अन्तरिक्ष भारत

SPACE INDIA

भारतीय अन्तरिक्ष अनुसंधान संगठन

Indian Space Research Organisation

जनवरी – जून 2012 January – June 2012

The Indian Space Programme

Space activities in the country were initiated with the setting up of Indian National Committee for Space Research (INCOSPAR) in 1962. In the same year, work on Thumba Equatorial Rocket Launching Station (TERLS), near Thiruvananthapuram, was also started. The Indian space programme was institutionalised in November 1969 with the formation of Indian Space Research Organisation (ISRO). Government of India constituted the Space Commission and established the Department of Space (DOS) in June 1972 and brought ISRO under DOS in September 1972.

Department of Space (DOS) has the primary responsibility of promoting development of space science, technology and applications towards achieving self reliance and assisting in all round development of the nation. Towards this, DOS has evolved the following programmes:

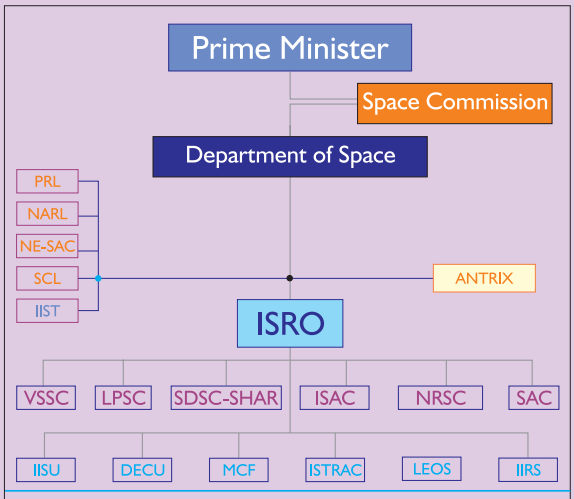
- Indian National Satellite (INSAT) programme for telecommunications, TV broadcasting, meteorology, developmental education, etc.
- Remote Sensing programme for the application of satellite imagery for various developmental purposes
- Indigenous capability for design and development of spacecraft and associated technologies for communications, resources survey and space sciences
- Design and development of launch vehicles with indigenous technology for access to space and orbiting INSAT, IRS spacecraft and space science missions
- Research and development in space sciences and technologies as well as application programme for national development

The Space Commission formulates the policies and oversees the implementation of the Indian space programme to promote the development and application of space science and technology for the socio-economic benefit of the country. DOS implements these programmes through, mainly, Indian Space Research Organisation (ISRO), Physical Research Laboratory (PRL), National Atmospheric Research Laboratory (NARL), North Eastern-Space Applications Centre (NE-SAC) and Semi-Conductor Laboratory (SCL).

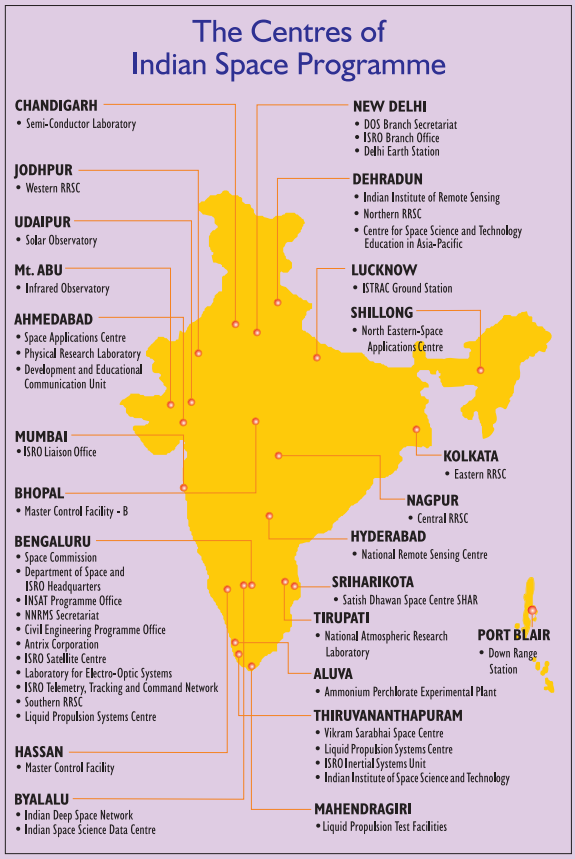
Antrix Corporation, established in 1992 as a government owned company, markets space products and services.

Both the DOS and ISRO Headquarters are located at Bengaluru. The developmental activities are carried out at the Centres and Units spread over the country.

So far, 66 Indian Satellite Missions and 36 Launches from Sriharikota have been conducted.



NRSC: National Remote Sensing Centre **PRL:** Physical Research Laboratory **NARL:** National Atmospheric Research Laboratory **NE-SAC:** North Eastern Space Applications Centre **SCL:** Semi-Conductor Laboratory **ISRO:** Indian Space Research Organisation **Antrix:** Antrix Corporation Limited **VSSC:** Vikram Sarabhai Space Centre **LPSC:** Liquid Propulsion Systems Centre **SDSC:** Satish Dhawan Space Centre **ISAC:** ISRO Satellite Centre **SAC:** Space Applications Centre **IISU:** ISRO Inertial Systems Unit **DECU:** Development and Educational Communication Unit **MCF:** Master Control Facility **ISTRAC:** ISRO Telemetry, Tracking and Command Network **LEOS:** Laboratory for Electro-optic Systems **IIST:** Indian Institute of Space Science and Technology **IIRS:** Indian Institute of Remote Sensing



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Cover Page: Majestic pre dawn *lift-off of PSLV-C19 carrying RISAT-1*

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Editorial / Circulation Office
Publications & Public Relations Unit, ISRO Headquarters, Antariksh Bhavan, New BEL Road, Bengaluru - 560 231, India.
www.isro.gov.in Designed by Imagic Creatives and Printed at Sharadh Enterprises, Bengaluru.

