Advancing frontiers and prospects

The Indian Space Research Organisation is ambitiously looking forward to achieve a quantum jump in technological capabilities and embark on missions with far reaching significance, writes **K. R. Sridhara Murthi**

The year 2009 was a watershed in India's space endeavours with the Chandrayaan-1 mission becoming an instrument for discovery of water on the moon. All across the globe, there has been tremendous interest in recent years in further exploration of space, triggered by a plethora of exciting discoveries such as the hundreds of extra solar worlds, dark energy and blazers. For its part, the Indian Space Research Organisation is ambitiously looking forward to achieve a quantum jump in technological capabilities and embark on missions with far reaching significance.

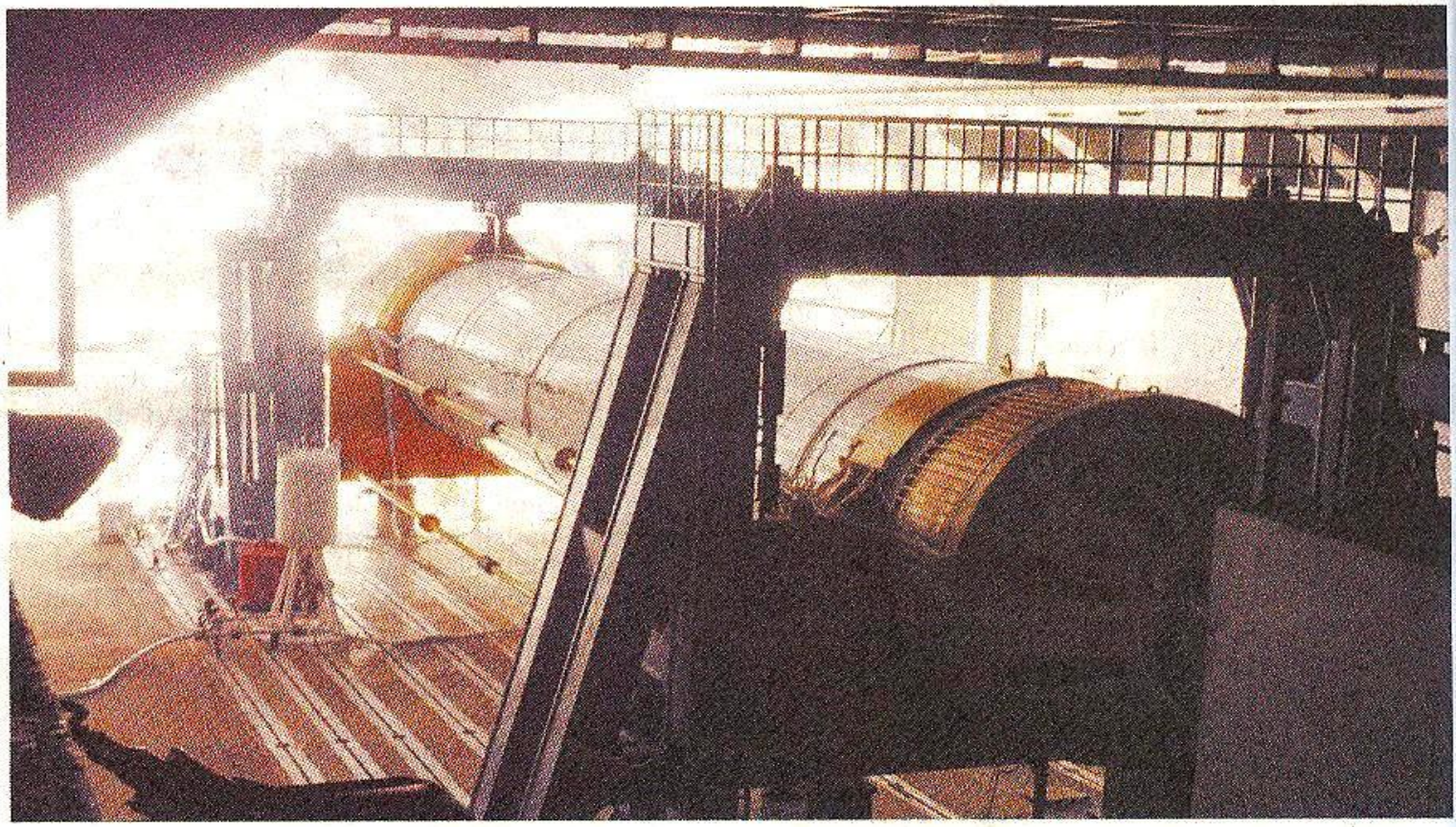
During the current five-year plan, ISRO is placing considerable emphasis on achieving heavy lift launch capability through the development of its GSLV-Mk III. In addition, it will wet its hands with futuristic technologies such as air breathing propulsion and will also develop a technology demonstrator for a reusable launch vehicle (RLV). It is on the path to realise a robust communications capacity in the geo-stationary earth orbit by enhancing the capacity of transponders from 211 to about 500 (each equivalent to 36 MHz) in the next 3-4 years. This will also incorporate the use of new higher frequencies as well as a capacity for communications with a variety of mobile terminals. The earth observations capability from space will not only yield sharper images but also involve new sensors that can provide three-dimensional views of parameters critical for the weather and climate phenomena. More robotic capabilities will be built into space probes and lunar landers.

