

Space for defence in India

October 2022



Preface

Today, armed forces across the globe are rapidly improving in terms of warfare strategy and technological innovation. Modern conflicts are seeing the growing use of cyberthreats and deployment of space-oriented intelligence systems like advanced imaging satellites and sensors. These technologies have the potential to increase lethality and reduce the observe–orient–decide–act (OODA) cycle time, which in turn can boost combat effectiveness.

With technology revamping warfare and the ever-changing geopolitical scenario, integrating defence with space could help in strengthening the defences of our country. Past and ongoing conflicts have demonstrated the importance of satellite imagery not only during war but also in the grey zone and during peacetime. This report looks at how India can integrate its Armed Forces with new-age space innovation.

India's space industry is taking centre stage due to its indigenous innovation and Government policies. Technologies such as hyperspectral imaging, satellite-based navigation and advance satellite sensors are the need of the hour for the Indian Armed Forces. This report presents a detailed approach on how India can enhance its military through policies, organisational structuring and integration of advanced space solutions.

The Government (military, defence R&D organisations and the public sector), private sector and academia need to come together and take ownership for developing strategic capabilities. Although the private sector needs to play a major role in the realisation of this vision, the Government must also act as a facilitator in integrating military and civil capabilities with its defence ecosystem.

PwC's strategy is aligned with the vision of combining human ingenuity, experience and technology innovation in order to deliver sustained outcomes while building trust. This report mirrors the strategic focus on achieving India's potential to establish a strong defence ecosystem as a space-faring nation.



Vishal Kanwar
Executive Director
Aerospace and Defence, PwC India

Message from SatCom Industry Association (SIA)-India

It is heartening to note PwC's initiative in bringing out a position paper on integrating India's space sector with defence at a time when national security is among the top priorities of the state.

The service requirements of the country's defence sector have traditionally been met by state-owned agencies, the Defence Research and Development Organisation (DRDO) and Indian Space Research Organisation (ISRO). The current rising demands, from within the defence sector and allied areas, call for massive augmentation of capabilities as well as capacity, necessitating larger involvement of the private sector in integrating the activities of the space sector with those of the defence sector. The activities that need to be harmonised include end-to-end designing and manufacturing of space-based systems meeting defence needs and their application in the areas of observation, communication, navigation and so on. This will not only assist the country's Armed Forces, but also potentially place the nation in a stronger position from the national security perspective.

In this context, it is necessary that an enabling-cum-regulatory framework is put in place forthwith. It should clearly spell out the mechanisms for developing and manufacturing advanced space systems and their deployment, with a unified space ecosystem comprising the government and private sectors working harmoniously for the cause.

India is witnessing the emergence of indigenous innovation in the defence as well as space sectors. The 100 plus start-ups, around 400 micro, small and medium enterprises (MSMEs), large corporates, and defence public sector undertakings (DPSUs) working in space sector activities could together form a formidable workforce in the country, and help develop the required systems, products, and services much faster. In the process, they will contribute substantially to the nation's space economy as well.

Further, as a major space-faring nation, India needs to ensure a congenial environment for start-ups to grow and leverage the situation for business gains and forge ahead in the global arena too.

I hope that this position paper will be useful in integrating India's space and defence sector activities in allied areas and in putting the right mechanisms in place to achieve this objective.



Dr. Subba Rao Pavuluri
President, SIA-India

Message from PwC

To sustain and secure India rising global stature as well as growing aspirations, its needs to strengthen its national security capabilities. Defence space will play an increasingly important role in this context. The challenges and complexities of the present security landscape are increasing by the day. The technology asymmetry between India and its adversaries needs to be addressed on priority. Building strategic and technological superiority in the defence space through collaboration between the Government and private space enterprise is critical.

Space technology is no longer limited to civilian applications and is being leveraged for military purposes to protect borders and secure national interest. Specific areas around communication, remote sensing and navigation impact space application in defence. Technologies like hyperspectral imaging, satellite constellations, infrared sensors and space situational awareness (SSA) are assisting the military in monitoring and tracking threats and reducing the OODA cycle across the spectrum of warfare.

Modern warfare has also evolved with time, and non-kinetic warfare (Command, Control, Communications, Computers [C4], Intelligence, Surveillance and Reconnaissance [C4ISR], net-centric warfare, cyberwarfare, etc.) are taking centre stage. The military effectiveness and lethality of non-kinetic warfare is largely influenced by space-based systems. Non-kinetic warfare can also impact non-military domains by crippling a state's economy or hacking into confidential information pertaining to national security. The increasing number of Indian start-ups and MSMEs developing these technologies need to be incubated and funded to leverage the space sector and enhance combat effectiveness. The DRDO has already successfully demonstrated its capabilities to develop solutions to defend our assets in space through the anti-satellite (ASAT) missile mission.

India has the capabilities and skills to develop advanced indigenous solutions to leverage space-based solutions for the Armed Forces. The need of the hour is to innovate and develop cutting-edge technologies in space for defence in the areas of remote sensing, satellite communication, and reliable and accurate navigation. This will make India's defence programme more resilient and enhance its combat power.



