CENTRE FOR LAND WARFARE STUDIES

SPACE – THE NEW FRONTIER
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SEMINAR REPORT

Background

India's highly successful space programme has strong civilian roots with emphasis on use of space technology for human & societal development. This is in conformity with its standing in the world as a proponent of peaceful use of space and whose policies pursue harmony and stability in the region. Recent technological achievements of ISRO have greatly expanded its abilities in pursuance of national goals. Despite the advances in the space sector, both the intrusion in Kargil and the terrorist attacks of 26/11 indicated deficits in the use of space assets for national security. Meanwhile, the security calculus has further expanded to include larger area and domains, which would require great support from space based assets. India cannot overlook regional and global developments in space and needs to institute measures to secure its assets and interests in this competitive environment.

Since the first Gulf War, there is an increasing dependence on terrestrial military operations in space and the demarcating line between strategic and tactical operations has diminished. Space would be integral to military capabilities in all future conflicts. Indian space programme cannot remain immune to these developments in the military sphere. Consequently, for the past few years there has been a gradual shift in the acceptability of their employment in support of national security objectives. Effective utilisation can only be achieved through appropriate doctrines and strategies. This necessitates clear and defined policies and a roadmap for setting up of the institutional framework. With the above in view, the seminar aimed to focus on the following:

- The global status and regulatory framework with respect to utilisation of space and implications for its military use.
- Space security concerns and the required response capabilities.
- Space applications/ technologies for the defence services and the capabilities of our adversaries.
- The supporting organisational structure including C4I2SR infrastructure that can augment and support these capabilities.
- Institutional mechanisms and HR requirements to meet the future challenges.
- Militarisation of Space.

The panellists who took part in the discussion were:

- Lt Gen VK Saxena, AVSM, VSM, Director General

- Maj Gen Sanjay Kumar Jha, AVSM, YSM, SM ADGPP & Space (Designate)
- Dr Ranjana Kaul, Space Law Analyst
- Commodore RS Dhankar, DACIDS (ISC), IDS
- Gp Capt Ajay Lele, Senior Fellow IDSA
- Brig R Jairath , BGS, Army Air Defence College, Gopalpur
- Col Vikram Nagpal, Director Space, Army HQ
- Mr. Arvind K John, Research Assistant, Observer Research Foundation

In addition, the seminar was well attended by serving officers of the Armed Forces, distinguished veterans, members of the strategic community and representatives from defence industries who shared their views on the subject.

Seminar Proceedings

Space: The Ultimate High Ground

The German V-2 guided missile, designed and realised by Dr. Wernher von Braun and Klaus Reidel during the Second World War, was a sub-orbital guided missile and the first man-made device to achieve this feat. Following the defeat of Germany, both the United States and Soviets managed to prise the rocket scientists and technologies from Germany. The USSR managed to put out the first satellite in orbit when Sputnik, the first communications satellite was launched in October 1957 on the R-7 rocket. The United States soon followed with the launch of Atlas A, the first ICBM and an improvement on the V-2 missile, in December 1957.

Throughout history, the militaries have wanted to gain the high ground to have advantage over the enemy. Space has and will continue to remain a military zone because that is how the great powers of the world entered into space – to attain the ultimate high ground. Since the 1991 Gulf War displayed the advantages of space assets in navigation and communications for armed forces, there has been an increasing demand for satellite services for military use. During operation Iraqi freedom, the US deployed 6,600 GPS guided munitions and over 100,000 precision lightweight GPS receivers in Iraq and used 10 times the satellite capacity and 42 times the bandwidth employed in the Gulf War of 1991. Op Geronimo is a classical example of space enabled strike capabilities in a seamless command & control environment where distances or geography had no meaning. Their use by the US forces, in support of its military operations in Iraq and Afghanistan, has been universally recognised. Some of the primary roles that space based assets provide to the military are:

- Imagery Intelligence.
- Navigation.
- Communication.
- Early Warning. Infrared satellite sensors provide knowledge of rocket/missile launches by detecting the hot plumes of missile exhaust.

- Meteorology. They provide weather data to the armed forces.
- Ocean surveillance.
- Technology Development and Demonstration. Satellites allow space flight experiments for the research and development community, ranging from basic research to advanced development.
- Anti-satellite systems.
    - Kinetic Kill Vehicles
    - Directed Energy Weapons
    - Manoeuvrable satellites to inspect, service or attack
    - Counter space initiatives – disrupt adversary's satellite-based communication

Space capabilities are force multipliers that in the high-tempo, non-contiguous, simultaneous framework of distributed operations, are essential for a well-coordinated and synchronised tactical capability. They integrate weapons systems, missiles, radars and sensors, unmanned vehicles, electronics and communications networks, aerial capabilities, logistics and support systems, and defence forces spread across a vast geographical area. The 21st century is seeing a shift from a nuclear backdrop to asymmetric warfare. Focus is on empowering the militaries in conventional warfare through space. The capabilities mentioned above enable the implementation of these concepts spanning six core warfighting functions viz:

- Command and Control – Space capabilities support this by providing intelligence and communication and enabling speeding up the decisional cycle. Network-centric operations mandate all services to be integrated by linking all the radars and sensors to the satellite system for early warning and control system.
- Intelligence - Space systems provide systematic observations of aerospace, surface, or subsurface areas; and places, persons, or things by visual, electronic, photographic, or other means that provide commanders with situational awareness within a given area. EW, ELINT and COMINT capability form part of this. Development of Space Based ISR Capability would entail integration and exploitation of prevailing and forthcoming advances in space based sensors such as multi imaging techniques. The integration should not be limited to just space-based ISR systems but also to corresponding air and surface-based systems.
- Movement and Manoeuvre - Space-based PNT systems support strategic, operational, and tactical missions by providing the military forces with essential and precise three-dimensional position capability. This along with a highly accurate time reference enable coordinated manoeuvre and concentrated direct fire to achieve a position of relative advantage over the enemy.
- Targeting – PNT systems along with weather and environmental sensors enable collective and coordinated use of artillery indirect fires, air and missile defence and joint fires through a deliberate targeting process.

