



# **INDIAN SPACE PROGRAMME**

## **- *For National Development***

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4 CONCLUSIONS



**SPACECRAFT**

# **NATIONAL SPACE SYSTEMS**

**LAUNCH VEHICLES**

# NATIONAL SPACE SYSTEMS

## ROCKETS/LAUNCH VEHICLES

### PSLV



### GSLV

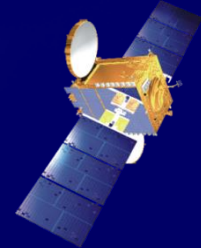


## SPACECRAFT

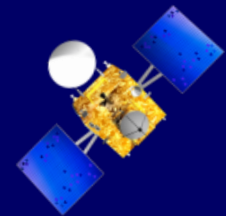
### Remote Sensing (IRS) Satellites



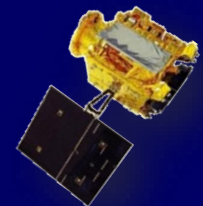
### Communication & Meteorological Satellites



### Navigation Satellites



### Space Science & Planetary Exploration Satellites



# **DIMENSIONS OF INDIAN SPACE PROGRAMME**

## **Space Infrastructure**

- Launch vehicles (PSLV, GSLV)
- Spacecrafts (LEO, GEO, Navigation & beyond) – INSAT, GSAT, IRS
- Sensors and Transponders

## **Ground Segment**

- Data Acquisition, Processing, Calibration -Validation
- Fixed Satellite Services, Broadband Satellite Services, Mobile Satellite Services, Ground stations
- Deep Space Network , TTC Network

## **Applications**

- Natural Resources Management
- Meteorology & Ocean Studies
- Satcom & Navigation
- Synergy: Earth Observation /Satcom/Navigation – Village Resource Centre

## **Capacity Building**

- Formal education through Centre for Space Science & Technology Education in Asia & the Pacific , Indian Institute of Remote Sensing,...
- Indian Institute of Space Science & Technology

## **Institutionalization**

- National Natural Resources Management System
- Involvement of stake-holders from the planning level
- Antrix

## **International Cooperation**

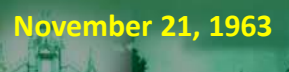
- Bilateral and multilateral cooperation with various countries and international Organisations



# LAUNCH VEHICLE

# SATELLITE

**November 21, 1963**



## 42 Launch Vehicle Missions

## 40 Satellites from other countries

69 + 2 Spacecraft Missions

**INSAT-3E**  
**28.09.03**

**KALPANA-1**  
**12.09.02**

**ARYABHATA**  
**19.04.75**

IRS-1C  
28.12.95

IRS-P3  
21.03.96

**INSAT-3C**  
**24.01.02**

IRS-1D  
29.09.97

IRS-P4  
26.05.99

**INSAT-2E**  
**03.04.99**

**INSAT-3B**  
**22.03.00**

**INSAT-3A**  
**10.04.03**

TES 22 10 01

**RESOURCESAT-1**  
**17.10.03**

EDUSAT  
20.09.04

**GSAT-2**  
**08.05.03**

PSLV  
26

**GSLV  
7**

**INSAT-4A**  
**22.12.05**

**HAMSAT**  
**05.05.05**



ions

PSLV

|          |          |
|----------|----------|
| GSAT-14  | 05-01-14 |
| IRNSS-1A | 01-07-13 |
| GSAT-10  | 29-09-12 |
| GSAT-11  | 15-07-1  |

IRNSS-1B  
04-04-14  
MOM  
05-11-13  
INSAT-3D  
26-07-13  
SARAL  
25-02-13

**GSAT-8**  
**21-05-11**

**RISAT-1**  
26-04-12

**HYLAS**  
26-11-15

EQUATRO

W2M  
21-12-08

MEGHATRONICS  
12-10-13

INSAT-4CR  
02.09.07

**RESO-2**  
**20-04-11**

**INSAT-4B**  
**12.03.07**

**EANSAT-2**  
**23-09-09**

**CHANDRAYAAN-1**  
**22.10.08**

**CARTOSAT-2**  
**10.01.07**

**CARTOSAT-1**  
**05.05.05**

# APPLICATIONS

**COMMUNICATION**

**SAPCE  
SCINECE  
EXPLORATION**

# **Satellite Applications**

**NAVIGATION**

**REMOTE SENSING**

# SATELLITE APPLICATIONS



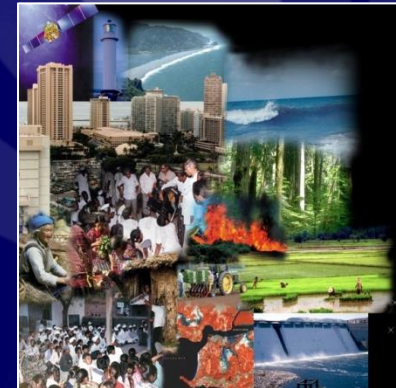
## COMMUNICATION

- SPEECH CIRCUITS ON TRUNK ROUTES
- TV BROADCASTING
- BUSINESS COMMUNICATIONS
- MOBILE SATELLITE SERVICES
- RADIO NETWORKING
- SEARCH AND RESCUE SERVICES
- VSAT CONNECTIVITY
- METEOROLOGY IMAGING
- DISASTER WARNING SYSTEM



## NAVIGATION

- IMPROVED POSITION ACCURACY
- NAVIGATION APPLICATIONS FOR : AIRCRAFT, SHIPS, VEHICLE, FLEET MOVEMENT, ROUTING / ALIGNMENT
- SCIENTIFIC RESEARCH APPLICATIONS FOR ATMOSPHERIC STUDIES
- IONOSPHERIC SCINTILLATIONS



## REMOTE SENSING

### INFORMATION TO SOLUTIONS :

- AGRICULTURE & CROPS
- FOREST & BIO-RESOURCES
- WATER RESOURCES
- GEOLOGY
- OCEAN/COASTAL
- ENVIRONMENT
- RURAL DEVELOPMENT
- URBAN MANAGEMENT
- CARTOGRAPHY/MAPPING
- CLIMATE MODELLING
- GLOBAL CHANGE