President of India Dedicates New Mission Control Centre and Launch Control Centre at Sriharikota to the Nation

Mrs Pratibha Devisingh Patil, President of India, visited Satish Dhawan Space Centre SHAR at Sriharikota on January 2, 2012 and inaugurated the new Mission Control Centre and Launch Control Centre. She dedicated the new control centre to the nation. Dr K Radhakrishnan, Chairman, ISRO received the dignitary at the helipad along with Director, SDSC SHAR. Later, Chairman, ISRO made a brief presentation on the Indian space programme to the visiting dignitary and explained the exhibits displayed at the control centre. The President witnessed various exhibits at MCC, which portrayed the advances made by the country in the area of Space Science and Technology.

A simulation of PSLV Launch was shown to the visiting dignitary at MCC. The President later visited the First Launch Pad (FLP) where integration of PSLV-C19/RISAT-1 Mission was in progress and evinced keen interest in the operations at the FLP.

The President keenly observes a launch vehicle model as Chairman, ISRO looks on

Chairman, ISRO explains satellite launch procedures to the attentive President

The President presented ISRO awards for the year 2008 and 2009. Life Time Achievement Award for significant contribution to Indian Space Programme was conferred on Dr K Kasturirangan, Former Chairman of ISRO and currently Member (Science) Planning Commission. Other Senior Scientists and Engineers of ISRO were conferred with Outstanding Achievement Award, Performance Excellence Award, Merit Award, Group Achievement Award, Team Award and Young Scientist Award.

President of India, in her address to ISRO community, which was telecast live to ISRO centres and units across the country, paid rich compliments to ISRO on the successful missions accomplished. She felt that utilising the applications of research and working for the benefit of the society should be one of the overriding objectives of any discipline of science and technology. She expressed satisfaction that the Indian space programme had always been distinguished for being application oriented. The President also congratulated the award winners for their significant contribution to Indian Space Programme.

The Governor of Andhra Pradesh, Shri E S L Narasimhan; Minister of State (PMO), Shri V Narayanasamy; Minister in waiting, Mrs Sunitha Lakshma Reddy; Members of Parliament and a Member of the Legislative Assembly accompanied the President from Andhra Pradesh.

Address by Mrs Pratibha Patil, President of India at Satish Dhawan Space Centre SHAR, Sriharikota

Ladies and Gentlemen,

I am delighted to be at the Satish Dhawan Space Centre, the spaceport of India. This gives me an opportunity, which I have been looking forward to, to interact with the Indian Space Research Organisation family present here, and with those at other ISRO centres, through video conferencing. It is, indeed, a wonderful way to begin the New Year. I extend my warmest greetings to all the members of the ISRO family, and wish you all a very successful and happy 2012.

The vision of the founding father of the Indian space programme, Dr Vikram Sarabhai, conceived about half a century ago, has manifested into the reality which we can see, feel and experience around us today. He had envisioned a meaningful role for space science and technology in finding solutions to the problems of the people in the country, and society as a whole. Dr Sarabhai's vision was aptly executed by his illustrious successor Prof Satish Dhawan. Of course, this was accomplished with a group of brilliant

The President formally dedicates the control Centre to the nation

scientists and engineers working with Prof Dhawan and his successors, who shaped ISRO from its early days to its current state of glory. I congratulate the entire lineage of the founding architects of ISRO, an organisation which has brought pride and a sense of accomplishment to the nation. As I speak at this auditorium, I would like to specifically mention Mr M R Kurup, the former Director of this Centre, and the man behind India's strength in solid propulsion and rocketry, after whom this auditorium is also named.

Utilising the application of its research and work for the benefit of society, should be one of the overriding objectives of any discipline of science and technology. The Indian space programme has always been distinguished for being application oriented. Today, space based applications have revolutionised the way Government machinery reaches out to its citizens, even in the far flung remote areas of the country. Tele-education and telemedicine are among the readily identifiable areas. Along with these, we should develop tele-agriculture that educates farmers about rain-fed and dryland farming, so that it helps them in better farming, higher agriculture productivity and increased incomes. Satellite platforms will greatly help our economic growth. Remote sensing applications are needed for better management of our resources, whether these are land, forests, water or minerals. The role of observation systems in space and development of latest technology, as well as weather prediction systems, will become of even greater importance in the years ahead, for our food, water and energy security. The impact of climate change and the occurrence of disasters require enhancing our early warning systems and response capabilities. This will have a direct impact on the people and their ability to maintain their livelihood. In all these, the contribution of space technology is crucial.

It was the foresight in the early years of our independence that led us to focus on developing a scientific temper in the country. The excellent calibre and the willing commitment of our scientific community to national advancement made this possible. It is heartening that the Indian space programme was entirely indigenous, and has made much progress and achieved much since its inception. It has demonstrated the scientific capabilities and the technological prowess of the country, thereby, earning international approbation. Space cooperation is an important aspect of India's engagement with other countries, just to recall one instance. During my last visit overseas, in Austria, I was pleased to learn that two mini-satellites, built by researchers from the technical universities of Vienna and Graz are being launched by ISRO. There are many other instances of ISRO launching satellites of other countries. India does enjoy a niche amongst the space fairing nations of the world. I congratulate you for this.

A couple of hours ago, I experienced a fascinating simulation of the launch of a Polar Satellite Launch Vehicle from our new 'Mission Control Centre'. I am delighted to have declared open this new 'Mission Control Centre', along with the new 'Launch Control Centre', and to have dedicated the complex to the nation. I also saw the integration of the soon to be launched

PSLV - C19 being assembled in full swing at the launch pad. Every launch brings its share of excitement and anxious moments to mission controllers and to every Indian and this new complex will be a witness to all these emotions in the future too.

