# OVERVIEW OF FUTURE ISRO SATELLITE MISSIONS

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**Scientific Research and Developments by SC/ST Scientists & Technologists of DOS/ISRO**

**7TH FEBRUARY , 2014**

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# ISAC OVERVIEW

***MANDATE of ISAC:***

**1.Design, Development and Realisation of Satellites**

**2.Research & Development**

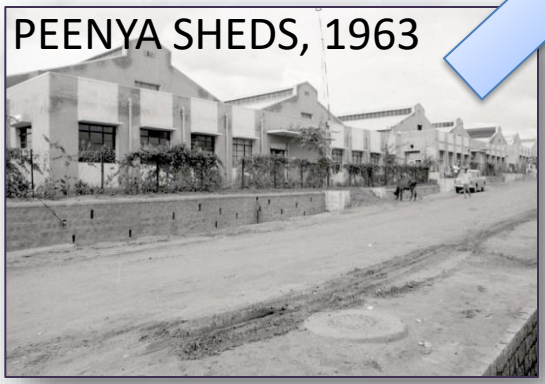
**3.Establishment of critical facilities**

**4.Industry & academia interface**

ISITE, 2006

ISAC, 1984

PEENYA SHEDS, 1963



## ACHIEVEMENTS

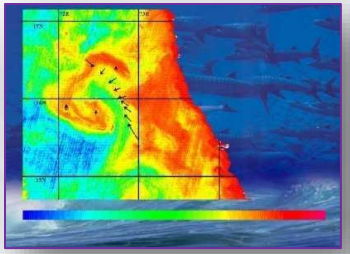
**69 +2 Satellites realized**

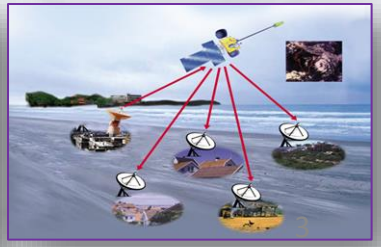
**Houses State of art facilities**

**State of art technologies**

**Participation /Consultation for Global Satellite Missions**

## SATELLITE APPLICATIONS





# Four Decades of Indian Space Programme

**Applications driven, self-reliant programme**
**Focus on supporting national development goals**

LAUNCH VEHICLE

November 21, 1963

**41** Launch Vehicle Missions

**35** Satellites from other countries

**69 + 2** Spacecraft Missions

PSLV 25

GSLV 8

SATELLITE

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

IRS-1C 28.12.95

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 05.05.05

HAMSAT 05.05.05

INSAT-4A 22.12.05

CARTOSAT-2 10.01.07

CHANDRAYAAN-1 22.10.08

INSAT-4B 12.03.07

INSAT-4CR 02.09.07

OCEANSAT-2 23-09-09

RESO-2 20-04-11

W2M 21-12-08

MEGHATRO 12-10-11

HYLAS 26-11-11

RISAT-1 26-04-12

GSAT-8 21-05-11

SARAL 25-02-13

GSAT-12 15-07-11

INSAT-3D 26-07-13

GSAT-10 29-09-12

GSAT-7 30-08-13

IRNSS-1A 01-07-13

MOM 05-11-13

APPLICATIONS

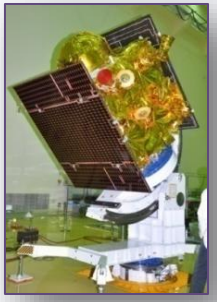
# RECENTLY LAUNCHED SATELLITES

**SARAL**

**26.02.13**

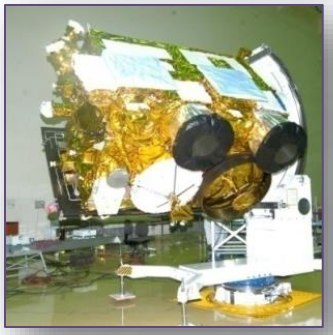
**IRNSS-1A**

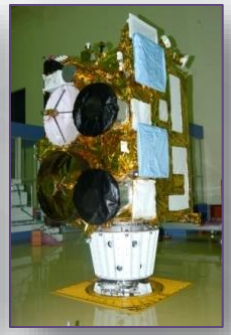
**01.07.13**



**INSAT-3D**

**26.07.13**





**GSAT-7**

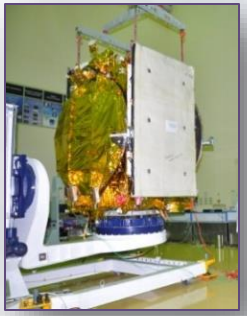
**30.08.13**

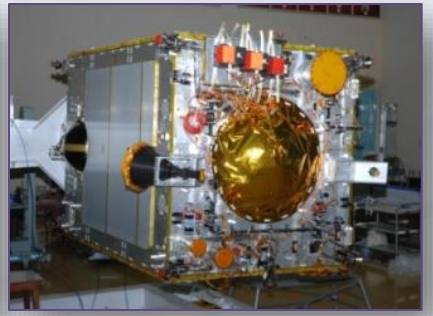
**MARS**

**05.11.13**

**GSAT-14**

**05.01.14**





# STATE-OF-THE-ART FACILITIES

# STATE-OF-THE-ART FACILITIES

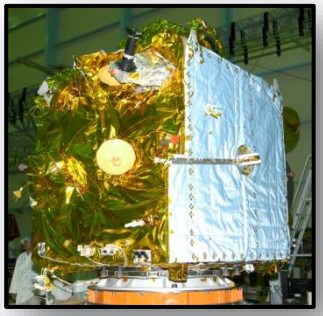
1. INTRODUCTION
2. GEOSAT SATELLITES
3. NAVIGATION SATELLITES
4. REMOTE SENSING SATELLITES
5. SPACE SCIENCE & INTERPLANETARY MISSIONS
6. FUTURE CHALLENGES & CONCLUSIONS

# GEOSAT BUS CONFIGURATIONS

| PARAMETERS | I-1K | I-2K | I-3K |
|---|---|---|---|
| Mission | MET/COM | COM/MET | COM/MET |
| Lift Off Mass (Kg) | 1000-1500 | 2000-2500 | 3000-3500 |
| Max Propellant (Kg) | 850 | 1100-1400 | 1700-1900 |
| S/C Dry Mass (Kg) | 500-600 | 900-1100 | 1200-1500 |
| Payload Mass (Kg) | 75-125 | 150-275 | 250-350 |
| Max Solar Power (W) | 900-1500 | 2500-3000 | 5000-6500 |
| Solar Cell technology | Si/GaAs | Si/GaAs/MJ | Si/GaAs/MJ |
| Battery Capacity/ Technology | 24AHx2/36AHx2 NiCd/LiIon | 70AHx2/100Ahx2 NiH2/LiIon | 140AHx2/100AHx3Ni H2/LiIon |
| Payload Power (W) | 750 | 2500 | 5200 |
| Mission life | 7 Years | 10-12 Years | 12 to 15 Years |

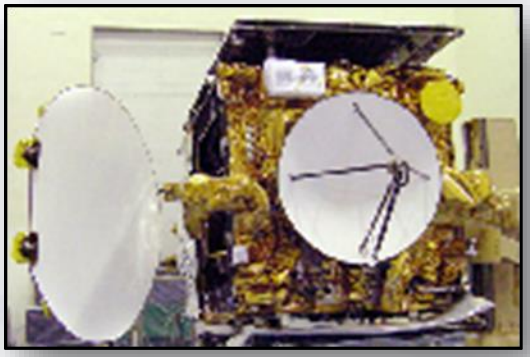
# GEOSAT BUS CONFIGURATIONS - PROJECTS

## I-1K Spacecraft



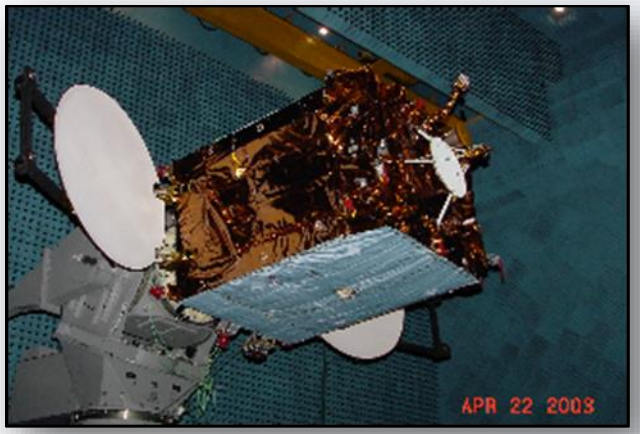
- KALPANA-1
- GSAT-12
- IRNSS (11)
- IDRSS

