Space as a Future Force Multiplier

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Introduction

The US' worry on the loss of direction at the National Aeronautics Space Agency (NASA) as regards the space programme is that when the European Space Agency (ESA) astronauts reach the moon by 2015-20, with the Chinese aeronauts already there, it is unlikely that the American astronauts would be anywhere in sight.[1] The US' concern on being left behind in the space race is the main reason for the closing down of the Shuttle programme and paving the way for private companies to run the same.[2] A major chunk of the NASA money, thus, available is planned to be utilised for robotic missions to asteroids (between Jupiter and Mars) and Mars, to be followed subsequently by manned missions.[3]

The renewed focus of major space-faring nations on missions to Mars/Moon is aimed to extend the strategic leverage in space, besides the national prestige that such on endeavour will provide. This is a clear indication that missions to the Moon/Mars will continue to remain the arena of future endeavours. India, which possesses the indigenous capability of designing and developing satellites and launches them from its own soil, needs to take note of this trend and factor it in its civil and military segments of the space programme.

The US, the undisputed leader in the world and the sole space superpower as regard both civil and military capabilities,[4] is closely followed by Russia, China and other nations, including India. As per Futron Space Competitiveness Index 2010, India, with its more than three dozen satellites in orbit, ranks seventh

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amongst the fraternity of space-faring nations, besides being a global leader in remote sensing.[5]

Space Exploitation in Civil Segment

Space applications for communication, navigation, understanding of weather and climate, natural resource management and understanding the universe have matured over the last three-four decades. An exciting aspect of space exploitation is the multi-dimensional and multi-mission applications of its technologies and products. This has forced many space-faring countries to combine various space ventures towards common goals. European governments, through the European Union and the European Space Agency have integrated their policy-making structures and are increasing spending, particularly within the civilian and commercial spheres.[6]

The exploitation of navigation signals, reflected from a minimum of four satellites, has virtually set in a revolution in various applications such as town planning, maritime/road/rail traffic management, etc. At present, the US Global Positioning System (GPS) and Global Navigation Satellite System (GLONASS) of Russia are two major satellite constellations that are operational. Moreover, navigation through satellites is reaching new horizons with each passing day. The GALILEO satellite navigation system of the European Space Agency, COMPASS/BeiDou navigation system of China and Indian Regional Navigation Satellite System (IRNSS) of India are under development and soon going to be deployed, which will multiply the navigation quality and service manifold. The need has been felt and understood by all nations to stay abreast with the developments in this field to exploit the facilities for better accuracy, reliability and integrity.[7]

Space-Faring Nations: Military Exploitation

The use of satellites for military applications dates back to 1959, when the US Navy launched the world's first navigational satellite, Transit-1A. Since then, military usage of space has grown exponentially, transforming warfare for nations with access to such resources. Especially in the last decade or so, there has been a sudden change of focus for most of the advanced militaries of the world, which involves transforming battle groups into smaller, lighter and more agile units with greater capabilities to address uncertainties. 'Military exploitation of space' is becoming one of the most important enablers for this transformation.[8] This trend is corroborated by the very fact that by December 2008, there were 232

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military satellites (out of a total of 903 satellites in orbit) as against a handful of satellites a decade earlier. Moreover, 95 percent of these satellites look towards the Earth and only 5 percent look towards outer space, thus, proving beyond doubt that the main focus is not inter-stellar discovery or space travel but to gain a competitive advantage on Earth.[9]

It may also be mentioned here that nations such as the US and China are moving towards achieving space control, which involves putting satellites in orbit, establishing Earth stations and the requisite network to ensure freedom of action in space for themselves and their allies and deny the same to the adversaries when required. Space control is an extremely important capability given that it facilitates projection, surveillance and conduct of operations over any place on Earth.

The use of GPS has resulted in faster, more accurate and effective weapon delivery of conventional as well as nuclear warheads. Capability provided by satellite communication is best illustrated by the use of satellite communication for remotely controlling the drones flying over Waziristan by an operator sitting on the other side of the Earth at Creech Air Force base, near Nevada. Combining high-tech video surveillance, with the ability to deliver deadly fire, these drones allow joystick wielding US operators to track moving targets in real-time and destroy them.