Sudhir Singh Dungarpur
Partner, Advisory
PwC India

Having completed 75 years of independence, India is now at an inflection point. It is set to become the most populous country and on the back of its rapidly growing economy, the world's largest democracy has been strengthening its position in the global arena. However, India is also located in a hostile neighbourhood. To defend itself and project power regionally and globally, there is a strong push for the country to strengthen its national security capabilities. The defence space is thus emerging as a critical domain and is likely to be a game changer. There are two aspects to this domain: defending space capabilities that will increasingly become vulnerable, and using space in situations of war. In both cases, the core space infrastructure will come into play, and thus we need new energy to enable India to become a leader in both use of space for defence and the defence of space.

It is our belief that unlike conventional war, this requires a 'whole-of-nation' approach, with the service sector, Ministry of Defence (MoD), private sector, and research establishments coming together. In this context, we have proposed various ways for utilising space for defence comprising Intelligence, Surveillance and Reconnaissance (ISR), communication, navigation, and electronic warfare. This paper presents a strategic view on how India can use its space sector strength to become a global leader in the defence space within a decade. Neither the public nor the private sector alone has the skills to enable India to become a leader. Instead, both must collaborate and invest in R&D, manufacturing and software. Further, considerable investments are required consistently over the coming decade. However, apart from the USD 8 billion market that can be created through this effort, several civilian downstream businesses will also come into existence. The strategy requires financial as well as technological investments in areas such as SSA, technology-enabled advanced manufacturing, artificial intelligence (AI)/machine learning (ML), quantum computing and immersive technologies.

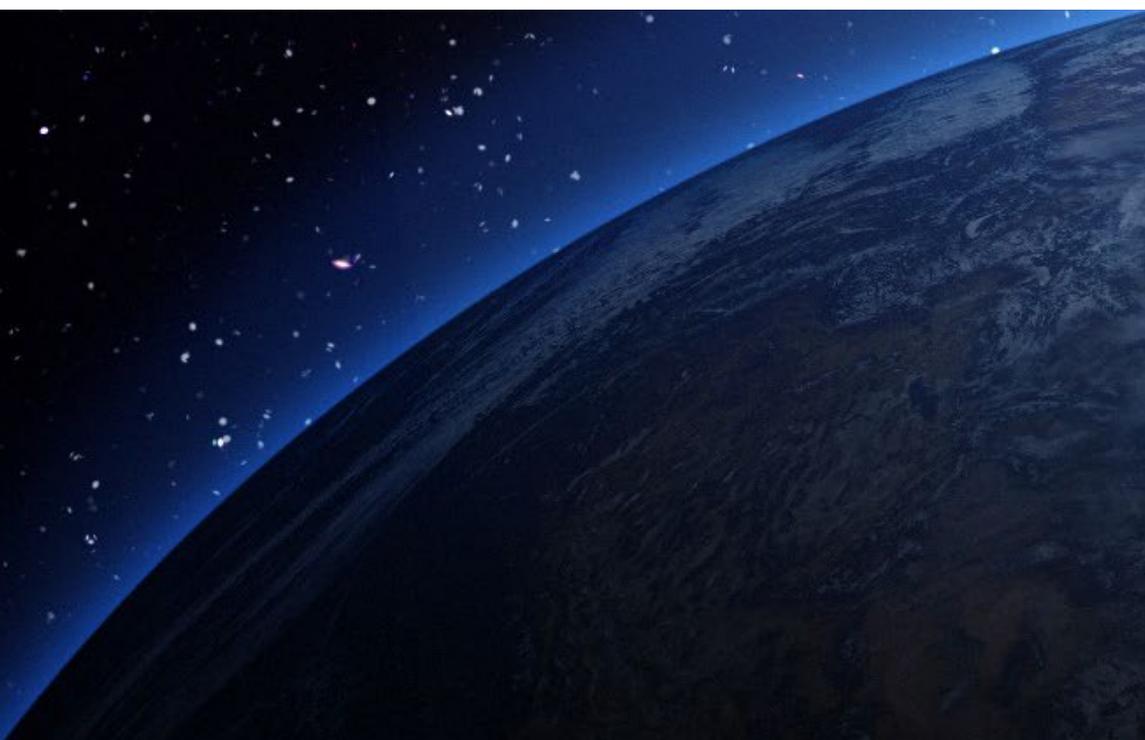
This report aims to stimulate discussion around the collaboration required to develop the space and defence industry. It would be relevant to private companies in space, defence, IT services, new start-ups in emerging tech, as well as public sector units and the defence ministry. In the next decade, space technologies will enable India to strengthen its defence sector. Moreover, the development of the country's strategic capabilities will also boost the technological growth of its civil sector, and thus increase the GDP.

