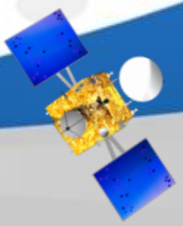
ISRO SATELLITE CENTRE



08.01.2014

Five Decades of Indian Space Programme

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

November 21, 1963

41 Launch Vehicle Missions

35 Satellites from other countries

69 + 2 Spacecraft Missions

LAUNCH VEHICLE

PSLV
25

GSLV
7

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-3A
10.04.03

INSAT-3B
22.03.00

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

CHANDRAYAAN-1
22.10.08

CARTOSAT-2
10.01.07

INSAT-4B
12.03.07

OCEANSAT-2
23-09-09

INSAT-4CR
02.09.07

RESO-2
20-04-11

W2M
21-12-08

HYLAS
26-11-11

RISAT-1
26-04-12

GSAT-8
21-05-11

GSAT-12
15-07-11

GSAT-10
29-09-12

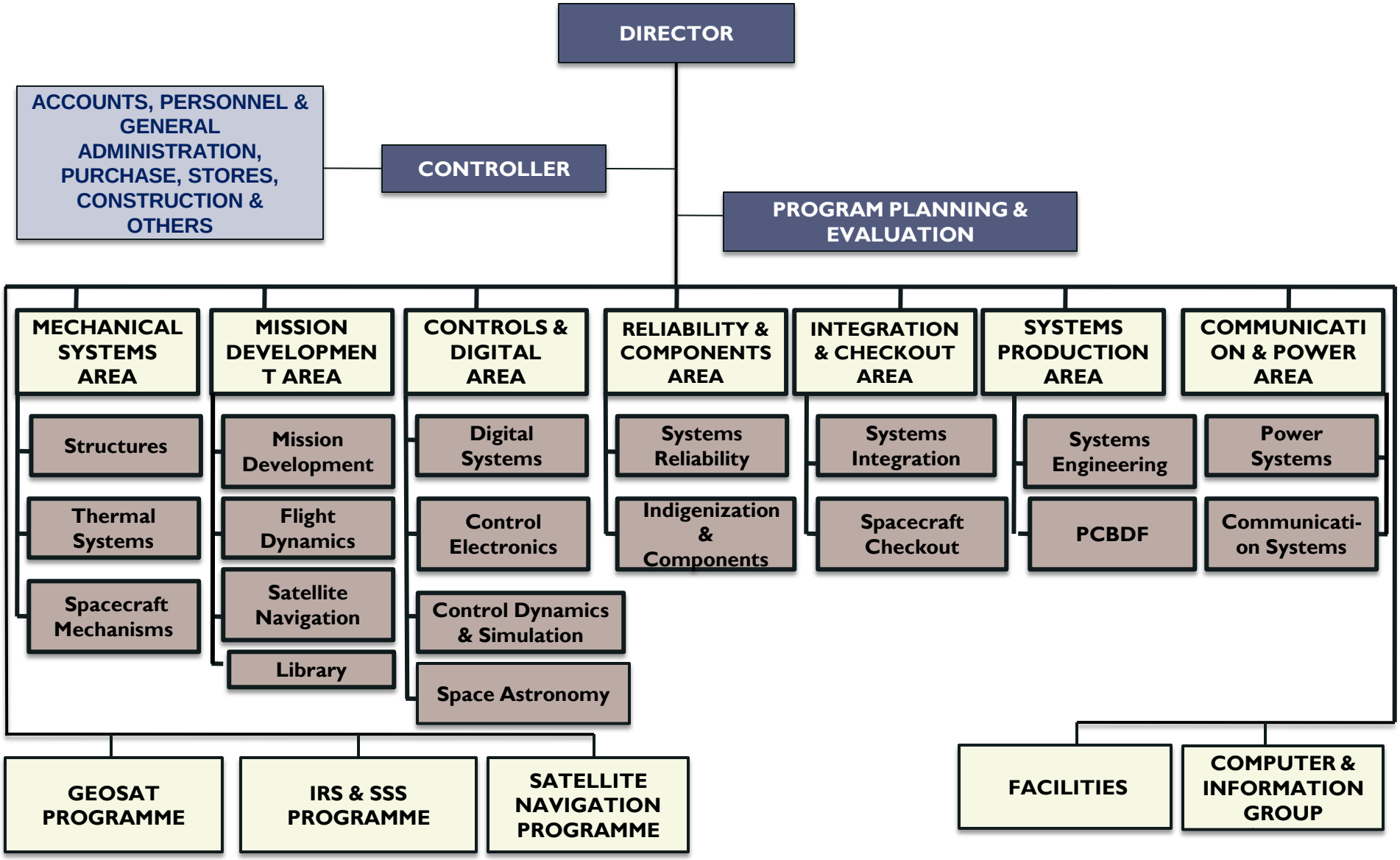
IRNSS-1A
01-07-13

GSAT-14
05-01-14

MOM
05-11-13

APPLICATIONS

ISRO SATELLITE CENTRE-ORGANISATION STRUCTURE



ISRO SATELLITE CENTRE

RESOURCES

Land Area	
ISAC-MAIN	35 Acres
ISITE	110 Acres
Manpower	2359
(Multi-Disciplinary)	
Technical	1831(78%)
Admin	528 (22%)

ACTIVITIES

- Major centre for design, development & Integration of Communication, Remote sensing & Scientific satellites
- R & D in the area of advanced state-of-the-art technologies
- Total project management for Satellite Missions
- Industry development & Technology Transfer, academia interface

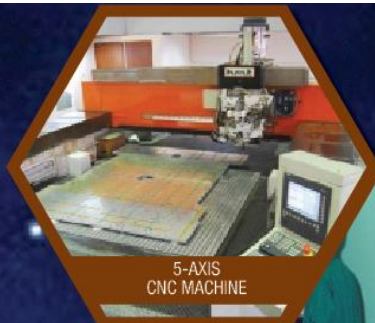
FACILITIES

- 4 Clean Rooms
- Large Space Simulation Chamber, Hot & Cold chambers & Thermovac chambers,
- Anechoic chambers and EMI test facility
- Vibration & Acoustic test facility
- Precision Mechanical & Electronics – Fabrication facility
- Large optics fabrication facility
- HMC & Electronics packaging facility
- Solar panel lab
- CATF & so on ....

ACHIEVEMENTS

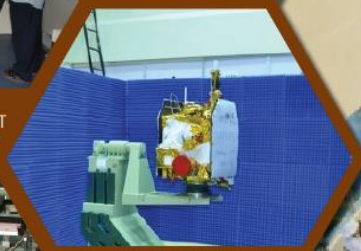
- 69 Satellites realized
- *25 satellites in operation*
- State-of-the-art facilities
- State-of-the-art technologies
- Participation /Consultation for Global Satellite Missions