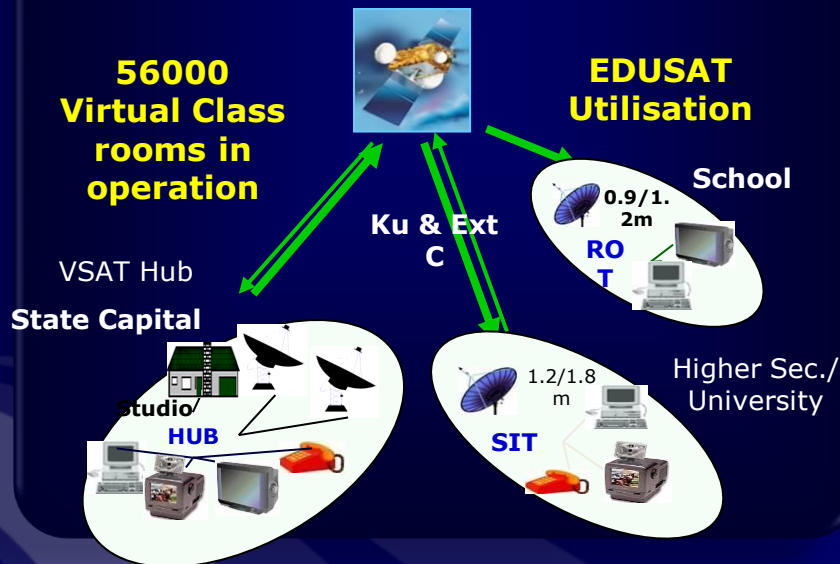


# SATELLITE APPLICATIONS

## – SOCIETAL BENEFITS

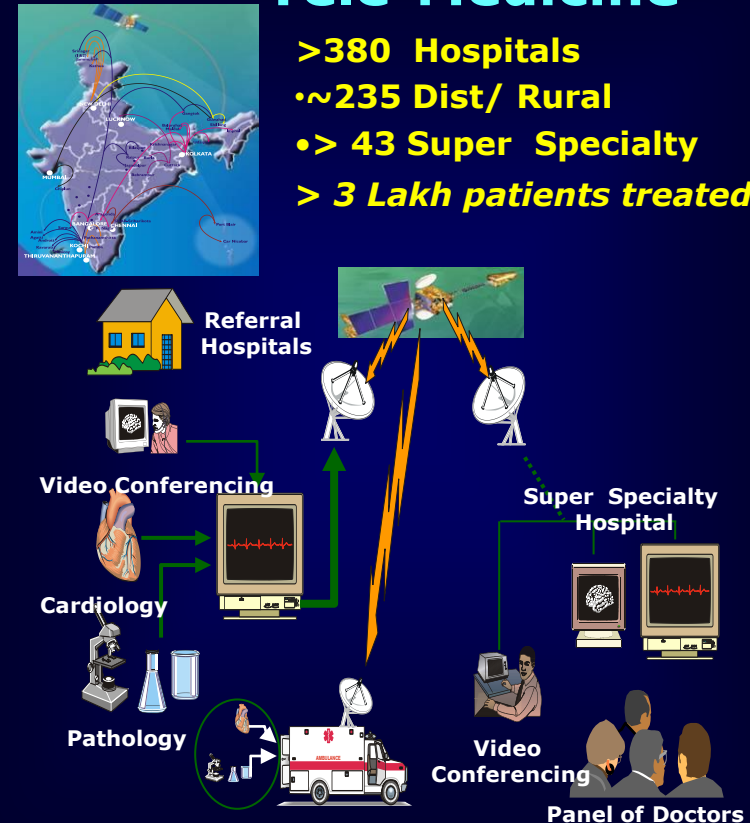
### Tele-Education

- Training & Development Communication Channel (TDCC - 1995)
- Jhabua Development Communications Project (JDCCP - 1996)
- GRAMSAT Pilot Project (GPP)



### Tele-Medicine

- >380 Hospitals
- ~235 Dist/ Rural
- > 43 Super Specialty
- > 3 Lakh patients treated