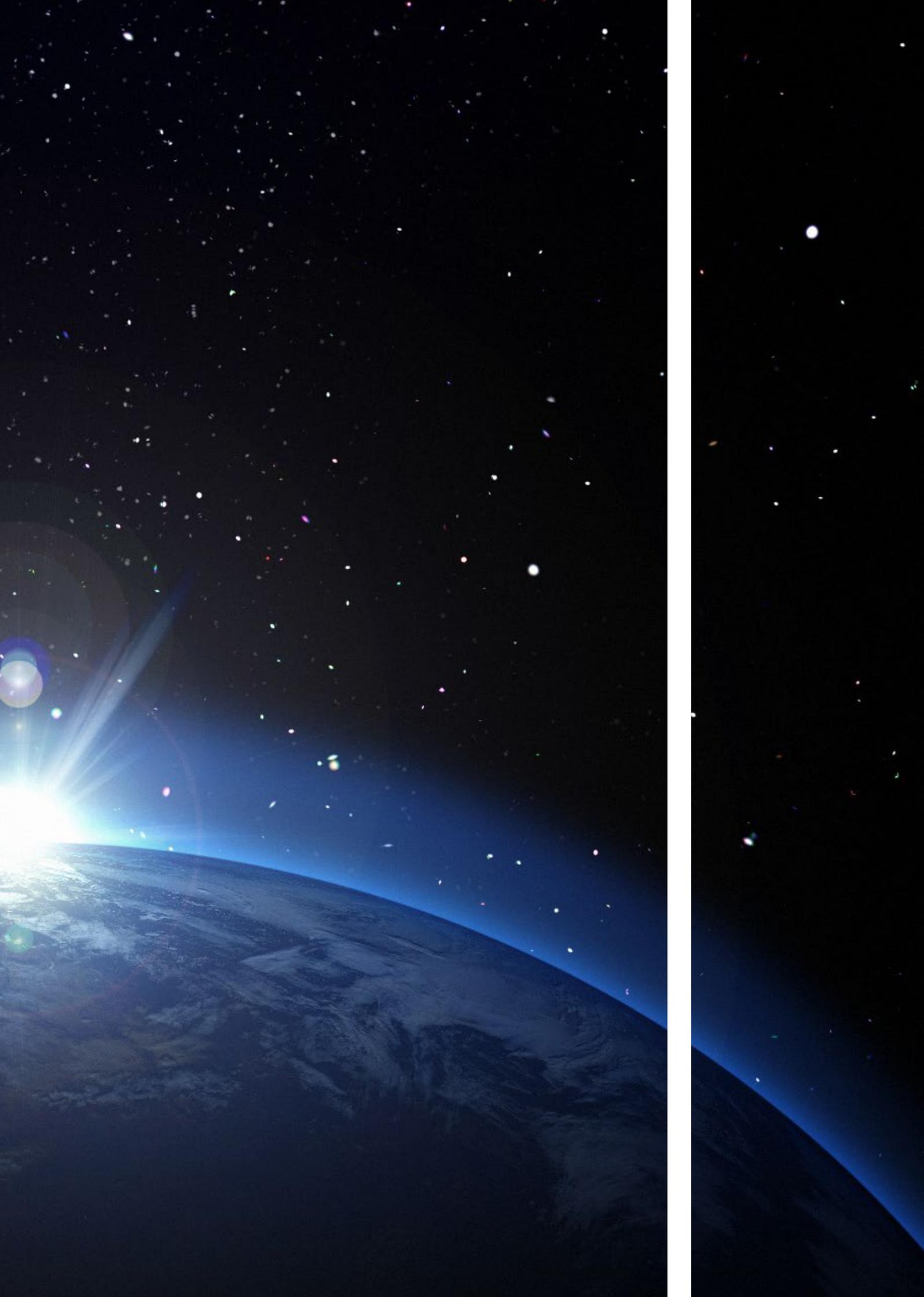


Shashank Tripathi
Ex-Partner and Leader, Aerospace and Defence
PwC India

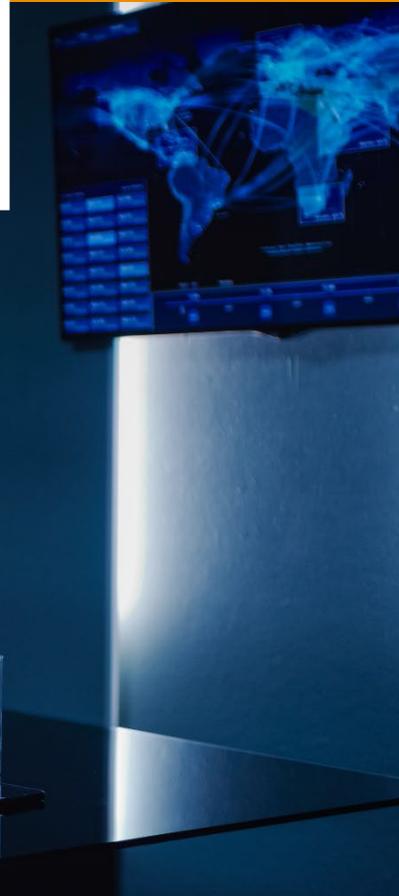
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Introduction



Over the last decade, there has been a steep rise in the direct application of space assets for critical defence requirements. Many of these assets have been weaponised to carry out subversive action against space assets belonging to rival nations. This is despite the multilateral ‘Outer Space Treaty’, according to which outer space will only be used for peaceful operations. However, the space orbits have now become a core instrument of surveillance for many militaries across the globe. In India, the use of space has largely been limited to civilian applications that enable communication and space and Earth observation.