Launching of the Polar Satellite Launch Vehicle (PSLV)-C14 of the Indian Space Research Organisation from the Satish Dhawan Space Centre (SDSC) SHAR in Sriharikota. — PHOTO: AFP

Growing role

The experience of the global satellite industry during the recent worldwide financial crisis is indicative not only of its resilience but also its ability to aid the path of recovery. The state of the satellite industry as surveyed by a study sponsored by the U.S.-based Satellite Industry Association has indicated a consistent growth trend in revenues, with an average annual growth of 14.2 per cent for the period 2003 to 2008. It is noteworthy that the business related to space infrastructure including satellites and space launches was $14.2 billion, which constitutes only 10 per cent of the total value of world satellite industry revenues in 2008.

A major share (58 per cent) was taken by satellite services including satellite television, fixed communications and remote sensing. Since improved



Testing s/200 rocket motor of the GSLV Mark III in progress at Sriharikota. The motor is powered by 200 tonnes of solid propellants. — PHOTO: ISRO

technologies now permit satellites to directly communicate with installations at homes or with individual consumer oriented equipment, tremendous opportunities are foreseen for industries which provide services or those which supply ground equipment such as satellite TV and broadband dishes, satellite radios, satellite phones and positioning devices.

Commercial services

Broadly viewing, ISRO's space assets serve two different segments of commercial services, apart from many societal or strategic applications. The first pertains to telecommunications and broadcasting related services and the other relating to information derived through imaging from space. The private sector is actively contributing to the provision of services in the first segment including Direct-To-Home television, and a variety of other telecommunications services primarily using VSAT (Very Small Aperture Terminal) networks.

While the full potential for DTH penetration is yet to be tapped in India, this industry is already characterised by keen competition. Some level of consolidation could help in making it profitable besides contributing to efficiency in bandwidth usage in the overall national context.

The other segment relating to geo-spatial information services has been growing over the years with Indian industry manifesting sophisticated technological competence, particularly in software as well as value adding services. A recent survey on the Indian geospatial industry conducted by Geospatial Today has indicated a marked growth from a level of Rs.839 crore in 2008-09 to Rs.2,407 crore by 2012-13.

I : Foreign satellites slated for future launches of PSLV

Satellite	Country	Launch Schedule
Alsat-2A	Algeria	2010
X-SAT	Singapore	2010
Protiers	Japan	2010
AMSAT	Indonesia	2011
Lapan A2	Indonesia	2011
Sapphire	Canada	2011
NLS-7	Netherlands	2011
EnMap	Germany	TBD

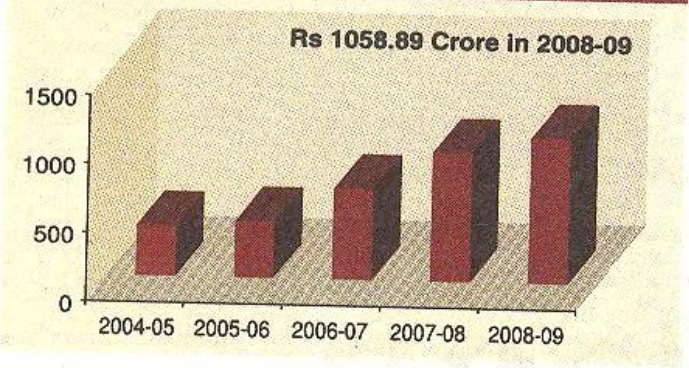
In addition, there are firm commitments for two more launches beyond 2011.