ISAC Facilities


5-AXIS
CNC MACHINE


PRINTED CIRCUIT BOARD
FACILITY


THERMAL CONDUCTIVITY
MEASUREMENT INSTRUMENT


EMI/EMC
TEST FACILITY


ELECTRONIC FABRICATION FA-
CILITY


HYBRID MICRO CIRCUITS
FABRICATION FACILITY


SOLAR PANEL
FACILITY

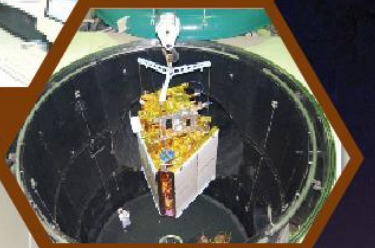

AIT CLEAN ROOM, ISAC


OPTI CS INTEGRATING SPHERE
AT LEOS


EARTH DISC TEST FACILITY AT
LEOS


SOLAR PANEL
DEPLOYMENT TEST FACILITY

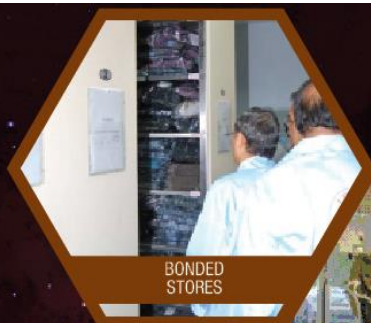

SPACECRAFT
CHECKOUT

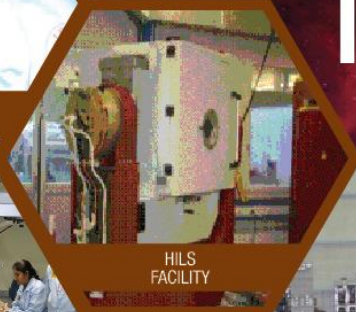

9M LARGE SPACE
SIMULATION CHAMBER


VIBRATION
TEST FACILITY


4M THERMOVAC
CHAMBER

ISITE Facilities


BONDED STORES


HILS FACILITY


TEST & EVALUATION LAB


ELECTRONIC FABRICATION LAB

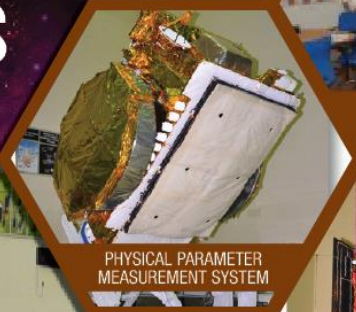

SUN SIMULATOR AT LEOS


6 . 5 M THERMOVAC CHAMBER


UNFURLABLE ANTENNA DEPLOYMENT FIXTURE


AIT CLEAN ROOM, ISITE


SPACE CRAFT CHECKOUT


PHYSICAL PARAMETER MEASUREMENT SYSTEM


VIBRATION TEST FACILITY

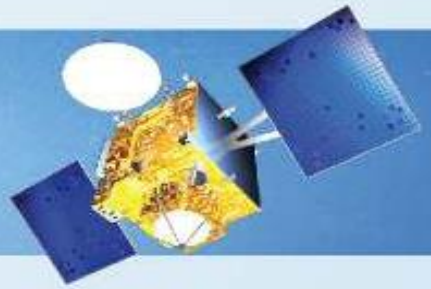

COMPACT ANTENNA TEST FACILITY

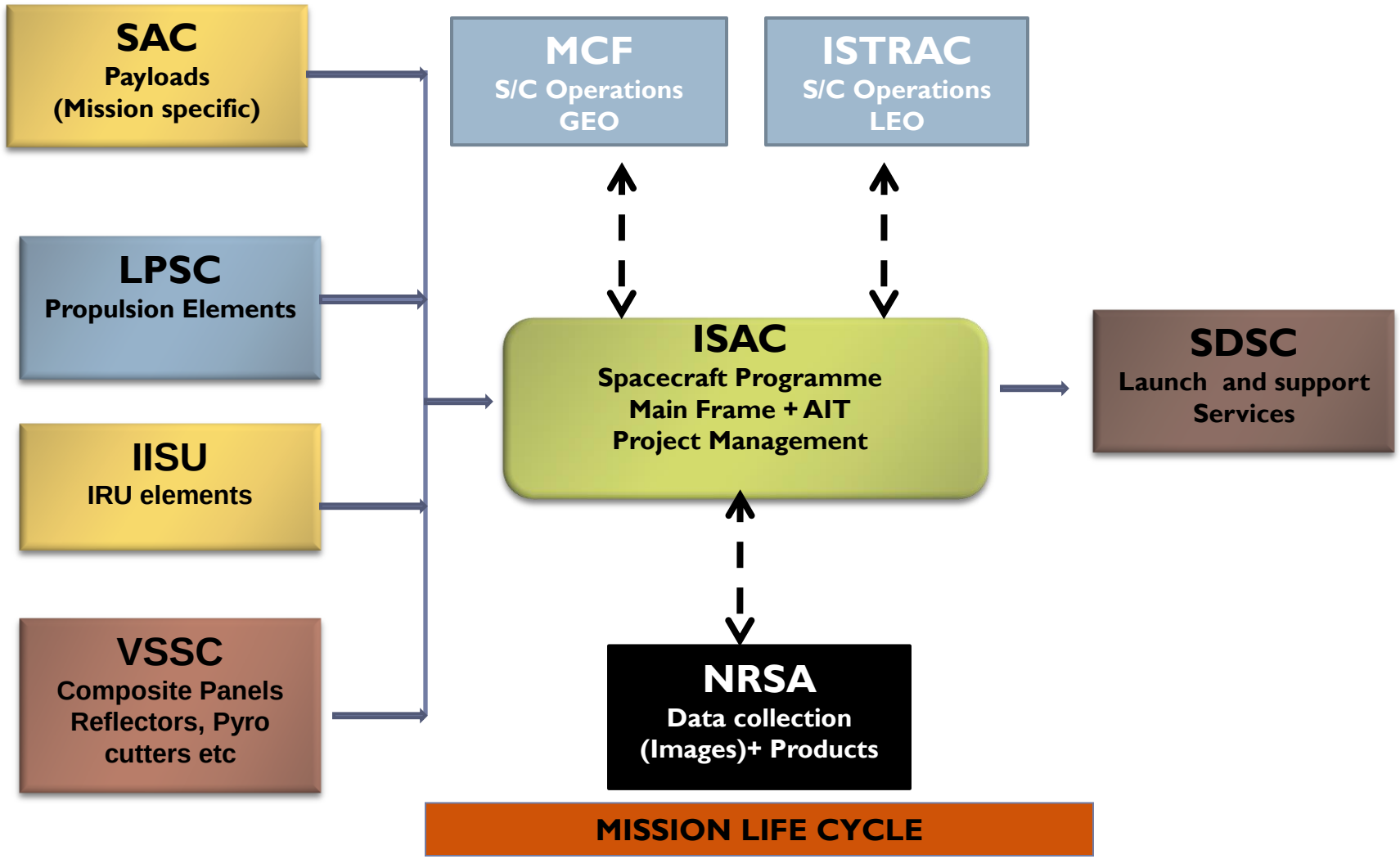

ACOUSTIC TEST FACILITY


GAGAN MASTER CONTROL CENTRE AT KUNDALAHALLI

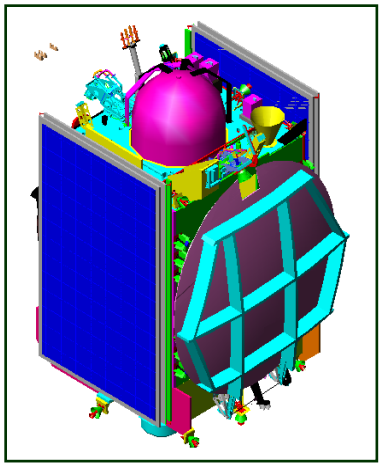

SENSOR FABRICATION FACILITY AT LEOS

WORK CENTRES- SATELLITE PROGRAMME





SPACECRAFT DEPLOYED CONFIGURATION



RECENTLY LAUNCHED SATELLITES

SARAL

26.02.13

INSAT-3D

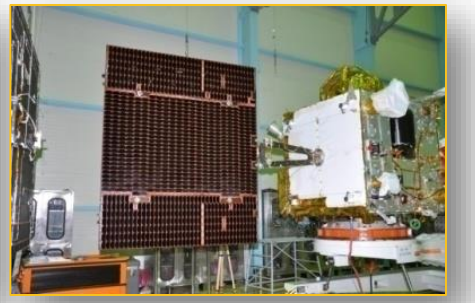
26.07.13