Today, space has become a critical aspect for the Armed Forces for detecting activities such as border infiltration, artillery movements and missile launches. With rapid developments in military technology, satellites have become an integral part of operations and strategy building for the military in terms of:

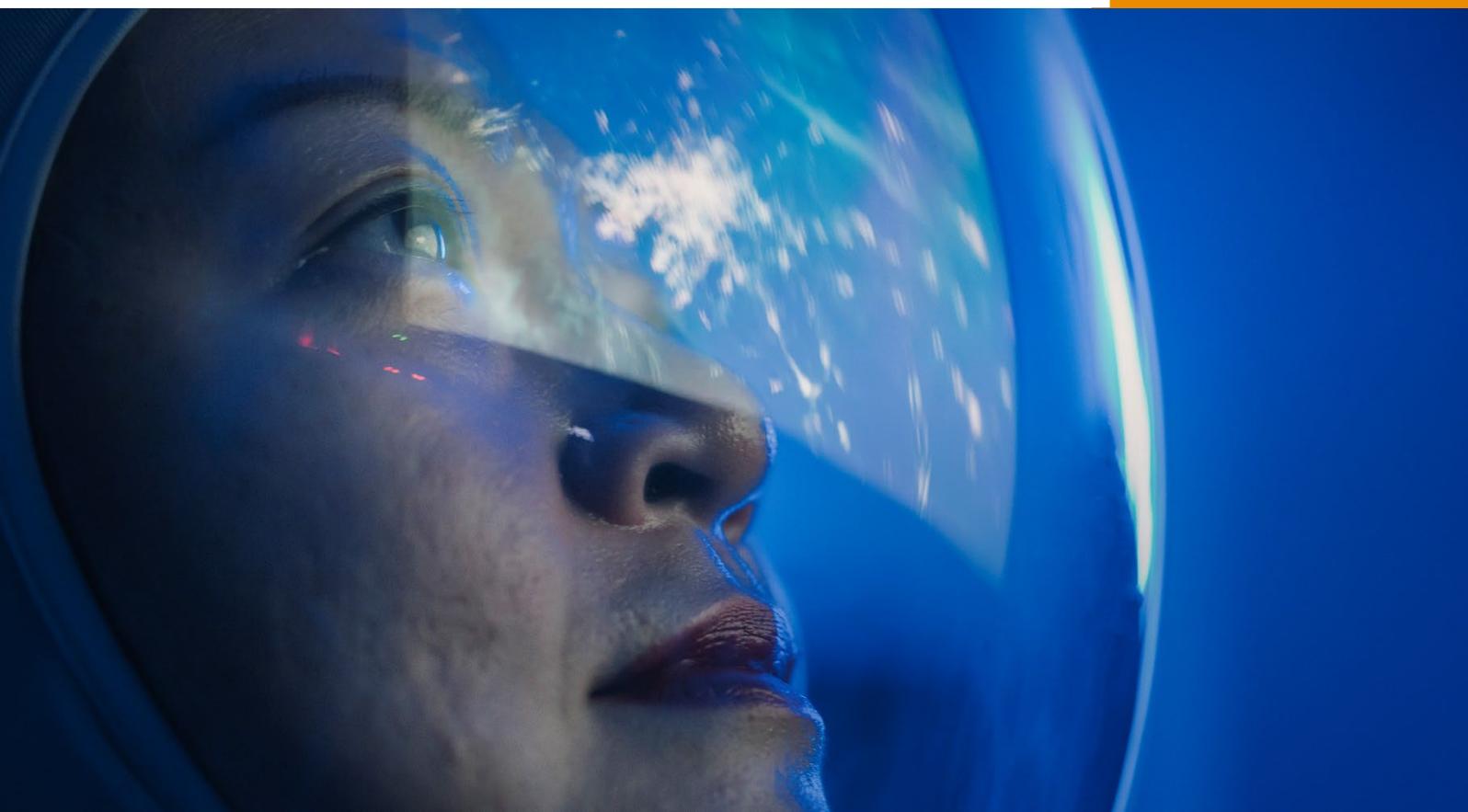
1	remote sensing use cases like border surveillance, monitoring enemy positions and target tracking	
2	both kinetic (kinetic weapons with satellite-guided location systems, etc.) and non-kinetic (economic warfare, sensing, etc.)	
3	satellite communication	
4	SSA	
5	RPOs for anti-satellite manoeuvres	
6	other offensive operations that may include satcom jamming, GPS spoofing, offensive electronic countermeasure (ECM), etc.	

With modern warfare looking at space to establish virtual command centres, private companies across the globe are developing the required technologies. The demand for satellite applications is expected to reach USD 7 billion by 2031, accelerating at a compound annual growth rate (CAGR) of 3.67% between 2021–2031. Of the overall space market worth USD 423.8 billion,¹ defence applications contributed approximately 8%. In comparison, the Indian space sector is estimated to grow at a CAGR of 13% and by 2025, it is expected to be worth USD 13 billion.²

¹ <https://www.cnbc.com/2020/07/30/space-economy-worth-over-420-billion-weathering-covid-crisis-report.html>

² <https://economictimes.indiatimes.com/news/science/do-you-know-indian-space-economy-will-be-worth-usd-12-8-billion-by-2025-says-report/articleshow/94760093.cms?from=mdr>

Factors driving the integration of space and defence





Strategic

In the field of launch vehicles and satellite development, India has developed and deployed several technologies over the years which are supporting the growth of the country's economy. In 2014, the Indian Space Research Organisation (ISRO) unveiled an indigenous regional satellite navigation system, Indian Regional Navigation Satellite System (IRNSS) (operational name NavIC). This satellite system is programmed to assist the Indian Armed Forces in border surveillance. Currently, the private Indian space ecosystem is still at an early stage of development, providing solutions ranging from satellite development and launch vehicle services to satellite imagery applications.

