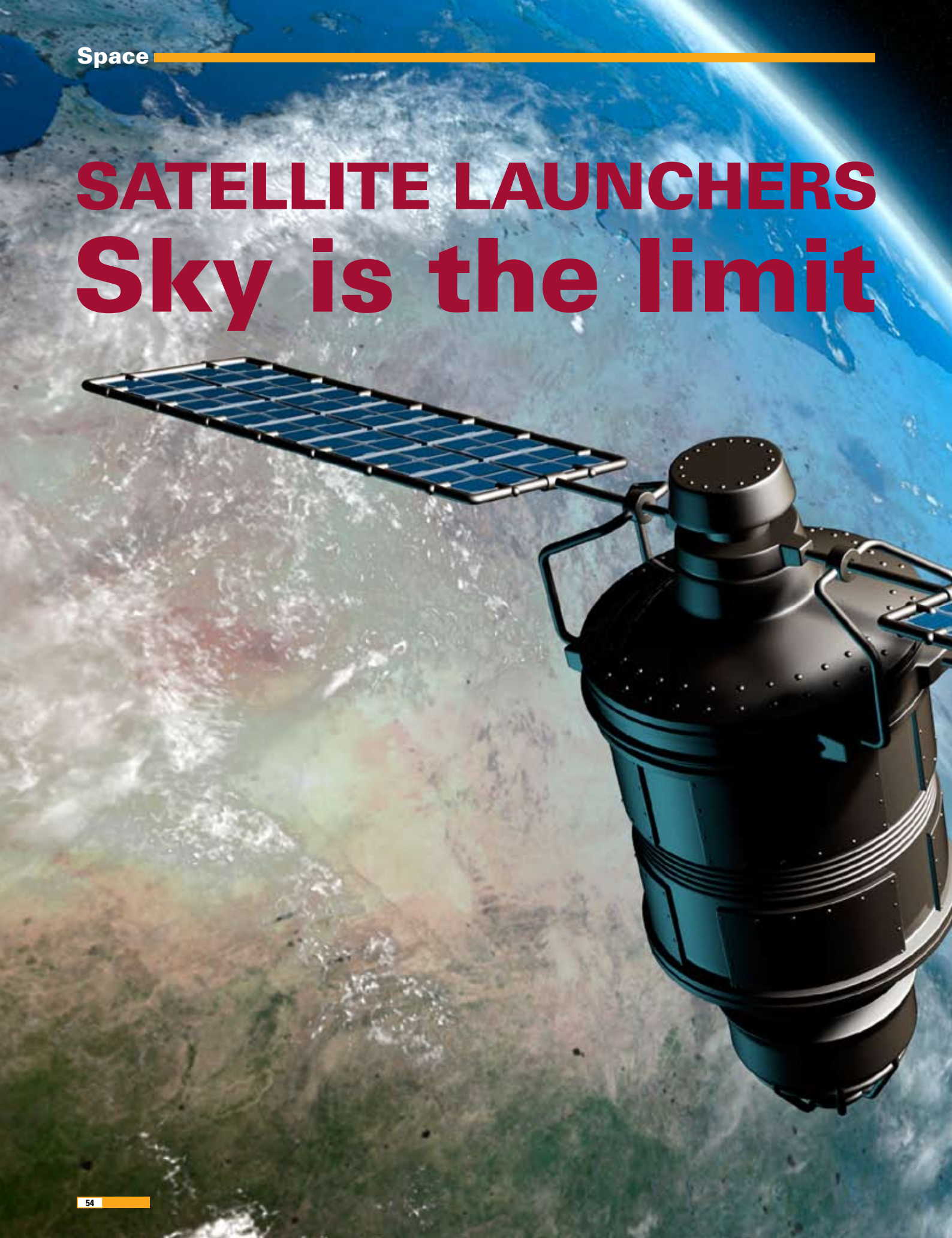
SATELLITE LAUNCHERS
Sky is the limit



ISRO is working on building lighter launchers that would cut the cost of launching satellites. **By Shivkamal.**

The cost of launching satellites has come down dramatically in recent years thanks to the emergence of India as a significant player in space and related technologies.