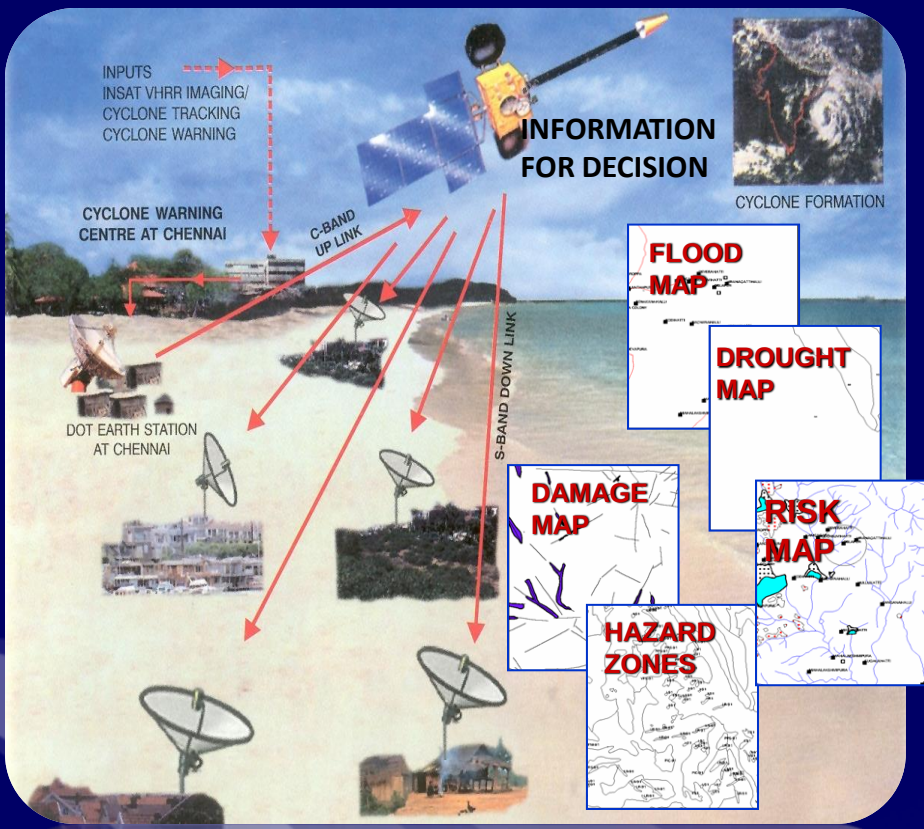


**DEDICATED SATELLITE BASED SERVICES IN THE AREAS OF  
EDUCATION & HEALTH SECTORS**

# SATELLITE APPLICATIONS - DISASTER MANAGEMENT

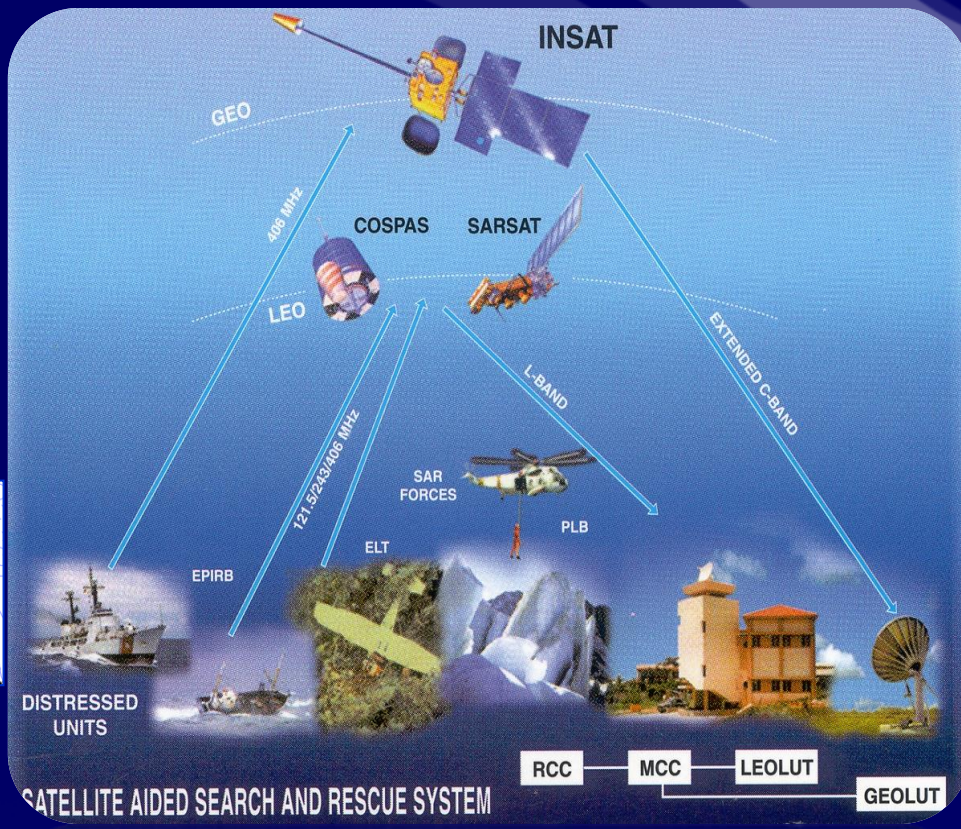
## Disaster Management Systems

Hazard Zonation, Risk Assessment



## Satellite Aided Search & Rescue

Networking, Early Warning



COMMUNICATION & REMOTE SENSING SATELLITES SERVICES  
FOR DISASTER MANAGEMENT & MITIGATION

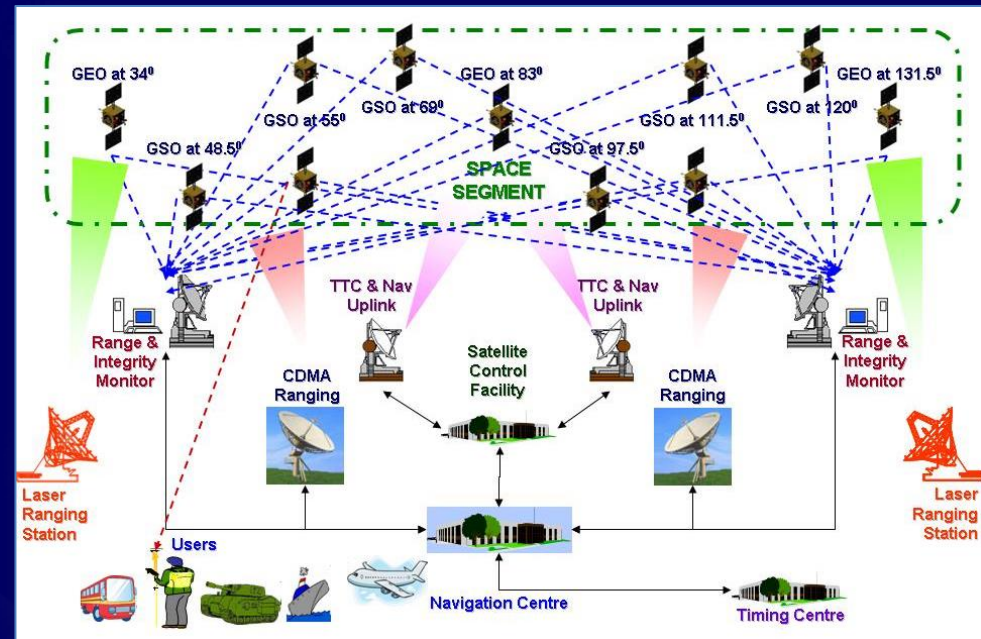
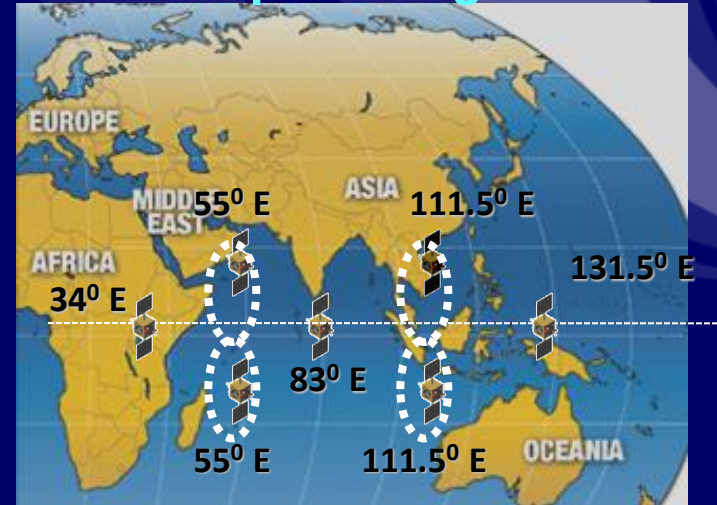


# SATELLITE APPLICATIONS - NAVIGATION

## IRNSS CHARACTERISTICS

- A Regional Navigation satellite system for Indian Region
- An independent, self-reliant and civilian system
- 7 Spacecraft (3 GEO + 4 GSO) Constellation
- Satellite Mass 1304 Kg at Lift-off
- Dual Frequency downlinks for User
- Position Accuracy : 18.3m
- Navigation Applications: Aircraft, Ships, Vehicle, Fleet Movement, Routing/alignment
- Scientific research Applications: Atmospheric studies & Ionospheric scintillations

## IRNSS Space Segment



# SATELLITE APPLICATIONS - NAVIGATION

- Civil Aviation
- Land transportation/Fleet Management
- Railways
- Surveying and Geodesy
- Mobile Phones
- Car navigation
- Atmospheric studies
- GIS & related data products
- Precision farming



**Space Transportation**



**Maritime**



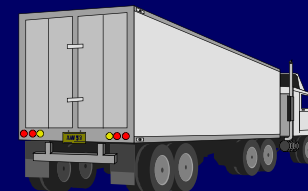
**Aviation**



**Positive Train Control**



**Intelligent Vehicle Systems**

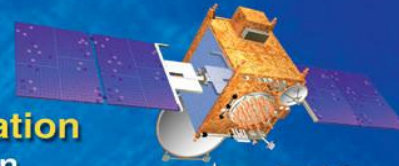


**Fleet Management**



# GAGAN

**GPS Aided Geo Augmented Navigation**  
Indian Satellite Based Augmentation  
System



## ARCHITECTURE

**GAGAN Coverage 82°E**

**GEO (GSAT/INSAT)**  
(L1,L5)

**GEO (GSAT/INSAT)**  
(L1,L5)

**GPS**

**GPS**

**GPS**

**INRES**

**INMCC**

**FIBRE OPTIC**

**INLUS**

- ★ Total Electron Content Station (TEC)
- Indian Reference Station (INRES)
- Indian Land Uplink Station (INLUS)
- Indian Master Control Centre (INMCC)

**Navigation - Air, Sea and Land, Positioning Applications, Survey, Image Correction, GIS, Timing, Surveillance/fleet monitoring**



# SATELLITE APPLICATIONS - NATURAL RESOURCES MANAGEMENT

## Space-based Services for Community Outreach- Village Resource Kiosks

### Water Resources

- Potential Drinking Water Zones
- Command Area Management
- Reservoir Sedimentation
- Canal Alignment

### Forest, Environment, Bio resources

- Forest Cover & Type Mapping
- Forest Fire and Risk Mapping
- Biodiversity Characterization
- Environmental Impact Studies



### Rural & Urban

- Landuse/Land Cover Mapping
- Wasteland Mapping
- Rural Roads Inventory
- Urban Sprawl Studies
- Large Scale Mapping

### Weather & Climate

- Extended Range  
Monsoon Forecasting
- Ocean State Forecasting
- Regional Climate Model

### WATERSHED DEVELOPMENT



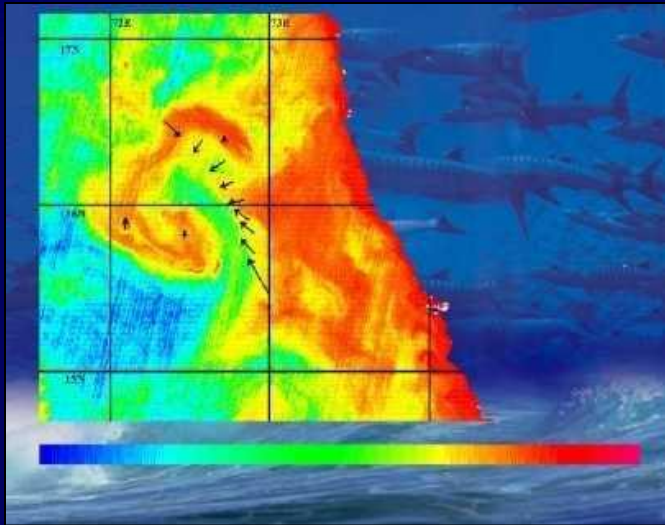
### Agriculture & Soil Resources

- Crop Acreage & Production Estimation
- Soil & Land Degradation Mapping
- Watershed Development
- Horticulture Mission for North-East