With India's space capabilities and the changing nature of warfare, India has a strategic imperative to prepare for and adapt to the major developments and threats in space. By investing in the development of the sector through private and public means, the nation can develop strategic autonomy in the space defence domain and potentially define a doctrine for the use of force in space. India must strive to first build space capabilities and assets through both public and private enterprises with support from the Indian Space Promotion and Authorization Center (IN-SPACe) and ISRO, and consequently protect our national interests in space by constituting a dedicated Space Command in addition to the Defence Space Agency (DSA), to focus specifically on the strategic use of satellites.

In 2018, to take over space-related capabilities of the three forces, the Government of India approved the establishment of the DSA. The agency is a tri-service agency of the Indian Armed Forces under which the Defence Imagery Processing and Analysis Centre and Defence Satellite Control Centre were subsumed. At present, the Indian Armed Forces have two dedicated operational military satellites in orbit, GSAT-7 and GSAT-7A.



Industrial

In the context of the Russia–Ukraine war and China–Taiwan standoff as well as India's existing frictions and tensions across the northern and western borders, it has become necessary for the Armed Forces to enhance their industrial military capabilities. The Armed Forces need an additional advanced set of satellites with high-resolution sensors and cameras that can assist them in detecting activities like the deployment of unwanted weapons and other potential threats. Procurement interest from the Armed Forces will be a strong indicator of domestic demand for space and space-enabled products and services. This will serve as an opportunity to domestic industries to showcase their capabilities in delivering the required systems.

India is very well positioned to develop satellites and launchers indigenously to meet the requirements in these areas. Further, infrastructure assets of government organisations equipped with the required testing facilities and technology can be leased to the private sector to develop new solutions that directly impact the defence sector. Some such solutions are listed below:

hyperspectral imaging	launch on demand	SSA	space mobility airborne sensors and advanced space sensors
fusion of optical and radar images	satellite-based navigation	sub systems and full stack systems solution development	

Currently, the industry faces a challenge as the core product that a firm may be focusing on might be very different from the end product demanded by the Defence Forces. As defence of space is still an evolving concept and there is greater focus from the Armed Forces in this domain, one large defence contract for any firm may trigger investments in the space defence segment. Many start-ups have set up small satellite and launch vehicle manufacturing centres in states such as including Telangana, Tamil Nadu, Gujarat, and are capable of manufacturing 50–250 satellites and over 30 launchers per facility annually. Various start-ups in the downstream domain are working on critical defence applications, including Space Situational Awareness (SSA) and resource protection. These developments will cater to India’s civil and military requirements at a faster pace.



Government

Today, the Indian space sector is one of the key priorities of the Indian government as there are around 368³ private space firms and over 100 space start-ups.⁴ This is evident as the government has introduced several policies to enable commercialisation of the Indian space sector in addition to creating dedicated agencies to focus on specific areas under the space domain. The following are the key initiatives taken by the Government:

sanctioned INR 13,700 crore in Union Budget 2022–23 towards the Department of Space	policy enabling promotion and participation of private space entities in the Indian space sector	formation of the IN-SPACe	revising the FDI policy
formation of Indian Space Association (ISpA)	transfer of technologies between ISRO and private Indian industry for commercialisation	sharing ISRO’s facilities with Indian space entities	National Space Policy (draft)
Make in India programme	start-up funding through iDEX		

By 2025, the Indian space sector is expected to see a steep rise in private launch vehicle service providers and private satellite manufacturers entering the global and domestic space market. Further, with a rapid launching facility and low-cost advanced satellites, India will have the potential to become a space hub of the world. The Government can utilise this opportunity to deploy defence satellites/satellite constellations in space at a much faster rate. Geopolitically, India, China, Russia and Japan are the only four countries in Asia with active and successful space programmes.

With an active presence in space and existing cordial relations with the major global powers, India can gain an important position in the worldwide space sector and develop strong bilateral relationships with Indo-Pacific nations and other space powers.

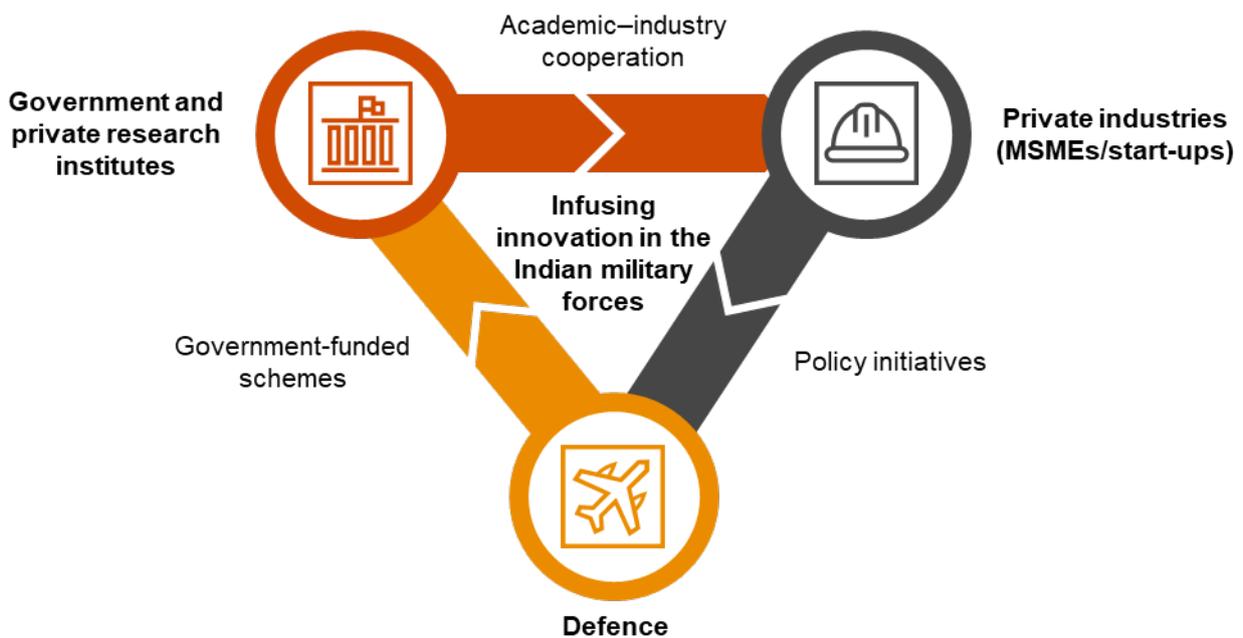
³ <https://www.ibef.org/blogs/major-reforms-transforming-indian-space-sector>