The Indian Space Research Organisation (ISRO), the country's premier space body which launched its moon mission (Chandrayaan I) last year, is now working on slashing rates even further, as it develops new technology to meet future challenges.

Many countries that do not possess the technology to launch satellites, and were earlier dependant on American or Russian agencies, are now looking to ISRO. The Indian agency is now building a smaller launcher that will cost 40 per cent less than existing ones to hurl satellites into the space.

ISRO launched the 300-kg satellite Tecsar for the Israeli government and the 352-kg satellite Agile for the Italian government into low-earth orbit, which is 400-500 km above the earth, in 2007. The Italian Agile was the first international satellite to ride exclusively on the Polar Satellite Launch Vehicle (PSLV) and at almost half the normal cost.

Buoyed by the success of these launches, ISRO is now working on an as yet unnamed, three-stage rocket that will launch remote-sensing satellites weighing less than 500 kg into an orbit that will ensure they return to map a targeted region on earth at more frequent intervals. The new launcher is targeted both at global and domestic customers.

According to an ISRO spokesperson, the agency is working on a different variant of the PSLV. It costs about US$20 million to launch a satellite – of up to 1.3 tonnes – in a polar orbit on a PSLV rocket, its workhorse. But stripped-down versions of the rocket carried the lighter Israeli and Italian satellites.

"We had to first send the satellites into polar orbit, before we placed Tecsar in the low-earth orbit," says the spokesperson. "That detour consumed 60 per cent of the energy of the rocket, bringing

down the cost by 40 per cent. With this success, the demand for low-cost launches has increased."

ISRO now plans to build custom-made rockets for low-cost launches. The new launcher would take around six months to build. The low-cost launcher will be lighter than earlier versions, as it will not have the six first-stage solid propellant strap-on motors, which will lower costs significantly. It will also save 400 kg of propellant in the fourth stage.

The cost-cutting measures include reducing the number of fuel stages in a vehicle, use of new engine-air breathing engine and using cheaper fuel and modular assembling.

The PSLV has been flying ISRO's remote sensing satellites of up to 1.5 tonnes into orbits 900 km from the earth since 1994. The national space agency has put six small international experimental satellites into orbit since 1999 using the PSLV. These rode 'piggyback' with a main ISRO satellite.

ISRO began its commercial foray into the launch service market with the 100-kg South Korean Kitsat-3 and the 50-kg German DLR-Tubsat in May 1999. In October 2001 came the 100-kg German Bird and Belgium's Proba. Last year, the PSLV-C7 took the 56-kg Indonesian Lapan-Tubsat and the 6-kg Argentinian Pehuensat-1 as piggybacks along with Cartosat-2.

According to K R Sridhara Murthi, executive director, Antrix Corporation, ISRO's commercial arm, Singapore University has contracted it to fly its XSAT on the PSLV. Murthi says Antrix is aiming at the emerging market of small scientific satellites of up to 600 kg, a class which the European and US launch majors such as Arianespace, Lockheed Martin and Boeing have long moved out of. The ISRO spokesperson says Antrix's price will also be attractive. Antrix's main revenue is from the lease of transponders on Insat communication satellites.

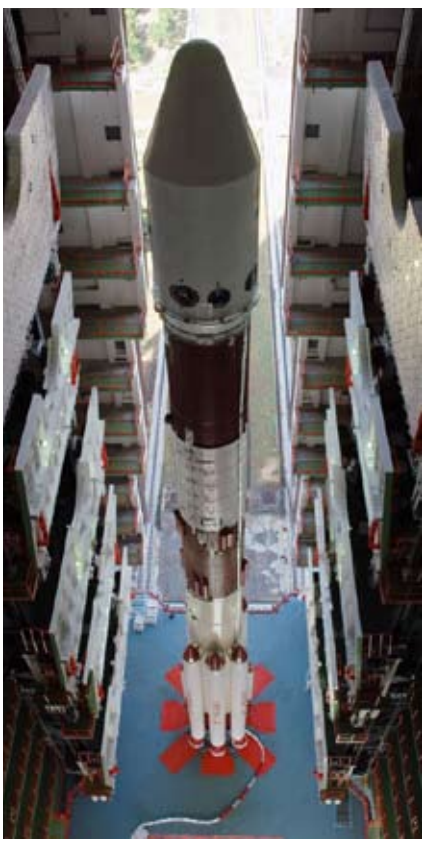
ISRO's launch capabilities will come to the fore when it does a commercial launch on the Geosynchronous Satellite Launch Vehicle (GSLV), which will be able to carry a 2-tonne Insat-class load to 36,000-km heights. At present, GSLV is used only for scientific launches, not commercial ones.