There are other important "work missions" of ISRO. The entire country is looking forward to the successful flight testing by ISRO, of the indigenous cryogenic stage on-board the Geosynchronous Satellite Launch Vehicle or GSLV. I understand that our next generation heavy-lift launch vehicle, the GSLV Mark III, is also in an advanced stage of development. The country felt a sense of joy and pride following the success of the Chandrayaan -1 mission, and the remarkable discovery of the water molecule on the lunar surface. I am sure the country will rejoice and once again be proud, when the Chandrayaan-2 mission places the lander and rover modules on the lunar terrain.

Satellite navigation is also coming up as a whole new vista in the Indian space programme. I am delighted to note that a constellation of seven navigation satellites would provide navigational services for civilian and strategic applications in the coming days.

There is a lot that has been achieved and there is a lot more to be achieved in the coming days. ISRO has a rich past and a very promising future. The entire country looks up to this team as a model of unflinching commitment, untiring energy, and professional excellence. I am pleased to be honouring the achievers, and the ISRO awards will, I am sure, go a long way in further encouraging the motivated and competent workforce which this organisation represents. I am also pleased, that on this occasion, ISRO has given recognition to the efforts of young achievers and seasoned veterans. I congratulate each one of the awardees and their family members.

Today, at the dawn of 2012, we are at the threshold of advancements in our ambitious space programmes. There is hope and promise; optimism and potential; there are avenues that reckon us to celebrate mankind's victory over gravitation; to reach the unreached; to do the undone, and to excel in understanding the mysteries of our limitless Universe.

I wish you the very best. Once again, I convey my greetings to all for the New Year.

Thank you.

Jai Hind!

New Mission Control Centre at SDSC SHAR

For meeting the GSLV-Mk III launch requirements and future missions of ISRO, a new Mission Control Centre (MCC) with state-of-the-art facilities, has been realised at SatishDhawan Space Centre (SDSC) SHAR. The MCC, situated about 6 Km away from the launch complex, monitors and conducts the launch operations during the pre-countdown and countdown phases until the injection of the satellite into orbit. It is linked to all the ground stations through communication links for voice, video and data transmission. The launch preparations on the vehicle are monitored from MCC, using a multi channel Closed Circuit Television System (CCTV). The important facilities at MCC include Mission Control Hall, Launch Control Centre, Real time Network, VIP Gallery, Video Conference, Mission Executives rooms, Commentator rooms, etc.

Outside view of the new Control Centre

Major functions carried out at MCC include

- Co-ordination of different operations during final vehicle servicing and checkout operations
- Conducting simulation exercise prior to pre-countdown and actual launch countdown
- Scheduling and regulating mission activities during countdown phase
- Monitoring the progress of launch operations during final countdown phase and taking decisions at appropriate time
- To have a hold on countdown in the event of any deviations from launch operation procedure or hazardous situations
- Monitoring the status of launch vehicle systems, spacecraft and other ground support systems, during countdown
- Authorising launch after ensuring that all the systems are functioning satisfactorily
- Monitoring and displaying the performance of vehicle, spacecraft and ground systems after lift-off

- Displaying all important mission performance details up to injection of satellite(s) into orbit(s)

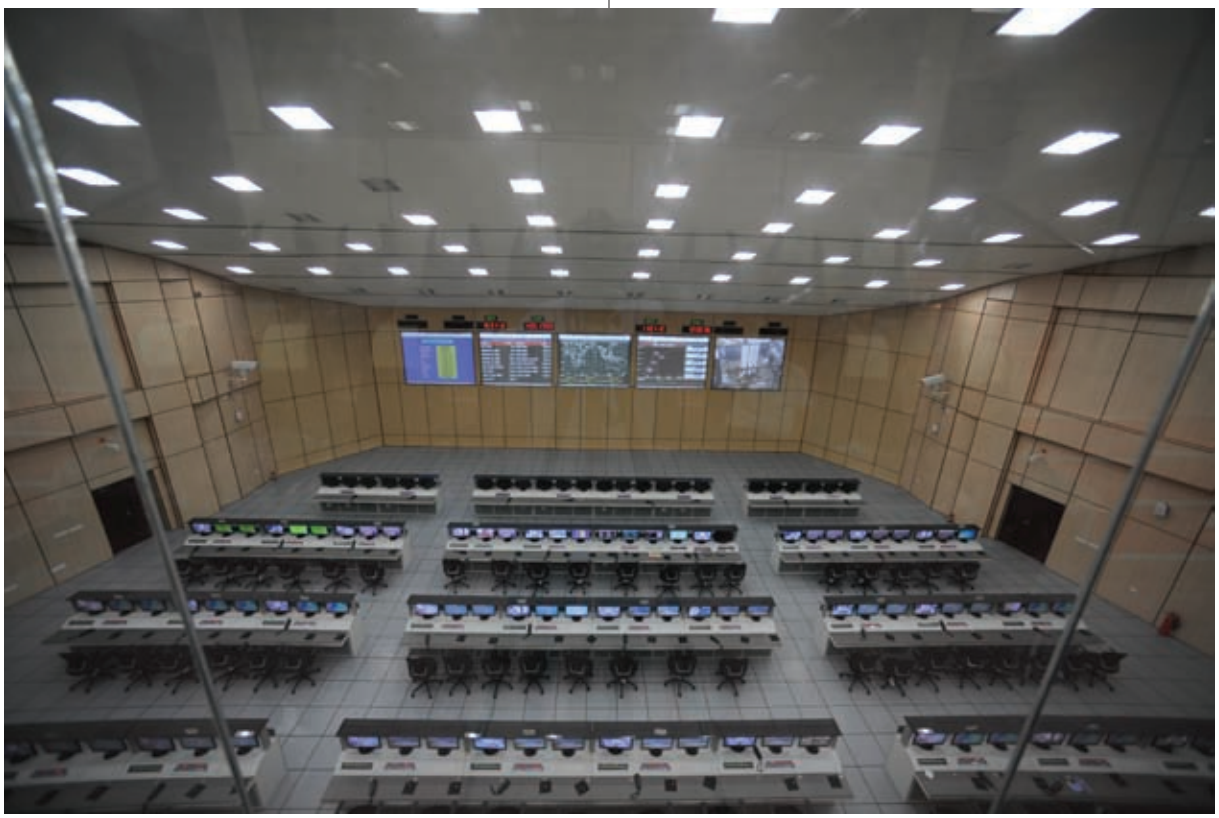
The major subsystems of the new MCC are:

- Data Processing Systems to acquire the status data of all the ground stations participating in the mission as well as the checkout data from Vehicle and Satellite systems. This data is processed and the processed data is transmitted to MCC displays. The data is also logged for post flight analysis. The Data Processing System also processes the Countdown Hold/Release and readiness status from each Mission Executive console in MCC and generates synthesised information.
- Real Time Network: All data sources and sinks are geographically distributed all over the Range and in various parts of the Globe. A real time network with the state-of-the-art technology is deployed with complete redundancy to meet the mission requirements.
- Wide Screen Display Systems, which are common for mission executives, VIPs and VVIPs provide video and trajectory related information in video, text and graphic formats
- Consoles with data displays and audio / video facilities: Mission executives and all other important personnel involved in decision making sit at respective consoles during countdown phase, till lift-off
- Electronic Interfacing Systems (Timing, Communications, CCTV and Data Links)

Consoles

Altogether, there are 38 consoles, arranged in 4 rows. Each console is of 3-bay open type and has the following hardware systems installed in it:

- Two PCs and one TV monitor with video selection keyboard
- UT / CDT Time Displays
- 16 channel intercom units



A bird's eye view of the Control Centre Layout

- Count down Hold / Release switches at designated consoles
- Telephones

Wide Screen displays

- Five 150 inches screens with rear projection system
- Five Single chip DLP projectors with wide angle lenses with 100% hot standby
- Information displayed in the large screen displays:
  - Close up and overall view of propellant filling operations
  - Ignition sequence and launch vehicle lift-off views
  - Initial trajectory of vehicle as tracked by video cameras
  - Ground stations status
  - Flight parameters display
  - Automatic Launch Sequence (ALS)
  - Graphical display of flight trajectory
  - Alphanumeric / Animation display of flight events

Features of real time network

- Totally isolated two chains of network (Main and redundant)
- Giga Ethernet (1 Gbps) back bone network
- One IP Subnet each for input network and output network, in each chain
- Time synchronisation of switches and computer systems with GPS based time server
- Three pairs of servers, one is redundant to the other
- Embedded system based network time server in each chain
- Range stations network is through single mode fiber, and external stations network is extended through leased lines and sky link

Other Facilities at Mission Control Centre

- VIP gallery to accommodate 200 persons with attaching launch viewing lounge
- Separate VVIP gallery to accommodate 60 persons with attached launch viewing lounge
- One Discussion room
- Three Commentator rooms
- Office rooms for Mission Executives

Launch Control Centre

A Launch Control Centre (LCC) is realised in the ground floor to take care of Vehicle Checkout operations. LCC is configured as two control halls, namely, LCC1 and LCC2, to take care of parallel operations from both the launch pads. Sixteen consoles are provided in each entity to carry out the vehicle checkout operations. Specialists' display consoles have also been set up here to offer vehicle data to experts and specialists from centres related to launch vehicle development.

Features of LCC

- LCC 1 & LCC 2 are identical in hardware configuration and are easily configurable for PSLV, GSLV/GSLV-Mk III launches from any of the two launch pads
- Network Interface
- Data Analysis PC of each console is connected to an independent data network
- Hard-line multiplexing system for reducing hardline requirements between LCC & remote systems
- Display nodes for data presentation to system experts
- All Hardware interfaces are provided with dual redundancy
- System Time of all consoles synchronised

Global Navigation Satellite System(GNSS) User Meet held at Bangalore

A Global Navigation Satellite System (GNSS) User Meet was organised jointly by ISRO and Airports Authority of India at ISRO Satellite Centre, Bangalore on February 23, 2012. Dr T K Alex, Member, Space Commission and Director, ISRO Satellite Centre (ISAC) inaugurated the meet. Mr E K Bharat Bhushan, Director General, DGCA was also present.

Two technical sessions and a panel discussion were held during the meet. An overview of GAGAN and IRNSS navigation projects was presented by Mr A S Ganeshan, Project Director, Navigation systems. During the technical sessions, eminent experts in satellite based navigation presented their experiences and expertise on utilising the navigation signals for precise positioning and civil aviation and several other services. Various leading Indian industries showcased their products in an impressive exhibition organised as a part of the meet.

A panel discussion with the theme "Opportunities and Challenges in utilising navigation signals over Indian region" was chaired Mr S K Shiva Kumar, Associate Director, ISAC with members from academia, industry and ISRO.

Navigation has become an integral part of human activity. The space based navigation system has emerged as a forerunner in providing the position, velocity and timing services. ISRO has identified Satellite Navigation as an important thrust area by planning GAGAN (GPS Aided GEO Augmented Navigation) and upcoming IRNSS (Indian Regional Navigation Satellite System).

ISRO and the Airports Authority of India (AAI) are implementing the GAGAN project as Satellite Based Augmentation System (SBAS) for the Indian Airspace and Safety of Life applications. The GAGAN Signal-In-Space is now available for civilian users since December 15, 2011.

Indian Regional Navigational Satellite System (IRNSS) system being developed by ISRO is a regional navigation satellite system providing navigation services over the Indian region that will provide the user a position accuracy that is better than 10 meters on a 24/7 all-weather basis.