MARS

05.11.13

IRNSS-1A

01.07.13

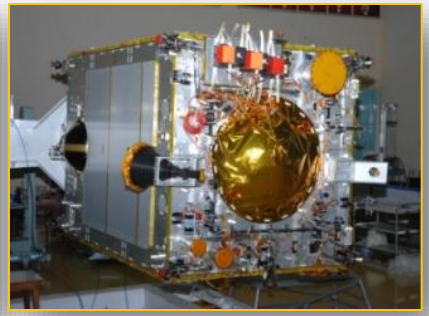


GSAT-7

30.08.13

GSAT-14

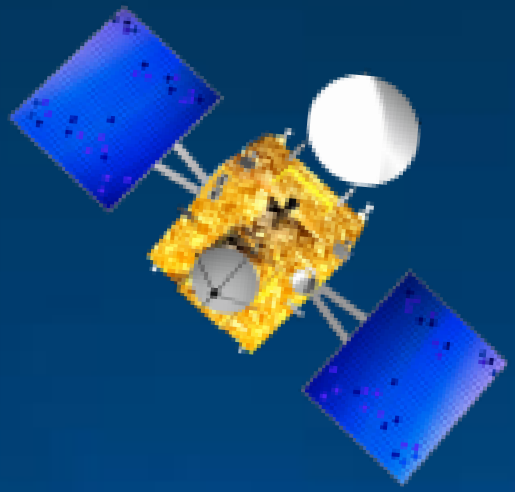
05.01.14

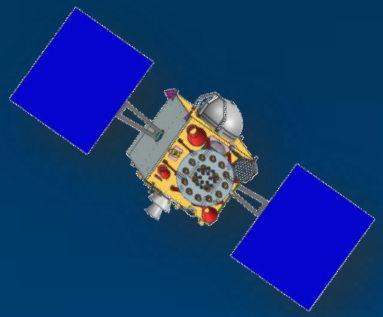


NATIONAL SPACE SYSTEMS

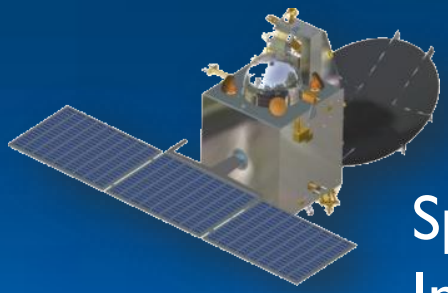
SPACECRAFT MISSIONS

Communication Satellites

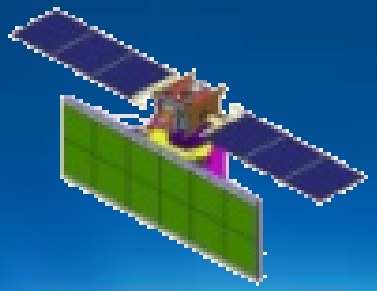




Navigation Satellites



Space Science & Interplanetary Satellites

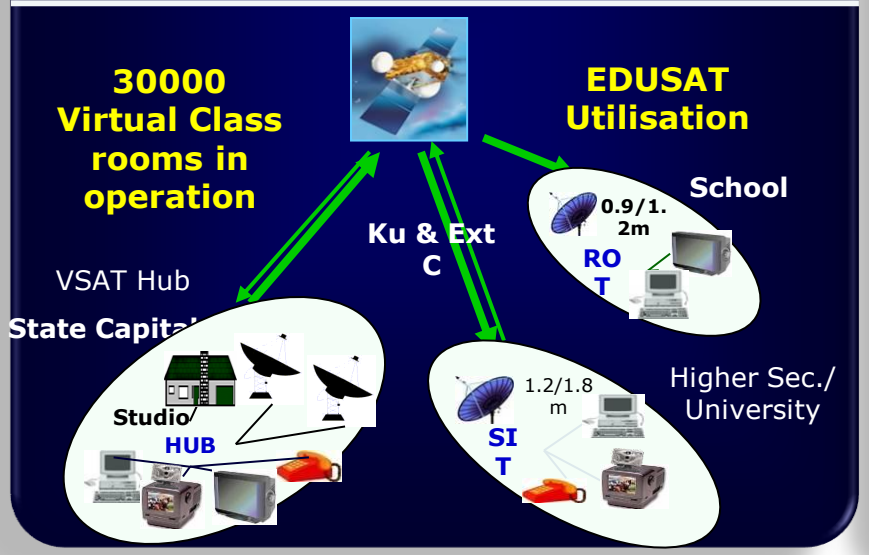


Remote sensing & Scientific Satellites

INSAT APPLICATIONS

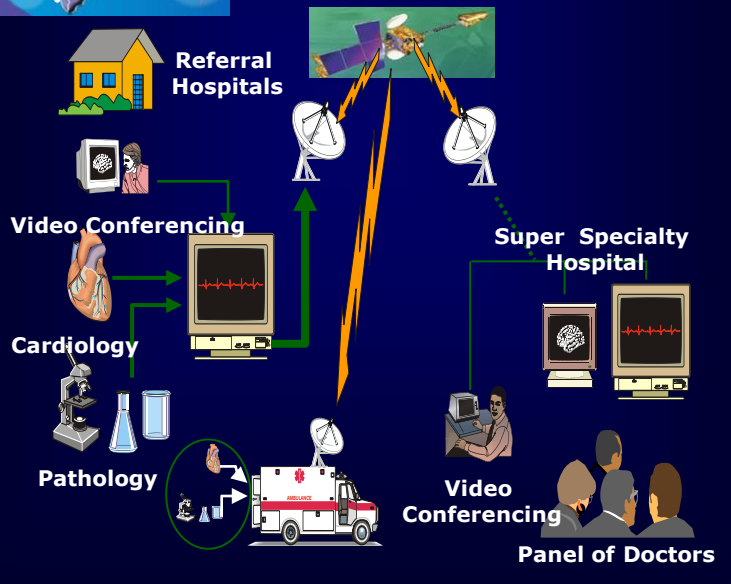
Tele-Education

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



Tele-Medicine

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



BROADCAST

- Television Broadcasting
- Direct To Home (DTH)
- TV & Radio Networking

COMMUNICATION

- Speech Circuits on Trunk Routes
- VSAT Connectivity

OTHERS

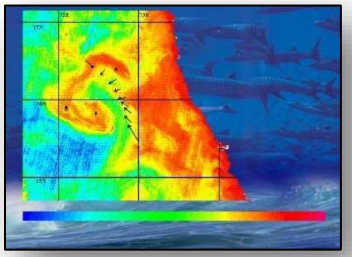
- Mobile Satellite Service
- Search and Rescue
- Satellite Navigation

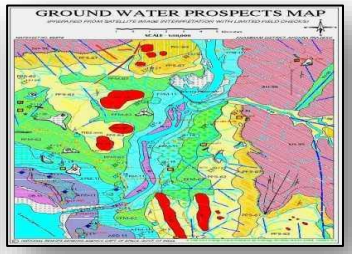
REMOTE SENSING APPLICATIONS

Natural Resources Management

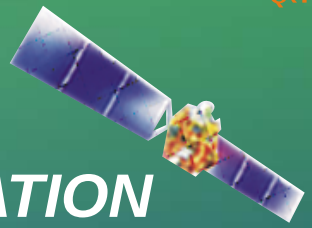
- Agricultural Crop Inventory
- Watershed Development Planning & Monitoring
- Irrigated Command Area Monitoring
- Irrigation Infrastructure Monitoring
- Potential Ground Water Zones
- Potential Fishing Zones
- Urban /Infrastructure Planning
- Biodiversity at Landscape level