There is a quantum leap in the usage of satellites for surveillance and reconnaissance due to the technological advances, resulting in much better resolutions as accurate as 0.25m, which is a thousand times better than the resolution of the "Corona" spy satellite of the US way back in 1961. The role of satellites in early warning, nuclear detonation, weather monitoring and close area surveillance has assumed great importance in any military operation.[10] In today's highly mobile battlefield, exact positioning and versatility can be a vital factor for the success of a mission. Early warning military surveillance satellites carry infrared sensors, which are designed to detect a missile launch by observing the characteristic infrared signatures of the exhaust from its rocket. Satellites also provide the capability to monitor communications as well as characterise the parameters and location of electronic warfare equipment and radar systems.

During the Cold War era, both superpowers had carried out numerous anti-satellite (ASAT) tests. In 1997, the US Army successfully blinded an ageing satellite by the use of laser.[11] The military use of satellites touched new horizons in 2007 when China shot down the Feng Yun-1C, one of its own 'weather satellite' orbiting 530 miles above the Earth.[12] With this demonstration, China also busted the notion that the US is still the uncontested leader in space.[13] A year later, the US followed suit by destroying its own satellite in orbit.

Navigation through satellites has brought in a revolution in military operations. Satellite-based communication coupled with better secrecy and low jamming probability has enabled swift military operations.

Satellites for military purpose need not be dedicated ones but information available from any commercial satellite source is also exploited for military usage. There are numerous examples where the capability of space-based applications to narrow down ground information within a resolution of less than a metre is exploited for military usage through commercial resources.[14] More than 80 percent imagery requirements of the US during Gulf War I were met through commercial satellites.

Space Technologies

The arrival of space technologies in the 1950s enabled development of space launch vehicles which were initially derived from military rockets. Subsequently, space technology facilitated orbiting instruments and cameras to take imageries of area of military interest and enabled information dominance through communication satellites.[15] Continuous exploration of space and technology progress has increased human reach into space and habitats on the Moon or Mars may soon be a reality. The main focus of space-faring nations in the future will be on reusable launch vehicles, microsatellites and improved cryogenic engines.

Launching the same vehicle into space repeatedly will bring down the launch cost by a great margin. Today, scientists across the world are working on reusable launch vehicles which have a low weight, strong heat shield to withstand disintegration while reentering the Earth's orbit, increased range, better propulsion and increased payload carrying capacity. The US has already achieved a few successes in this direction. The orbital test vehicle X-37B which

was initially launched on April 22, 2010, returned to Earth on auto pilot on Decemer 3, 2010.[16] Encouraged by the success achieved in the first flight, the X-37B left for its second secret mission on March 5, 2011.[17]

Micro/mini satellites are usually 100-500 kg in weight and are of immense use due to the low cost, requirement of smaller launch vehicles, possibility of piggyback launching and, most importantly, their ability to accomplish missions beyond the capability of larger satellites. These can also be used to gather data from multiple points and inspect larger satellites in orbit. NASA launched its new generation microsatellite, the fast, affordable, science and technology satellite (FASTSAT) in November 2010. A month later, another chapter in space history was written when FASTAT further launched the NanoSail D, a demonstration nano satellite, into space from space.[18] The role of microsatellites as an ASAT weapon in the near future is also possible.[19]

Cryogenic engine technology is crucial to launch lunar missions. India had started its cryogenic engine initiative in 1993 but the nuclear tests in 1998 aborted its progress due to various international restrictions. World leaders in cryogenic technology reacted by stopping the sale/ sharing of cryogenic technology to India. As such, low cost cryogenic technology available in India might have adversely affected their business interests. Indian scientists proved their worth by successfully developing the first cryogenic engine in the country in March 2003. These engines are required to launch heavy satellites into space. The technology is also crucial to execute manned missions into space.[20]