Technology transfer

Traditionally, ISRO has forged a strong relationship with a large number of industrial enterprises, both in public and private sector to implement its space projects. This strategy has resulted in diffusing the state-of-art technologies, which are developed for the space projects into industry. The technology transfer scheme of ISRO facilitates this mutually beneficial interaction between ISRO and industry. Close to 30 per cent of ISRO's budget (which was Rs.3,499 crore for 2008-09 under revised estimates) flows into industry for supply of various goods and services.

Industry plays an active role in the supply of various subsystems and components of launch vehicles as well as satellites. Many sophisticated items that go into satellites such as satellite structures, state-of-the-art heat pipes, solar panels, component parts of spacecraft mech-

Fig. 1 : Growth of Antrix revenue



anisms, electronic packages used in satellite telemetry, command and control systems are provided by industry. Similarly, a large part of launch vehicle fabrication including its stage and engine hardware, propellants and avionics are carried out in Indian industry.

Consortium approach

Many specialised facilities, which are required for the development and testing of space systems, are also built by industry. ISRO's initiative to indigenise a large variety of aerospace materials has been successfully implemented in industry. Many ground systems such as complex weather radar systems are developed in collaboration with industries such as Bharat Electronics. When a single enterprise lacks the multi-disciplinary expertise demanded by complex projects. ISRO encourages a consortium approach and teamwork among various industries.

An excellent example of such an approach, resulting in world-class performance, was the Deep Space Communications Network facility at Bylalu, on the outskirts of Bangalore. This facility, which was critical in the Chandrayaan-1 mission, was built from scratch in a record time of 35 months. One of the key components of the facility is the massive 32 metre antenna system weighing about 300 tonnes, with capability to pinpoint towards spacecraft in deep space with an accuracy of 15 milli degrees.

This facility was built under the guidance of ISRO's Telemetry, Tracking and Command Network (ISTRAC) and by a consortium of industries including ECIL, Godrej & Boyce, L&T, HAL, SLN Technology and others. Technical inputs for this system also come from the Bhabha Atomic Research Centre and ISRO Satellite Centre. Although this was a maiden effort, the facility demonstrated excellence in performance by global standards. Another recent example where industrial consortia approach has yielded rich dividends is the establishment of facilities for GSLV's solid boosters at Shriharikota.

Global marketing

The technological advances in Indian space scene combined with the increased interest in access to and use of outer space by a large number of countries across the globe have opened a new window of opportunity for commercial exploitation. Antrix Corporation, which was established in 1992 as a corporate front of ISRO, promotes commercial exploitation of technologies developed in ISRO as well as enables the growth of space related industries. It has been playing a pivotal role in marketing capacity available from Indian satellites and providing space launch services to international customers.

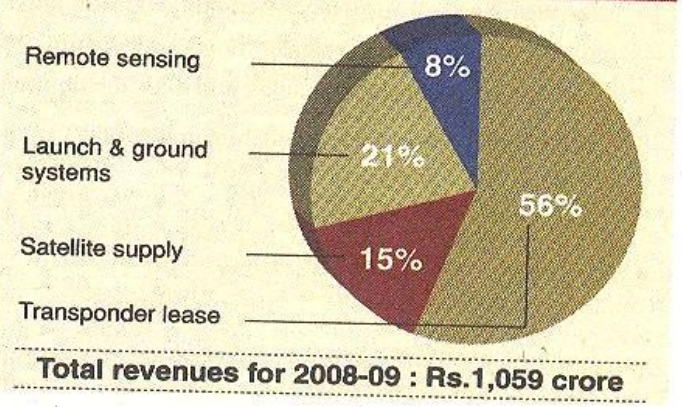
Aided by the continuous improvements in PSLV to service a variety of customers, Antrix could successfully bring international payloads from many countries including Canada, Germany, Israel, Indonesia, Belgium, Argentine, Netherlands, Japan, Korea, Italy and Denmark. Twenty-two foreign satellites have been launched so far with PSLV, which is capable of placing multiple satellites into orbit in a single mission. The consecutive success of PSLV — fifteen times in a row — has instilled strong confidence among customers. The order book for PSLV already comprises another 10 satellites which will be launched during 2010 and beyond, as illustrated in Table–I. In addition, there are firm commitments for two more launches beyond 2011.