Village Resources Centre

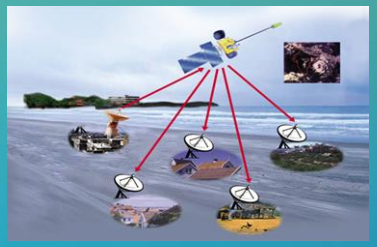




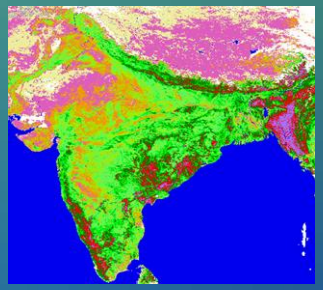
SPACE & DISASTER MANAGEMENT

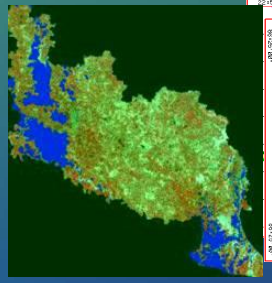


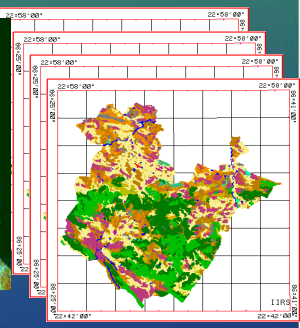
SPACE FOR CONNECTIVITY & OBSERVATION



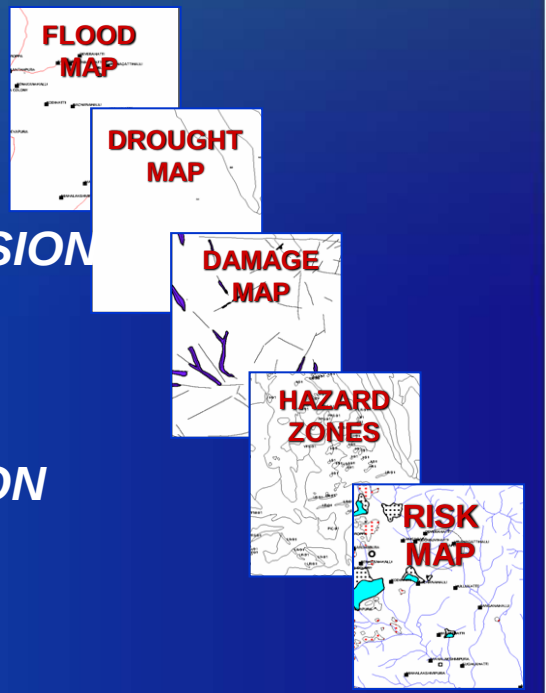
OBSERVATION FOR INFORMATION







INFORMATION FOR DECISION

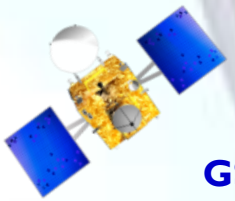


DECISION FOR ACTION

COMMUNICATION SATELLITE PROGRAMME

-Uniquely tailored to develop innovative grass root level applications

I-1K BUS



GSAT-12
15.07.11
12.Ext C

Kalpana-1
12.09.02
VHRR

I-2K BUS

GSAT-7
30-08-13

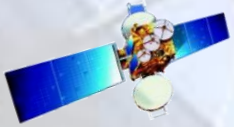
INSAT-3D
26-07-13

HYLAS
26.11.11

INSAT-4CR
02.09.07
12 Ku

INSAT-3E
28..9.03
24 Nor C, 12 Ext C

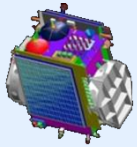
INSAT-3A
10.04.03
112 C, 6 Xc, 6 Ku,
VHRR, DRT, SAR



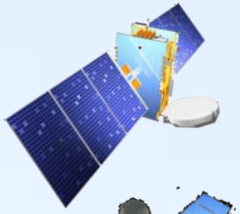
INSAT-3C
24.01.02
12 x C, 3 Ku, 1 MSS

INSAT-3B
22.03.00
12 x C, 3 Ku, 1 MSS

I-3K BUS



GSAT-10
29.09.12
12. Ku, 12 Nor-
C,6 Low-Ext C



GSAT-8
21.05.11
24 Ku

W2M
21.12.08
32 Ku

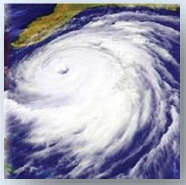
INSAT-4B
12.03.07
12 Ku, 12 C

INSAT-4A
22.12.05
12 Ku, 12 C

APPLICATIONS

Telecommunication

TV Broadcasting

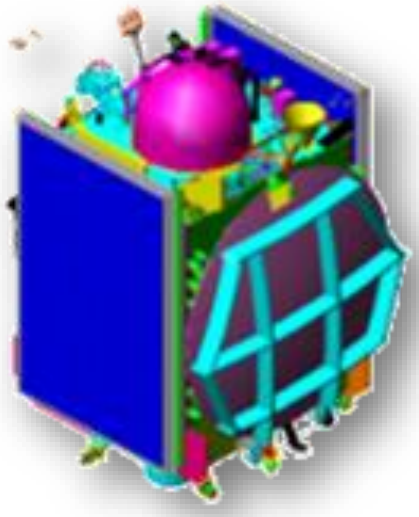


Meteorology

- **C-band Fixed Satellite Service ; Ku-band Fixed Satellite Services ; Broadcast Satellite Services ; and Mobile Satellite Services**
- **World's largest domestic satellite communication system (206 transponders & growing)**

GSAT-14

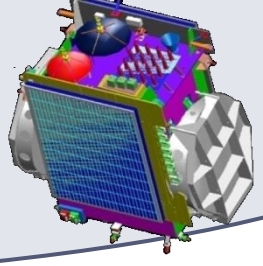
The spacecraft is envisaged to enhance communication transponder capacity of the INSAT system. It is built around ISRO's I-2K Bus carrying 6 Ext C band,6 Ku band transponders & 2 Ka Band Beacons. The spacecraft was successfully launched onboard GSLV-D5 with indigenous Cryogenic stage on 5th of January 2014.