- Sustainment – Sustainment function provides support and services that ensure freedom of action, extend the reach of operational forces and prolong their endurance. Space capabilities which support the sustainment function are the PNT and SATCOM.
- Protection - This function preserves the forces so that a commander can apply maximum combat power to accomplish a mission. Preserving the forces includes protecting personnel (friendly combatants and non combatants) and own physical assets. Space-based ISR and missile warning sensors contribute significantly to this ability.

The list of mission areas and mission support include space lift operations (launching and deploying satellites), satellite operations (maintaining, sustaining, and rendezvous and proximity operations), and reconstitution of space forces (replenishing lost or diminished satellites). Space force enhancement operations multiply joint effectiveness by increasing the combat potential, operational awareness, and providing needed joint force support. There are five force enhancement functions: intelligence, surveillance and reconnaissance (ISR), missile warning, environmental monitoring, satellite communications and Space-based positioning, navigation and timing (PNT).

Space superiority is the degree of dominance in space of one force over another that permits the conduct of operations by own joint forces at a given time and place without prohibitive interference by the opposing force. Space Control consists of Offensive Space control (OSC), Defensive Space control (DSC) and Space Situational Awareness (SSA). OSC is used to deny adversary freedom of action in Space and is based on negation and offensive measures. The purpose of space superiority is to secure the freedom to take advantage of the capabilities provided by space systems and deny the same to the enemy. Space force application operations consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through Space.

Space Security Concerns

It is difficult to define Space Security because this notion of security could have different interpretations principally based on country's national interests. However, essentially it includes those activities that ensure the sustainability, stability, and free access to outer space in support of a country's vital interests, which could be both civilian and strategic in nature. Space security is defined holistically through its four identified fields. They include the condition of the space environment, access to and use of space by various actors, security of the space system and outer space policy and governance.

Threats to space based assets could emanate from the cosmos or from hosts of man-made objects. Cosmos relates to those comets and asteroids whose orbits are in close proximity to the Earth and could be potentially hazardous. An asteroid of diameter 1km can cause extinction of life form on earth if hit. In 2012,

there were a total of 9448 near-earth asteroids of which 857 were 1km in diameter.
Space has become highly congested, contested and competitive, because of both military and commercial space assets. From two countries 50 years ago, today there are 11 countries with indigenous space launch capability and 60 countries that have access to space. New technologies, dual space assets, privatisation of the launch industry leading to space tourism and the validation of these technologies and capabilities has also allowed defence forces to look at outer space as another medium to use. This has resulted in a race for allocation of orbital slots, especially in the geo-stationary orbits, by the International Telecommunication Union (the agency that allots orbital slots and operating radio communication frequencies for space operations).

There are also constituents from man-made threats, most predominantly from orbital debris. The debris of FY1C satellite is an inner-orbit object that can kill another satellite. The anti-satellite test conducted by China in 2007 created debris of 150,000 pieces larger than 1cm, 79 percent of which will remain in the orbit for the next hundred years. Experts have found that there are over 300,000 junk objects in space. There is a need for situational awareness of the activities of various countries in space and space debris is a very important mandate.

Space Arms and Counter Space technologies have further enhanced the space threat scenario. As space becomes a medium to enhance national power, countries like US and China have displayed aggressiveness in the domain by testing or displaying their ASAT capabilities. The international laws related to weaponisation of space are soft and there is no acceptable definition of Space Security at the United Nations. The need of the hour is to find a global approach towards active space threat mitigation at the international level and building confidence within its strengths and limitations.

International Regulatory Framework and Military Implications. Even though we don't count the Partial Test Ban Treaty of 1963 as part of the cache of five international agreements on space, this treaty which prohibits all test detonations of nuclear weapons in outer space, air and underwater testing has an important bearing on space security. All countries with the exception of France and China have ratified this treaty. Concerns about space came into origin in the backdrop of nuclear realities between US and USSR during the post World War II era. Since US and USSR were the only countries operating in the space domain, they wanted to ensure that space was open for them to continue with their military technology development while making sure that neither was able to steal a march. The United Nations General Assembly passed a resolution called UNGA Resolution 1962 (XVIII) which recognised the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes. The resolution was adopted in December 1963 and it finds a reflection in the Outer Space Treaty 1967 (OST) which governs human activity in outer space. It lays down the conduct of human activity in outer space and rest of the

agreements, namely Rescue Agreement 1968; Liability Convention 1972; Registration Convention 1974 and Moon Agreement 1979 are an extension of certain elements. Majority of the countries have ratified the Rescue, Liability and Registration Agreements but the bigger powers have yet to sign the Moon Agreement as the Moon has vast resources that have yet to be explored. There has been opposition to any new space treaties since 1979.