⁴ <https://www.livemint.com/economy/economic-survey-india-home-to-more-than-100-space-startups-11643688042215.html>

With one of the most credible space programmes and its expertise in space-oriented defence applications, India’s space missions in the field of military satellites can address sovereignty and national security concerns by assisting the Armed Forces in monitoring any unwanted activities. At the same time India can also address the increasing assertiveness of major space powers to broaden their strategic expansion to space. This will further enhance bilateral cooperation with desired countries. Further, India will be able to position itself as a regional space power economy that other countries can rely on for required support, such as technology transfer/exchange related to space in defence solutions.

The Indian space domain rests on three main pillars. To position India on the global space podium, the three key pillars must be integrated with each other to deliver cutting-age innovative solutions. The integration will be a perfect blend of research and commercial manufacturing supported by Government policies, which can be then leveraged by the Indian Armed Forces.

Figure 1: The space domain and key stakeholders



Space for defence and defence of space

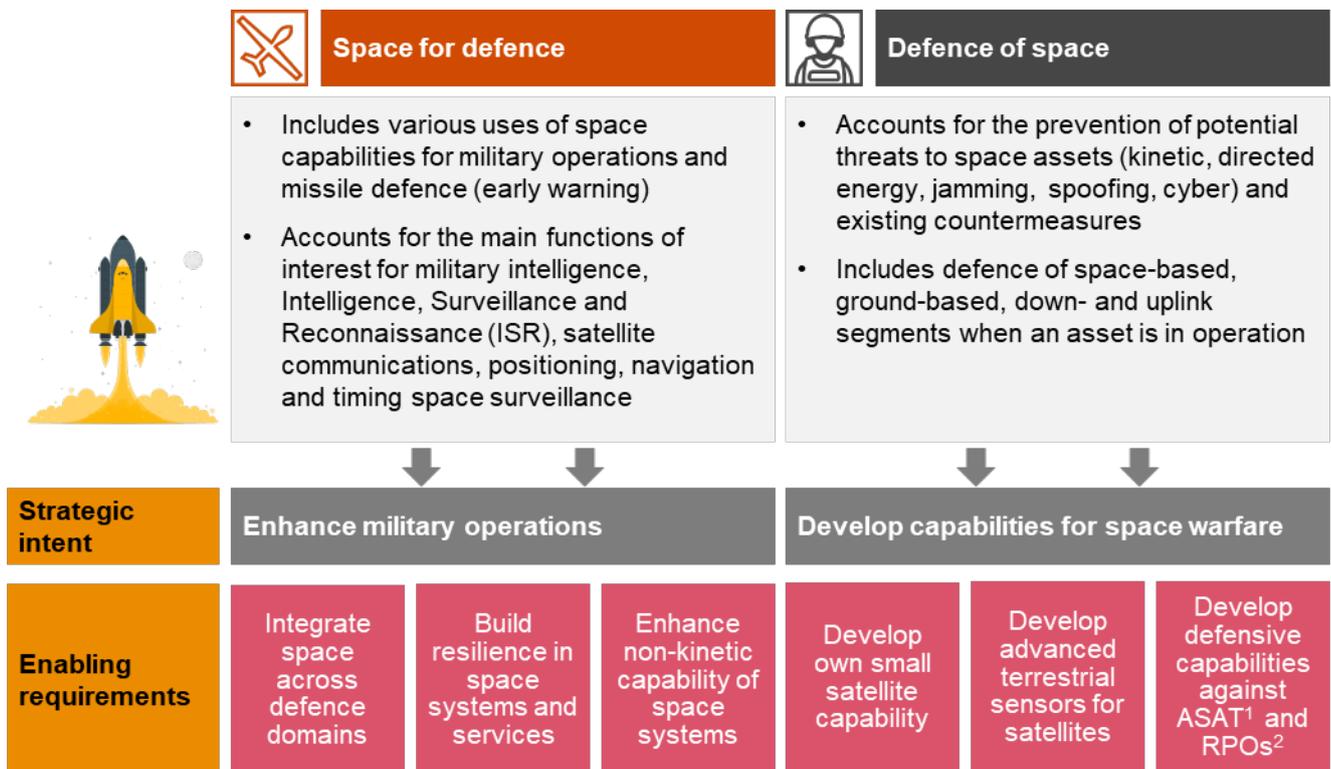




Introduction

The common enabler and backbone for close operational collaboration and coordination between the Army, Air Force, and Navy is the seamless communication interface between the three services. In addition, there is a need for high-quality imaging and remote sensing capabilities for effective earth observation and surveillance. Satellites are also used for navigation in maritime and land-based operations. Space is an important domain for enhancing military operations and supports military intelligence, Intelligence, Surveillance and Reconnaissance (ISR), communication, navigation and surveillance.

