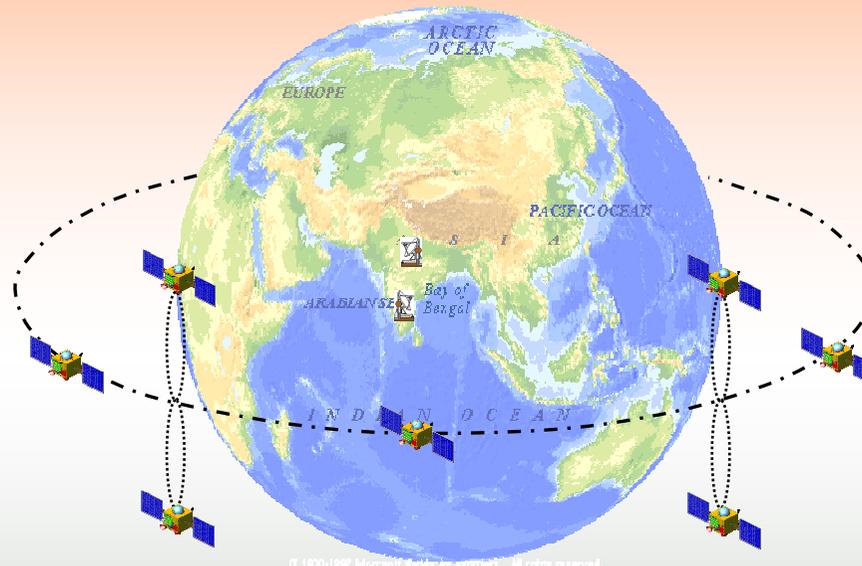




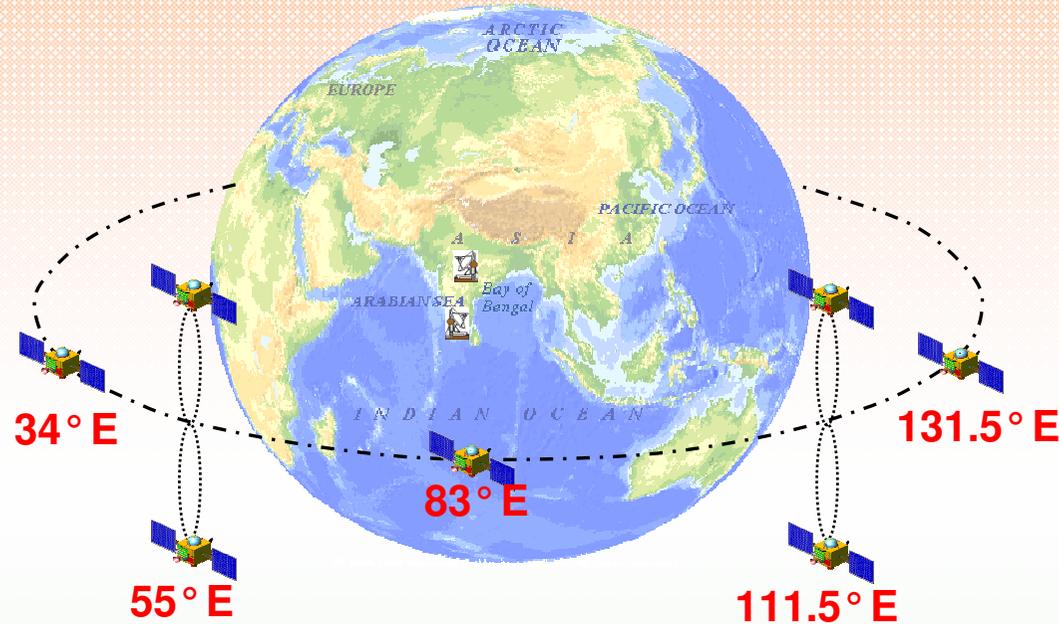
# Indian Regional Navigation Satellite System { IRNSS }



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United Nations / Azerbaijan / ESA / USA workshop on  
Applications of Global Navigation Satellite System, held at  
Baku, Azerbaijan from 11<sup>th</sup> – 15<sup>th</sup> May 2009