Outer space includes the moon and other celestial bodies. It covers the orbits, orbital slots and the radio-frequency spectrum. Besides the military, the domain is populated by civil and commercial assets, which have economic and social development aspects attached to them. There is no definition in international law of outer space and it has emerged through practice primarily because the atmosphere becomes too thin for aeronautical purposes beyond 100kms. The National Air Space of any country extends till 112kms above sea level above the sovereign territory and adjacent territorial waters. The question of elimination of air-space and outer space has been on the agenda of Committee on Peaceful Use of Outer Space (COPUOS), a permanent body of the United Nations. Article I of the 1944 Chicago Convention, which is a convention of the International Civil Aviation organisation under the UN, allows the contracting states to recognise that every state has complete and exclusive sovereignty over the airspace above its territory. However, state and military aircraft are exempted from the convention vide its Article III. In contrast, application of sovereignty in outer space is prohibited. According to Article II of the OST 1967, outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means. Article I of the same treaty states that the exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. Article IV of the treaty prohibits weaponisation of outer space with countries not undertaking any efforts to place into orbits any objects carrying nuclear weapons or any other kinds of weapons of mass destruction. Article IV and the general scheme of the OST establishes that outer space can be used for military purpose provided it is not aggressive. However, Article IV does not prohibit the use of military personnel for scientific research or any other peaceful purposes and the use of any equipment necessary for peaceful exploration of the Moon and other celestial bodies. The OST does not expressly prohibit the development, testing, and deployment of conventional weapons in outer space; nor does it prohibit the development, testing, and deployment of groundbased systems that can reach targets in space using conventional, nuclear, or directed-energy kill mechanisms. Consequently, Article IV has often been cited to support the claim that all military activities which use outer space are permissible, unless specifically prohibited by another treaty or customary international law. This has allowed the non-reversible destruction of space objects. Article XI of the OST requires countries involved in outer space activities to inform the UN Secretary General, the public and the international scientific community to the greatest extent feasible and

practicable about the nature, conduct, locations and results of such activities. Henceforth, the exact number of military satellites and their applications is unknown and is kept privy to the country that has them. Also, no country is to engage in any activity that amounts to harmful interference in outer space. Article IX of the OST requires that the exploration and use of outer space shall be guided by:

- Due regard to the corresponding interests of all other States Parties.
- Avoid their harmful contamination, including introduction of extraterrestrial matter that may cause adverse changes in the environment of the Earth.
- Adopt appropriate measures if there is reason to believe that an activity or experiment would cause potentially harmful interference with activities of other States.
- Undertake appropriate international consultations before proceeding with any such activity or experiment.

The OST links the conduct of space activities with international law and with the UN Charter. Article III says that State Parties to the Treaty shall carry on activities in exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation. The UN Charter 1945 prohibits the threat or use of force against the territorial integrity or political independence of any state. It codifies the right of self-defence in a case of armed aggression. Article VI and VII impose international responsibility and liability for national activities in Outer space by government and non government entities. Any country that launches a space asset retains the ownership of that asset and is liable if the asset is harmful in any way to the sovereignty to another country.

There is an internal conflict between the international obligations and the national objectives. The scheme of the OST says that all countries must have the ability to continuous, uninterrupted, non-discriminatory and secure access to space. Any pre-emption in space would amount to a violation of the treaty as well as the UN Charter. The OST and the related treaties that are administered by the UNGA through the COPUOS do not talk about military offence. The weaponisation context is discussed in a multilateral forum called the Conference on Disarmament, which has conspicuous mentions in Fissile Material Cut-off Treaty 1993, Resolution on Prevention of Arms Race in Outer Race (PAROS) 1998, Draft Treaty on Prevention on Placement of Weapons in Outer Space (PPWT) 2008 and the Unilateral Security Assurances by Nuclear Weapon States (NSA). The Nuclear Weapon States assure not to attack non-nuclear states with nuclear weapons. The Convention on Disarmament has had some success but the foreign policies of various countries have stifled the progress.

The EU Code of Conduct for Activities in Outer Space, 2008 does not expressly authorise national security prerogative as a reason for the production of space debris which forced the United States to not support it. It has since

metamorphosised into the International Code of Conduct for Outer Space Activities, 2010 which are a set of voluntary best practices aimed at ensuring security in Outer Space. The idea of Code of Conduct is to get broad regional and global acceptance. China and Japan are supportive but India is yet to take a stand. China has also been pushing for its own Space Treaty Regime.

Since the introduction of the Moon Agreement in 1979, there is no appetite for another treaty-based mechanism to come into force for governance of space. Therefore, the global approach has been to find soft alternatives. However, the efficacy of soft laws, which are not binding on countries and have no legal provisions, is questionable. In addition, as the response to the Chinese ASAT showed, there has been reluctance to utilise even the existing mechanisms. Despite China being a signatory of the IADC debris mitigation guidelines, no country formally protested its ASAT test that created large amounts of debris. Additionally, entry of various non-state players could complicate the matter in absence of globally accepted regime.

The final document of the UN Group of Governmental Experts (GGE) that was constituted in 2012 has been presented. The GGE report is only to make a consensus, outline, conclusions and recommendations on transparency and confidence-building measures (TCBMs) in space sustainability and stability. The report does not shed light on any information that is not already available. India is in agreement with the idea in principle despite not being part of the deciding group.

