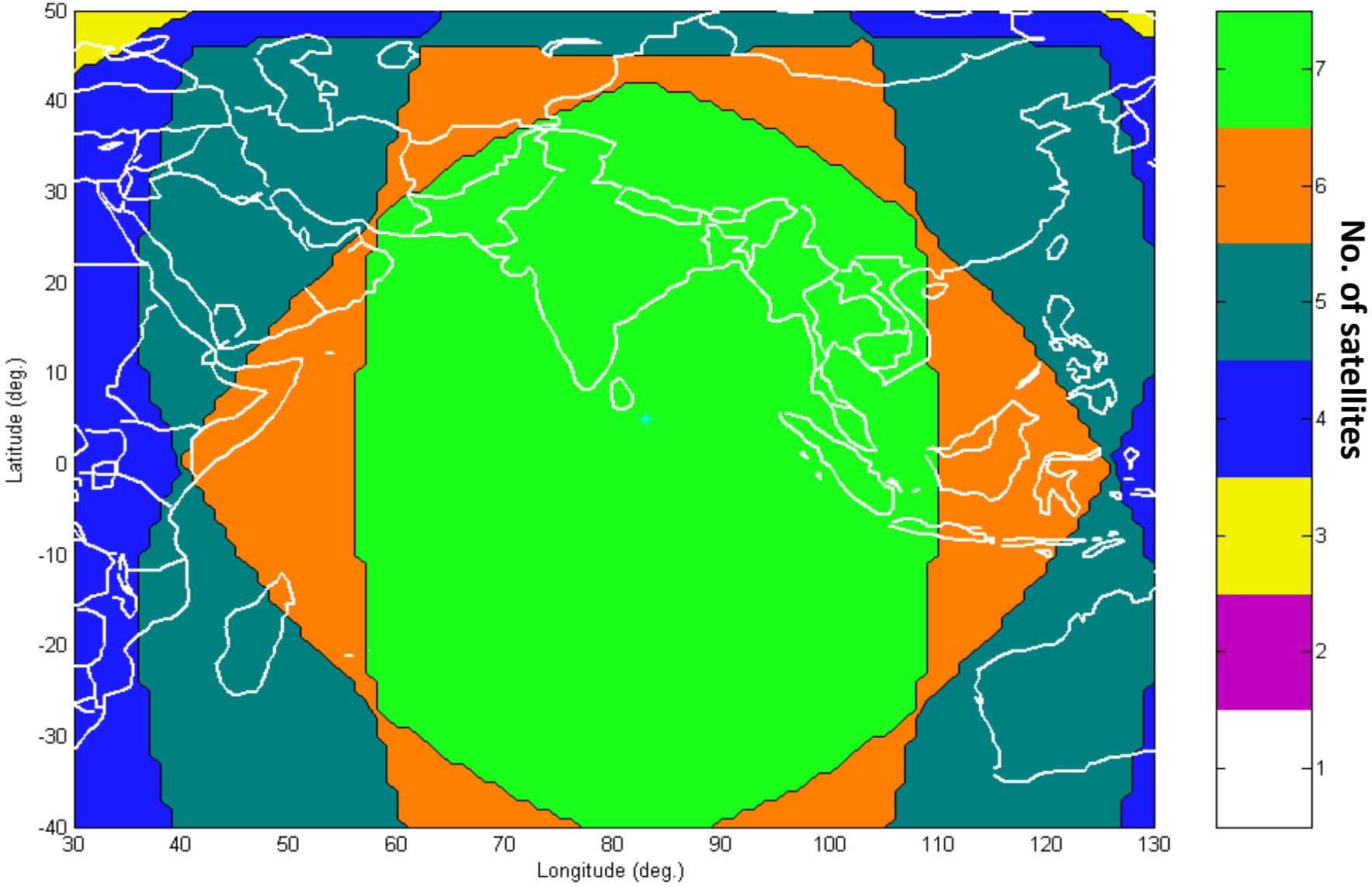
User Segment

- The user segment consists of IRNSS receivers operating in
  - **Single Frequency (L5 or S band)**
  - **Dual Frequency (L5 and S band)**
  - **Multi-GNSS receiver using IRNSS and other GNSS systems.**