# Indian Regional Navigation Satellite System

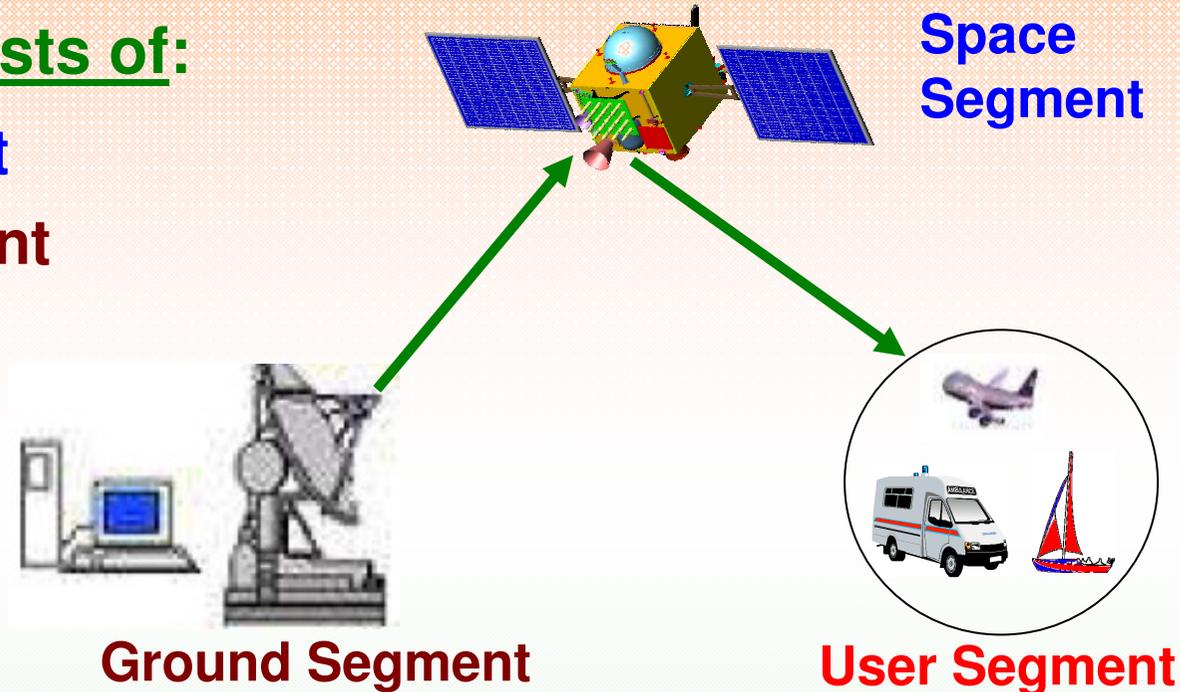


- IRNSS constellation consists of seven satellites.
- It is an independent regional navigation satellite system of India.
- Designed to provide position accuracy better than 10m for dual frequency users.
- Coverage area is over Indian land mass & region extending about 1500 Kms from Indian geopolitical boundary.

# IRNSS Elements

## IRNSS system consists of:

- Space Segment
- Ground Segment
- User Segment



## Space Segment:

- Constellation of seven satellites.
- Three satellites in Geostationary orbit at  $34^{\circ}\text{E}$ ,  $83^{\circ}\text{E}$  &  $131.5^{\circ}\text{E}$
- Four satellites in the Geosynchronous orbit with an equator crossing at  $55^{\circ}\text{E}$  &  $111.5^{\circ}\text{E}$  with an inclination of  $29^{\circ}$



# IRNSS Elements

## Ground Segment:

- Satellite Control Facility.
- Navigation Control Centre.
- Range & Integrity Monitoring Stations.
- TT&C and Navigation Parameter Uplink Stations.
- CDMA Ranging Stations & Laser Ranging Services.
- Timing Centre and Data Communication Links.