In terms of the national nuclear doctrines, only China and India have a declarative, unqualified, unconditional no-first use policy. The United States have a qualified policy wherein they have expressed no use of nuclear weapons against non-nuclear states but retain the right of belligerent attack. In 1982, at a special session of UN General Assembly, the USSR pledged not to use nuclear weapons first, regardless of whether its opponents possessed nuclear weapons or not. This pledge was later abandoned by post-Soviet Russia.

The space-cyberspace domains are the new military high-ground. Both systems are critical in enabling modern warfare—for precision strikes, navigation, communication and information gathering. Presently, there is no international cyber law treaty. In 2012, US and Russia signed a Cyber Security Pact to regularly share cyber-security information. In April 2013, the Chinese agreed to work with the US on cyber-security because the consequences of a major cyber attack “might be as serious as a nuclear bomb”. There is a need for Indian defence services to get up to speed with these technologies.

India is a signatory to most of the international treaties that govern space activities. To be taken seriously in the international arena, it needs to redefine its focus and participate as an engaged partner which suggests and supports legislations that are implementable. India should take the initiative and suggest a

concrete action-plan which is then implemented under the auspices of the UN. India appreciates the fact that the major space players have the responsibility to shape the space security regime and no result can be achieved unless these players demonstrate the willingness to set an example. It should champion the cause of a weapons free space and take the lead to establish bilateral and multilateral mechanisms. It could position herself as a mediator and an initiator to garner international consensus for further strengthening treaties that aim to make space a conflict-free zone.

Regional Developments and Military Implications

To understand the regional footprints, there is a need to know the players, their nature of investments in space and the level of threat they pose for India. In the context of space, information is required on the hard power and soft power options available along with the prospects of a 'space race' amongst the regional players. India, Japan and China are the major developed space powers in the region while Israel, Iran, North Korea and South Korea are other space-faring nations. States like UAE, Malaysia, Singapore, et al also have business interest in the space domain. The primary focus of the investments of Asian countries in space is for socioeconomic development as satellites are able to provide huge amounts of database, which assist in land-water resources planning, meteorological assistance and communication. There is major opportunity for the future in Space Commerce and space tourism and service industry is starting to make great inroads in the region. Even smaller states like UAE and Singapore are looking at space tourism.

Japan, China, India, Israel and South Korea have declared interests in using space for strategic purposes. Dual-use technology is the key for intelligence gathering, communications, navigation and ELINT. Satellites of different shapes and sizes have been put up in orbits with varying perspectives and intentions. Japan has officially declared its military space agenda, which amounts to space-based surveillance and reconnaissance capabilities for military requirements. In January 2013, it launched a pair of reconnaissance satellites-a multiyear effort to rebuild a spy satellite network (Information Gathering Satellites, IGS). India launched its strategic satellite for Navy, the GSAT-7 in August 2013. China launched its first Yaogan Weixing satellite in April 2006 and the Yaogan Weixing-17 (A,B,C) in September 2013. Israel has launched Amos-4 satellite with military payload. The number of imaging and military communications satellites in Asia is increasing. India is becoming self-sufficient in space navigation while China also boasts of a major navigation programme.

The security challenges for the region are very intricate because almost every part of the region including West Asia, South Asia and East Asia is a conflict flashpoint. The region has extremely complex nuclear footprint and any intentional destruction of a satellite could quickly escalate the ongoing conflict. Even acts like jamming of satellites or the construction of space-based weapons

could lead to increasing tensions. In the realm of counter-space technologies, ASAT is a global challenge. Specific acts by states in the region could increase the concerns of the other states within the region. Even India's legitimate actions could come under criticism.

To put the space security milieu into perspective, the South Asian region has two space-faring states in India and China and three nuclear weapons capable states. All these states are missile capable too. During the 1980s, the Chinese and Indian space programmes were almost at par. With the breaking up of the erstwhile USSR, China was able to make use of the Soviet human resource to take a leap forward in both aeronautics and space. It has since become the most important player in space domain in Asia, with an impressive space inventory with Russian dependence and a focused well-articulated strategy. It does not maintain strong separation between its civil & military space programme. Its national defence strategy is based on active defence and this applies to space. The Chinese have an ambitious outer space and deep space agenda with the roadmap having nationalism, foreign policy, commerce and security connotations. China has a network of space-based ISR sensors, space-based SAR, its Beidou Navigation System and spy satellites.

On May 13, 2013 China launched a rocket from the Xichang Satellite Launch Center (called it a high-altitude scientific research mission), probably a covert test of a new ballistic missile related to China's anti-satellite (ASAT) programme. Three Chinese satellites (Chuang Xin-3, the Shiyan Weixing-7 and the Shijian-15) were launched together on July 19, 2013. Shiyan 7 made a sudden manoeuvre on Aug 19, 2013. It was a surprise rendezvous with a completely different satellite, Shijian 7 (SJ-7, Practice 7), launched in 2005. China's threat perceptions are not India-centric; rather they centre on the United States. The Chinese space programme started as a military programme while India started in the civil domain with the objective of socioeconomic development. In the civil and military domain, China also has other programmes running like the manned space mission and the space station programme but these might not have enough spin-offs. China has major advantages in terms of their Beidou navigation programme involving the compass series of around 35 satellites, which started as a continental system but has grown into a global project. As far as their strategic requirements are concerned on the weaponisation point of view, China is capable of developing both hard & soft kill capabilities – ASAT systems, ground based and space based jamming technologies. It has already demonstrated its hard kill capabilities and is much ahead of India in this realm. Micro and nano satellites could be easily converted space weapons/space mines and there arereports of Chinese investments into parasitic satellite technologies. There is research going on in the field of on-orbit servicing, space debris removal technologies and Operationally Responsive Launch capability. China is exploiting the soft power options that its capabilities in space afford it and has used it as a foreign policy tool by making significant investments in Africa, Latin America and South-East Asia. Besides Pakistan, other states that could potentially benefit