### AGRICULTURE

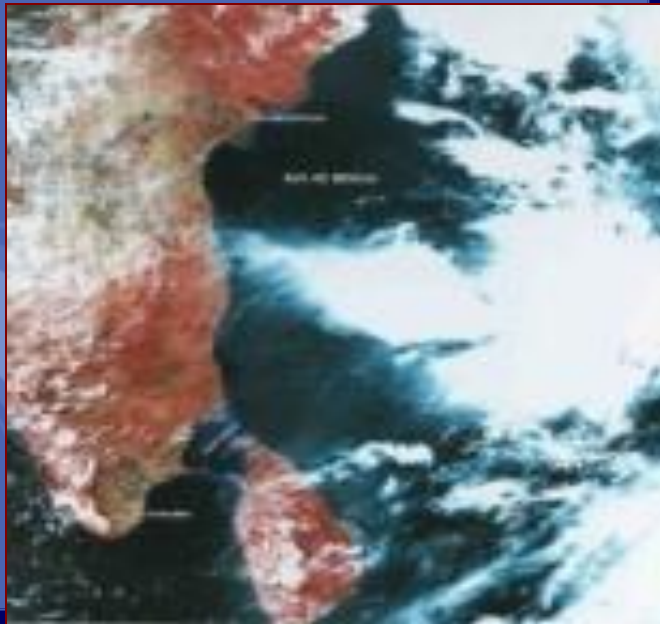


# SATELLITE APPLICATIONS - OCEANOGRAPHY



## Coastal & Ocean Resources

- Potential Fishing Zone (PFZ) Identification
- Coastal Zone Mapping

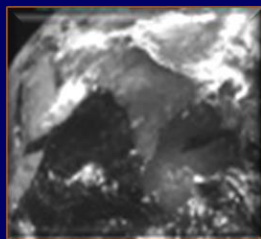




# IRS IMAGING CAPABILITIES

## Global Coverage : Application Specific 1 KM – < 1M Resolution

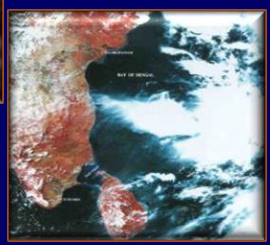
KALPANA



1 KM  
VHRR

CLIMATE/  
WEATHER

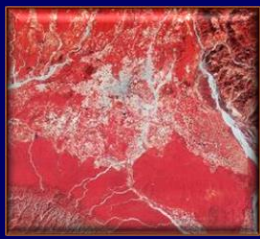
IRS-P4



360 M  
OCM

OCEAN  
APPLICATION

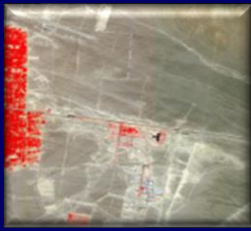
IRS-1C/1D



188 M  
AWIFS

NATIONAL  
SURVEYS

IRS-P6



60 M  
AWIFS

NATURAL  
RESOURCE  
MAPPING

IRS-1C/1D

IRS-P6



23 M  
LISS III

DETAILED  
PLANNING

STEREO  
CAPABILITY

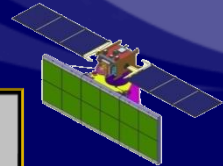
IRS-1C/1D

IRS-P6



5.8 M  
LISS IV  
PAN

RISAT-1  
3M TO 50 M  
Resolution



MICROWAVE  
IMAGING

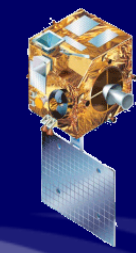
TES



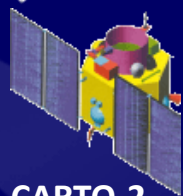
1 M

CARTOSAT-1

2.5 M



CARTO-2  
1 M Resolution



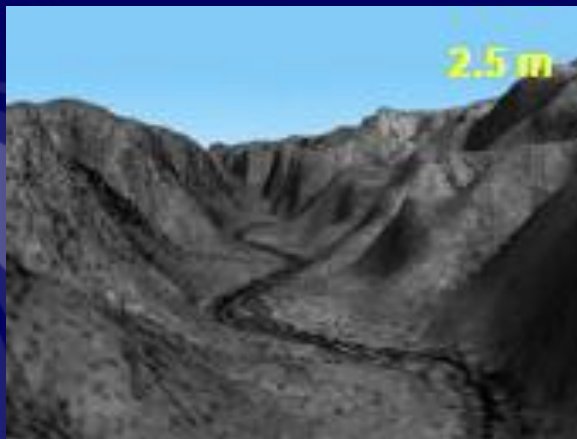
# CARTOSAT DATA PRODUCTS



**CARTOSAT-1 IMAGE**



**TES IMAGE (1M) – BANGALORE VIDHANA SOUDHA**



**CARTO-2A PAN ( 2.5M) + IRS-P6 LIV MX(5.8M)**



# SPACE SCIENCE EXPLORATION

Much before applied science and technological applications enriched human lives astronomy (Space science of yesteryear) and its applications held sway over humans. These interests later led into number of other disciplines like Astrophysics, stellar physics, Astronomy, aeronomy & planetary atmospheres, earth sciences, life sciences & solar system studies and Theoretical physics.

1. X-RAY ASTRONOMY
2. GAMMA RAY BURSTS
3. IONOSPHERIC PLASMA
4. MIDDLE ATMOSPHERIC DYNAMICS
5. EQUATORIAL ELECTROJET
6. SOLAR FLARES AND STORMS
7. IONOSPHERIC TOPOGRAPHY
8. PLANETARY EXPLORATION







**SPACECRAFT**

# **CHALLENGING MISSIONS**

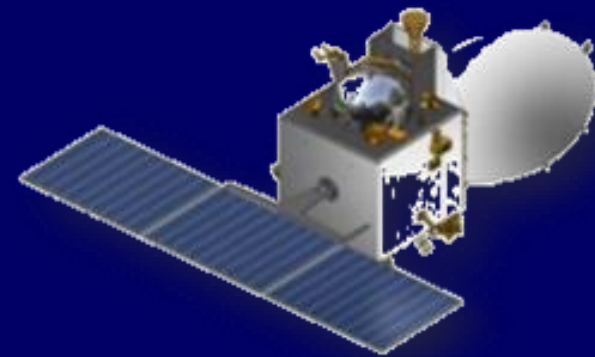
**LAUNCH VEHICLES**

# MARS ORBITER MISSION

ISRO's first interplanetary mission to Mars planet with an orbiter craft designed to orbit Mars in an elliptical orbit. The scientific payload instruments are intended to study surface features morphology, topology and mineralogy of Mars, Constituents of Martian atmosphere. The Earth-Mars trajectory comprises of three phases namely, Earth-centered phase, Heliocentric phase and Martian phase.

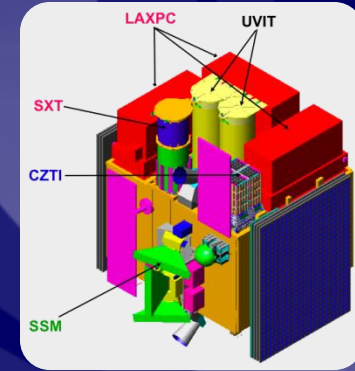
## SALIENT FEATURES

|                                  |                                                                                                                                            |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Orbital Location</b>          | : 370 X 80,000 Kms elliptical orbit                                                                                                        |
| <b>Voyage from Earth's orbit</b> | : 300 Days                                                                                                                                 |
| <b>Mass</b>                      | : 1350 Kg                                                                                                                                  |
| <b>Power</b>                     | : 750 W                                                                                                                                    |
| <b>Mission Life</b>              | : ~ 6 Months                                                                                                                               |
| <b>Launcher</b>                  | : PSLV C 25                                                                                                                                |
| <b>Payload</b>                   | : Lyman Alpha Photometer, Methane Sensor for MARS, Martian Exospheric Composition Explorer, MARS Color Camera and TIR Imaging Spectrometer |
| <b>Launch Date</b>               | : 5 <sup>th</sup> November , 2013                                                                                                          |



# ASTROSAT

India's first satellite dedicated for multiwavelength astronomy for observation of galactic objects. The satellite will have simultaneous wide spectral coverage extending over visible, ultraviolet, soft X-ray, hard X-ray and low energy Gamma ray regions



## SPACECRAFT SPECIFICATIONS

|              |           |
|--------------|-----------|
| ALTITUDE     | 650 KM    |
| INCLINATION  | 8 DEG     |
| MASS         | ~ 1500 KG |
| POWER        | 940 WATTS |
| MISSION LIFE | 5 YEARS   |
| LAUNCHER     | PSLV      |

## PAYLOADS

|       |                                              |
|-------|----------------------------------------------|
| UVIT  | ULTRA VIOLET IMAGING TELESCOPE (IIA/IUCAA)   |
| LAXPC | LARGE AREA XENON PROPORTIONAL COUNTER (TIFR) |
| SXT   | SOFT X-RAY TELESCOPE (TIFR)                  |
| CZT   | CADMIUM ZINC TELLURIDE DETECTOR (TIFR)       |
| SSM   | SKY SCANNING MONITOR (ISAC-ISRO)             |

## SCIENCE OBJECTIVES

- *Determination of black hole masses*
- *Details on nature of transient behaviour, QPO and its evolution, period evolution*
- *Improved UV morphology, star formation & its evolution, galaxy luminosity function*
- *Study of Galactic binary systems*
- *X-ray monitoring of Sky & Deep UV survey of selected regions of sky.*



# ADITYA

The first Indian space based coronagraph intended to study the solar corona in visible and near IR bands. The main scientific objectives of the mission is to study the Coronal Mass Ejections (CME).The mission is also intended to obtain completely new information on the velocity fields and their variability in the inner corona which has an important bearing on the unsolved problem of 'heating of the corona'.

## Spacecraft Bus

IRS Bus

## Mass

~ 1400 Kg

## Power

1500 W

## Mission Life

> 5 Years

## Orbit

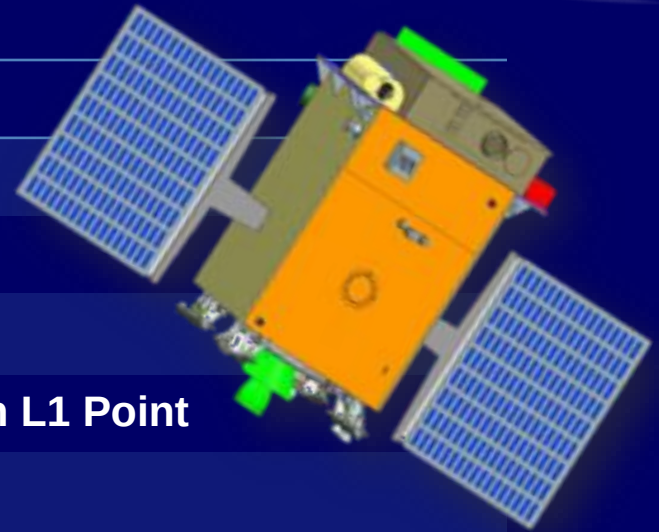
Halo Orbit about Sun- Earth L1 Point

## Data Volume & Download Read out Rate

110 Gb, 4 MBPS

## Payloads Proposed

1. Enhanced Visible Emission Line Coronagraph
2. High Energy L1 Orbiting X-ray Spectrometer
3. Plasma Analyser Package
4. Solar Wind & Thermal Ion Spectrometer
5. Solar Low Energy X-ray Spectrometer
6. Solar Ultraviolet Imaging Telescope



# CHANDRAYAAN-2

A follow on mission to the first Indian lunar mission with a capability to soft land at a specified lunar site and to carry out in-situ chemical analysis of the lunar surface and will have Orbiter Craft and Lander craft equipped with rover.