## I-2K Spacecraft



- GSAT-2
- GSAT-3
- INSAT-4C/4CR
- GSAT-4/14
- INSAT-3D/3DR
- GSAT-5/5P
- GSAT-6/6A
- GSAT-7/7A
- HYLAS
- GSAT-9

## I-3K Spacecraft




- INSAT-2E
- INSAT-3A
- INSAT-3C/3E
- INSAT-4A/4B
- W2M
- GSAT-8/10
- GSAT-15/17
- GSAT-16/18

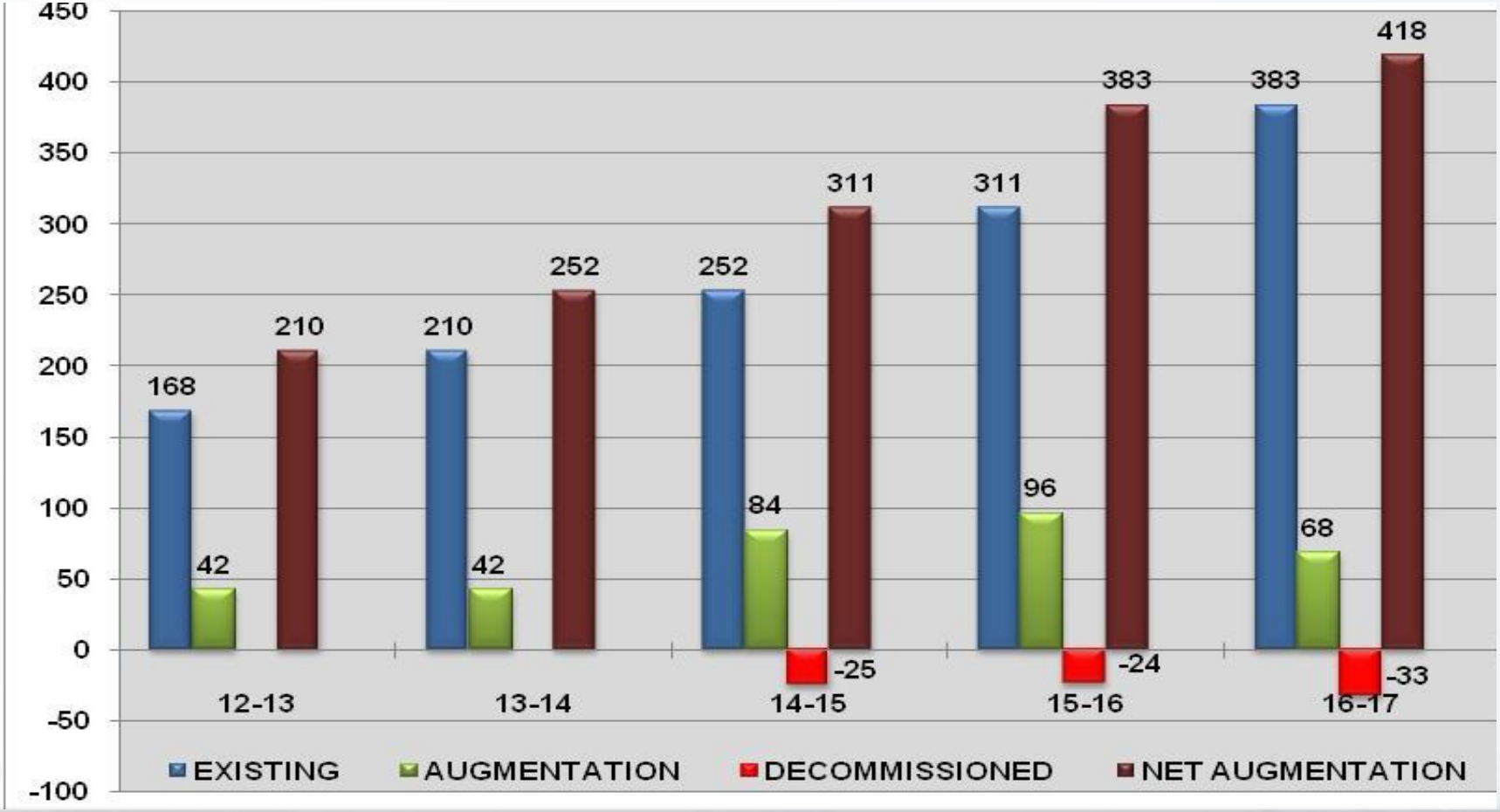
# FUTURE COMMUNICATION APPLICATIONS

1. **Present domestic satellite communication is dominated by Fixed Satellite Services and Direct To Home services.**

2. **Future service growth areas :**
   - Internet, multi-media and personal communication services
   - Direct to home high definition TV services
   - Thematic missions such as Tele-Medicine, Tele-Education
   - Bandwidth on demand services
   - E-Governance and Strategic communications
   - Satellite aided navigation

3. **Communication payload configuration drive engines :**
   - Ku-band DTH with national beam
   - Ka-band broad band connectivity using multiple spot beams
   - S-Band mobile communication using multiple spot beams with hand held terminals
   - Broad band VSAT connectivity 0.512 - 4 Mbps data rates
   - Onboard capacity building - 80-100 transponders

# TRANSPONDER AUGMENTATION PLAN



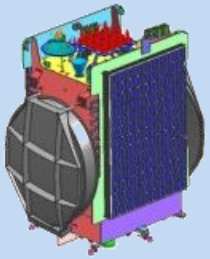

| Spacecraft addition | GSAT-14<br>GSAT-10 | GSAT-6<br>GSAT-15<br>GSAT-7 | GSAT-11*<br>GSAT-16<br>GSAT-7A | GSAT-9<br>GSAT-17<br>GSAT-18 | GSAT-6A<br>GSAT-19E<br>GSAT-11S*<br>GSAT-KA* |
|---|---|---|---|---|---|
| S/c to be decommissioned | | | INSAT-3E | INSAT-3A | INSAT-3C |



Gsat-11- Ku 24, Gsat 11S – 34 S, Gsat-Ka – 24 Ka, Gsat 19E - TBD

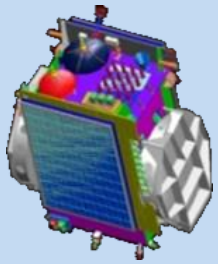
# ONGOING GEOSAT PROJECTS

## GSAT-15



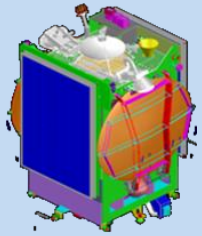
I-3K
93.5 $^{o}$ E
3 T
6.5 KW
24 Ku , 2 Channel GAGAN

## GSAT-16



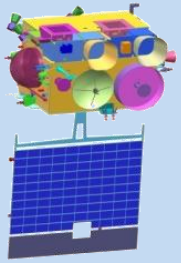
I-3K
55 $^{o}$ E
3T
6.5 KW
12 Ku, 24 Nor C,12 Ext C, Ku band Beacon

## GSAT-9



I-2K EX
48 $^{o}$ E
2.1 T
3 KW
12 KU BAND

## INSAT-3DR/3DS

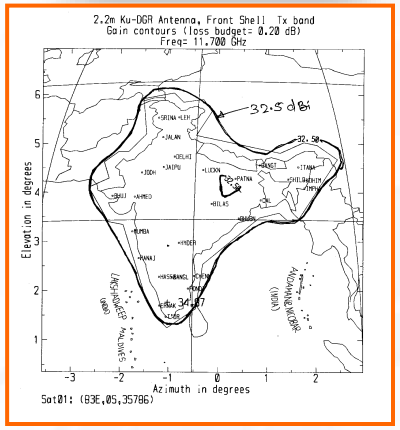


I-2K
74 $^{o}$ E
2.2 T
1.1 KW
6 Channel imager &
19 Channel sounder

# GEOSAT APPLICATIONS-NEW FRONTIERS

## High Power GSAT-8

**Ku 52 dBW**

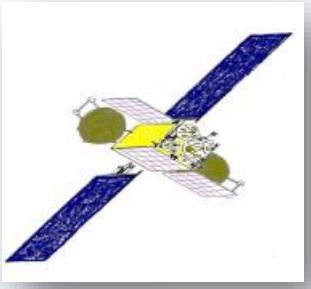


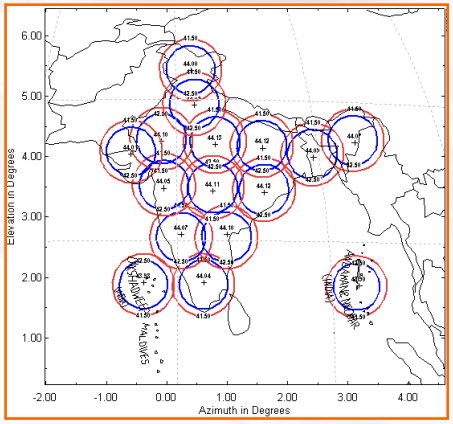

**Launched on *21-05-11***

- DTH/HDTV
- VSAT
- Networking

## Multi Beam GSAT-11

**Ku 57 dBW Ka 55 dBW**






- Broadband Internet
- High EIRP/Increased Throughput
- Increased capacity by Spectrum reuse (10GBps)