SPACECRAFT SALIENT FEATURES

Orbital Location	:	74^0 E 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

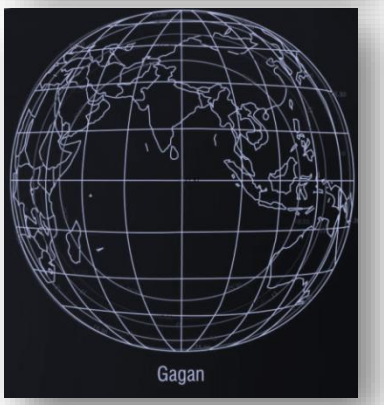
GSAT-10

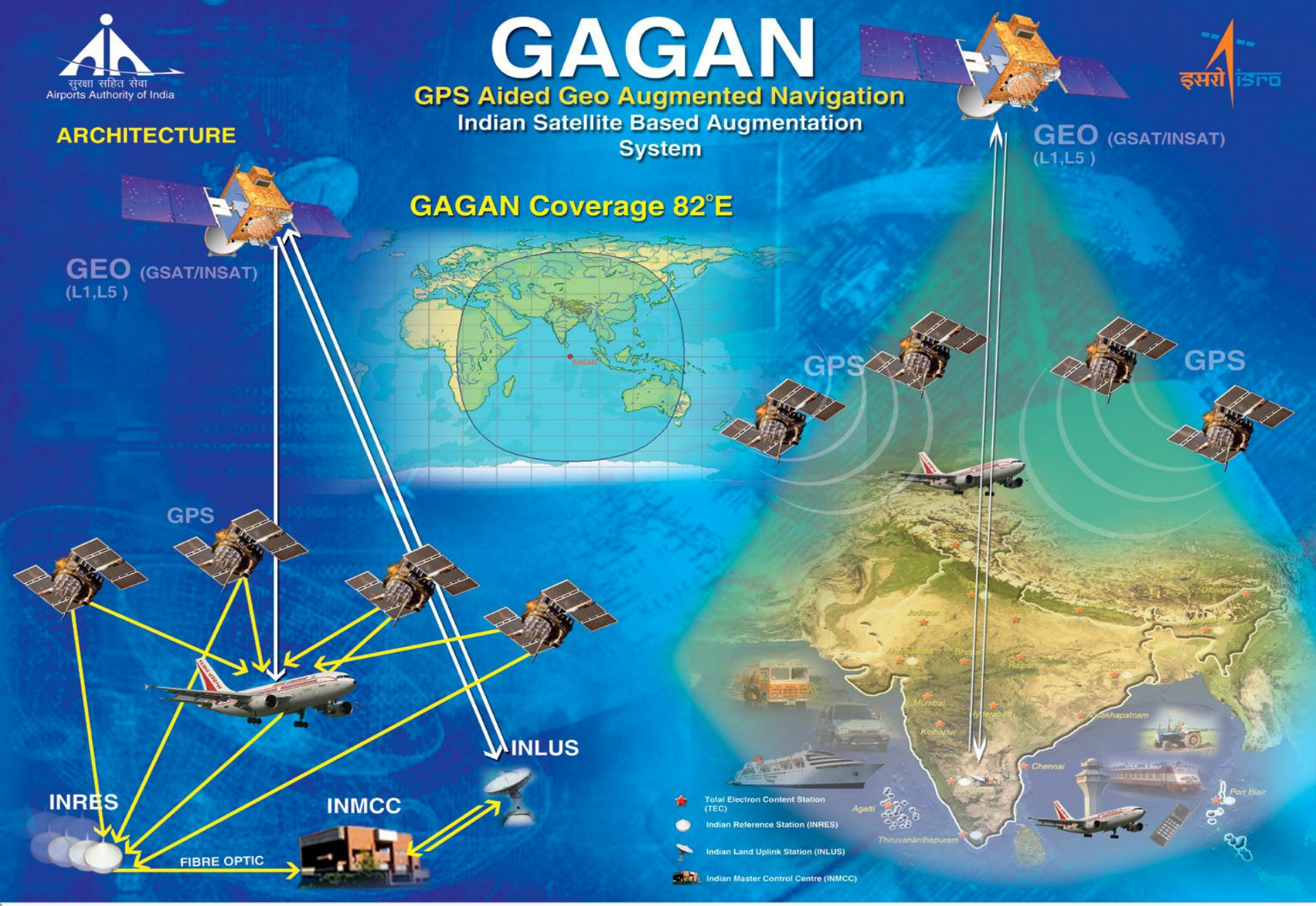


The spacecraft is built around ISRO's I-3K Bus carrying 12 Ku, 12 Nor C, 6 Lower Ext C transponders, GAGAN & Ku beacon. The spacecraft was launched by Ariane, Kourou

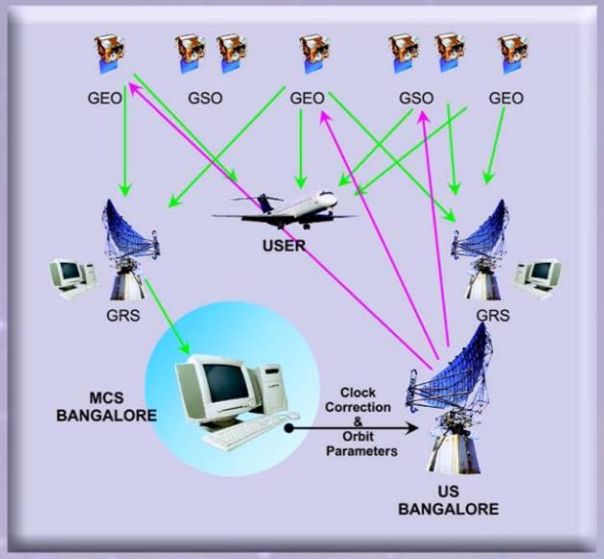
SPACECRAFT SALIENT FEATURES

Orbital Location	:	83 Degree E
Communication Payload	:	12 Ku, 12 Nor C, 6 Lower Ext C, GAGAN
Mass	:	3425 Kg
Power	:	6 KW
Mission Life	:	15 Years
Launcher	:	Ariane 5





GAGAN system is certified by DGCA (Director General of Civil Aviation) for en-route /non precision approach service operations over Indian region. GAGAN system is the fourth



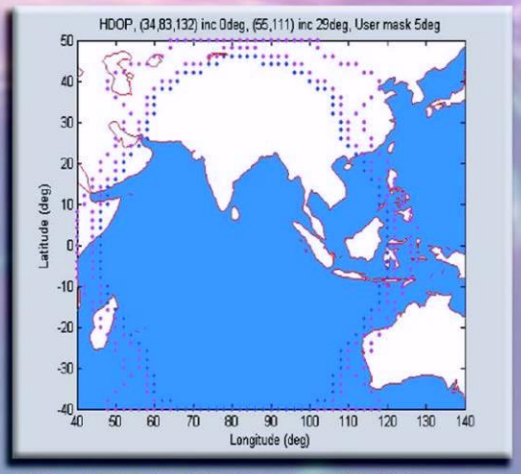
IRNSS SPACE SEGMENT

IRNSS

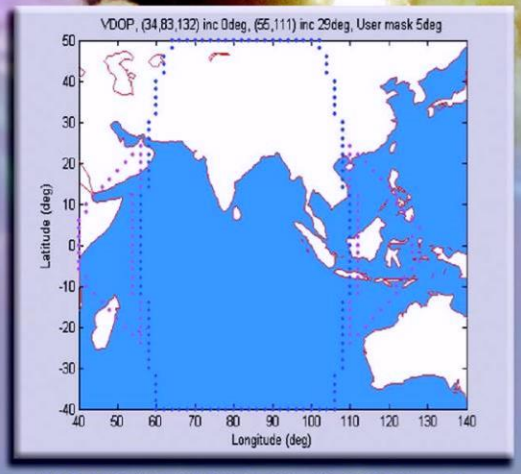
INDIAN REGIONAL NAVIGATION SATELLITE SYSTEM

IRNSS CHARACTERISTICS

- A Regional Navigation System for Indian Region
- An independent, self-reliant and civilian system
- 7 Spacecraft (3 GEO + 4 GSO) Constellation
- GSO Longitudes: E 55 deg and E111 deg
- GSO Inclination: 29 deg
- GEO Longitudes: E 34, E 83 and E 132 deg
- 7 Independent Launches of PSLV
- 1304 Kg Satellite Mass at Lift-off
- Dual Frequency downlinks for user
- Position Accuracy = 18.3 m (1-sigma)



PROJECTED ACCURACY – HORIZONTAL <20 m



PROJECTED ACCURACY – VERTICAL <20 m

IRNSS APPLICATIONS

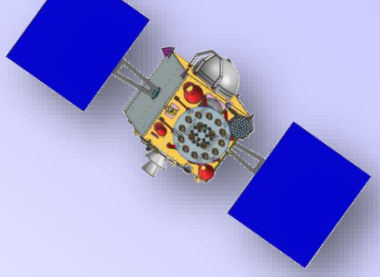
NAVIGATION

- Space Craft
- Aircraft
- Ship
- Vehicle
- Fleet Movement
- Routing/Alignment
- Timing

SCIENTIFIC RESEARCH

- Atmospheric Studies
- Ionospheric Scintilations

IRNSS-1A



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 seven spacecraft to be in place by 2015.