## User Segment:

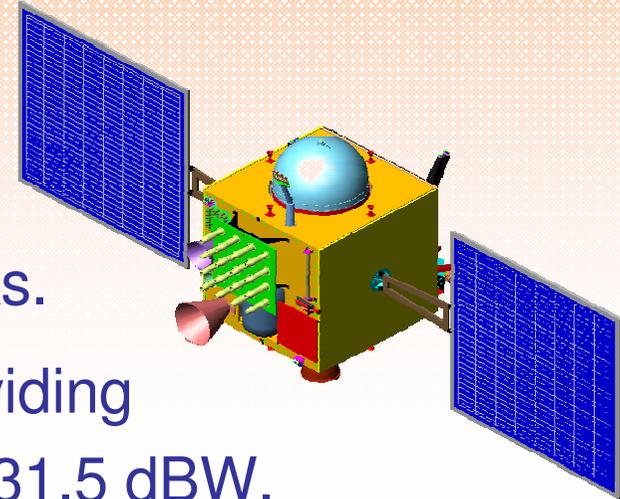
- Single & Dual frequency receivers.
- Receivers capable of receiving multi-constellation signals inclusive of GPS, GLONASS, GALILEO etc are also envisage.





# IRNSS Spacecraft

- Satellite mass is 1370 Kgs.
- Designed to have 7 to 10 years life.
- Payload have 3 Rubidium Atomic clocks.
- There will be 2 downlinks (S & L5) providing dual frequency operation with EIRP of 31.5 dBW.
- Two sided Solar Panel of size 1.8m x 2.15m to generate 1525 watts of power. Lithium Ion Battery of 68 Ah capacity.
- TTC system is in C-Band links.
- Navigation Parameters to be uplinked through TTC link itself.
- CDMA Ranging Transponder and Laser Ranging Reflector.
- It will be launched by Indian launcher - PSLV launch vehicle. 6





# Navigation Signals & Services

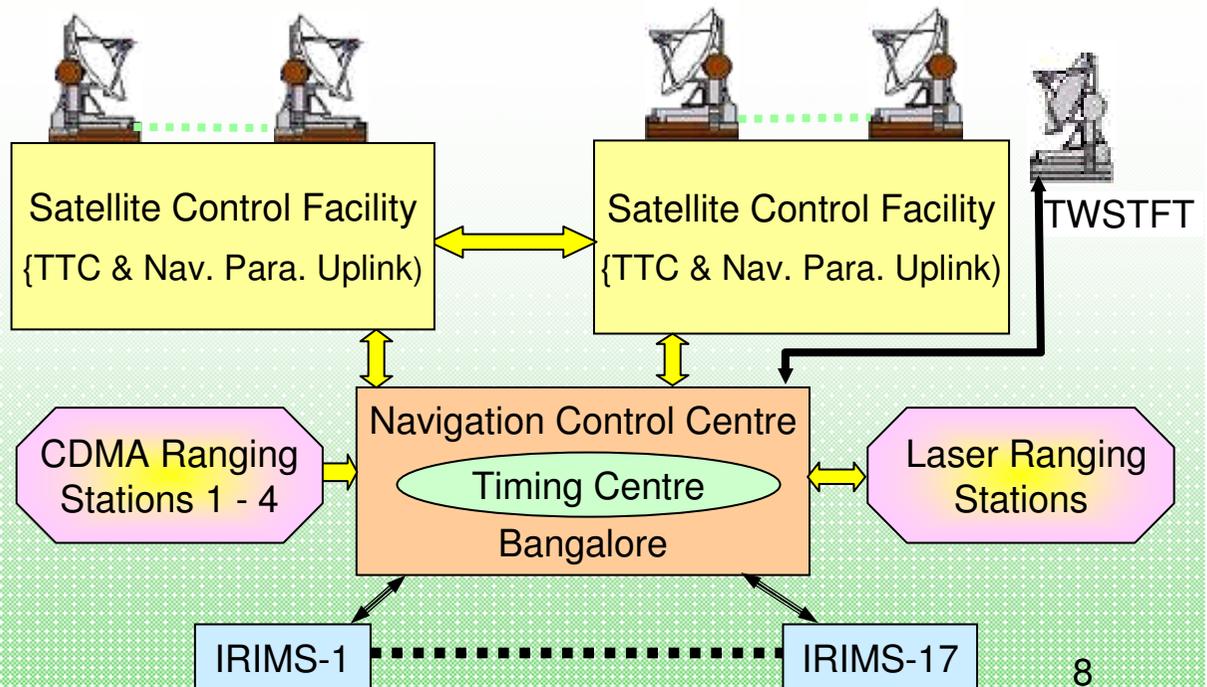
- **Two types of signals in L5 & S - Band will be transmitted.**
  - L5 - Band centre frequency is 1176.45 MHz
  - S - Band centre frequency is 2492.028 MHz
  - Both L5 and S band consists of two downlinks.
  