## Personal Mobile

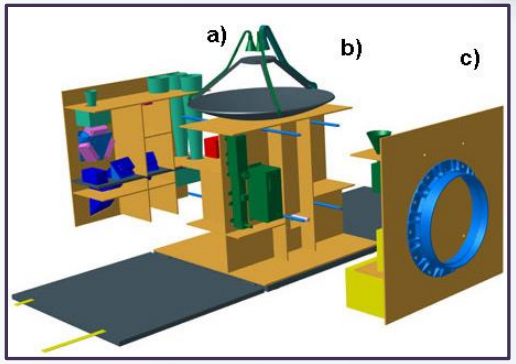
**S-Band 57 dBW**

**GEO**

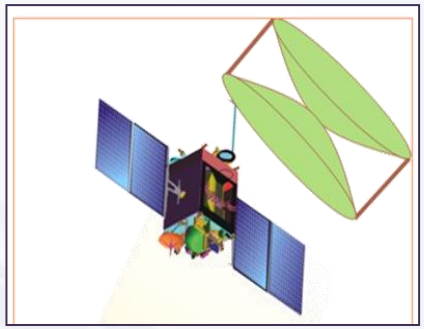

- Wireless Internet
- Mobile commence
- Emergency Infrastructure

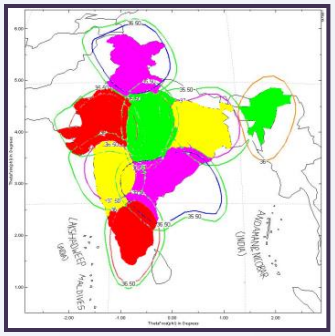
# ADVANCED TECHNOLOGIES

1. Modular design: bus-module, propulsion, battery and payload modules



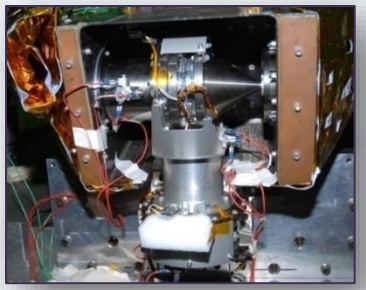

2. Satellite as major switching station with multiple spot beams and large unfurlable/ reconfigurable antenna systems





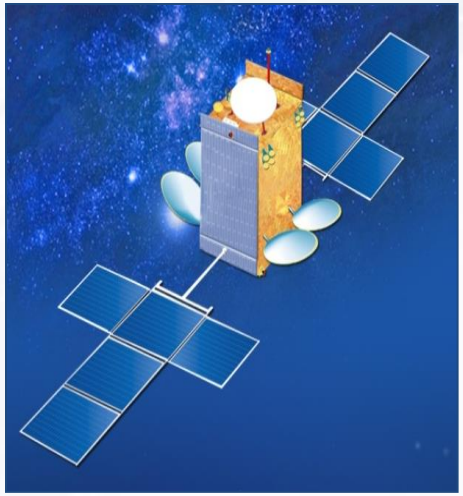
3. Usage of plasma thrusters to enhance the on-orbit life

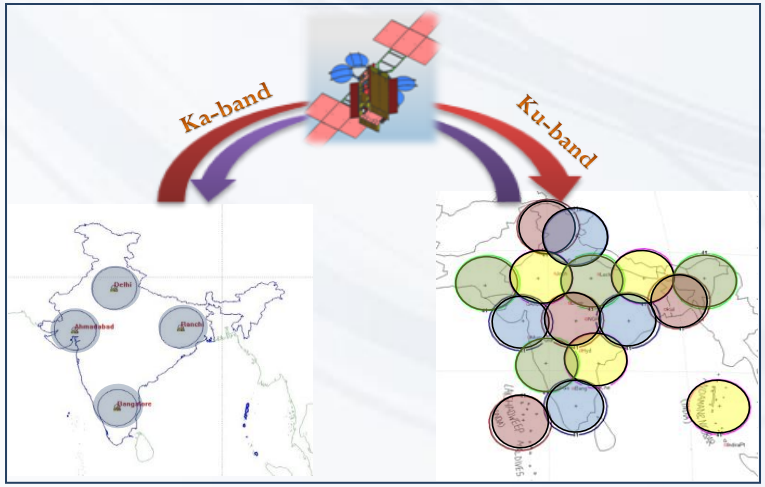
4. Antenna Auto Tracking for finer RF beam pointing



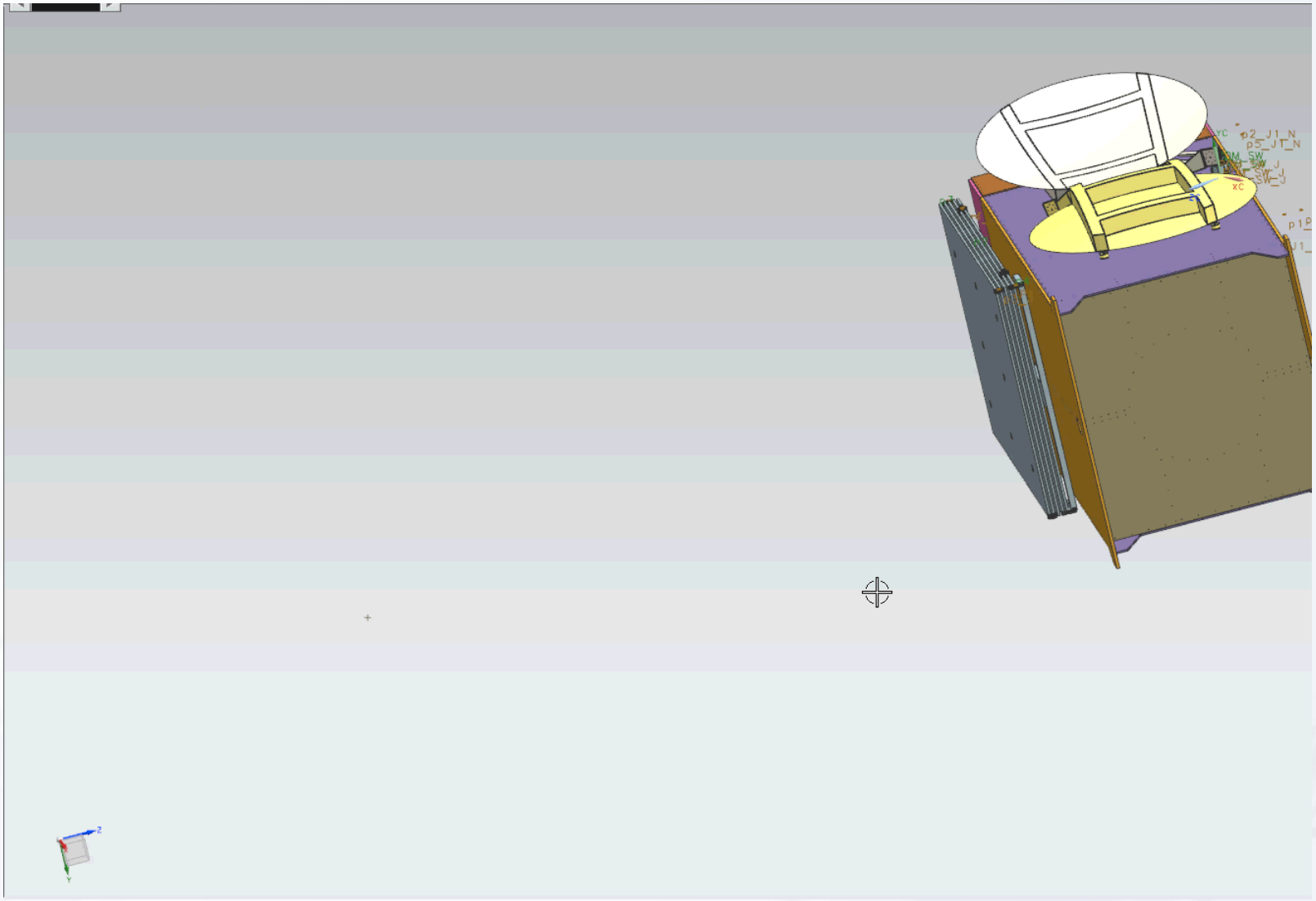
# GSAT-11

1. **Multi Beam Communication spacecraft**
2. Orbital location: $74^0$E
3. **New Modular, high power, high capacity bus**
4. Advanced concepts and new technological elements
5. **32 user beams in Ku band and 8 hub beams in Ka band to provide a through put of 10 GBPS**
6. New communication architecture to support various telecom services and VSAT networks .
7. Compatible ground support system to provide seamless connectivity .
8. Bus Compatible with GSLV mark III & all commercial launchers.
9. **Workhorse for our future communication satellite programme.**