from Chinese help in space are Myanmar and DPR Korea. China is already offering military rights to the use of its Beidou navigation system. It could also look at ground infrastructure in smaller countries like Nepal, Bhutan and Bangladesh.

Pakistan's space ambitions are still in the nascent stage but could flourish with help from China. The diabolical nexus between the two could help Pakistan, already a missile power, to develop or test ASAT capability. Possible trends in the region could see Iran developing space deterrence if they fail to develop nuclear deterrence. Israel could opt for ASAT capabilities to defend their space systems while Saudi Arabian activities also need to be watched. In case of failure of development of any reasonable space security architecture, states like Japan, South Korea and India could demonstrate debris-free ASAT. Security connotations of increasing involvement of non-state players also need to be factored in.

There are some multilateral mechanisms available in the region. The Asia-Pacific Space Cooperation Organisation (APSCO) is an intergovernmental organisation to promote peaceful use of Outer Space in the Asia-Pacific Region. The convention was signed in October 2005 by eight countries -Bangladesh, China, Indonesia, Iran, Mongolia, Pakistan, Peru and Thailand. Presently it has 16 members that do not include India and Japan. The Asia-Pacific Regional Space Agency Forum (APRSAF, 1993) is a 30-member regional mechanism with India and Japan as the main actors. None of the ASEAN member states are space-faring nations. However, ASEAN+3, i.e. China, Japan and South Korea and with dialogue partners like India, there is good ongoing science and technology collaboration. Also, the Sub-Committee on Space Technology and Applications (SCOSA) is functional. China has been keen to push space agenda at various meets and summits, particularly via SCO declarations.

The Indian Space Programme began keeping in mind our civilian needs and it gave prominence to communication and remote sensing satellites. While space has emerged as an important element of our national security policy today, ISRO's space mandate is civilian in nature. Indian communication satellites are used for television broadcasting, weather forecasting, disaster warning and search and rescue missions. Our Remote Sensing Satellites include IRS-1C, IRS-1D, IRS-P3, Oceansat-1, Resourcesat-1, Resourcesat-2, Cartosat-1, Cartosat-2, Cartosat-2A, RISAT-2, RISAT-1, and SARAL. In total, since our first space launch in 1963, Indian Space Research Organisation (ISRO) has launched more than a 100 missions and has a robust space structure in place.

Besides launching satellites in LEO and GEO, the missions to the Moon, Chandrayaan and the mission to Mars, Mangalyaan mission have been very important milestones of scientific achievements. The Space Capsule Recovery Experiment of 2007 can be deemed to be the pre-cursor of an Indian manned space flight in the years to come. India is in the process of fielding two space-

based navigation systems, the GAGAN and the IRNSS. IRNSS and GAGAN have expanded India's reach in the global market and much work is being put in to increase the country's footprint, both in the military and civil space domain. Though GAGAN has been operational, India is still lagging in the development of the receivers, which continue to be imported. These developments are testimony to the country's multi-dimensional space programme evolving over the years standing today self-reliant and technologically robust. From the initial Satellite Launch Vehicles SLV-3, we have graduated onto the PSLV and GSLV series (Mk 1, Mk 2, Mk 3, D5). Each launch has been a step forward and kept us abreast with the pinnacle of technology. India's space programme has helped to raise its stature internationally but it needs to use space expertise to enhance its geopolitical influence.

Post Kargil the Subrahmanyam Committee recommended dedicated space based assets for the defence forces, which included elements of human resource as well. As a result of the report, space based surveillance programme was implemented and our IRS capabilities improved and orbital spectral was enhanced. Over time, the need was felt to exploit the outer space to develop our capabilities to address our strategic concerns, with the area of interest from India's perspective extending from the Persian Gulf in the west to the Malacca Strait, with core area being the Southern Asian region. The strategic Developments in the neighbourhood, such as China's ASAT test of 2007 and its nuclear and other technology proliferation history have been instrumental in dilution of the strong Indian stance against militarisation of space. Indian scientists have begun designing space programmes to enhance our capabilities in the outer space with a focussed agenda that is driven by the National Security Advisor (NSA), Ministry of Defence (MOD), Ministry of External Affairs (MEA) and the three services. Recently in July 2013 a dedicated GSAT-7 was launched for use by the Navy. In the near future IRNSS will have its own spinoffs for the defence forces. DIPAC and DSCC were also established during SBS-1.