"Serious and real launch opportunities will open up when we get the GSLV-Mark III ready," points out Murthi. It is meant to carry a 4-tonne load and is slated for a trial later this year.

At present, ISRO has two launch vehicles, the four-stage PSLV for placing satellites in polar orbit and the three-stage GSLV to place satellites in the geosynchronous transfer orbit (GTO). The latter is heavier, more powerful, has a higher payload capacity and costs about US$32 million to launch, nearly double that of PSLV.

According to ISRO officials, both the vehicles are built on the same platform. They have several common components and the fuel used to fire them is also the same, barring the cryogenic stage in the GSLV. This has helped in containing costs to some extent.

With the global launch industry being competitive, ISRO has been cutting costs. It has, for instance, started using



THE GLOBALISATION OF SPACE

It is called the globalisation of space. While America and the former Soviet Union dominated the race to space from the 1960s onwards, the 21st century has seen the emergence of half-a-dozen countries, including India, as significant players in the rocket and satellite business.

"Space is no longer the exclusive province of a handful of countries," notes a report by Futron, a US-based technology consulting firm. "The increasing complexity of global space activity suggests that conventional approaches will not be sufficient to achieve and maintain leadership in the next space race. Traditional leaders such as the US, Europe, Russia, and Japan face challenges from emerging leaders such as India and China."

Realising the enormous scientific and commercial opportunities in the space sector, the Indian Space Research Organisation (ISRO) has been introducing innovative technologies and slashing the cost of satellite launches. Last April, for instance, ISRO set a record by launching 10 satellites – including eight foreign ones – in a single mission.

Three major developments currently under way – the development of an indigenous cryogenic engine that will make India self-reliant in all aspects of space launch vehicle technology, the development of the Geostationary Satellite Launch Vehicle Mark III (GSLV Mk III) and the development of reusable launch vehicles – will give a big thrust to India's satellite-launching capabilities.

Until now, the agency has been using Russian cryogenic engines; of the seven cryogenic stages that were obtained from Russia, five have already been utilised.

At the same time, though, ISRO began work in the mid-1990s to develop indigenous cryogenic propulsion technology.

"The indigenous cryogenic engine is getting ready for flight and I hope by the middle of the year we should be able to make a launch," says G. Madhavan Nair, chairman, ISRO. The GSAT-4 communication satellite is likely to be the first one to be launched using the indigenously developed cryogenic stage.

Another ambitious project of ISRO's is the development of next-generation rockets, the first of which will be the GSLV Mk III, expected to take-off in 2011. The test flights are expected this year. Besides carrying astronauts, it will also put heavier satellites in orbit.

While GSLV Mk II has the capability of sending two astronauts and launching 2.5-tonne satellites, Mk III will enable three astronauts to go on longer flights; it will also put 4-tonne satellites into geosynchronous orbit and up to 10-tonne satellites into low-earth orbit.

At present, ISRO depends on the European Space Agency

to put its communications satellites into orbit.

Additional transponders on the GSLV Mk III will make it a cost-effective option for satellite launches, attracting more clients for ISRO and its commercial arm, Antrix Corporation. Once this version of the GSLV becomes operational in about two years, Antrix is confident of offering the cheapest space launches on earth.

GSLV rockets use all three kinds of propellants – solid, liquid and cryogenic. The Polar Satellite Launch Vehicles (PSLVs), capable of carrying payloads of less than 2 tonnes, use only solid and liquid propellants.

ISRO, which last year launched its moon mission, Chandrayaan-I, plans to use the GSLV Mk III for Chandrayaan-II in 2012.

On reusable launch vehicles, Nair says the initiative would bring down the cost of launching satellites even further; it is expected to decline sharply to US$3,000 a kg from the present US$15,000 a kg.