# GSAT-11 DEPLOYMENT MECHANISMS

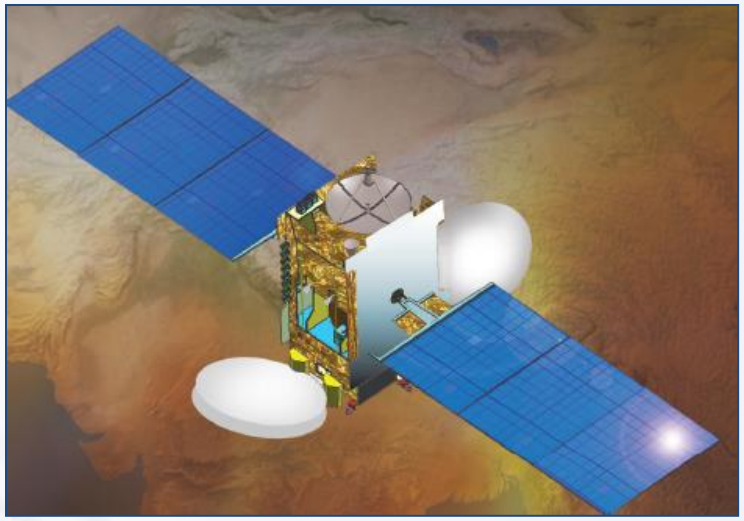


# GSAT-17

| SALIENT FEATURES | |
|---|---|
| Structure | Standard I-3K Bus |
| Orbital slot | $93.5^0$E |
| Proposed Payload | • 24 Nor-C band transponders - Wide Coverage<br>• 2 Lower Ext-C band transponders - Antarctica & Southern Indian peninsula coverage<br>• 12 Upper Ext-C band transponders - India Coverage with islands<br>• 2 MSS Forward ( C x S) & 2 MSS Return ( S x C) Transponders<br>• DRT , SAS & R (UHF) |
| LOM | 3425 kg |
| Propulsion | Unified bi-propellant system with two 860 liter propellant tanks. |
| Power | ~6 KW generation. 2x144 AH Li-Ion battery for eclipse support |
| TTC | C Band TTC system |
| Mission life | 15 Years |

# GSAT-18

| SALIENT FEATURES | |
|---|---|
| Structure | Standard I-3K Bus |
| Orbital slot | $74^0$E |
| Proposed Payload | 24 Nor-C band transponders - India Main Land & Island Coverage<br>12 Upper Ext-C band transponders - India Main Land & Island Coverage<br>12 Ku-band transponders - India Main land and Island Coverage<br>Ku-Band Beacon Transmitter |
| LOM | 3425 kg |
| Propulsion | Unified bi-propellant system which employs 16 thrusters with a LAM and two 860 liter propellant tanks. |
| Power | ~6 KW generation. 2x144AHLi-Ion battery for eclipse support |
| TTC | C Band TTC system |
| Mission life | 15 Years |



# GSAT-19 Spacecraft – Payload for GSLV MK-III D1

GSAT-19 Spacecraft is configured around I-6K for GSLV MK-III Launcher.

| SALIENT FEATURES | | |
|---|---|---|
| Spacecraft Bus | : | I 6K Bus Modular Structure |
| Mission Life | : | 10 years |
| Launch Vehicle | : | GSLV-MK III |
| Payload | : | 3 Ka-band , 2 Nor-C band &<br>1 MSS Forward (C x S) &<br>1 MSS Return (S x C) Transponders |
| Orbital Slot | : | 48$^{o}$E |
| Power | : | 70 V fully Regulated bus ( ~ 3.5 KW power) |

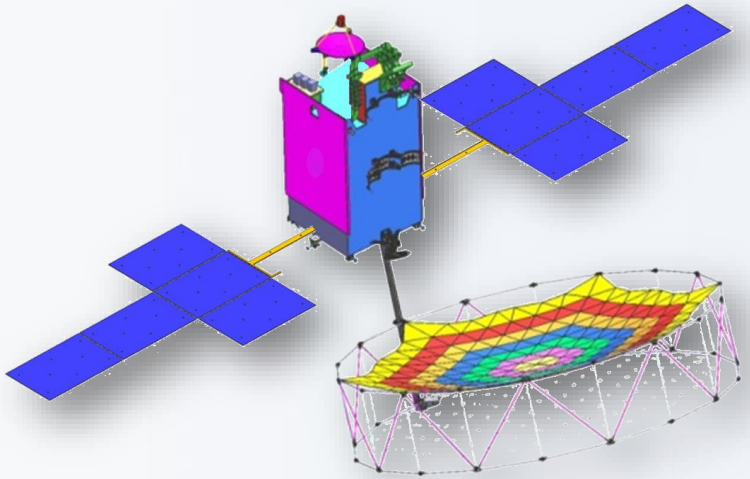
**NEW TECHNOLOGIES**

Modular structure (Independent Bus, Payload and Propulsion modules), Deployable Thermal Radiators, Electrical Propulsion System, Motorized deployment of solar panels, Ku Band TTC-RF System, Miniaturized IRU and Indigenous Li ion battery

# GSAT-20

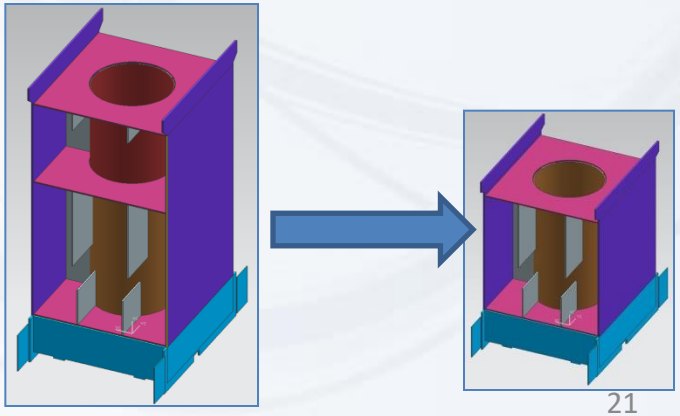
The Spacecraft will be configured around the reduced version of I-6K bus with a Lift Off Mass of 4000Kg to be compatible with GSLV MK-III and Commercial Launch Vehicles.

| SALIENT FEATURES | | |
|---|---|---|
| Spacecraft Bus | : | Reduced Version of I-6K Bus |
| TTC-RF | : | Ku/C band TTC-RF |
| Propulsion | : | 70 V electrical interface<br>10N/22N chemical thrusters &<br>75mN SPT for station keeping |
| Mission Life | : | 15 Years |
| Thermal | : | Rigid panels can support Payload dissipation |
| Power | : | 70 V fully Regulated bus<br>Solar panels of size 3.3m X2.1m<br>2 Lithium Ion cells based battery for eclipse support<br>Modular Battery Discharge Regulators |