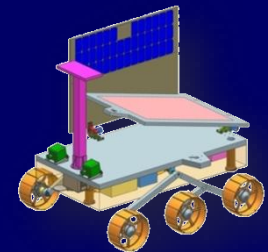
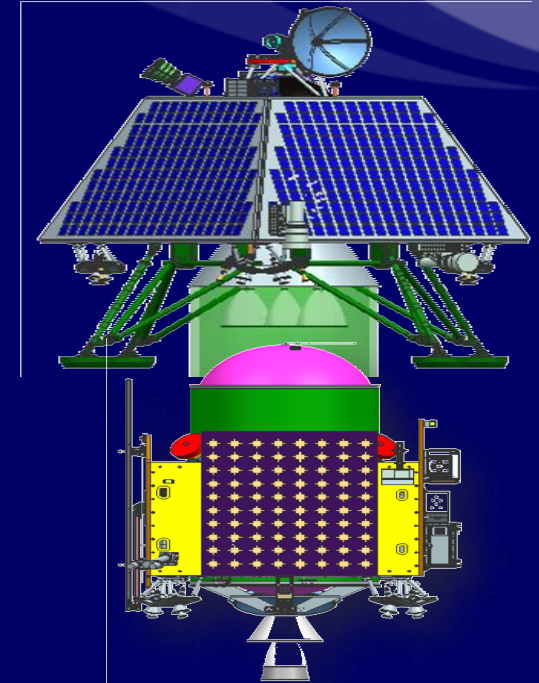
Orbit : 170 x 17000km  
Lift off mass : 3200 Kg  
Orbiter : 2260 Kg  
Lander : 940 Kg

## Lander payloads :

1. Rover – 25 kg ( With LIBS and APIXS)
2. Radio Anatomy of Moon bound Hypersensitive Ionosphere & atmosphere
3. Lunar Electrostatic & Dust Levitation Experiment
4. Chandra's surface thermal experiment
5. MEMS based Seismometer

## Orbiter Payloads:

1. CLASS- Chandrayaan-2 Large area soft X ray Spectrometer
2. SAR- Synthetic Aperture Antenna
3. IIRS - Imaging IR Spectrometer
4. ChACE 2- Chandra's Altitudinal Composition Explorer
5. TMC-Terrain Mapping Camera



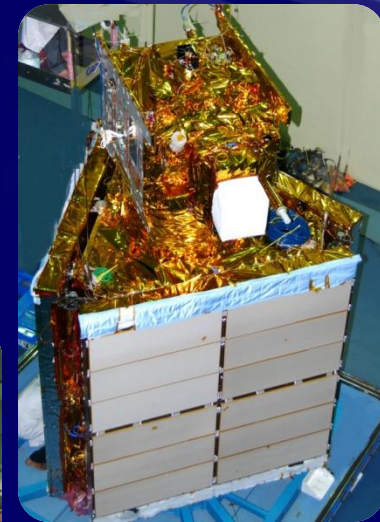
# RADAR IMAGING SATELLITE (RISAT)

RISAT is the first microwave remote sensing satellite and it carries a multimode C-band synthetic aperture radar payload based on active phased array antenna technology. The mission is envisaged to augment mainly Agriculture & Disaster support applications in the country.

## SPACECRAFT SPECIFICATIONS

|              |                         |
|--------------|-------------------------|
| ALTITUDE     | 536.38 KM               |
| INCLINATION  | 97.554 DEG              |
| LOCAL TIME   | 6AM/6PM                 |
| MASS         | 1850 KGS (P/L :950 KGS) |
| POWER        | 4.5 KW                  |
| MISSION LIFE | 5 YEARS                 |
| LAUNCHER     | PSLV                    |

## SAR PAYLOAD DEPLOYED



## MODES OF PAYLOAD OPERATIONS

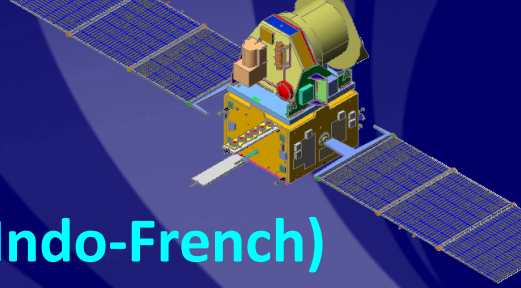
| Fine Resolution Stripmap (FRS-1) | Fine Resolution Stripmap (FRS-2) | Medium Resolution ScanSAR (MRS) | Coarse Resolution ScanSAR (CRS) | High Resolution Spotlight (HRS) |
|----------------------------------|----------------------------------|---------------------------------|---------------------------------|---------------------------------|
| Resol: 3 m<br>Swath: 25 Km       | Resol: 9-12 m<br>Swath: 30 Km    | Resol: 25m<br>Swath: 115 Km     | Resol: 50 m<br>Swath: 223 Km    | Spot size :<br>10 km X 10 km    |



# MEGHA-TROPIQUES



**MEGHATROPIQUES is ISRO-CNES (Indo-French) collaborative satellite to study water cycle and energy exchanges in the tropics .**



## SPACECRAFT SALIENT FEATURES

|                      |               |
|----------------------|---------------|
| <b>Altitude</b>      | 867 Km        |
| <b>Inclination</b>   | 20 deg        |
| <b>Period</b>        | 102.16 min    |
| <b>Repetitivity</b>  | 6 times a day |
| <b>Mass</b>          | 1000 Kg       |
| <b>Launch</b>        | PSLV - C18    |
| <b>Misssion Life</b> | 5 Years       |

## MADRAS

## SAPHIR

## SCARAB

## ROSA

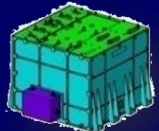
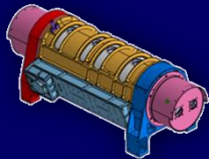
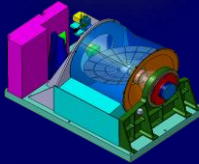
## PAYLOAD SALIENT FEATURES

a multi-frequency scanning microwave imager at 18, 23, 37, 85 and 157 GHz

a 6-channel millimetre wave humidity sounder retrieving information in six atmospheric layers

a 4-channel Earth radiation budget instrument, at 0.5-0.7mm, 0.2-4mm and 10.5-12.5mm, 0.2-200mm, spatial resolution of 40 km.

To obtain vertical profiles of Humidity, Temperature Aerosol contents etc



# CARTOSAT-3

## MISSION OBJECTIVES:

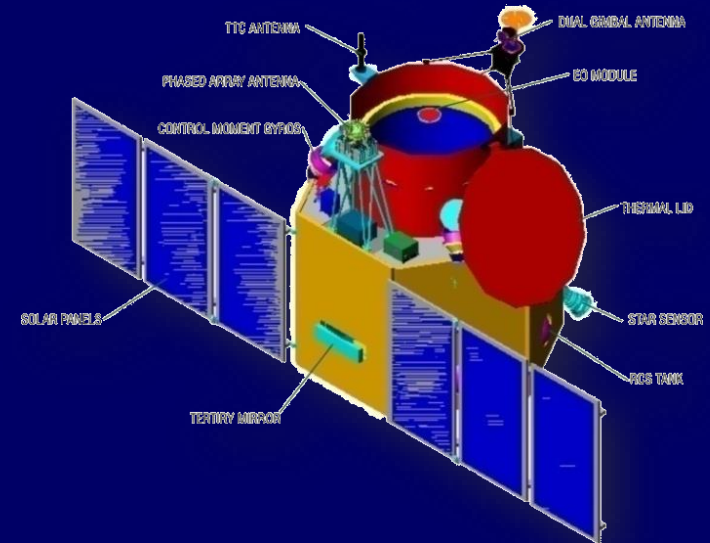
Agile advanced satellite to obtain imagery with a very high spatial resolution of 0.25m in panchromatic & 1m in 4 band multi spectral and 12m in HySI .