Figure 2: Strategic intent and enablers required for the space domain



¹Anti-satellite weapons; ²Rendezvous proximity operations



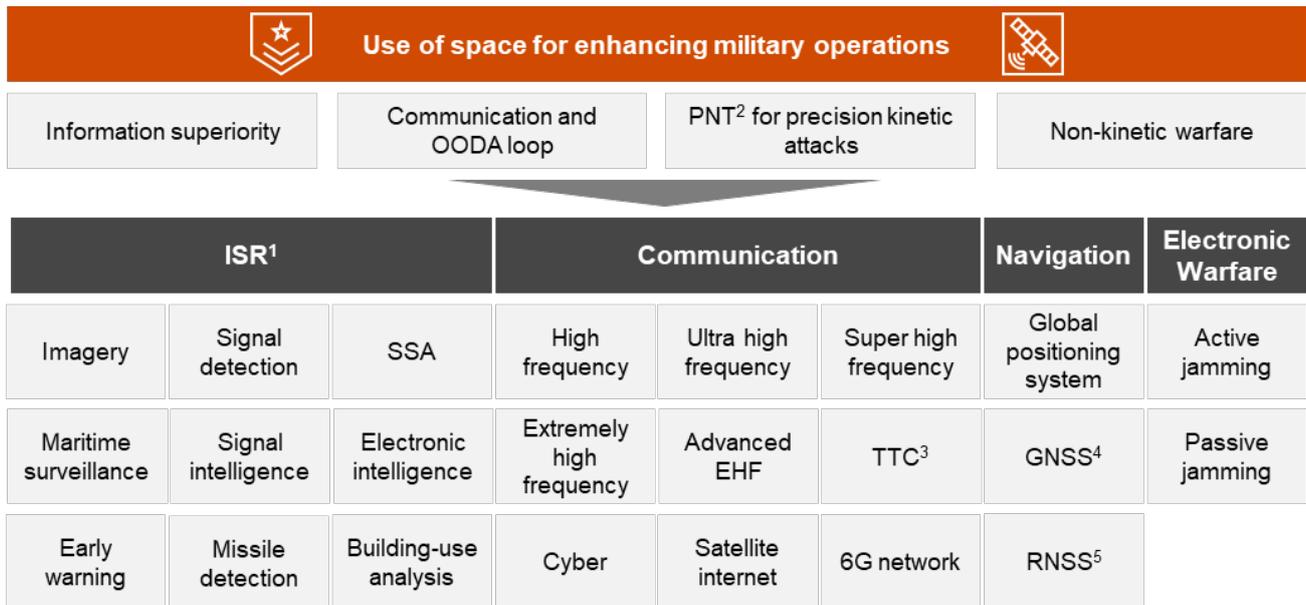
Space for defence

Satellites are equipped with multi-sensor technologies and electro-optic capabilities, thermal sensors, high-resolution cameras, communication sensors and high-precision radars (like synthetic aperture and inverse synthetic aperture radars) that can provide much better image clarity and definition. India is flanked by adversaries on both the eastern/northeastern and western/northwestern borders, and it is imperative to monitor critical military information about these neighbours by building SSA capabilities, especially in terms of weapon deployment, border infrastructure like roads and buildings, border security posts and troop deployment.

Over the last two decades, there has been an increased activity in the space domain which can be directly classified as offensive actions taken by the nations involved. There is an increased risk of extensive militarisation of space and there has been a significant increase in satellite jamming, RPOs and cyberattacks against ground stations. The militarisation of space has thus led to the creation of a new battlefield: space. Thus, all defence-related activity in the space domain can be clubbed under two major categories: using space for defence-related activities and defending one's own assets in space.

To enhance military operations through space capabilities, India will need to integrate, in a focused manner, space capabilities and applications across defence domains, build resilience in various space systems and services, and enhance the non-kinetic capabilities of space systems.

Figure 3: Typical use cases for enhancing military operations using space



¹Intelligence, Surveillance and Reconnaissance (ISR); ²Position, Navigation and Timing; ³Telemetry, Tracking and Command; ⁴Global Navigation Satellite System; ⁵Regional Navigation Satellite System

Defence of space

Space assets are susceptible to different types of threats. These may be due to natural causes/reasons, or due to offensive military action by adversaries. Given the strategic importance of the space domain, it is imperative to have a robust 'defence of space' strategy which must include defence of space-based, ground-based, and down and uplink segments when space assets are in operation.

Cumulatively, threats in space can be categorised into non-military threats and military threats. Non-military threats are uncontrolled and mostly stem from natural factors, while military threats emanate directly from fear of subversive action by adversaries.