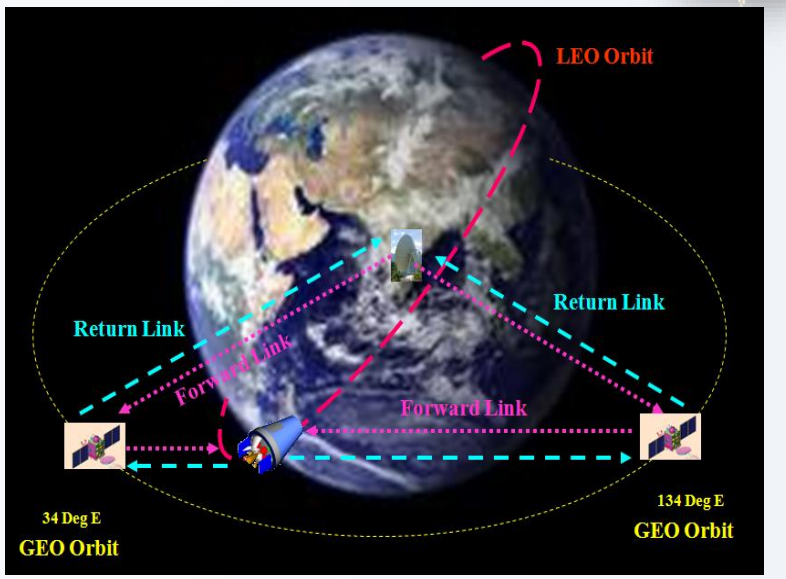
**Full-fledged I-6K Bus**

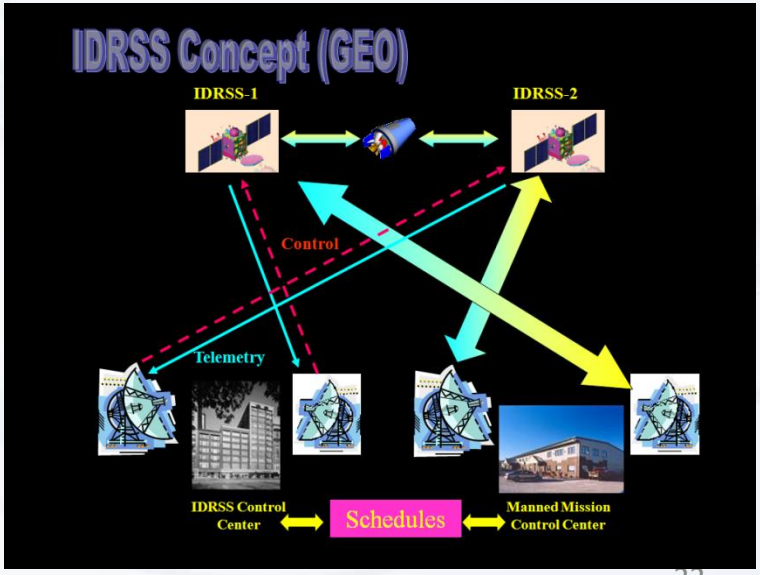
**Reduced version of I-6K Bus**



# 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

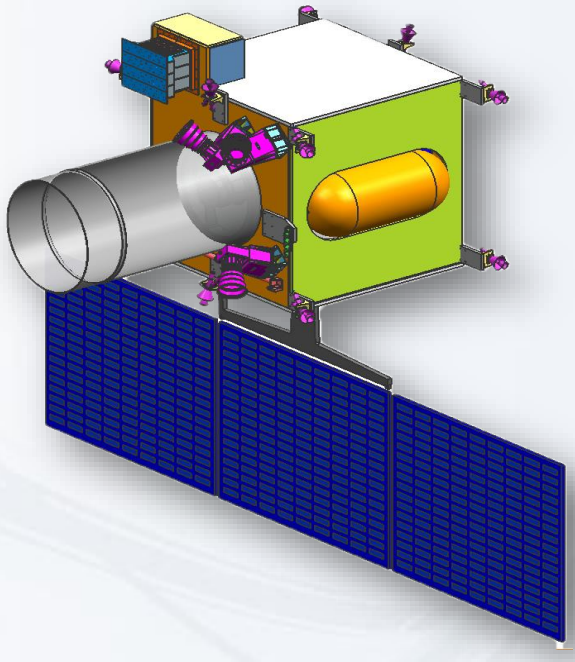


# GISAT

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$^{Plus}$ 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 $m^2$
- 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)

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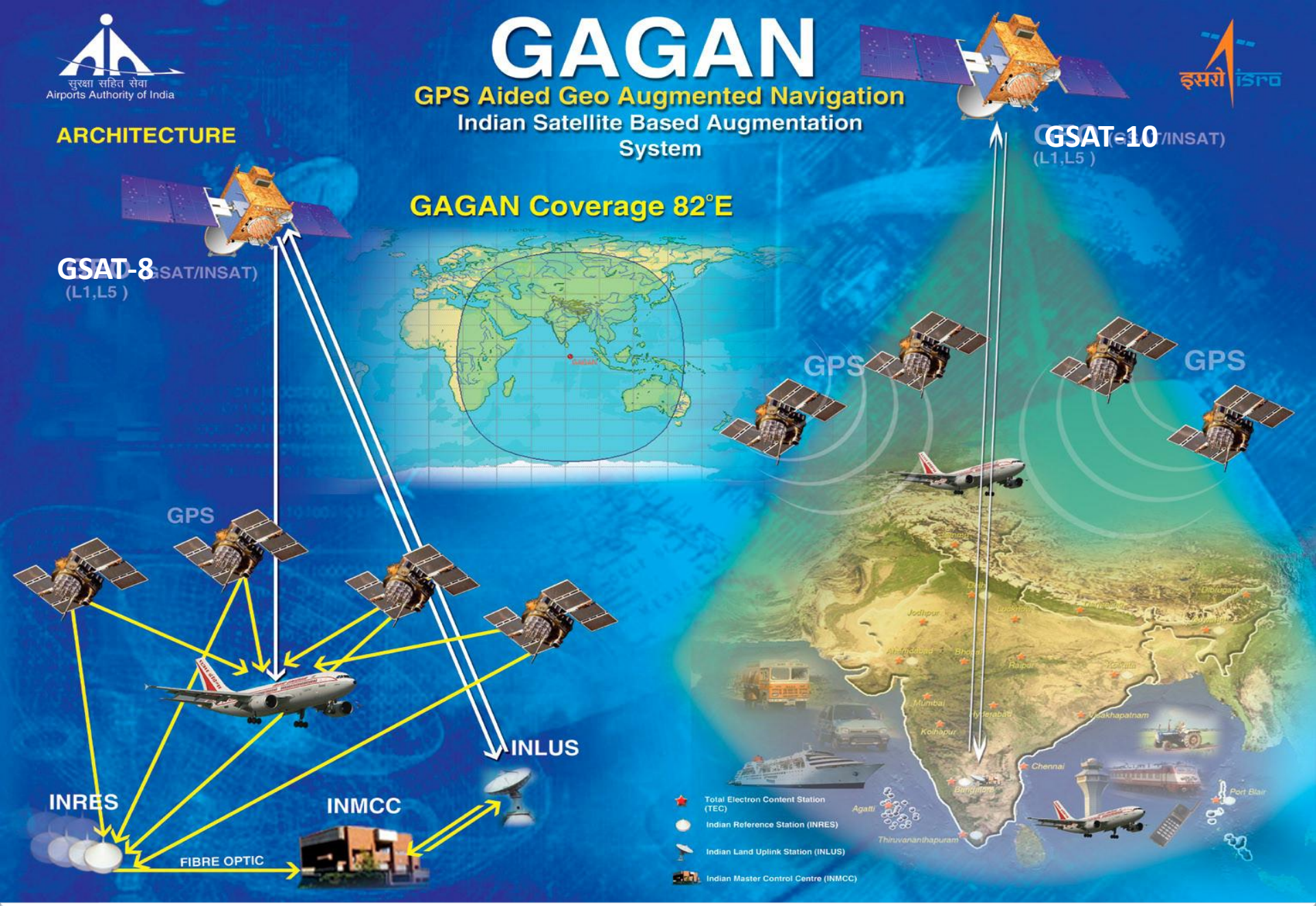
5 SPACE SCIENCE & INTERPLANETARY MISSIONS

6 FUTURE CHALLENGES & CONCLUSIONS



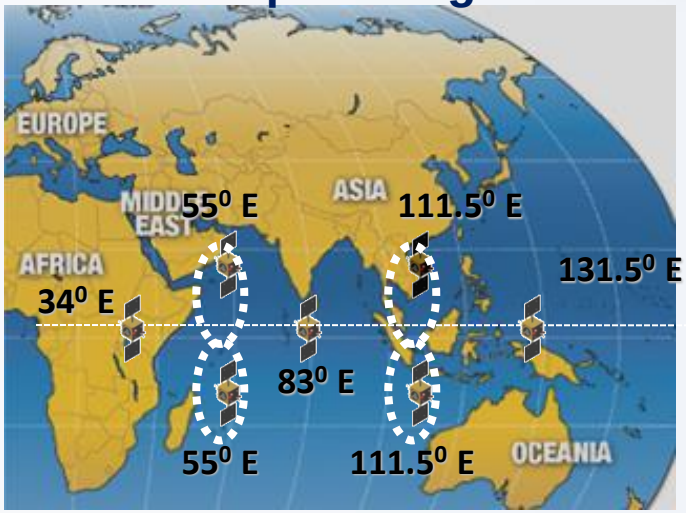

**Navigation - Air, Sea and Land, Positioning Applications, Survey, Image Correction, GIS, Timing, Surveillance/fleet monitoring**

# INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM

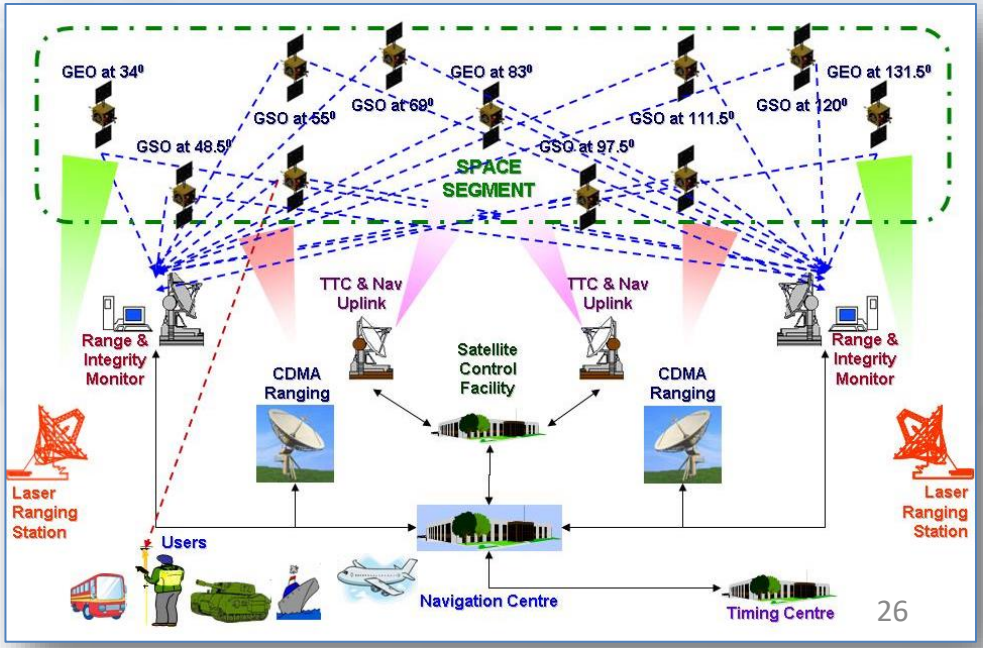
## IRNSS CHARACTERISTICS

- 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

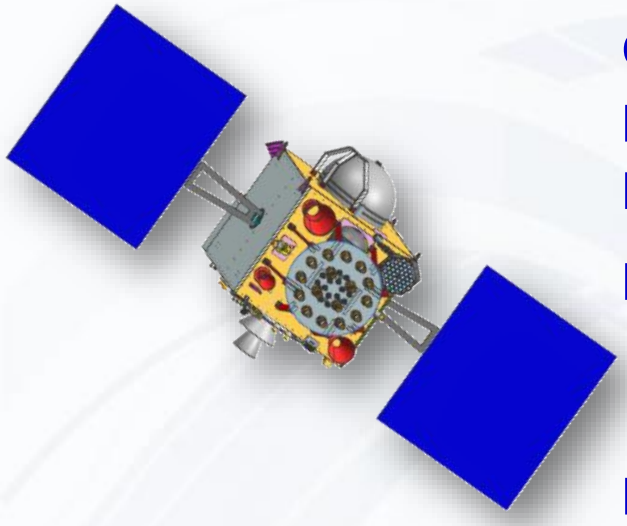



## IRNSS Architecture



# IRNSS - SERIES

To develop an independent satellite based navigation system capable of providing uninterrupted navigation services. Navigation system provides Standard positioning service and Restricted Service with encryption. Constellation of similar spacecraft to be in place by 2015 and are being realized in production mode.



## SPACECRAFT SALIENT FEATURES

| | | |
|---|---|---|
| **Orbital Location** | : | Geosynchronous with 29 Deg inclination |
| **Bus** | : | I-1K Bus |
| **Payload** | : | Navigation Payload and Ranging Payload operating in S and L5 bands |
| **Power** | : | 1600 Watts |
| **Mass** | : | 1426.74 Kg |
| **Mission Life** | : | 10 Years |
| **Application** | : | Regional Navigation application |

1 INTRODUCTION

2 GEOSAT SATELLITES

3 NAVIGATION SATELLITES

4 REMOTE SENSING SATELLITES

5 SPACE SCIENCE & INTERPLANETARY MISSIONS

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# REMOTE SENSING APPLICATIONS – NEW FRONTIERS

The major thrust areas of Remote sensing programme are to provide continuity of services in the Land and water resource observation, Ocean and Atmospheric series, Cartography & large scale mapping application and Micro wave imaging

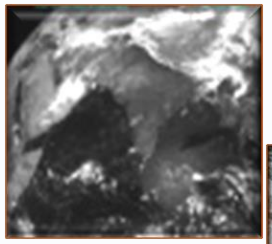
## NEW TECHNOLOGIES

1. High Resolution Imaging Payloads - 0.1-0.3 m
2. Hyper spectral Imaging and Multi spectral Imaging payloads
3. Onboard Automation
4. Highly Stable & Agile platforms
5. High Data rates & Ka-Band Data transmission system
6. High Data Compression Ratio and encryption system
7. Advanced modular Data Handling and Storage System
8. Advanced Sensors like Star Trackers
9. Detector Development
10. Advanced Image processing system

# INDIAN IMAGING CAPABILITY

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

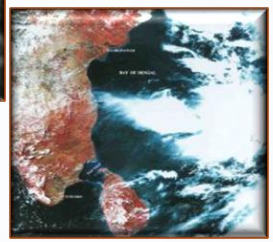
KALPANA



1 KM
VHRR

CLIMATE/
WEATHER

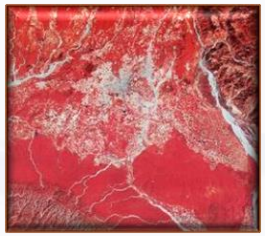
IRS-P4



360 M
OCM

OCEAN
APPLICATION

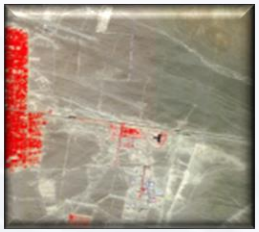
IRS-1C/1D



188 M
AWIFS

NATIONAL
SURVEYS

IRS-P6



60 M
AWIFS

NATURAL
RESOURCE
MAPPING

IRS-1C/1D
IRS-P6

23 M
LISS III

DETAILED
PLANNING

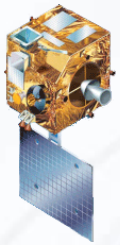
STEREO
CAPABILITY

IRS-1C/1D
IRS-P6

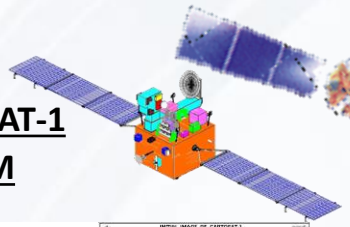
5.8 M
LISS IV
PAN

TES


1 M



CARTOSAT-1
2.5 M

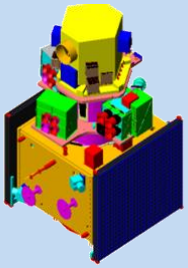




CARTO-2
1 M Resolution

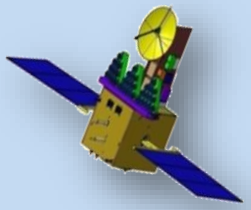
# ONGOING IRS PROJECTS

## RESOURCESAT-2A



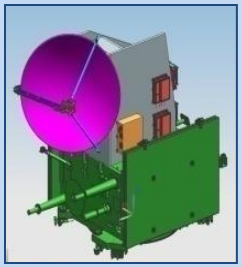
**Payloads:**
LISS-4, LISS-3, AWIFS
Orbit : 817 Km SSPO
LT :10.30 AM
**Applications:** Resource applications

## OCEANSAT-3



**Payloads:**
13 band OCM, Ku-band SCAT, Sea Surface Temperature Monitor (SSTM)
Orbit: 720 Km SSPO
Local Time:12.00 Noon
**Applications:** Oceanography

## SCATSAT-1



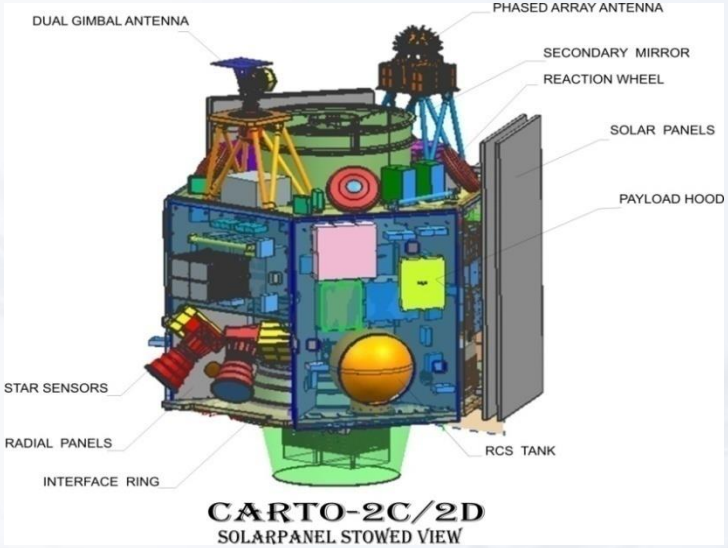
**Payloads:** Scatterometer
Orbit: 720 Km SSPO
Mass: 360 Kg ( IMS-2 Bus)
Power : 280W
**Applications:** Oceanography

# CARTOSAT-2C/2D/2E/2F

## MISSION OBJECTIVES

- High resolution imaging from an altitude of 500 kms
- For cartographic applications with panchromatic (PAN) and **4 multi-spectral (MD) bands with TDI (time delay integration) detectors.**
- Design is based on cartosat-2/2A/2B spacecraft platform

| **Payload Proposed** | PAN | MX |
|---|---|---|
| **Resolution** | 0.64 m | 3 m # |
| **Swath (km)** | 7.6 km | 7.6 km |




## NEW TECHNOLOGIES

- Data transmitter for 320 Mbps
- **Multi-spectral Payload with TDI devices**
- Optical butting of devices for swath
- JPEG 2000 Data compression system
- 600 Gb Solid State Recorder