**PAYLOADS PROPOSED :** Advanced High resolution Panchromatic Camera, Multispectral Camera, Hyperspectral Imager

- Mass : 1500 Kg
- Power : 2000 W
- Orbit : 450 Km (SSPO)
- Mission life : 5 Years

## NEW TECHNOLOGIES

- New spacecraft structure
- Advanced OBC
- High accuracy star sensors & gyros
- **Advanced Data handling and transmission system**
- 12-channel dual frequency SPS system
- New Dual Gimbaled Antenna



# INSAT-3D – Satellite for Meteorology

The Spacecraft is multipurpose with high resolution imager and sounder systems for storm warning and improved atmospheric observations and data dissemination capabilities. It also provides communication services. DRT SAS & R transponders will be providing continuity to some of the INSAT services.



## SPACECRAFT SALIENT FEATURES

|              |                                                                |
|--------------|----------------------------------------------------------------|
| Orbital      | : 82 Deg East                                                  |
| Location     |                                                                |
| Bus          | : I-2K Derived Bus                                             |
| Payload      | : 6 channel Imager, 19 channel Sounder and DRT, SAS&R payloads |
| Power        | : 1100 Watts                                                   |
| Mass         | : 2100 Kgs                                                     |
| Mission Life | : 7 Years                                                      |



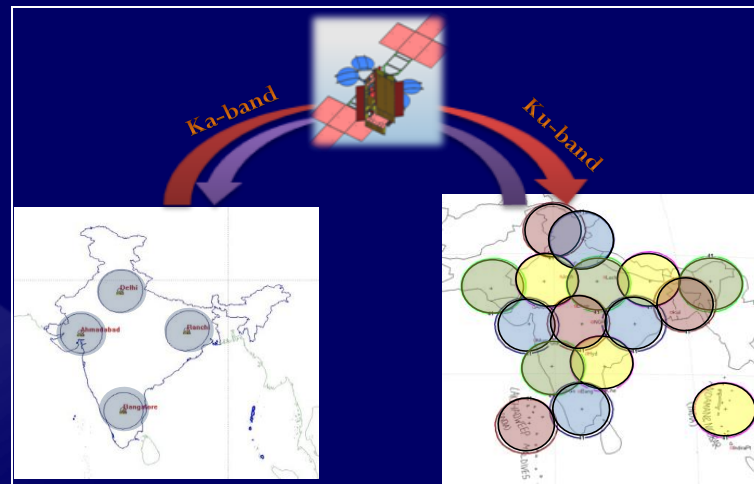
Weather Information





# GSAT-11 , Advanced Communication Satellite

- Multi Beam Communication spacecraft
- Orbital location: 74°E
- New Modular, high power, high capacity bus
- Advanced concepts and new technological elements
- 32 user beams in Ku band and 8 hub beams in Ka band to provide a through put of 10 GBPS
- New communication architecture to support various telecom services and VSAT networks .
- Compatible ground support system to provide seamless connectivity .
- Bus Compatible with GSLV mark III & all commercial launchers.
- Workhorse for our future communication satellite programme.

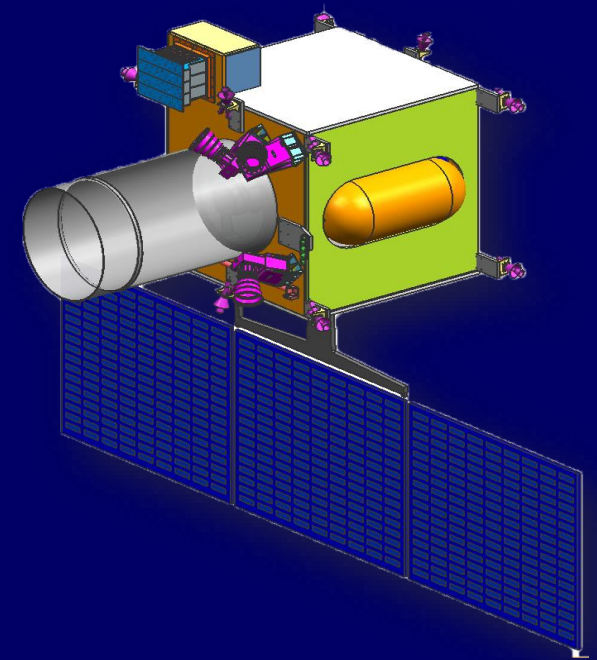


# GISAT

GISAT is a geo imaging satellite at geostationary orbit with high temporal resolution. It has a multispectral imager operating in visible, near infra-red and thermal infrared bands and hyper-spectral imager operating in visible, near infra-red and short wave infra-red bands

## SALIENT FEATURES

- Standard I-1K<sup>Plus</sup> bus
- Power : 920 W Heat
- LOM :977kg
- Zero momentum biased 3-axis body stabilised [5xRWs]
- OBC with LEON-3 processor
- Star Sensors : Mark-3 type
- LIRU / FOG
- Single sided solar array with 3 panels, 2.15x1.6 m<sup>2</sup>
- Single 90Ah Li-ion battery

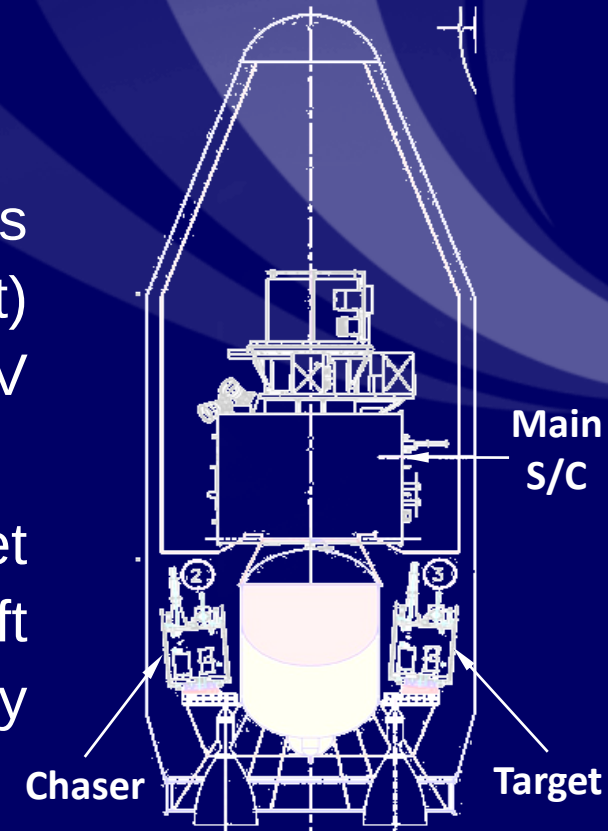


**OPTICAL PAYLOADS:** 700mm CARTO-2A type telescope Scanning through agile platform using Electronically steerable Antenna (PAA) with High Data rate transmission in Ku-band (200Mbps)

# DOCKING EXPERIMENT

## Objectives:

- Technology demonstration for rendezvous and docking, using two IMS (Youthsat) spacecraft - piggy-back on a single PSLV flight
- Demonstrate controllability of target spacecraft from AOCE of chaser spacecraft in docked condition, showing the possibility of extending target spacecraft life