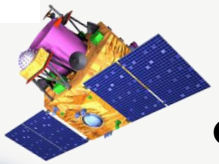
SPACECRAFT SALIENT FEATURES

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
Spacecraft Mass	:	1426.74 Kgs
Mission Life	:	10 Years
Application	:	Regional Navigation application
Launch Date	:	01st July 2013

EARTH OBSERVATION SYSTEMS

Cartography & large scale mapping application

RISAT-1
26.04.2012
SAR ANTENNA

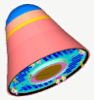


Cartosat-2B
12.07.2010
PAN CAMERA

Cartosat-2A
28.04.2008
PAN CAMERA

IMS-1
28.04.08

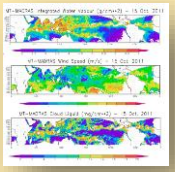
Cartosat-2
10.01.2007
PAN CAMERA



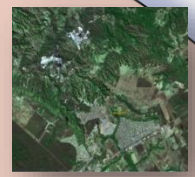
SRE-1
10.01.07

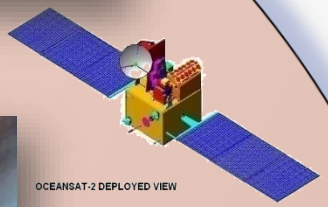
Environmental monitoring & Atmospheric research

Meghatropiques
12.10.2011
MADRAS, SAPHIR, SCARAB, ROSA



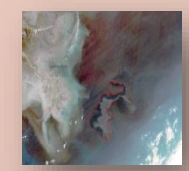
SARAL
25-02-13
ALTIKA, ARGOS, SCBT

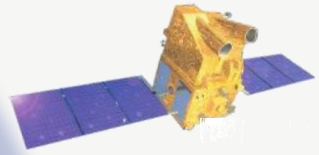




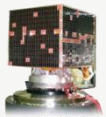
YOUTHSAT
20.04.11

Resourcesat-2
20.04.11
LISS-4, LISS-3, AWIFS





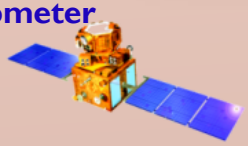
Cartosat-1
05.05.2005
PAN CAMERA



HAMSAT
05.05.05

PSLV

Oceansat-2
23.09.09
OCM, ROSA
Ku Band Scatterometer



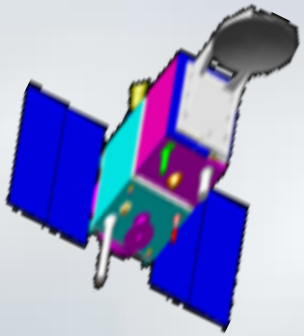
Resourcesat-1
17.10.03
LISS-4, LISS-3 & AWIFS

Technology Experiment satellite
22.10.01
PAN CAMERA

Land & Water Resources Management

INDIAN MINI SATELLITE - SARAL

Satellite for Argos and Altika (SARAL) is a joint ISRO-CNES Mission



PAYLOADS

ALTIKA: SCIENCE & APPLICATIONS

The aim of ALTIKA mission is to provide altimetric measurements designed to study ocean circulation and sea surface elevation. The applications include Marine meteorology and sea state forecasting, operational oceanography, seasonal forecasting ,climate monitoring and climate research.

ARGOS

Argos is a data collection platform to collect weather information from ocean buoys for ocean currents, fish migration, weather predictions.

Solid state C band Transponder (SCBT):

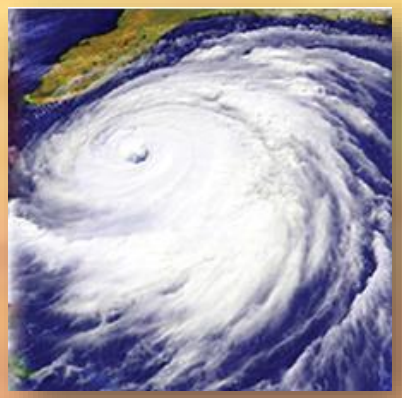
SCBT payload for SHAR Radar Calibration.It is envisaged to provide continual calibration support .

SPACECRAFT SPECIFICATIONS

BUS	:	Indian Mini Satellite (IMS)-2
POWER	:	720 Watts
PAYLOAD	:	Altika & Argos
INCLINATION	:	98.55 deg
ORBIT	:	800 Km, Sun Synchronous
MISSION LIFE	:	5 YEARS
LIFT OFF MASS	:	396 KG
LAUNCH VEHICLE	:	PSLV

INSAT-3D

INSAT-3D Spacecraft is a multipurpose spacecraft 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.



Weather Information

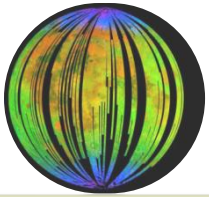
SPACECRAFT SALIENT FEATURES

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

SPACE SCIENCE & PLANETARY EXPLORATORY MISSIONS

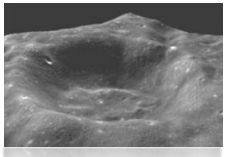
Chandrayaan-1

22.10.08



DISCOVERY OF WATER

TRI COLOUR ON MOON



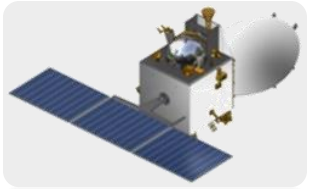
CRATERS ON MOON

FACILITIES ESTABLISHED

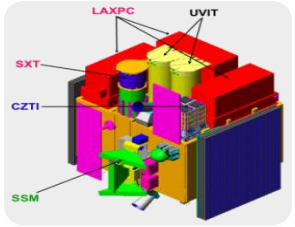
Indian Deep Space Network

18m Terminal

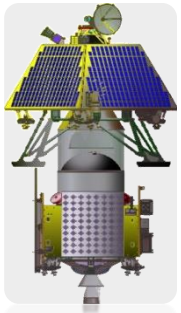
32m Terminal



MARS ORBITER MISSION
Study of Martian surface, Martian Atmosphere and Ionosphere



ASTROSAT
Multi-wavelength Astronomy Satellite for observation of galactic objects



CHANDRAYAAN-2
Landing in a high latitude region
First Rover-based in-situ studies of lunar chemistry & volatiles

ADITYA-1
A Space based Advanced Solar Coronagraph to study solar Corona

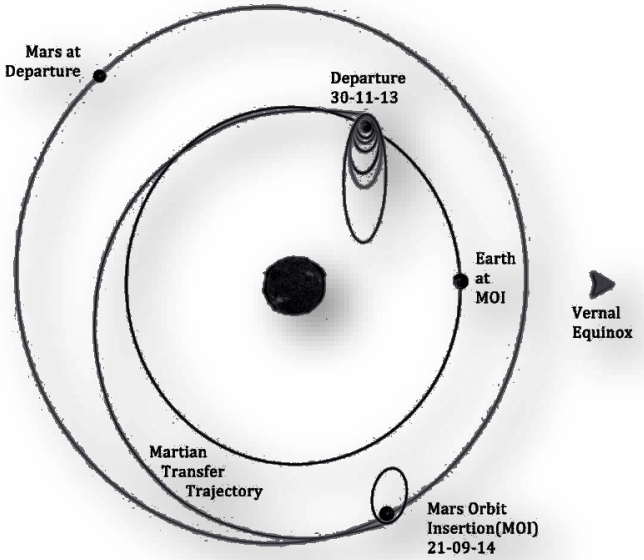
MARS ORBITER MISSION

India's first interplanetary mission to Mars to study surface features, morphology, topology and mineralogy of Mars and constituents of Martian atmosphere.