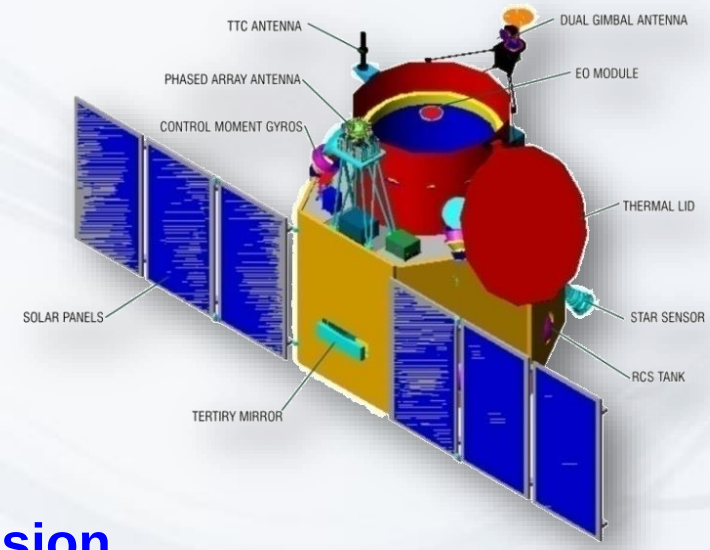
# CARTOSAT-3

**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

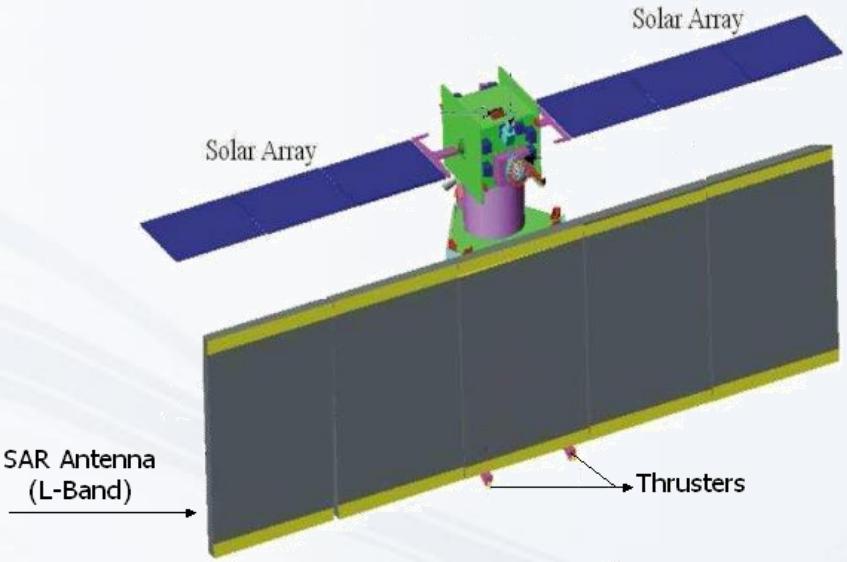
# RISAT-3

## Mission objectives

RISAT-3 is a follow on spacecraft for microwave imaging. It provides multi resolution imaging capability for natural resource management and other applications

## PAYLOADS:

- L-band SAR 1.25GHz,
- Resolution: 1m to 35m,
- Swath : 10km to 240km
- Spacecraft mass: 2530 kg
- Power: 4500 W
- Orbit: 536 km



RISAT-3 DEPLOYED Configuration

## New technologies

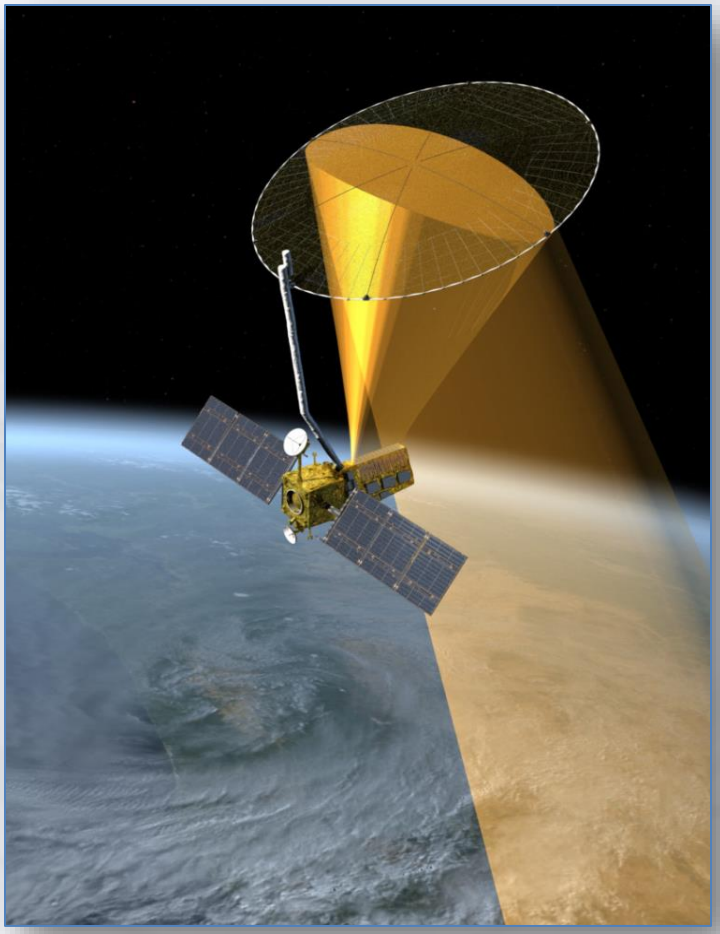
- Main & payload structure (tiles &frames)
- L band SAR
- Battery modules
- SAR deployment mechanism

# NASA-ISRO SAR (NI-SAR) Mission

NI-SAR is a Global mission for monitoring Deformation, Ecosystem Structure and Dynamics of Ice (DESDynI). It is a collaborative Mission between NASA/JPL & ISRO with World's First Dual Band (L & S) Synthetic Aperture Radar (SAR) for Earth Imaging.

**SALIENT FEATURES**

- New Sweep SAR Technology with large (12m) unfurlable reflector
- Payloads : L-Band SAR payload by NASA-JPL and S-Band SAR payload by ISRO-SAC
- Spacecraft Mainframe by ISRO-ISAC
- Launch: ISRO-GSLV
- Target Launch Date: 2019-20



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# SPACE SCIENCE - THE QUEST FOR KNOWLEDGE

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**

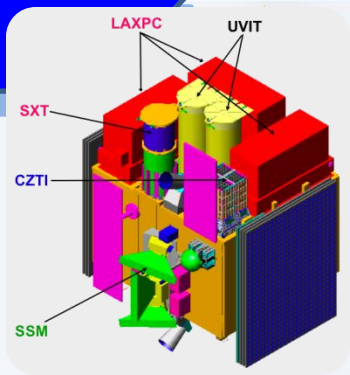
# MARS ORBITER MISSION

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

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

# ASTROSAT




Astrosat is India's first satellite dedicated for multiwavelength astronomy for observation of galactic objects. It carries 5 payloads for observations of cosmic objects at UV, soft X-ray and hard X-ray regions of the electromagnetic spectrum.

| 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) |

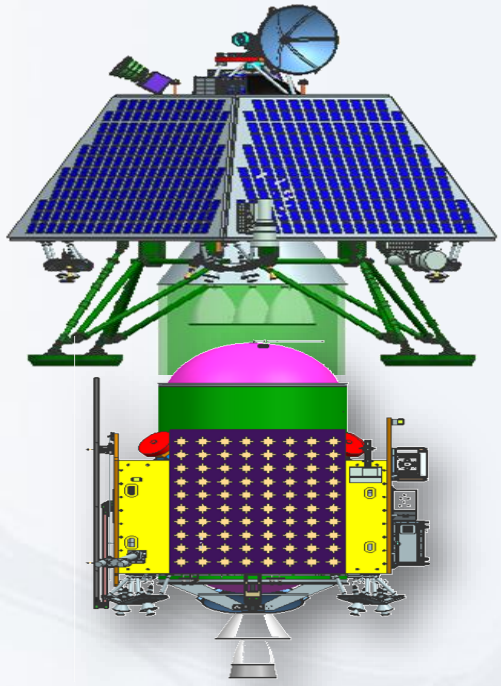
## SCIENCE OBJECTIVES

- *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.*

# CHANDRAYAAN-2

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

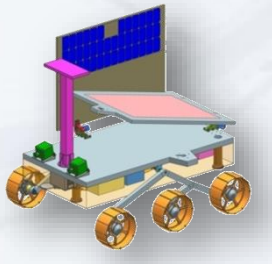


**Lander payloads :**

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:**

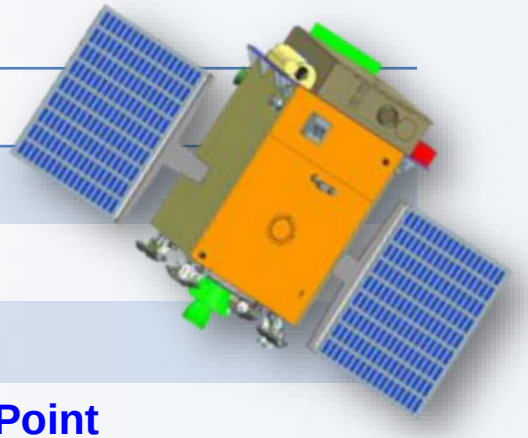
1. CLASS- Chandrayaan-2 Large area soft X ray Spectrometer
2. SAR- Synthetic Aperture Antenna
3. IIRS - Imaging IR Spectrometer
4. ChACE 2- Chandra's Altitudinal Composition Explorer
5. TMC-Terrain Mapping Camera