Over 250 delegates from government, industry and academia participated in the meet. The objective of this user meet is to provide a thrust in the development of GNSS based applications and user receivers utilising GAGAN and IRNSS navigation signals in India. The user meet aimed to link industry, users and service providers enabling them to share information to promote navigation and positioning satellite systems for transportation, disaster management, environment and agriculture. The meet provided an opportunity to the industry on the infinite possibilities of using navigation signals and its spin-offs.

Mr A S Ganeshan delivering the welcome address during the inauguration

Indian Regional Navigation Satellite System (IRNSS)

Indian Regional Navigation Satellite System (IRNSS) is an independent regional navigation satellite system. It is designed to provide position accuracy better than 10m over India and the region extending about 1500 kms around India. It will provide an accurate real time Position, Navigation and Time (PNT) services to users on a variety of platforms with 24x7 service availability under all weather conditions.

The IRNSS system mainly consists of three components, namely, Space Segment (Constellation of Satellites & Signal–In–Space), Ground Segment and User Segment. IRNSS constellation consists of seven satellites. Three Satellites will be placed in the Geostationary Equatorial orbit (GEO at 34 deg East, 83 deg East & 131.5 deg East) and two satellites each will be placed in the Geosynchronous orbit (GSO) with equator crossing at 55 deg East and 111.5 deg East and an inclination of 29 deg. Two spare satellites are also planned to be realised. IRNSS will have two types of signals in L5 and S-band centre frequency, with the L band centre frequency being 1176.45 MHz and S-band centre frequency being 2492.028 MHz. Both L5 and S-band consist of two downlinks. IRNSS provides two basic services such as Standard Positioning Service (SPS) for common civilian users and Restricted Service (RS) for special authorised users.

An artist's view of IRNSS constellation

The spacecraft configuration has been finalised and the satellites of the constellation are being configured identically with each spacecraft weighing 1425 kg. Efforts are on to productionise the standard subsystems. First flight model structure has been ready for assembly and integration. Clearance has been given for the fabrication of two more structures. Design reviews of major subsystems of IRNSS satellites like Spacecraft structure, Thermal control system, Propulsion system, Power System, Telemetry, Tracking and Command, Deployment mechanisms, Pyrotechnic devices, Composite elements, Check out and Integration, etc., have been completed. The spacecraft is basically configured with I-1K Bus to be compatible for launch onboard PSLV.

The navigation software for IRNSS is being indigenously developed at ISRO Satellite Centre. In house development of single channel SPS and RS dual frequency receiver to facilitate the testing of Navigation payload is under progress. Efforts are on to realise the IRNSS Signal Simulator. ISRO is collaborating with NPL to realise a space qualified Rubidium Atomic Frequency Standard.

A S Kiran Kumar takes over as Director of Space Applications Centre, Ahmedabad

Mr A S Kiran Kumar, Distinguished Scientist and Associate Director, Space Applications Centre (SAC), Ahmedabad, has assumed the office of Director, SAC on March 31, 2012. He took over the charge from Dr R R Navalgund, the outgoing Director.

Mr Kiran Kumar joined SAC/ISRO in 1975. He has made immense contribution to the design and development of Electro-Optical Imaging Sensors for Airborne, Low Earth Orbit and Geostationary orbit satellites starting from Bhaskara TV payload to the latest Terrain Mapping Camera and Hyperspectral Imager payloads for Chandrayaan-1 mission. He has made very significant contributions to the task of evolving the observation strategy encompassing land, ocean, atmospheric and planetary studies.

As Associate Director of Space Applications Centre, Mr Kiran Kumar has steered the design and realisation of communication, navigation, microwave and remote sensing payloads.

Mr Kiran Kumar obtained B.Sc (Honours) degree in Physics and M.Sc degree in Electronics from Bangalore University as well as M.Tech degree in Physical Engineering from the Indian Institute of Science, Bangalore.

Mr Kiran Kumar is the recipient of many laurels and awards like Indian Society of Remote Sensing Award for the year 1994, VASVIK award (Electronic Sciences and Technology) for the year 1998, Astronautical Society of India Award (Space Sciences and Applications) for the year 2001, ISRO Individual Service Award 2006, Bhaskara Award conferred by the Indian Society of Remote Sensing for the year 2007, Laurels for Team Achievement Award 2008 of the International Academy of Astronautics and ISRO Performance excellence Award 2008.

He is a fellow of the National Academy of Engineers and Corresponding Member of the International Academy of Astronautics. Mr Kiran Kumar has represented ISRO in international forums like World Meteorological Organisation (WMO) and Committee on Earth Observation Satellites (CEOS) and is currently the Chairman of CEOS.

India-ASEAN Heads of Space Agencies Meeting

A meeting of India-Association of South East Asian Nations (ASEAN) Heads of Space Agencies was organised at Indian Space Research Organisation (ISRO) Headquarters, Bangalore during June 19-20, 2012 with the participation of delegates from all the ten member countries of ASEAN (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam). Senior officials from Department of Space and Ministry of External Affairs, Government of India as well as from ASEAN secretariat also participated in the deliberations.

This meeting was organised as a follow-up to the announcement made by the Prime Minister of India during the ninth India-ASEAN Summit held in Bali, Indonesia in November 2011. The objective of this meeting was to further strengthen the existing cooperation and to foster newer relations between ISRO and the Space Agencies of ASEAN.

India already pursues bilateral relations with individual ASEAN Member countries. India has launched satellites for some of the ASEAN countries on a commercial basis by country's workhorse Polar Satellite Launch Vehicle. Besides, Indian ground stations for monitoring launch vehicles and satellites have been established in Brunei and Indonesia. This apart, many officials from ASEAN member countries have been trained in space science, technology and applications using ISRO facilities.