Future Trends in Space Initiatives

Which country will be the first to build a permanent outpost on the Moon? In 2006, NASA declared that they are planning to build up a permanent Moon base, with continual presence by 2024.[21] With the closing down of the Shuttle programme, NASA has realigned the focus to the Moon.[22] Although the Russian space programme is heavily constrained for funds, China and India have big space aspirations and are funding lunar efforts. One amongst these three nations could be the first country to build a permanent habitat on the Moon.[23]

Today, control of key geographical regions in space and exploiting them for one's own military advantage is the thrust area for all space-faring nations.[24] The longest human occupation in space till date is the International Space Station (ISS) which has been in existence for more than 12 years now.[25] It has

a length of a football field and weighs around 40 tonnes.[26] It is likely to be functional till 2015 and NASA is working to enhance its life till 2020. With the successful establishment of the ISS, the race for acquiring control in space had started long back and is cruising towards new destinations with every passing minute. [27]

NASA, ESA and other leading space agencies have their hands full till 2030 with a number of robotic and manned missions. In 2012-13, NASA is planning to land and operate a rover, named Curiosity, on Mars. NASA either independently or in collaboration with leading space agencies of the world is all set to launch another five major unmanned missions to Mars between 2016 and 2022. In the same period, Russia and Canada are also planning unmanned missions to Mars. In 2014, India will add another feather to its cap by sending the Chandrayan-2. This mission will be undertaken by the Indian Space Research Organisation (ISRO) in collaboration with Russian Federation Space Agency (RKA) and has a projected cost of Rs 425 crore.

Indian Civil Space Programme

India has made rapid advancements in space exploitation and has the fourth highest space budget.[28] With the PSLV, GSLV and GSLV Mark III as its launch vehicles and a wide range of geo-stationary Earth observation and experimental satellites, ISRO has come a long way and has made its mark in space technology.[29] Since its conception, ISRO has been focussing on achieving self-reliance and developing the capability to build and launch communication satellites for television broadcasts, telecommunications, meteorological applications and remote sensing satellites for management of natural resources. The Indian space programme has been unique, as unlike those of US and Russia, it was not motivated by military goals but driven largely to meet the socio-economic needs of the nation.[30] Presently, India has more than 30 satellites in orbit which itself speaks volumes about ISRO's fast growth in the last five decades.

As on date, Indian National Satellites (INSAT) for communication and Indian Remote Sensing (IRS) satellites for natural resource management are the two major satellite systems which are the backbone of the Indian space programme.[31]

Space Vision India 2025 talks about satellite-based communication and navigation systems enhanced imaging capability, reusable launch vehicles and human space flight in the times to come. As regards development of reusable

launch vehicles, ISRO has already initiated the 'Avtaar' scramjet project to develop reusable launch vehicles restricted to the launch of small satellites into low Earth orbit (LEO). The vehicle is proposed to be used for at least 100 launches. This will not only reduce the cost per launch but also restrict the space junk created by the burnt out stages of expendable launchers.[32]

ISRO has already geared up to establish a facility at Bangalore to train its astronauts for the first ever Indian human space flight. The government gave its final go-ahead to ISRO for the first manned space mission in 2009, which is likely to be launched in 2016.[33] This project aims at developing a fully autonomous orbital vehicle which will carry two to three members and go up to 300 km in LEO and ensure its safe return.

In 2012-13, the Chandrayan-2 will also be making its flight towards the Moon.[34] Launched on the GSLV Mk II, it will carry a Rover, which will land on the surface of the Moon, a step forward from Chandrayan-I which involved placing a satellite at 100 km altitude in lunar orbit.[35] In addition to the launches of the PSLV-C18 and PSLV-C19 at the end 2011, ISRO is also planning for the first experimental launch of the GSLV Mk III in 2012. This self-reliant launch vehicle will be capable of launching satellites weighing around 5,000 kg as against the current capability of 2,500 kg. The focus of the Indian civil space programme is on reusable launch vehicles, development of heavy lift launchers and human space flight.[36] There has been a growth of 38 percent in the budget allotted to ISRO in 2011 as compared to 2010.[37]

Indian Military in the Space Realm: 2030

Rapid advancements in technology and increasing integration of space applications with military operations have changed the overall concept of modern warfare. As part of India's aspirations to become a global leader in space, alongwith its civilian space capability, India must develop it military space might commensurately. The Indian military needs to adopt space technology so as to employ satellites to provide real-time positioning data of ships, aircraft or missiles, navigation to assist movement of ground troops, and so on.