Over the years Antrix had steadily increased its revenues, which exceeded the Rs.1000-crore level in 2008-09 (Fig.1). The segment-wise business of Antrix is illustrated in Fig. 2. As regards launching of bigger satellites into geo-stationary earth orbits, the GSLV-Mk III provides a future opportunity. This vehicle with capability of launching a 4-tonne class of satellites into space will be able to address a significant portion of needs manifested in the global market. It will be competing for a share in competition with other major global operators from the U.S., Europe, Russia, China and Japan. This will be contingent upon creation of additional industrial capacity for production of the launch vehicles and augmenting the service infrastructure.

Remote sensing satellites

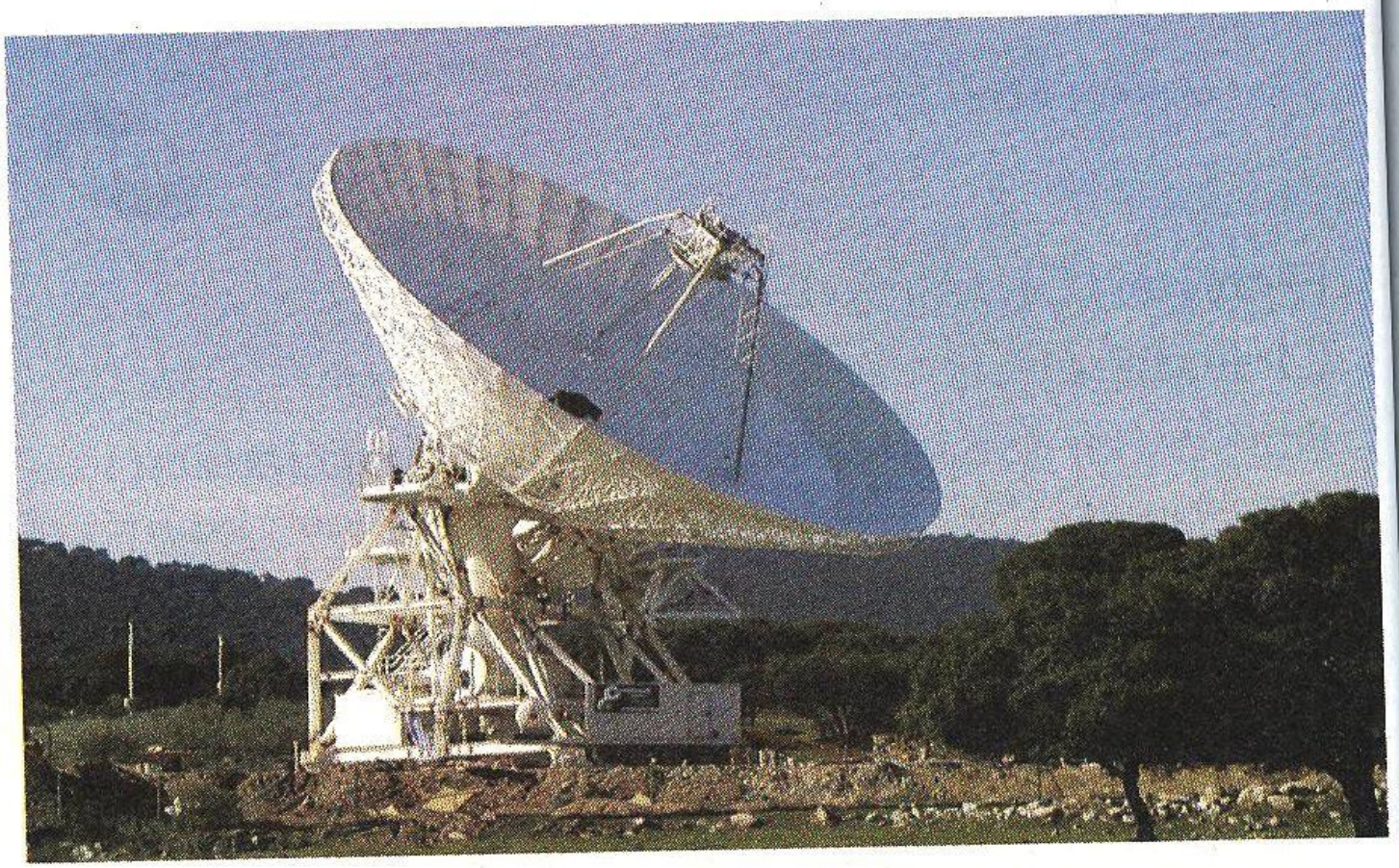
Indian remote sensing satellites have gained recognition worldwide as a source of reliable remote sensing data obtained from space for pursuing applications in resource management, mapping, environment assessment and use in decision support systems. The data from Indian remote sensing satellites are currently received in a number of countries / regions, including the U.S., Europe, the Middle East, Asia, Africa and Australia. Apart from providing satellite data, ISRO has been spearheading the development of software for various applications such as irrigation command monitoring, fisheries potential prediction, agricultural crop assess-