- **IRNSS provides two basic services as under**
  - Standard Positioning Service (SPS) for common users with 1 MHz BPSK modulation.
  - Restricted Service (RS) for special authorized users with BOC (5,2) modulation
  
- **Signal Structure similar to other GNSS systems is under study and will be finalize soon.**



# IRNSS Ground Segment Elements

## IRNSS Ground Segment consists of following elements:

- Satellite Control Facility
  - TTC and Land Uplink Stations (9 Nos ), Satellite Control Centre (2 Nos)
- Range & Integrity Monitoring Stations (17Nos) across the country
- Navigation Control Facility
  - Nav. Control Centre
  - IRNSS Timing Centre
  - Time Transfer Systems ( TWSTFT ..... etc )
- CDMA Ranging Stations (4 Nos)
- Laser Ranging Service
- Data Communication Network





# User Segment

- The user segment consists of a specially designed Single and Dual frequency receiver capable of receiving IRNSS SPS and RS signals.
- Receivers capable of receiving multi-constellation signals inclusive of GPS, GLONASS, Galileo etc are also envisaged.
- All the seven IRNSS satellites will be continuously tracked by the user receiver.
- The user receiver will have minimum G/T of -27 dB/K similar to GPS user receiver.



## User Equivalent Range Error (UERE) Budget

Error Source	L5 (m)	S (m)	Dual Freq. (m)
SIS (Ephemeris + Clock)	2	2	2
Ionosphere Delay	2.18	0.45	0.2
Multi Path	0.9	0.9	0.9
Troposphere Delay	0.5	0.5	0.5
Receiver Specific	0.7	0.7	0.7
UERE	3.21	2.41	2.3
HDOP	2.1	2.1	2.1
VDOP	2.4	2.4	2.4
Horizontal Accuracy (2 sigma)	13.49	10.11	9.93
Vertical Accuracy (2 sigma)	15.42	11.55	11.03 <sub>10</sub>

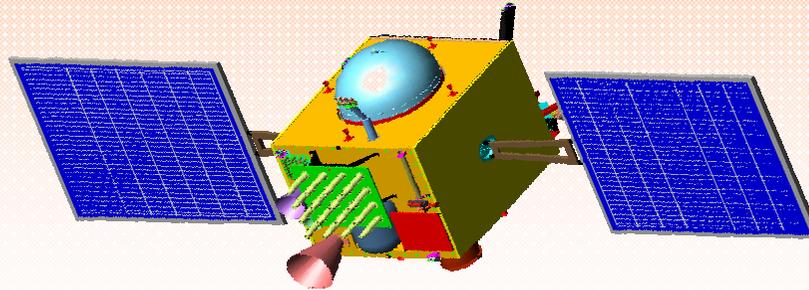


# IRNSS system features

S. No	Item Description	System features
1	Total Satellites	7 Satellites { 3- GEO and 4- GSO }
2	Orbital Period	24 hours (Always visible to the service area)
3	Orbital Height	36000 KM
4	Operating Frequency	S - Band 2492.028 MHz L5 - Band 1176.45 MHz
5	Modulation / Technique	1 MHz BPSK for SPS & BOC (5,2) for RS. CDMA
6	Receiver G/T	-27 dB/K (minimum)
7	Navigation Services	SPS for civilian users RS for authorized users
8	Coverage Area	Indian land mass & region up to 1500 Km from the Indian geopolitical boundary
9	Position Accuracy	Better than 10 m for dual frequency users <sup>11</sup>