Another key application of satellites which has immense relevance for the Indian military is the provision of a more robust command, control, communication, computers, intelligence and information (C4I2) system. Space-based meteorology applications by their suitable inputs and weather corrections can greatly enhance the accuracy of missiles and other weapons. Ballistic missile

defence has become the critical need of the hour with our adversaries acquiring greater ranges of missiles and all future conflicts forecast in a nuclear back-drop. Concepts vary from placing high energy lasers in orbit to mounting missile interceptors onboard satellites

As per newspaper reports, the Indian Navy is likely to get a dedicated satellite to facilitate its communication and network-centric warfare requirements.[38] Keeping in mind the vast frontages and difficult terrain manned by the Indian Army, it becomes critical that the Indian Army also have dedicated satellites to cater for its rising needs for battle space dominance as space is going to be the ultimate military high ground in the near future.

With the expertise gained by ISRO in designing, fabricating, launching and successfully operating remote sensing satellites, it won't be difficult for them to build and operate high resolution reconnaissance satellites for the extensive use of the Indian military. Currently, the Indian military is in the transition stage with regard to exploitation of space and development of space infrastructure for specific military use.[39] Space needs to be accepted as a tri-Service domain for defence by all the stakeholders.

During the seminar organised by CLAWS and PP Directorate on the "Indian Military in Space" held on June 16, 2008, then ADG PP, Lt Gen (then Maj Gen) AK Singh, AVSM, SM, VSM, ADC, stressed on the need and importance of utilising satellites by the Indian military. Lt Gen Singh brought out that in view of the enhanced exploitation of space for military applications by nations the world over, it was imperative for the Services to exploit space-based military applications to meet operational requirements.[40]

A 'Space Cell' under the Integrated Defence Staff (IDS) has reportedly been established and is the only single tri-Service window for interaction in space by all agencies. It is the coordinating agency among the armed forces and various space agencies. An Army Space Cell has also been reportedly established in the Army Headquarters (HQ) in 2008.

Some experts are of the view that the present arrangement is not adequate to fully exploit space and there is an urgent need to have a dedicated Unified Space Command. The Unified Space Command will have to deal with diverse and complex space related technologies to enhance the military exploitation of space, to provide planning, integration, control and coordination of the armed forces and space capabilities in support of the overall defence of the country. The Unified Space Command will be required to have different modules working under it, which will be responsible for

management of space assets and programme control, battle management to include intelligence, training of required persons and coordinate with ISRO, NTRO (National Technical Research Organisation) and various civil agencies. In addition, suitable staff from Ministry of Defence, Ministry of Finance and industry representatives will be needed to make the organisation more effective.

India also needs to articulate a comprehensive space policy demarcating the roles of the civilian, military and national security segments. This will facilitate a balanced and structured development of various space programmes.[41] The future is going to be filled with challenges as many space-faring nations have already taken noticeable steps in this direction. So the challenge would be to have a system in place as also ready to respond to the future space threats effectively. Keeping in mind the finances required, another challenge would be to identify a coherent strategy duly prioritised in terms of investments. The space situational awareness should be the top priority in this regard.[42] The growing interdependence of various space sectors needs to be understood and analysed very carefully. While doing all this, it needs to be ensured that we move towards a more responsive space control system which is required to continuously improve the exploitation of space for better military results.

Conclusion

The future battlefields are going to be modular and extending into the region of space. Any nation which progresses ahead initially in the exploitation of space will retain the edge, as the medium of space largely remains unexplored and undefined – available for "first come first use".[43] The growing need and dependence of military operations on space-based systems and space-enabled functions, processes and information demands a dedicated space programme for the Indian military. In the times to come, all civil and commercial space-based assets would be required to contribute for the Indian military's space-based requirements for effective defence.

Notes

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