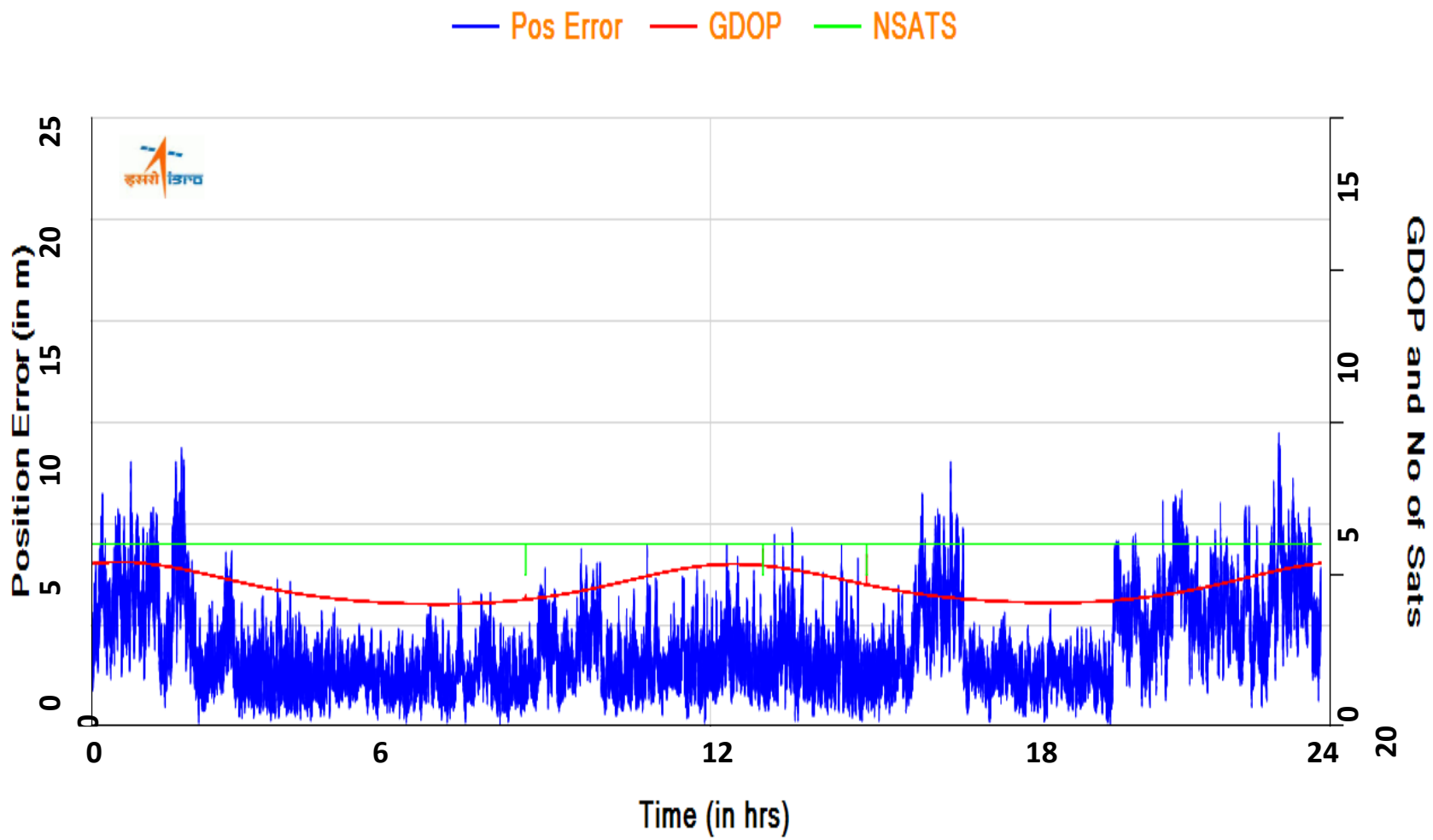
NAVIC ARCHITECTURE

Spacecraft Visibility



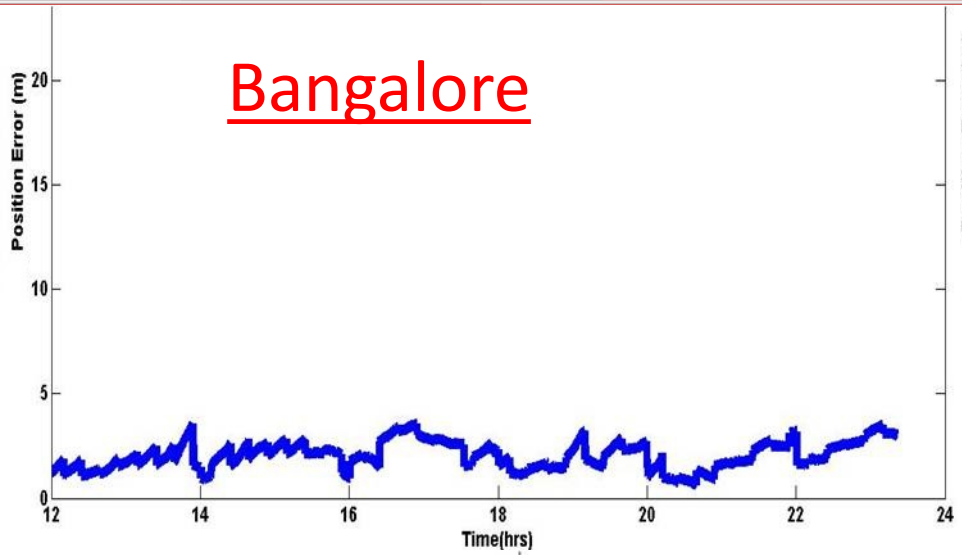
PERFORMANCE

IRNSS Dual Frequency 3sigma RMS Position Error: 4.3 m

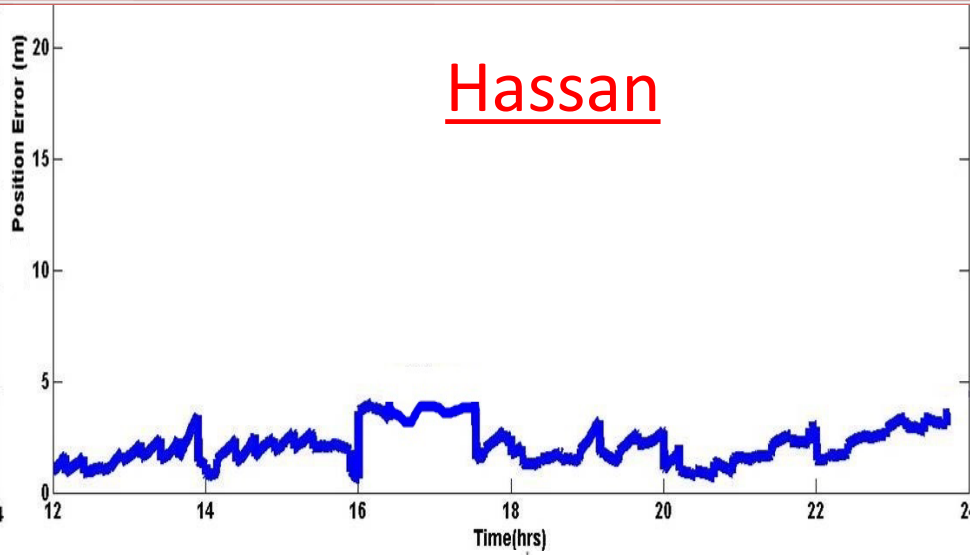


PERFORMANCE

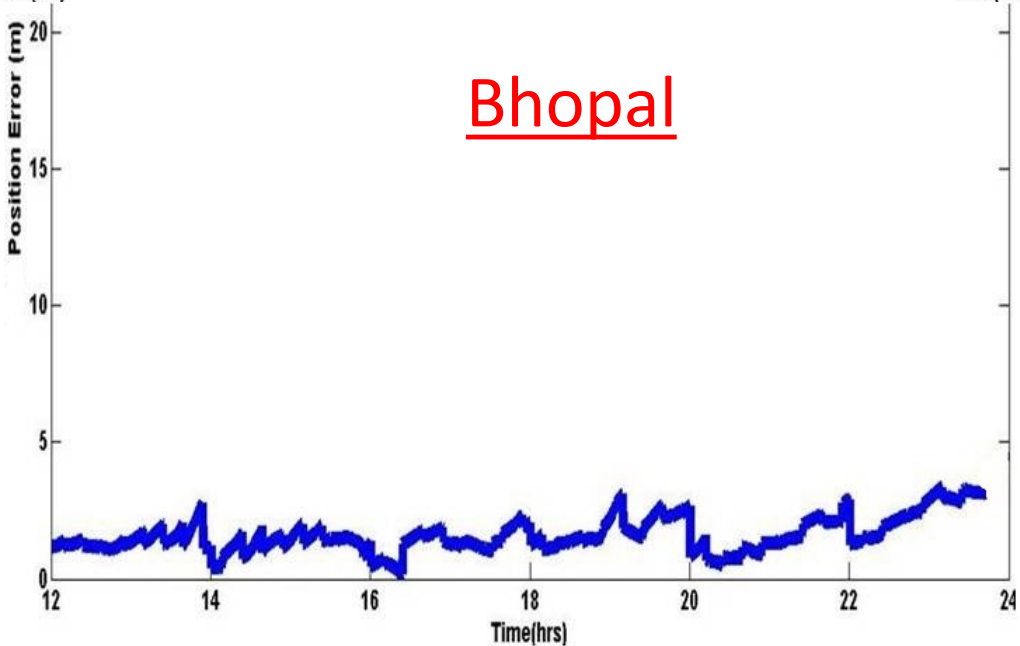
Bangalore



Hassan



Bhopal



Applications

- Mapping and GIS data capture
- Automated logistics in factories, construction sites and mines
- Vehicle tracking and fleet mgmt.
- Terrestrial navigation aid for hikers and travelers
- Visual and voice navigation for drivers
- Integration with mobile phones.
- Integration with E-goverance inculding Disaster management

THANK YOU