Dr K Radhakrishnan, Chairman, ISRO, while inaugurating the meeting, highlighted the achievements of Indian Space Programme and the existing cooperation with the ASEAN member countries. He also emphasised on the need to evolve new mechanisms to harness the benefits of space technology for the socio-economic development of ASEAN nations. Dr Alexander Lim, Head of Science & Technology, ASEAN Secretariat, in his opening remarks highlighted the importance of this meeting.

Four theme specific technical sessions, namely, (i) India's Proposal for Space Cooperation with ASEAN covering 'Establishment of Satellite Tracking, Data Reception and Processing Facility' and 'Training in Space Science, Technology and Applications' (ii) Space related activities in ASEAN member countries (iii) Indian Space Programme and (iv) Space Technology Applications were organised. A technical visit to ISRO Telemetry, Tracking and Command Network (ISTRAC) was organised as part of the meeting. A panel discussion with participation of all the Heads of space agencies / establishments was organised, wherein the possibilities of space cooperation between ASEAN and India, and challenges in ensuring the delivery of the benefits of space technologies to the developmental needs of ASEAN, were deliberated.

The ASEAN delegates concurred with India's initiative on space cooperation between India and ASEAN and agreed to work out the modalities of its implementation.

Indian Ministry of External Affairs and the ASEAN Secretariat were actively involved in organising this meeting.

Delegates of India-ASEAN Meeting

Padma Shri Award 2012 for ISRO Scientists

Dr Y S Rajan, honorary distinguished professor of ISRO and Dr V Adimurthy, Dean, Indian Institute of Space Science and Technology, received prestigious Padma Shri Awards 2012 for their contribution to the field of Science & Technology.

Dr Y S Rajan has made key contributions to space research, technology and applications since 1964 and continues to be an important expert on space matters. His contributions in shaping ISRO from its initial experimental phases into a major service delivery organisation have been remarkable. In the process, he has also been a creator of many institutions and sustainable mechanisms between ISRO and its end-users. Dr Y S Rajan was the Scientific Secretary of ISRO during 1976-1988.

He has built organisations like Technology Information Forecasting and Assessment Council (TIFAC) and worked in various institutions/organisations like Confederation of India Industry (CII). He served as Vice-Chancellor, Punjab Technical University (PTU). He was also Scientific Secretary to Principal Scientific Adviser to Government of India, Member–Secretary, Scientific Advisory Committee to Cabinet and Advisor, Dept of Science & Technology (DST), etc.

Dr V Adimurthy joined the Indian Space Research Organisation in 1973, soon after obtaining his Ph.D from the Indian Institute of Technology, Kanpur. He superannuated as Associate Director of Vikram Sarabhai Space Centre, in charge of Aeronautics Entity.

Dr Adimurthy is a Distinguished Visiting Professor of the Indian National Academy of Engineers. He received Astronautical Society of India Award in 1997 and served as the ISRO Representative in the Inter-Agency Space Debris Coordination Committee (IADC). Dr Adimurthy is a key member of the National Task Force that worked on the definition of the Indian Lunar Mission. He has contributed significantly in the area of launch vehicle trajectory optimisation and has published extensively on it.

Dr Y S Rajan receiving Padma Shri from Mrs Pratibha Patil, President of India

Dr V Adimurthy receiving Padma Shri from President of India

Space India takes this opportunity to congratulate
Dr Y S Rajan and Dr V Adimurthy

S K Shivakumar takes over as Director of ISRO Satellite Centre, Bangalore

Mr S K Shivakumar, Distinguished Scientist and Associate Director, ISRO Satellite Centre (ISAC), Bangalore, assumed the office of Director, ISRO Satellite Centre on June 30, 2012 He took over the charge from Dr T K Alex, the outgoing Director.

Mr Shivakumar began his career in ISRO by joining ISRO Telemetry, Tracking and Command Network (ISTRAC) in 1976 at Sriharikota and later served ISRO Satellite Centre for two decades (1978-1998) during which he made immense contribution to the mission planning, analysis and operations of several Indian satellite missions including Bhaskara, APPLE, IRS and INSAT. He served as Mission Director for IRS-1B and IRS-1C satellites which successfully completed a decade of operations in orbit.

From September 1998 to November 2010, Mr Shivakumar was Director, ISRO Telemetry, Tracking and Command Network (ISTRAC). He was also the Project Director for realising India's first indigenous Deep Space Network antenna that measures 32 meters (100 feet) in diameter at Byalalu, near Bangalore. This antenna was used for communicating with Chandrayaan-1, India's first mission to the Moon, and will also serve future deep space missions.

Mr Shivakumar had a distinguished academic career and obtained Bachelor's Degree in Science from Mysore University, BE in Electrical Communications Engineering as well as MTech in Physical Engineering from the Indian Institute of Science, Bangalore.

Mr Shivakumar is the recipient of many honours and awards like Indian National Remote Sensing Award of Indian Society of Remote Sensing, Award for excellence in Space systems management of the Astronautical Society of India and ISRO Merit Award for his outstanding contributions in Ground Systems establishment. He is also the recipient of 'National Aeronautical Prize-2008' from Aeronautical Society of India for his outstanding Contribution for Chandrayaan-1 mission. He received 'Karnataka Rajyotsava Award 2008' in the area of Science and was conferred with Honorary Doctorate by the University of Mysore during its 92nd annual convocation.

His current research interests are in the areas of highly capable space systems, autonomy in space systems and large antenna systems.

National Space Science Symposium (NSSS-2012) held at Tirupati

The Seventeenth National Space Science Symposium (NSSS-2012) was held at Sri Venkateswara (S V) University, Tirupati during 14-17 February, 2012, sponsored by ISRO in association with the Astronomical Society of India. The Symposium provided a scientific forum for the presentation of new results and to discuss recent developments in space science, planetary exploration and space and ground-based astronomy programmes/projects being pursued at various research institutions and universities in India.