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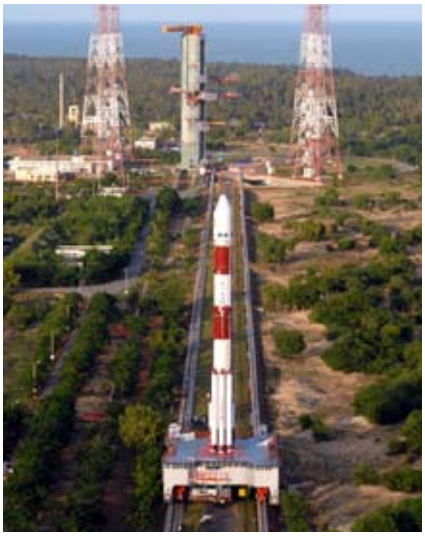

HEFTY HIKE IN SPACE FUNDING

With the Indian Space Research Organisation (ISRO) embarking on several ambitious projects, its funding requirements have grown significantly. The Indian government has consequently hiked its budgetary allocation in the interim budget by a hefty 27 per cent.

ISRO has been allocated US$875 million for the new financial year beginning April 1, 2009. Of this, about US$120 million has been allotted to the Vikram Sarabhai Space Centre, Thiruvananthapuram, which is developing the new-generation satellite launch vehicles. The GSLV Mk III programme has been given over US$42 million.

Over US$50 million has been allocated for the Indian Regional Navigation Satellite System, a constellation of seven satellites, which will provide position accuracies similar to the global positioning system (GPS).

Other projects getting significant funding include the development of a semi-cryogenic engine for future advanced satellite launch vehicles and the Chandrayaan missions.

indigenous materials like aluminum and titanium alloys to rein in the costs.

According to R V Perumal, director, ISRO's Liquid Propulsion Systems, the space agency is looking at reducing the number of fuel stages to cut the launch cost. "GSLV's Mark III will have reduced fuel stage, cutting costs significantly," he notes. The launch vehicle is being designed to carry a 4-tonne payload and is expected to cost half of what GSLV costs now.

While the six solid propellant strap-on motors in the present PSLV carry 9 tonnes of propellant, the new version, the PSOM-XL, will have a capacity to carry 12.4 tonnes of propellant.

ISRO is also looking at the possibility of a three-stage PSLV for carrying 500 kg payload in low-earth orbit. It is also considering plans for a new 229-tonne core configuration with a capability to launch 1,100 kg satellites into 622 km semi-synchronous orbit (SSO) and a vehicle that could carry 1,900 kg in SSO, by increasing the propellant in the second stage.

ISRO is also testing cheaper fuel for its rockets to bring down the launch costs. According to Dr B N Suresh, director, Vikram Sarabhai Space Centre (ISRO's main space research centre), the different engine stages and propellant account for the major share of rocket costs. "Nearly 45-50 per cent of the vehicle cost is on fuel. Avionics and software are the other cost factors," he says.

Perumal says ISRO is looking at semi-cryogenic fuel whose cost will be a fraction of the existing fuel cost.

ISRO is also in the process of developing air-breathing engines, which will use atmospheric oxygen and burn it with the stored on-board fuel for producing the forward thrust; in contrast, conventional chemical rocket systems carry both oxygen and fuel on-board. The air-breathing systems will be much lighter and more efficient, leading to reduced overall costs.

The other cost-reduction strategy is to go in for modular assembling of vehicles. At present, ISRO sources components and assembles them. What is being planned is to source assembled components from vendors so that ISRO makes the launch vehicles faster.

ISRO is also improving avionics by upgrading processors. While it uses Motorola's processors at present, it has developed a new one called Vikram. "More than the cost savings, chip designing is of strategic interest," says Suresh. ISRO is also constructing another launch control centre to reduce the cycle time for launches. It already has two launch pads at Sriharikota in Andhra Pradesh.

The cost-effective solutions that ISRO is working on will ultimately bring down the cost of launching satellites, attracting many other space and research agencies from around the world to utilise space on its rockets. For ISRO, there is enough room for growth and the only limit is the sky.