The Indian Space Programme is guided by the Allocation of Business Rules of the Department of Space along with domain-specific policies on remote-sensing, communications, meteorology, etc. A comprehensive national policy or legislation that deals with diverse space activities undertaken by the country is lacking. Space has become a critical facet of the nation's sovereignty, security and comprehensive national power. There is a requirement of laying down India's national space policy based on the current realities and the likely trend lines of the future, keeping in mind the regional and global aspirations. The space aspects of national security need recognition and a national space security policy needs to be defined as a subset of national security policy/ national space policy. This should cover the security environment and other security imperatives related to the space domain and national space capabilities. A comprehensive, publicly articulated space security policy would give the broad direction for harmonising space for security and also allow interlinking of ballistic missile defence with space security and space capability.

Military is the nation's force of decisive action and space is the nation's decisive enabler. Services must take a more influential role within the national security and space communities to ensure that current and future space capabilities are developed and leveraged to support decisive action across the complete range of military operations. India must integrate Space capabilities for national security and Services need to function as a full space partner by funding, developing and fielding organic space capabilities. They can jointly develop a capability generation plan through involvement of both technical and military minds.

There is a need to harmonise our potential such that we can meet our global aspirations and strategic needs. Compulsions of national interests endorse the approach that capabilities for defence should not be divorced from the economic and commercial uses of Space. These need to be regarded as challenges to be overcome jointly in the larger national security interests and prevalent threats. Given that space is an extremely important segment for India's security architecture and the environment in the sub continent, it is paramount that we continue to invest more in military space assets. Today we are strong enough to make that transition towards a more militaristic space programme, one that is dedicated to the military rather than a dual use one that has been followed so far.

Weaponisation of Space. Weaponisation is generally referred to the placement in orbit of space-based devices that have destructive capacity. Traditionally we make a difference between militarisation and weaponisation of space. However, with the emergence of new technologies, weaponisation of space might have already become a reality. The OST does not stop conventional weapons being developed, deployed and tested. It does not stop the ground-based system that can harm objects on outer space. It does not stop sensors or devices in space than kill targets on ground. It does not stop military activity in outer space unless prohibited by any treaty or definition. OST can only stop the activity of harmful interference. There is also the problem of lack of proper definitions for various terms and there is so much ambiguity in the legalities of this treaty. The aggressive policy statements of the advanced space faring countries, such as the US foreign policy statement that talks of establishing space dominance by denying access or limiting space capabilities of others, are potentially destabilising. Domination of space by few with proven ASAT capabilities could always 'influence' others to think of joining the 'club', leading to instability.

With the trend of greater weaponisation of the space, India cannot afford to ignore the developments in the region. Space has emerged as the fourth dimension of warfare (along with land, air and sea), no longer a force multiplier, rather a battlefield in isolation. Since ASAT is a real threat, future Indian space assets must have redundancy and satellite protection measures like satellite hardening. There is a need to develop redundancy measures that would include Operationally Responsive Space capability.

Developing capabilities for space based force enhancement and other defence and intelligence related activities in space still allows for the continued use of space for peaceful purposes. We would however have to develop increased capability for awareness in space and the ability to monitor activities and intentions to avoid being surprised by an adversary. In the future, there might be a requirement of protecting our vital national interests and assets by developing space application capabilities and capacities for Space Control. This could involve retaining the right to weaponise space to meet national security objectives. Such measures would however have a destabilising effect on space security.

Ballistic Missile Defence. India is surrounded by two declared and symbiotic nuclear powers. There is a diabolical nexus in the field of missiles technology and nuclear armament among these countries. Therefore, India must build an effective Space enabled missile defence system to counter any threat from these countries. A missile defence system without any military satellite network has no efficacy.

Developing HR Capabilities. ISRO is the fountainhead of space related research facilities and HRD. The department of space has started its own academic institutions to build up its human resource and has a well developed HRD programme. We have a robust civil space infrastructure and human resource capital in ISRO and DRDO. At present ISRO has sanctioned manpower strength of 7500. This is likely to be augmented by 1100 personnel during the 12^{th} plan period. It has approximately 27 facilities related to space activities out of which the following five are specifically devoted to HRD:

- Indian Institute of Space Science and Technology (IIST) has been established to meet the demand of the Indian Space Programme. The institute offers bachelors degree in Space Technology with specialisation in avionics, and engineering.
- Indian Institute of Remote Sensing (IIRS) trains professional in field of Remote Sensing, Geo-informatics and GPS technology.
- National Natural Resources Management System (NNRMS) conducts multi-theme and multi-level training programmes and awareness programmes.
- Centre for Space Science and Technology Education (CSSTEAP) in Asia and the Pacific conducts courses for foreign students.
- Development and Educational Communication Unit (DECU) conducts courses in societal application, tele-medicine, tele-education.

Based on the vision envisaged by the armed forces in the Defence Space Vision 2020, there is a need to create a strong military space culture. This could be achieved through a focus on developing the requisite equipment and infrastructure while at the same time creating a pool of space professionals with core competencies, through education, training and appropriate career development. Training should be made more inclusive, integrating civilian

professionals and scientists from DRDO and ISRO into the services' space development efforts. Such professionals would also form part of the training effort of uniformed personnel to create skilled manpower. Training is essential at tactical, operational and strategic levels to exploit full range of combat capabilities and thus be structured according to the target set. At one end it would involve educating general staff and leadership and would stress on application of Space systems to combat operations and space security. The other would involve training system engineers and operators. The manpower requirement of the rapidly developing space capability will also increase.