The Inaugural session of the symposium began with the welcome address by Prof A Jayaraman, Director, National Atmospheric Research Laboratory (NARL). The Symposium was inaugurated by Prof U R Rao, Chairman, Advisory committee on Space Research, ISRO in the Srinivasa Auditorium on 14th February, 2012. Prof J N Goswami, Director, Physical Research Laboratory (PRL), Ahmedabad, delivered the keynote address. Sri M G Gopal, IAS, Vice-Chancellor (AFC), S V University, was presided over the function.

Six hundred delegates across the country participated in the symposium. The scientific program had several parallel sessions, special plenary sessions and special invited talks by outstanding scientists from premier institutes. Special Plenary Sessions on (i) Advances in Astronomy (ii) Meghatropiques and (iii) Polar Research were also organised. A Popular Lecture was delivered by Prof G Srinivasan on 'The Accelerating Universe', Inter-disciplinary Lectures on "Cosmology-recent discoveries and challenges ahead", "CAWSES" and "Neutrinos in Physics and Astronomy", were organised as well.

Dr A Jayaraman delivering welcome address during the inauguration of the symposium

The technical sessions in the areas of i) Space –based Meteorology, Oceanography and Geosphere-Biosphere Interactions ii) Middle atmosphere, coupling dynamics and climate change, iii) Ionosphere, magnetosphere, Thermosphere, Space weather and sun earth relationships, iv) Astronomy and Astrophysics, v) The Solar system bodies including Planetary system, were organised. Space based Meteorology, Climate Change, Middle and Lower Atmospheric Coupling, Ionosphere, Astronomy and Astrophysics covered the overview of space activities. There were discussions on the new dimensions and future perspectives in space science research. A series of special invited talks in the areas of Astronomy/Astrophysics were delivered covering the recent developments in Cosmology, especially developments in the areas of 30 m Telescope and Gravitational wave Detector experiments of Advanced Laser Interferometer Gravitational Wave Observatory (LIGO). The research in Antarctica and the Arctic are of great significance and a special session was organised in these areas.

The conference was held for four days with oral and poster sessions and an ISRO exhibition was also arranged for the benefit of College / School students. Best Oral and Poster Cash Prize Awards were given during the concluding session.

ISRO Satellite Centre, Bangalore Celebrates Ruby Year

A galaxy of Dignitaries with imagery from RISAT-1 during Ruby Year celebrations at ISAC
From left: Dr K N Shankara, Mr D Aravamudan, Prof U R Rao, Dr K Radhakrishnan, Dr T K Alex, Mr S K Shivakumar

ISRO Satellite Centre (ISAC), Bangalore, the lead Centre of ISRO for design, development, fabrication and testing of all Indian made satellites, celebrated its 40 years of fruitful existence on May 11, 2012. It was May 10, 1972 that the agreement between India and erstwhile USSR was signed to build the first Indian Satellite 'ARYABHATA'-which heralded the satellite activities in the country.

Since then, the Centre has built more than 50 satellites that cover a wide spectrum of technologies and applications such as TV broadcasting, Telecommunications, Telemedicine, Distance education, Radio networking, Disaster Warning and a number of remote sensing applications in natural resources survey, monitoring and management. Satellites built by ISAC are the key elements of our national infrastructure.

From a modest beginning in the industrial sheds of Peenya, Bangalore, ISAC was shifted to its present

Testing a communication satellite at the centre's Compact Antenna Test Facility

Panoramic view of the sprawling clean room at ISITE

main campus at HAL Airport Road in the 1980s. The ISRO Satellite Integration and Test Establishment (ISITE) was established in 2006 near Marathahalli for integration and testing of large, high power communication satellites. The Center houses sophisticated design, development and fabrication facilities besides specialised R&D labs. A Space Research Facility (SRF) to augment the assembly and integration capacities and to support special projects of national importance, is coming up at Chellakere, near Chitradurga.

In addition to building communication, remote sensing and space science applications satellites, the centre has now embarked on a new programme to build satellites to provide navigation applications like position and timing services for civil aviation and strategic sectors.

It may be recollected that Chandrayaan-I, India's first mission to moon which made the path breaking discovery of water on moon, was built at ISAC. The Radar Imaging Satellite-1 (RISAT-1) which was launched on 26th April, 2012 is yet another accomplishment of ISAC. Presently, under the leadership of Dr T K Alex, Director, ISAC, more than seven communication satellites, a meteorological satellite, space science missions like Chandrayaan-2, ASTROSAT and Space Capsule Recovery Experiment - 2 (SRE-2) and a Joint mission with France - SARAL, are under various phases of execution. Many more satellites are in the planning phase.

Chandrayaan-1 Getting Ready for Thermo-vacuum test at ISAC

A function was organised at ISAC to celebrate this important occassion. It was inaugurated by Dr K Radhakrishnan, Chairman, ISRO, in Prof Satish Dhawan Auditorium at the Centre. Pioneers of Indian Space Programme like Prof U R Rao, Dr K Kasturirangan, Former Chairmen of ISRO, graced the occasion.

PSLV-C19 Launches India's First Radar Imaging Satellite (RISAT-1) Successfully

Indian Space Research Organisation (ISRO) successfully launched India's first Radar Imaging Satellite (RISAT-1) onboard its high end XL version of Polar Satellite Launch Vehicle (PSLV-C19) from Satish Dhawan Space Centre (SDSC), Sriharikota on April 26, 2012. This was the 20th successive successful flight of PSLV. RISAT-1,with a lift-off mass of 1858 kg, is the heaviest remote sensing satellite launched by PSLV. The PSLV-C19 injected RISAT-1 into an orbit with a perigee of 470 km, apogee 480 km and an orbital inclination of 97.639° which was very close to the intended orbit.