**APPROACH & CAPTURE PHASE**

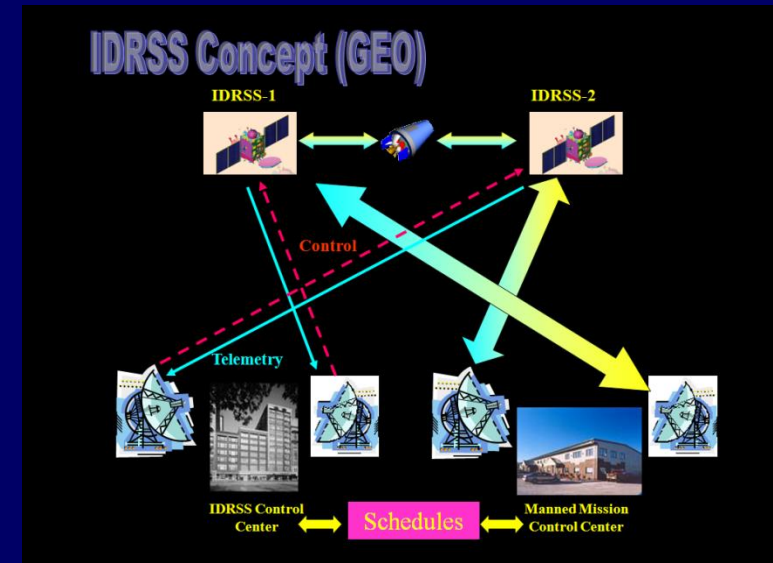
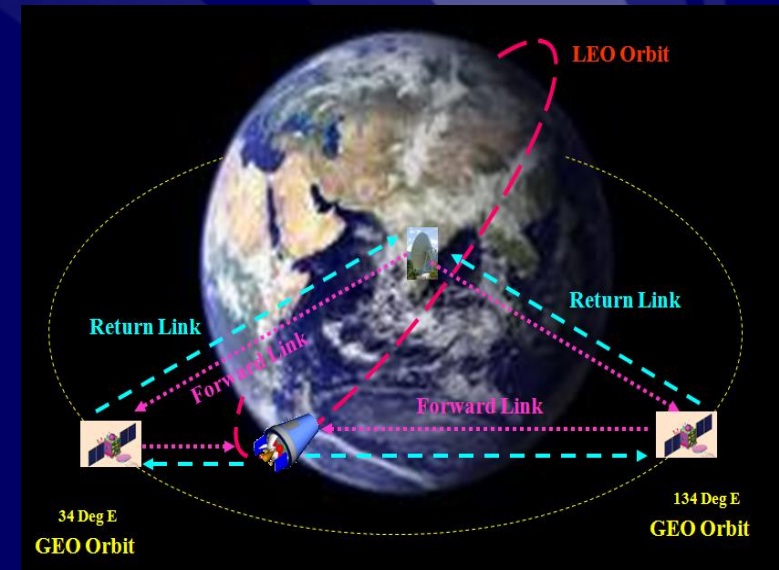


**DOCKED PHASE**



# INDIAN DATA RELAY SATELLITE SERVICES (IDRSS)

- IDRSS – Provides Tracking and Data Acquisition support for low altitude spacecraft, both manned and unmanned.
- IDRSS orbit : Geo-Synchronous orbit (34 deg E and 134 deg E) would serve as a communication/data link to LEO/Manned missions with nearly continuous visibility
- Remote sensing missions can benefit from IDRSS by way increasing the payload utility, better coverage for TTC purposes
- The data from ground from Mission control center will be transmitted to one of the IDRSS through which it reaches the Crew Module and vice versa.
- IDRSS shall cater
  - Low data rate from IRS for TTC
  - Medium Data rate from Manned mission TM/TC/Voice/Video
  - High Data rate from IRS payload



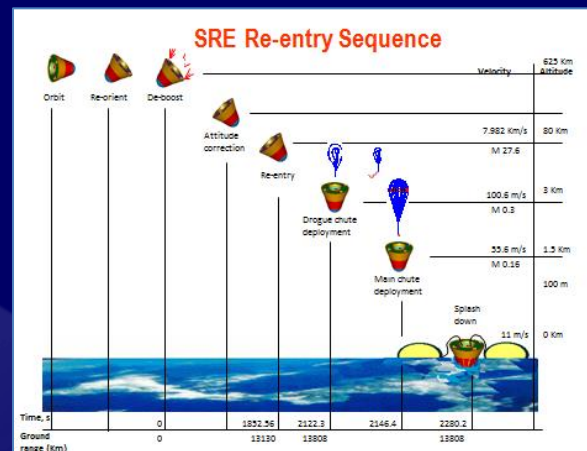
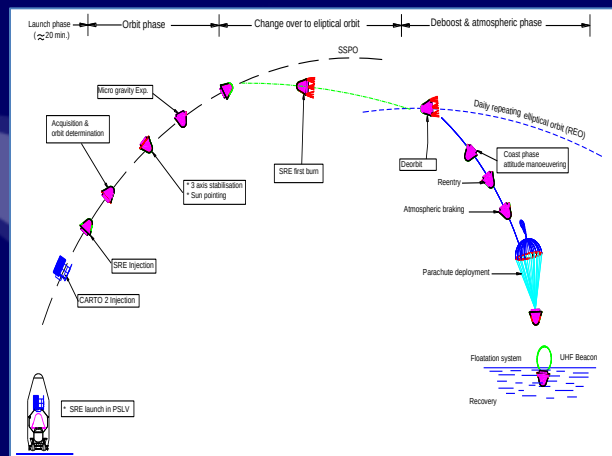
# SPACE CAPSULE RECOVERY EXPERIMENT

SRE laid the foundation for

- Reusable launch vehicles
- Reentry Technology
- Manned missions
- Microgravity processing
- Sample return missions.



**Aerothermostructure**



**Rentry**



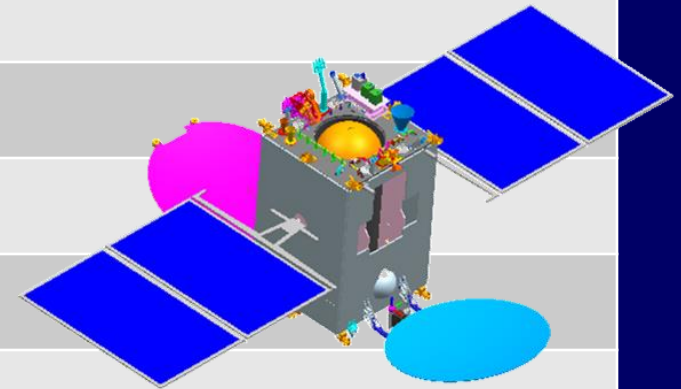
# GSAT-14

The Spacecraft will enhance the communication transponder capacity of the GEOSAT Constellation in-orbit. It is built around ISRO's I-2K Bus carrying 6 Ext C band, 6 Ku band transponders & 2 Ka Band Beacons. The Spacecraft was launched onboard GSLV-D6 with indigenous Cryogenic stage on 05<sup>th</sup> January 2014.



## SPACECRAFT SALIENT FEATURES

|                       |                                                         |
|-----------------------|---------------------------------------------------------|
| Orbital Location      | 74 Deg longitude                                        |
| Communication Payload | 6 Ext C band, 6 Ku band Transponder & 2 Ka band Beacons |
| Mass                  | 2018 Kg                                                 |
| Power                 | 2.6 KW                                                  |
| Mission Life          | > 11 Years                                              |
| Launcher              | GSLV-D5                                                 |



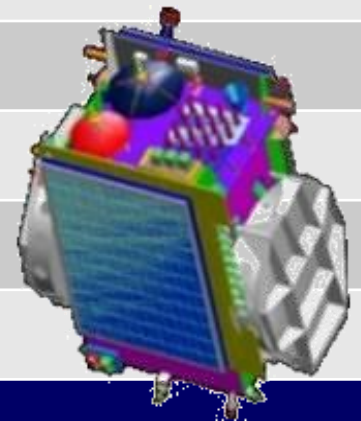


# GSAT-16

GSAT-16 is the most versatile communication satellite that will carry 48 onboard Transponders. This is one of the highest number of transponders flown so far on an Indian Communication Satellite. This will enhance in-orbit communication transponder capacity. The Spacecraft will be launched using a Procured Launch vehicle by end 2014.