# CHANDRAYAAN-2 MISSION PROFILE

# ADITYA- L1

**ADITYA- L1 is 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'.**

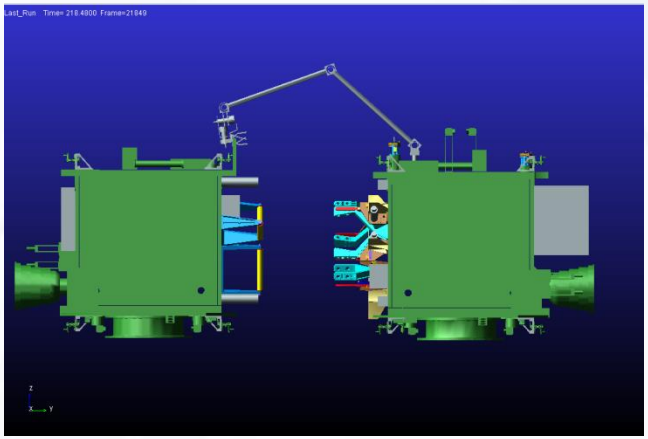


| | |
|---|---|
| Spacecraft Bus | IRS Bus |
| Mass | ~ 1400 Kg |
| Power | 1500 W |
| Mission Life | > 5 Years |
| Orbit | Halo Orbit about Sun- Earth L1 Point |
| Data Volume & Download Read out Rate | 110 Gb, 4 MBPS |
| Payloads Proposed | 1. Enhanced Visible Emission Line Coronograph<br>2. High Energy L1 Orbiting X-ray Spectrometer<br>3. Plasma Analyser Package<br>4. Solar Wind & Thermal Ion Spectrometer<br>5. Solar Low Energy X-ray Spectrometer<br>6. Solar Ultraviolet Imaging Telescope |

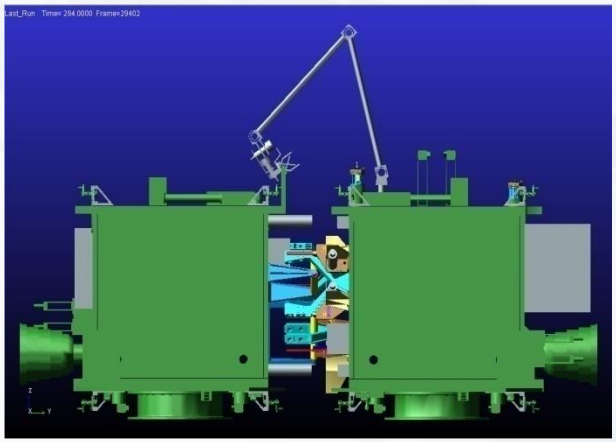
# RENDEZVOUS AND DOCKING EXPERIMENT

## Objectives:

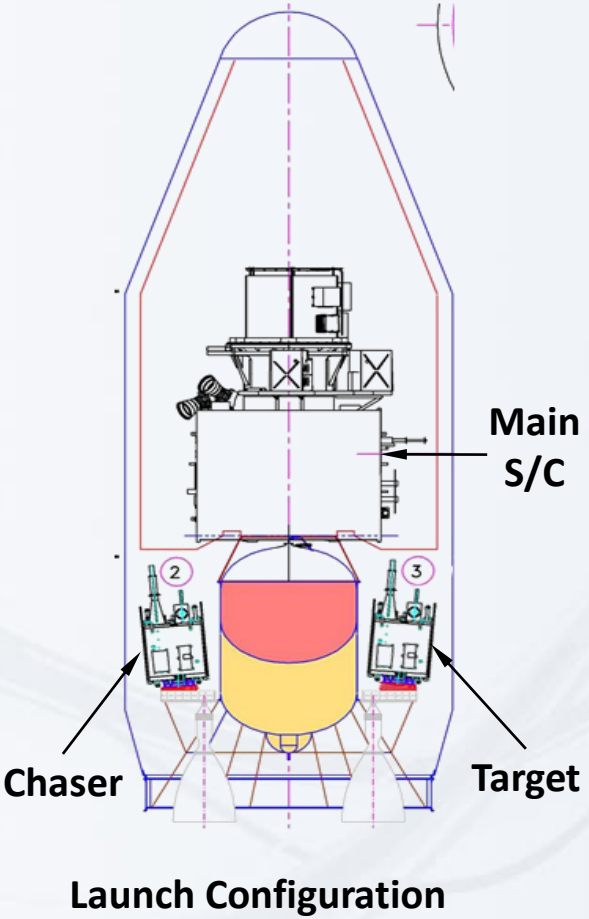
- Technology demonstration for rendezvous and docking, using two IMS (Youthsat) spacecraft - piggy-back on a single PSLV flight
- Demonstrate controllability of target spacecraft from AOCE of chaser spacecraft in docked condition, showing the possibility of extending target spacecraft life



APPROACH & CAPTURE PHASE



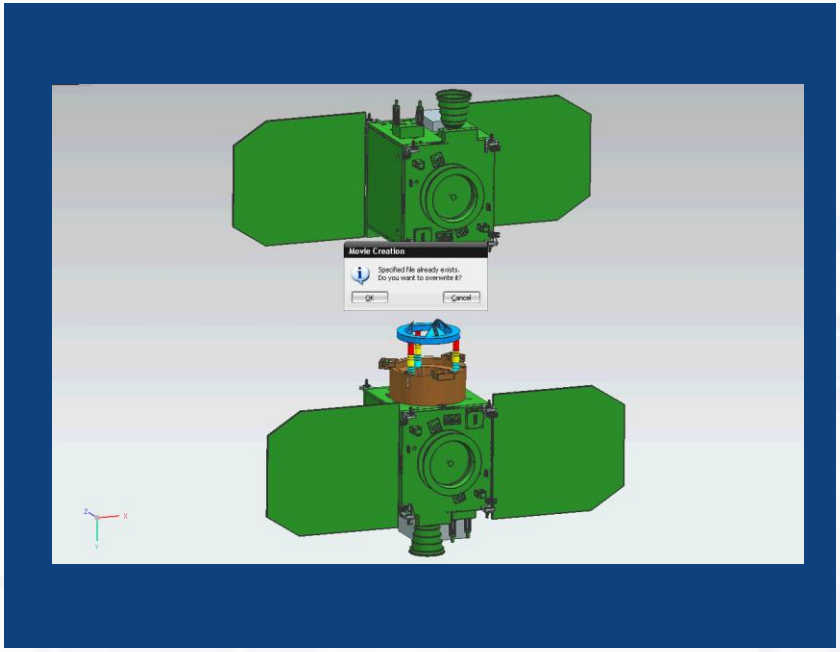
DOCKED PHASE




Launch Configuration

# RENDEZVOUS AND DOCKING EXPERIMENT

## Direct Low Impact Autonomous Docking




## Berthing (Manipulator Assisted)

**Subsequent to completion of docking experiment, both satellites can carry out their designated missions independently**

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# FUTURE CHALLENGES

## TECHNICAL CHALLENGES

- HIGH POWER COMMUNICATION SATELLITES
- HIGH RESOLUTION IMAGING SATELLITES
- ENVIRONMENT MONITORING SATELLITES
- CRITICAL TECHNOLOGIES FOR HUMAN SPACE PROGRAMME
- DOCKING EXPERIMENTS
- FORMATION FLYING CONCEPTS
- LANDING MISSIONS - UNMANNED & MANNED

## MANAGERIAL CHALLENGES

- COST EFFECTIVE SYSTEMS
- CONCURRENT ENGINEERING MANAGEMENT
- KNOWLEDGE MANAGEMENT
- PROJECT MANAGEMENT
- TEAM WORK & TEAM BUILDING

# CONCLUSIONS

***Today's Science is Technology of Tomorrow. It reduces the gap between possible and impossible. Set higher goals and strive to achieve them.***

***The future is full of challenges that beckons every ISROite to go ahead. We need to meet them with vigour and vitality. I have no doubts in my mind, you have all the capabilities.***

***All the very best to all of ISROites***

# CONCLUSIONS

# Thank You!