The current training within the armed forces is restricted to efforts of each individual service with the courses being conducted addressing only few facets of space application i.e. satellite communication and remote sensing. There are no structured courses dedicated exclusively to space security. Presently foundation courses on space technology for individual services and HQ IDS are being conducted at Space Applications Centre (SAC), ISRO, Ahmedabad. However, this effort is considered inadequate and needs to be enhanced in scope of labour and number of participants. Imagery courses at National Remote Sensing Centre (NRSC), Hyderabad are being conducted for officers of all three services. On completion of training these officers are being appointed to DIPAC, DSCC and the intelligence directorates of the three services centres. In addition M. Tech. programmes in Space Technology at SAC are also being offered to select few defence officers. Finally a case has been initiated to subscribe at least five officers for training at NSSI, USA, a premier space institution. The estimated manpower devoted to space related activities presently is in the range of 300 and the projected manpower to achieve functional space defence capabilities is estimated at 2000, thereby requiring large increase and transformation in the training effort.

Space Application Training. Space based assets are going to affect all terrestrial operations in the future and it is imperative that our future leaders should be well informed to harness and exploit space capability optimally and integrate these capabilities into military decision making process. These space leaders would be also expected to provide vision, technological expertise, doctrine, concepts and tactics to operate Space Forces. They would also lay down the policies to generate the cadre of space professionals. Thus this would require appropriate training throughout all echelons of command. Training must commence for officers during the young officers' courses of the respective services where they are sensitised to the importance of Space in Military Operations. Space operations' concept and elements of space technology should be included in the syllabi of Joint Services institutions like DSSC, CDM, NDC and HCCs. Short capsules on Space technology and operations should be made essential for all senior officers of the Armed Forces and decision makers in MoD associated with Defence Space programme. Senior military officers, prior to assuming defence Space appointments, must undergo a module on Space

Policy and Space Vision. We also need to train our junior/ mid level officers on Space operations in advance space faring nations like USA, Russia & EU.

Technical Training. Space systems would always be state of the art technology and thus require highly skilled work force including qualified maintenance and support personnel. A cadre of dedicated and capable space professionals, trained in related scientific and engineering disciplines, is needed to develop comprehensive space capabilities to defend national space interests. Technical programmes would have to be introduced/ modified/ enhanced to lay emphasis on space technology. Centres of excellence need to be created for space defence studies focusing on aeronautical, avionics, space & propulsion engineering. Specialist training modules are needed to train maintainers in specialised vertical areas like SATCOM, SSA and Ground Support Systems. Trainers could be trained at institutions like SAC, IIST, NRSC, CSSTEAP etc. Specialist officers should undergo requisite training modules with hands on training on equipment at training schools and OEM's premises. Technical expertise can also be built by sending technical officers to institutions of higher learning like IITs, IISc, IIST and similar institutes abroad. Individual services should develop space professionals to fulfil service specific requirements while also catering to inter services and Joint Services' postings. Exchange of personnel amongst organisation will improve manpower base. This, along with close relationship among research, development, acquisition and operations will increase understanding of each others' problems and issues. Human Resource Development issues related to space in the militaries have been a matter of concern the world over. There is a requirement to learn lessons from programmes in other countries to develop and maintain the space cadre the nation needs.

Career Development and Performance Management. Advances in the domain would require space professionals to have depth of experience, extensive education and training. This can only be achieved through emphasis on technical education, throughout one's career and through longer and more stable tenures in dedicated positions. Personnel Directorates of Service HQs need to have a data bank and comprehensive view of all space career positions and the means to manage individual assignments among the acquisition, operations and intelligence divisions. Career tracks need to be developed to create leaders with greater depth and breadth of experience in space career fields and to equip commanders at all levels with expertise while also ensuring career progression for such professionals. The lack of an integrated higher defence organisation dealing with space has meant that HRD policies with respect to space related manpower have also largely remained fragmented – more suited to respective service headquarter needs. Individual and career development of the services' manpower also remains the prerogative of the respective Service HQ. The most logical way ahead would be to build a majority of space capability jointly, to include human resource.

Organisational Requirements. There is a vibrant Integrated Space Cell (ISC) at HQ IDS, which has enunciated a “space vision” through its Long-Term Integrated Prospective Plan 2012-17 and progress is being made on a tri-service basis. Future space requirements are being considered in the 13th, 14th and 15th five year plan periods from 2012-2027. A Space Plan 2020 is also being conceived. There is reasonable interaction between the respective service directorates for coordinating efforts towards enhancing space capabilities. However, the lack of a completely integrated higher defence organisation impinges on the desired growth of capability. After due deliberations, a consensus was evolved amongst service headquarters for the need of a joint space command and a proposal was sent to the MoD in October 2013. Establishment of a Joint Space Command would provide unity of effort and coordinate Services’ common endeavours, thereby increasing efficiency and reducing duplications. The Space Command would enable integration of capability for joint war fighting and ISR operations and also act as nodal agency for space system/ capability development and acquisition. Meanwhile, we need to create suitable inter services organisation structures to enhance defence space capabilities. As part of space awareness initiative, institutions like IDSA, CLAWS, NMF, CAPS, CENJOWS etc. should be encouraged to undertake research on space policies and technologies and conduct seminars/conferences/round tables on current space issues on a regular basis.