SALIENT FEATURES

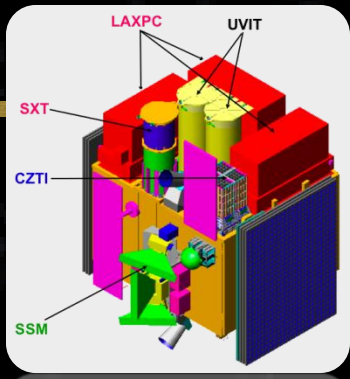
Orbital Location	:	370 X 80,000 Km elliptical orbit
Voyage from Earth's orbit	:	300 Days
Mass	:	1350 Kg
Power	:	750 W
Mission Life	:	~ 6 Months
Launcher	:	PSLV-XL
Launch	:	5th November 2013

High Gain Antenna Deployment



Payloads:
Lyman Alpha Photometer, Methane Sensor for MARS,
Martian Exospheric Composition Explorer,
MARS Color Camera and TIR Imaging Spectrometer

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

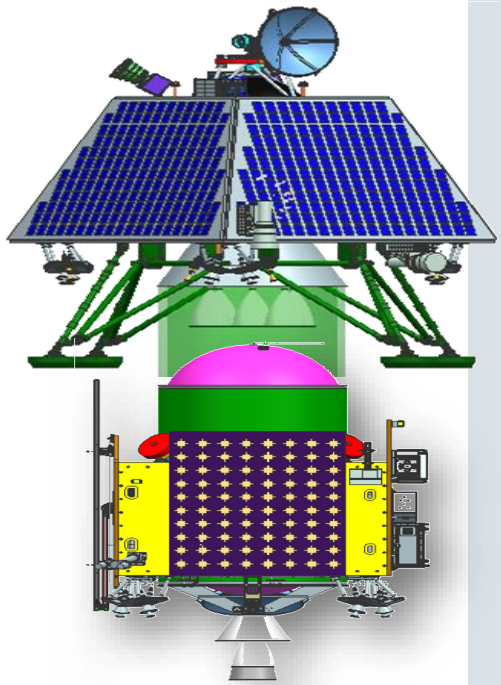
PAYLOADS	
UVIT	ULTRA VIOLET IMAGING TELESCOPE (IIA/IUCAA)
LAXPC	LARGE AREA XENON PROPORTIONAL COUNTER (TIFR)
SXT	SOFT X-RAY TELESCOPE (TIFR)
CZT	CADMIUM ZINC TELLURIDE DETECTOR (TIFR)
SSM	SKY SCANNING MONITOR (ISAC-ISRO)

SCIENCE OBJECTIVES

- *Determination of black hole masses*
- *Details on nature of transient behaviour, QPO and its evolution, period evolution*
- *Improved UV morpohology, 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.



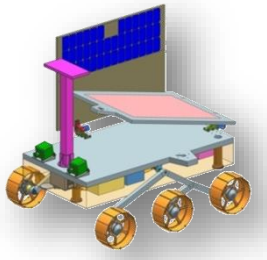
Orbit : 170 x 17000km
Lift off mass : 3200 Kg
Orbiter : 2260 Kg
Lander : 940 Kg

Lander payloads - 35 kg :

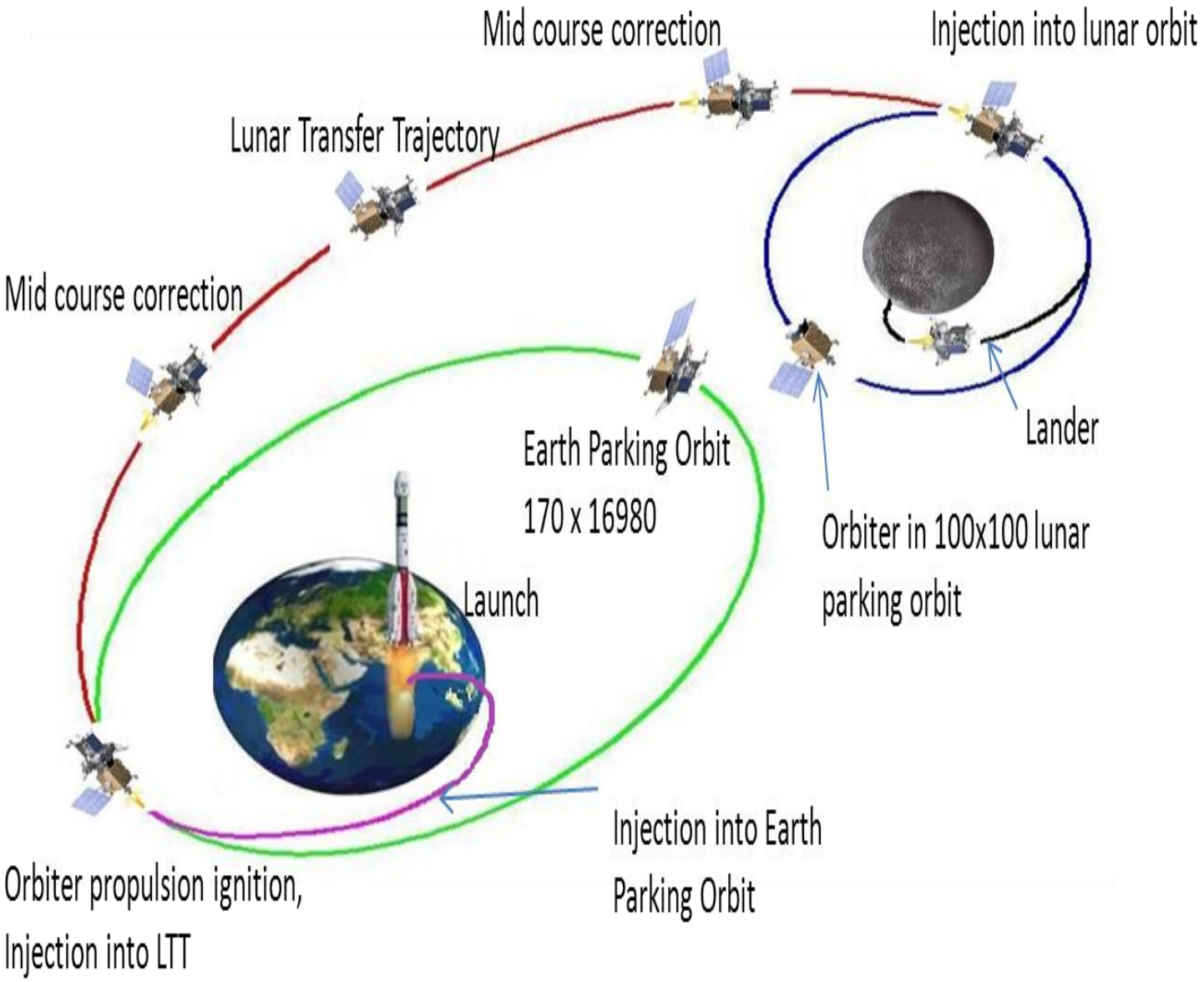
1. Rover – 25 kg (With LIBS and APIXS)
2. RAMBHA
3. Dust Levitation Experiment
4. Temp and Thermal property
5. Seismometer