# IRNSS Deployment Plan

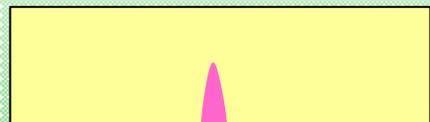
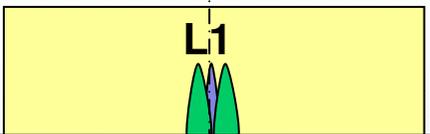
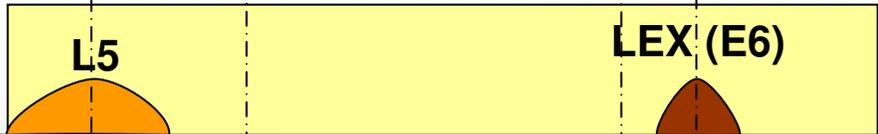
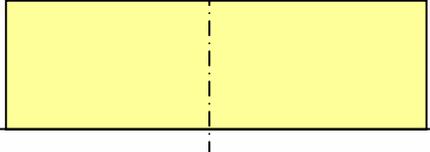
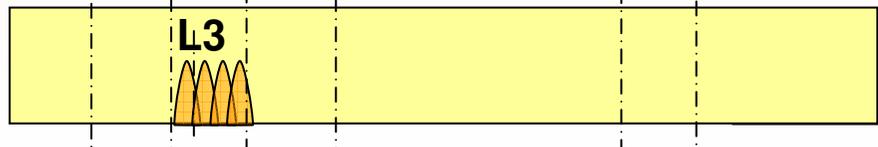
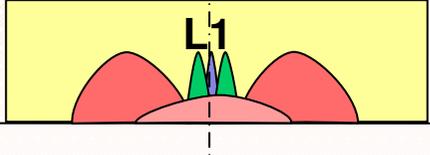
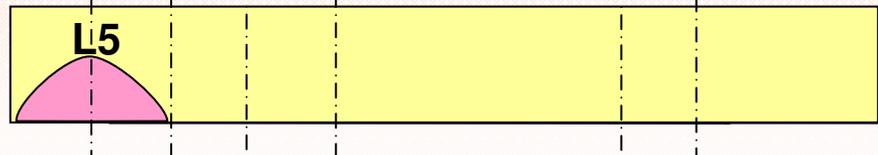
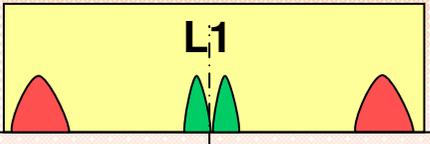
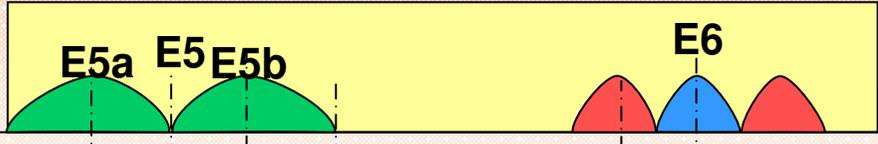


- **IRNSS Satellites to be launched by Indian Launcher - Polar Satellite Launch Vehicle (PSLV).**
- **First satellite to be launched by end of year 2009 or in beginning of 2010.**
- **Constellation to be completed by 2012.**





# Compatibility & Interoperability with other GNSS





# IRNSS Applications

- **Navigation**
  - Spacecraft
  - Aircraft
  - Ship
  - Vehicle
- **Geographic Data Collection**
  - Mapping
  - Surveying
  - Engineering
- **Scientific Research**
  - Atmospheric Studies
- **Geodynamics**
  - Crustal Movements
  - Crustal Deformations
- **Time Synchronization**
- **Natural Resource & Land Management**
  - Geographical Information System
  - Town Planning
  - Fleet Movement
  - Routing / Alignment
- **Monitoring the Health of tall Buildings / Towers, Long Bridges**
- **Power Grid Synchronization**
- **Agriculture**
  - Precision Farming
- **Emergency Response**
  - Search and Rescue
- **Location Based Services**
  - Mobile
  - Banking

*Many More .....*

*Thank You*