Partnerships. Space activities until 2000 were purely in the government’s domain with no private partnership. Since then, the space programme has aimed at bilateral and multilateral mechanisms towards collaborative ventures by sharing costs and technologies. ISRO is inviting partnerships based on the PPP format and is trying to expand the country’s influence in the sector. Antrix (the marketing arm of ISRO) has been successful in forging partnerships with the private sector, which has made forays into the civil space domain. However, we need to take this partnership to the next stage. Though we do not have a space policy, a citizen’s charter exists which states that private satellite systems will be allowed along with 74 percent FDI. However, no private satellite has been launched and we need to move from merely granting licenses to the private players on to the next stage of possibly having a private launch vehicle. This would enable large private entities to increasingly compete for civil and commercial space segment leaving the government agencies to focus on national concerns. The emergence of private industry in the satellite arena would also necessitate the government to adopt at the national level an unambiguous, transparent and user-friendly legal regime that covers all stakeholders involved in the programme and one that encourages cross sector cooperation in space capability enhancement. The policy should also address issues related to IP Rights that arise because of transfer of technology in the fields of communications, computers, electronics, optics and remote-sensing gathering.

Space Situational Awareness. Satellite launching worldwide has created a situation where the orbital bands are getting increasingly cluttered, especially the

Lower Earth Orbit (LEO). Risk of collision with another satellite, debris or a cosmic object rises exponentially and threatens space security. There is currently no global space surveillance network, largely due to the sensitive nature of the surveillance data. The American Strategic Command's Joint Space Operations Centre detects, tracks and identifies space objects through an elaborate network of 29 ground-based radars across the world and at no cost to the international community. Though it warns other governments and agencies of the risk of collision if any, it does not share all parts of information and only puts that information in public domain that they perceive will not be detrimental to their national interests. It would be in the interest of every stakeholder in the space community, including commercial ones to overcome the barriers to data sharing and promote sharing of satellite positions and data collected from own national space surveillance networks. Russia, France, Germany, China, Japan, Canada and India to some extent are some other countries that possess such national capability. India could enter into a collaboration where ISRO's Telemetry, Tracking and Command Network (ISTRAC), which keeps track of the satellites in the LEO and the Indian Deep Space Network could link with the SSA programmes with other countries in an architecture that allows sharing of space surveillance data through common data exchange and communications protocol. Besides contributing to space stability and sustainability, the endeavour will help exemplify transparency in the intentions and nature of Indian space programme.

International Cooperation. The quest and competition for these capabilities has evolved into a new world space order with interdependent and dominant relationships of nations. After hosting the 39th Scientific Assembly of the Committee on Space Research in 2012, India is now ready to take the collaborative approach further, cognisant of the fact that space ventures come with hefty price tags and are technologically challenging. Thus, it would be beneficial to collaborate with other developed and well-meaning space-faring countries, especially in the field of emerging technologies, space sciences and beyond earth missions for civil and commercial purposes. The strategic pay-offs of such ventures would exponentially harness the existing structure. Forays in the commercial sector and international partnerships in satellite construction broaden the spectrum of multilateral tie-ups. Partnerships with international players also provide foreign policy pay-offs. Such alliances could even influence the global space order.

Launch Capability. The country's launch capacity is 3-4 launches per year. This is used to meet both the domestic needs and promotional launch facilities using the two launch pads. India can ill-afford to stagnate at this rate and there is a need to look into plans for feasibility of another launch pad. Sriharikota was chosen specifically for the geostationary launch because of the eastward launch capability with the launch vehicle taking the payload over water. There is requirement of another polar launch site because during a polar launch from Sriharikota, we lose about 15 percent of the payload due to the dog-like manoeuvre over Sri Lanka to avoid populated areas. India could also enter

collaborative ventures with countries in the sub-continent and establish launch sites at places near the equator. Malaysia and Indonesia have adequate coastal land that is east facing and have fairly well developed domestic space assets but both countries lack indigenous launch capabilities. The non-availability of heavy lift capability has restricted the progress and India has failed to commercially exploit the scientific capabilities.

CLAWS RECOMMENDATIONS

Space was militarised with the launch of the first satellite into space. Subsequent international legal instruments related to space have also accepted the use of space for supporting military operations. In the 21st Century, militarisation of space cannot be wished away. Therefore, there is a requirement of clear public acceptance by India of its use of space for military purposes. At the same time it should strongly oppose any steps towards weaponisation of space. For this, it should be proactive in global forums against weaponisation.

A national space security policy needs to be enunciated as a subset of national security policy. This would help different organisations to devise their own long term security plans using space assets.

The requirements of the Services are presently being met through dual use of space assets. Dedicated space assets would however be required to meet their increasing demands. These can be defined and developed after due consideration and interaction among the involved agencies. A paradigm shift is needed from the philosophy of utilising whatever is available to developing dedicated assets.

Security of space assets is a major concern. Defensive measures for all future satellites and their associated systems must be put in place. Development of offensive capabilities in space as a credible deterrent should be discussed as an option.

Optimum utilisation of assets by the services, in a resource constrained country, can only be achieved through a tri-services integrated Space Command. Such an organisation would also contribute to jointness of operations.

Increased usage of space and deployment of dedicated assets in the future would need to be supported through appropriate human resource development. The Services need to define their individual and joint training to meet general service and specialist requirements.

To meet increased demands as well as redundancy requirements, there is a requirement to develop another launch site at a new location for PSLV launches.