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

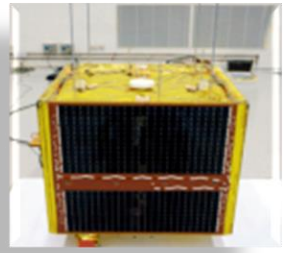


CHANDRAYAAN-2 MISSION PROFILE

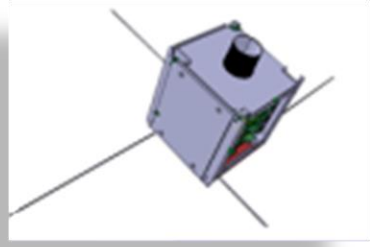


SMALL SATELLITES

Satellite	University	Payload	Lift of Mass	Spacecraft Power	Launch Vehicle	Launch Date
ANUSAT	Anna University, Chennai	store and forward payload, MEMS Gyro, MEMS Magnetometer and Satellite Positioning System	40 Kg	40 W	PSLV-C12	20.04.2009
STUDSAT	NITTE Meenakshi Institute of Technology, Bangalore	Imaging (Near IR) camera of resolution 90 m	< 1 kg	4 W	PSLV-C15	12.07.2010
SRMSAT	SRM University, Chennai	grating spectrometer to monitor green house gases in Near Infra-red region 900nm - 1700nm	8.5 Kg	~10 W	PSLV-C18	12.10.2011
JUGNU	Indian Institute of Technology, Kanpur	Near IR camera to capture near IR images of earth' surface	4 kg	5 W	PSLV-C18	12.10.2011



ANUSAT
2009

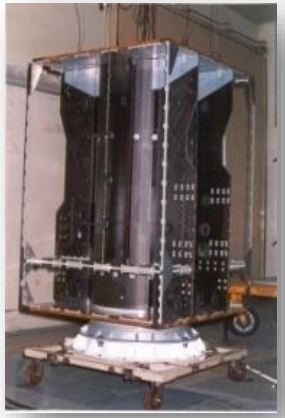


STUDSAT
2010

SRMSAT
2011

JUGNU
2011

Systems/Elements of a Spacecraft

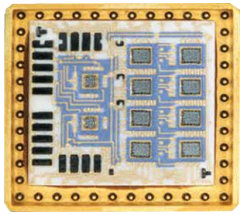


Structure

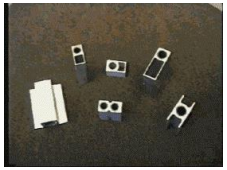
Propulsion tanks

Solar panel

Check out systems



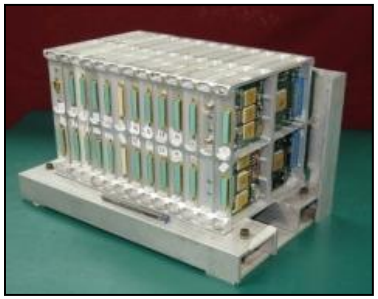
Hybrid Micro circuits



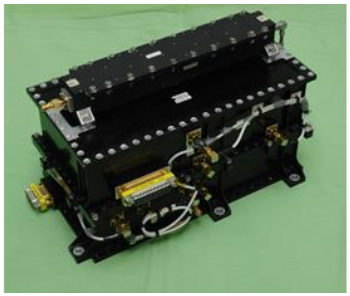
Heat Pipes

Multi Layer insulation

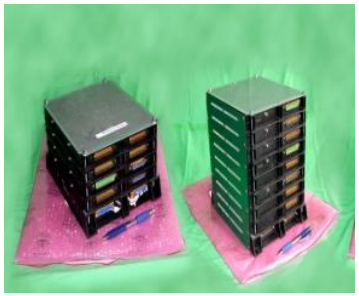
Crystal Oscillator



Attitude & Orbit Control Electronics

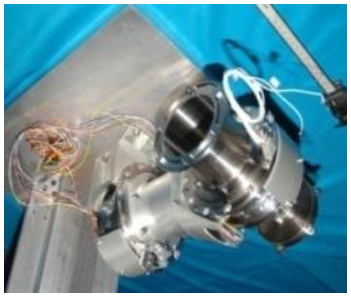


RF Transmitter

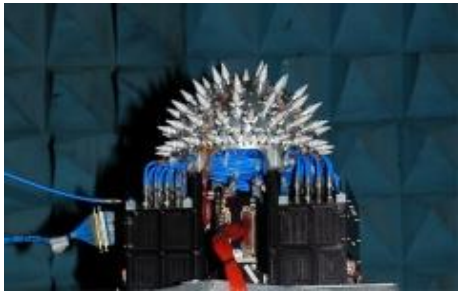


Telemetry Telecommand

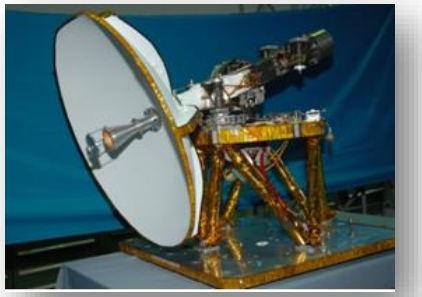
Battery



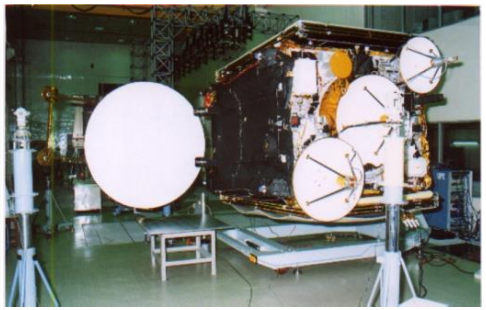
Mechanisms



Phased array antenna



Dual Gimbal Antenna



Reflector Antenna

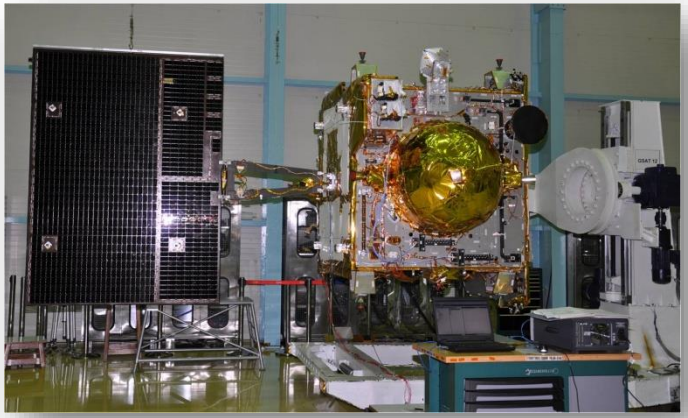
Sensors

Spacecraft Assembly & Integration

Structure Assembly at Clean Room

Panel Closure Activities in Clean Room

Loading to Thermovac Chamber



Solar Panel Deployment Test

Vibration Test

Acoustic Test

CATF Test

SPACECRAFT PROGRAMME PROFILE 2014-2016

	2014												2015												2016											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
GEOSAT PROJECTS	GSAT-6 *GSLV*						GSAT-16 *PROCURED*					GSAT-11 *PROCURED*	GSAT-7A GSLV						GSAT-9 *GSLV*						INSAT-3DR GSLV						GISAT GSLV						GSAT-18 *PROCURED*						GSAT-6A *GSLV*					
																			GSAT-15 *PROCURED*											GSAT-17 *PROCURED*											GSAT-19 *GSLV MK-III D1*					
IRS & SS PROJECTS								ASTROSAT PSLV											CARTO-2C PSLV											RES-2A PSLV						CARTO-2D PSLV			EMISAT + DOCKING PSLV			OCEAN-3 PSLV			CARTO-3A PSLV		
																			SRE-2 PSLV																	MICROSAT PSLV						ADITYA-L1 PSLV			CHAND-2 GSLV		
NAVIGATION PROJECTS	IRNSS-1B *PSLV*						IRNSS-1C *PSLV*			IRNSS-1D *PSLV*			IRNSS-1E *PSLV*			IRNSS-1F *PSLV*				IRNSS-1G *PSLV*																												

** All dates indicated above are spacecraft readiness schedules (Calendar Year)*

January 2014

Thank You