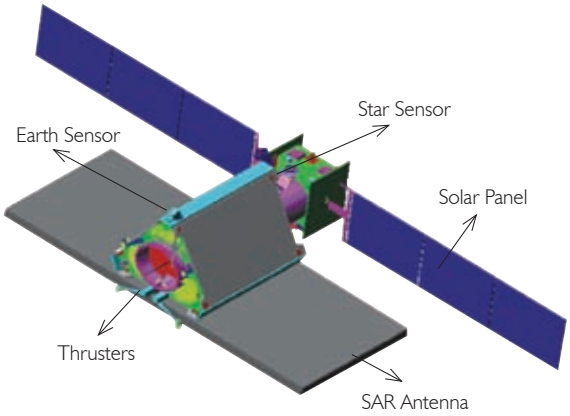
PSLV-C19 was the twenty first flight of PSLV. This was the third flight of the high end version (PSLV-XL) with six extended strap-on motors, each carrying 12 tonnes of solid propellant. (The two earlier flights of PSLV-XL were used to launch Chandrayaan-1 and GSAT-12 Communication Satellite).

PSLV-C19 at the First Launch Pad

PSLV-C19 after a few moments of its lift-off

Subsequent to the injection of the satellite into the orbit, the Antenna panels of C-band Synthetic Aperture Radar and the solar panels of RISAT-1 were successfully deployed. Further, the satellite was successfully placed into a polar Sun Synchronous Orbit of 536 km altitude and 97.552° inclination, using the satellite propulsion system, through a series of four orbit raising maneuvers during April 27-28, 2012. With this, the RISAT-1 was placed in its final orbital configuration.

This was further followed by the payload operations which included data handling tests and payload calibration operations. The first payload operation in Fine Resolution Stripmode (FRS-1) was successfully done on May 1, 2012 and good quality images, starting from Gangotri, passing through Bhopal and parts of North Karnataka were acquired and processed. Following this, more imaging options in FRS and Medium Resolution ScanSAR (MRS) modes were also successfully completed.



RISAT-1 Satellite (Schematic Diagram)

Radar Imaging Satellite-1 is a state-of-the-art Microwave Remote Sensing Satellite. Unlike optical remote sensing satellites that depend upon sunlight for imaging, RISAT-1 transmits its own radar pulses, at 5.35 Giga Hertz frequency, for imaging of the earth's surface. This facilitates cloud penetration and imaging even without sunlight. The Satellite can image an area irrespective of the weather and sun light conditions. It can image Indian Landmass both during morning and evening around 6:00 AM and 6:00 PM equatorial crossing (dawn–dusk imaging) times. RISAT-1 has imaging capabilities in multiple modes and polarisations with imaging resolutions from 3-50 m and swath coverage from 25 km to 223 km. This enables varieties of possibilities for imaging of the earth features for various applications.

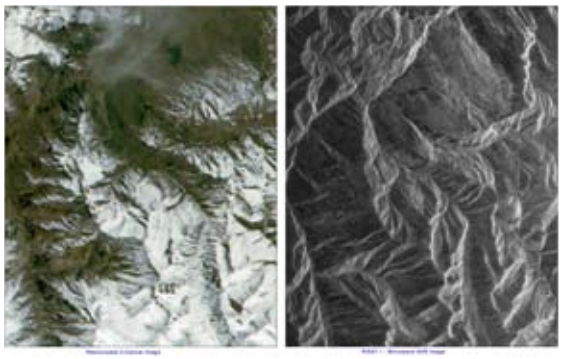
RISAT-1 Satellite undergoing pre-launch tests

Salient Features

Orbit	:	Circular Polar Sun Synchronous
Orbit Altitude	:	536 km
Orbit Inclination	:	97.552^0
Orbit Period	:	95.49 min
Number of Orbits per day	:	14
Local Time of Equator Crossing	:	6:00 am/6:00 pm
Repetivity	:	25 days
Lift-off Mass	:	1858 kg
Attitude and Orbit Control	:	3-axis body stabilised using Reaction Wheels, Magnetic Torquers, and Hydrazine Thrusters
Power	:	Solar Array generating 2200 W and One 70 AH Ni-H_2 battery
Nominal Mission Life	:	5 years

RISAT – 1 Applications

RISAT-1 is primarily meant for natural resources and disaster management applications. In agricultural sector, RISAT-1 helps in monitoring of paddy crops during Kharif season through identification, classification and acreage estimation. Mapping of inundated areas during floods and cyclones for disaster management is another important application.



Comparison of Gangothri optical imagery (left) with the microwave imagery (right) from RISAT-1

Successful Testing of Indigenous Cryogenic Engine

The acceptance test of the indigenous cryogenic engine for the forthcoming GSLV-D5 flight was conducted successfully for 200 seconds on May 12, 2012 at 17:10 hrs (IST) at Liquid Propulsion Systems Centre (LPSC) test facilities at Mahendragiri. The performance of the engine was as predicted.

19th PC-NNRMS Meeting

The 19th meeting of the Planning Committee-National Natural Resources Management System (PC-NNRMS) was held at India International Centre, New Delhi on June 26, 2012, under the chairmanship of Dr K Kasturirangan, Member (Science), Planning Commission, with active participation from all Ministries/ Departments and NNRMS Standing Committees. Secretaries, Additional Secretaries and other senior officers from various ministries participated in the deliberations. The Agenda of the meeting addressed the status of various earth observation applications as well as the specific activities to be pursued during the 12th Five Year Plan. Major emphasis of the discussion was on the active participation by the user ministries in the NNRMS programme through institutionalisation and internalisation of remote sensing technology in their respective sectors. In this context, one of the important highlights was the operationalisation of Mahalanobis National Crop Forecasting Centre (MNCFC) under Ministry of Agriculture for providing crop forecasts and drought related information to the nation.

ISRO Satellite Centre through the years

Sheds of Peenya

The present main campus

The INSAT building adjacent to main campus

ISITE building