Fig. 2 : Segmentwise business of Antrix



The L-110 stage of GSLV Mk-III undergoing final preparations for testing at the test stand at Mahendragiri, near Nagercoil, in Tamil Nadu. It is called L-110 stage because it is powered by 110 tonnes of liquid propellants. — PHOTO: ISRO

ment and so on. The strong capabilities in satellite remote sensing and their applications have also been encouraging several industries in geospatial information market to play an active role in the development of software and providing information solutions in the domestic and global markets. Speedy implementation of spatial data infrastructure at the national level can trigger further growth in applications of geospatial data through shared use of databases and efficient processes enabled by standardisation. Antrix has established an



An indigenously built 32-metre deep space network (DSN) antenna of ISRO at the hamlet of Byalalu, near Bangalore

alliance with Astrium of Europe for joint manufacturing and marketing of commercial communication satellites based on technologies developed in India and Europe. Though geographically separated by a great distance, the alliance partners provide a unified interface to the customers. The team has already delivered a satellite, namely W2M, for the global satellite operator Eutelsat. Barring a technical snag confronted in the space environment, the teamwork of the partners for this programme was well established. Following this, a second satellite called HYLAS is being jointly developed for delivery during mid-2010 to the U.K.-based customer, Avanti Screenmedia. This model can be potentially expanded and diversified to other areas such as ground systems. One of the ambitions of Antrix is to develop a commercial Indian satellite system owned by industry. Towards this it is looking for opportunities to acquire or invest in satellite systems. It also looks forward to further diversification of its services both in domestic and global markets based on new space systems, which are planned by ISRO. Broadband services, mobile multimedia, high definition television, positioning based services and geospatial information services constitute major drivers for growth. All these offer significant opportunities for Indian industry for downstream services.

Long-term vision

The vision of space for 2025 incorporates goals for advancing technological frontiers, particularly in the domain of satellite technologies governing many vital earth bound applications. Hand in hand, cutting edge scientific missions are envisaged for investigating the evolutionary processes in the multiverse, the origins of life and intelligence and the effects of solar variability on earth.

Major strides in space transportation system are planned with an aim to realise "Two stage to orbit" reusable vehicles, and conduct of planetary exploration through robotic missions and human activities in space.

Future strides in India's space endeavours have to take cognisance of the implications of the information and communications revolution and the commercial/societal opportunities. Further, the inevitable need for enhanced satellite services for national security applications requires reliable and cost effective technological solutions. Other priority considerations emerge from the needs for efficient management of natural resources, better forecasts of meteorology and severe weather, protection of the environment, mitigation of natural disasters and the creation of opportunities for forefront scientific pursuits and advancing horizons of knowledge.

The space agenda for the next one decade has to heavily rely on the above developmental goals even as India's economic growth can progressively allow other esoteric ambitions. The driving vision of space should be rooted in delivering services that will help the grassroots population to improve their quality of life. In the longer term, in pace with the resurgence of planetary exploration programmes in various countries across the globe, Indian missions can make important contributions to global efforts. ■

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