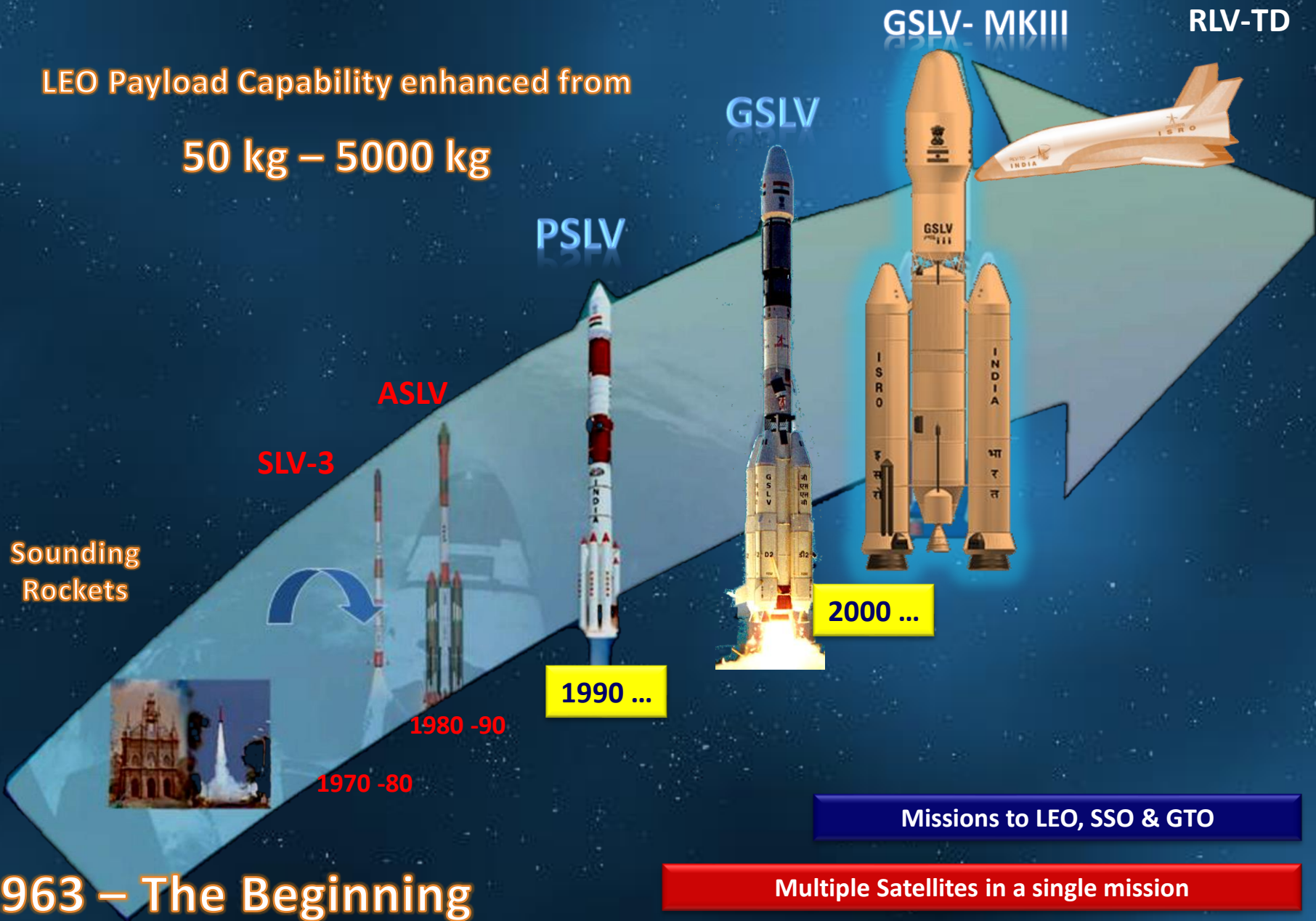
## SPACECRAFT SALIENT FEATURES

|                       |                                                                                                                                          |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Orbital Location      | 55 deg E                                                                                                                                 |
| Communication Payload | 24 Nor. C Transponders using 15 W SSPAs<br>12 Upper Ext. C Transponders using 15 W SSPAs<br>12 Ku-Band Transponders using 140 Watt TWTAs |
| Mass                  | 3500 Kg                                                                                                                                  |
| Power                 | 6.5 KW                                                                                                                                   |
| Mission Life          | > 12 Years                                                                                                                               |
| Launcher              | Procured                                                                                                                                 |



# SPACE TRANSPORTATION SYSTEM

LEO Payload Capability enhanced from  
50 kg – 5000 kg



# Mission Profile

## RLV-TD

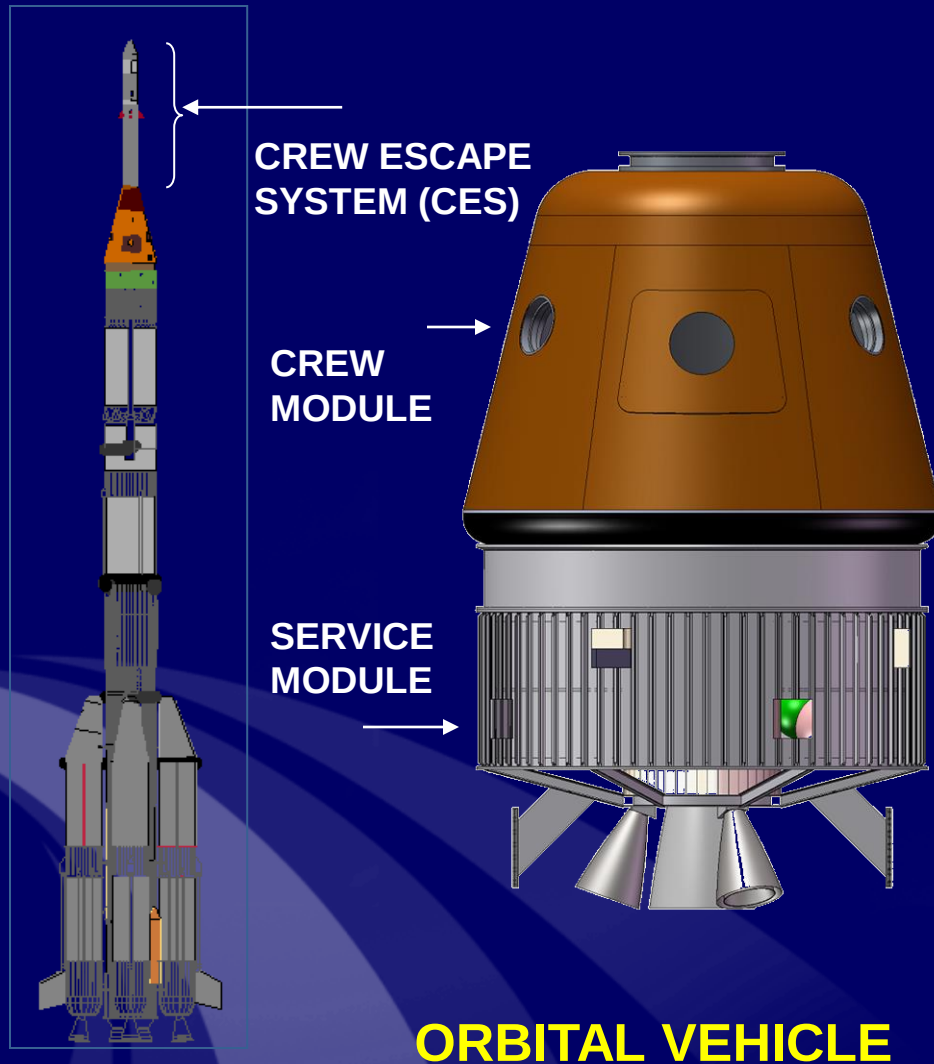
### HEX - 01



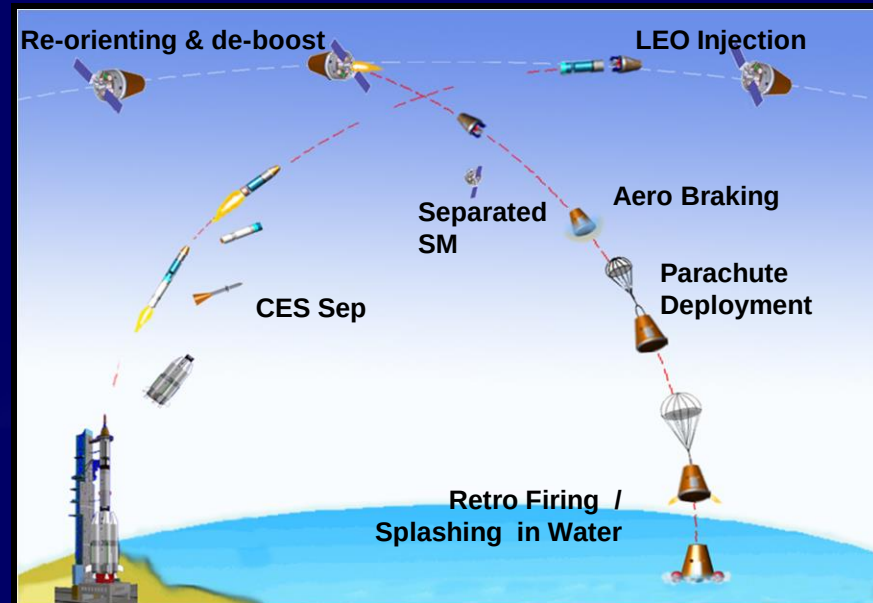


# INDIAN HUMAN SPACE FLIGHT PROGRAMME

To develop a space vehicle to carry crew of two to LEO and return safely to a predetermined destination on Earth



- Mission duration up to 7 days
- Emergency mission abort and crew rescue provision
- Crew module designed for re-entry and service module for mission management.



# **CONCLUSIONS**

- **Today, SPACE TECHNOLOGY is vital and indispensable in all walks of human life.**
- **Space is going to be a continued frontier for the growth human generation and is going transform the world from 'Nothing to Everything'.**
- **There are tremendous opportunities in Space Technology based Innovations**



THANK YOU