Non-military threats (uncontrolled and natural)

Space debris ranges from 1–10 cm in size and moves at a hypervelocity of 27,400 km per hour in the low Earth orbit. There are 10,000 bits of debris in space.⁵ This could increase with future missions, thereby increasing the likelihood of collision with satellites. Dysfunctional or de-commissioned satellites also contribute to space debris.

Radiation in space is generated by particles emitted from a variety of sources both within and beyond the solar system. Radiation effects from these particles can cause not only degradation but also failure of the electronic and electrical systems in space vehicles or satellites.

⁵ <https://yourstory.com/2019/09/digantara-research-and-technology-nasa-space-debris-satellite-isro/amp>

Military threats (controlled)

Military threats to space assets can manifest in many forms and are generally due to adversaries' capabilities in the space domain. The attacks can be classified into two categories, namely virtual and controlled, and physical and controlled. Based on the target and methodology used, threats fall into the category of cyber, anti-satellite weapons, weaponised spy satellite operations, RPOs, satcom jamming and nuclear attacks.

Figure 4: Classification of threats in space

 Non-military threats	Space debris		
	Space radiation		
 Military threats	Cyberattacks	Hacking on-board sensors	Uplink and downlink jamming
		Tracking operations	Cyberattacks on ground stations
	ASATs	Direct-ascent ASAT	Orbital ASAT
		Laser dazzling	High-energy EM pulse
	RPOs	De-orbiting satellites	Corrosive chemical spray
		Directed energy attack from proximity	Deterrence
	Others	TTC jamming	Nuclear attack

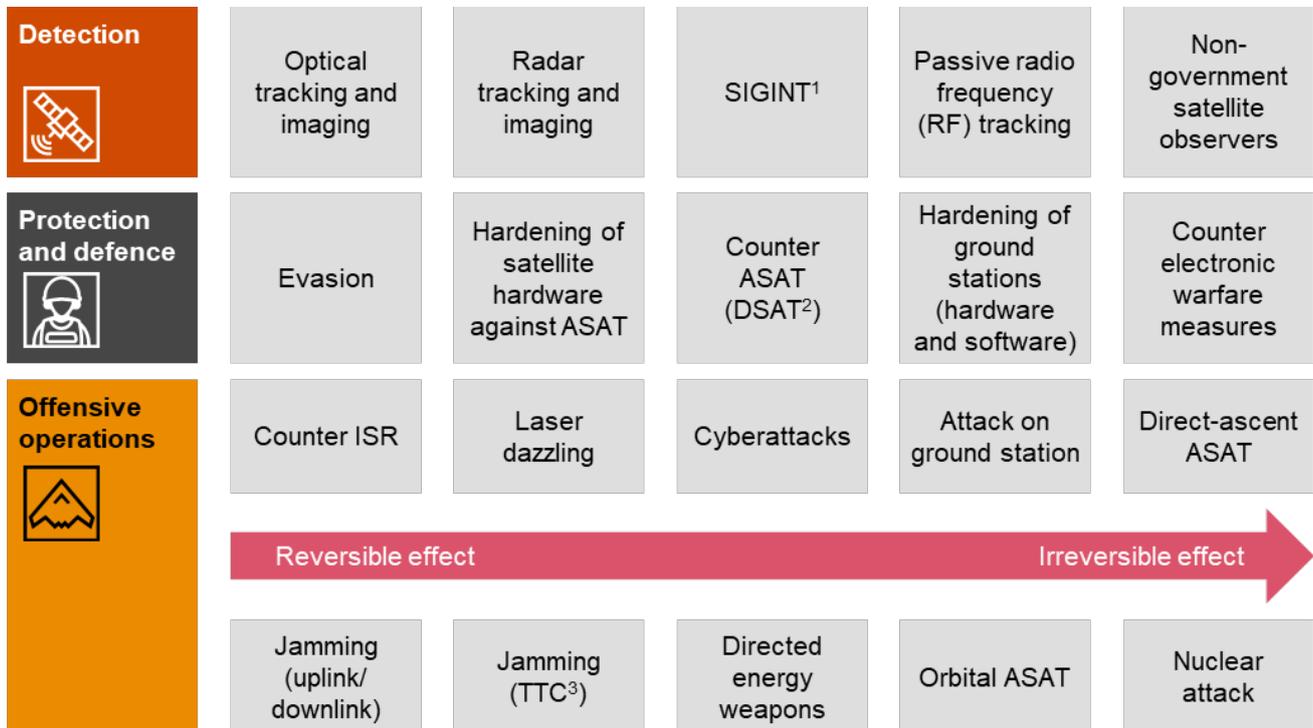




Focus areas for building defence capabilities in space

To gain a distinct advantage in the space domain, particularly from a defence standpoint, India needs to enhance its capabilities in the detection of threats, protection, and defence and offensive operations. There has been a high focus on the civilian use of space in India, and India already has a large part of the technology that will also enable use of space for defence as well as defence of space.

Figure 5: Focus areas for building defence capabilities in space



¹Signals intelligence; ²Defensive satellite; ³Telemetry, Tracking and Command

In addition to the above, India also needs to build capabilities to monitor its own space assets such that RPOs can be detected much before they are actually executed. India has made good progress in the space domain thus far and is currently among the top nations with good capabilities in civilian satellite applications. However, due to the changing nature of space use and a concerted move towards non-kinetic warfare, there is a need to increase focus on the military applications of space technologies.

India's state of play

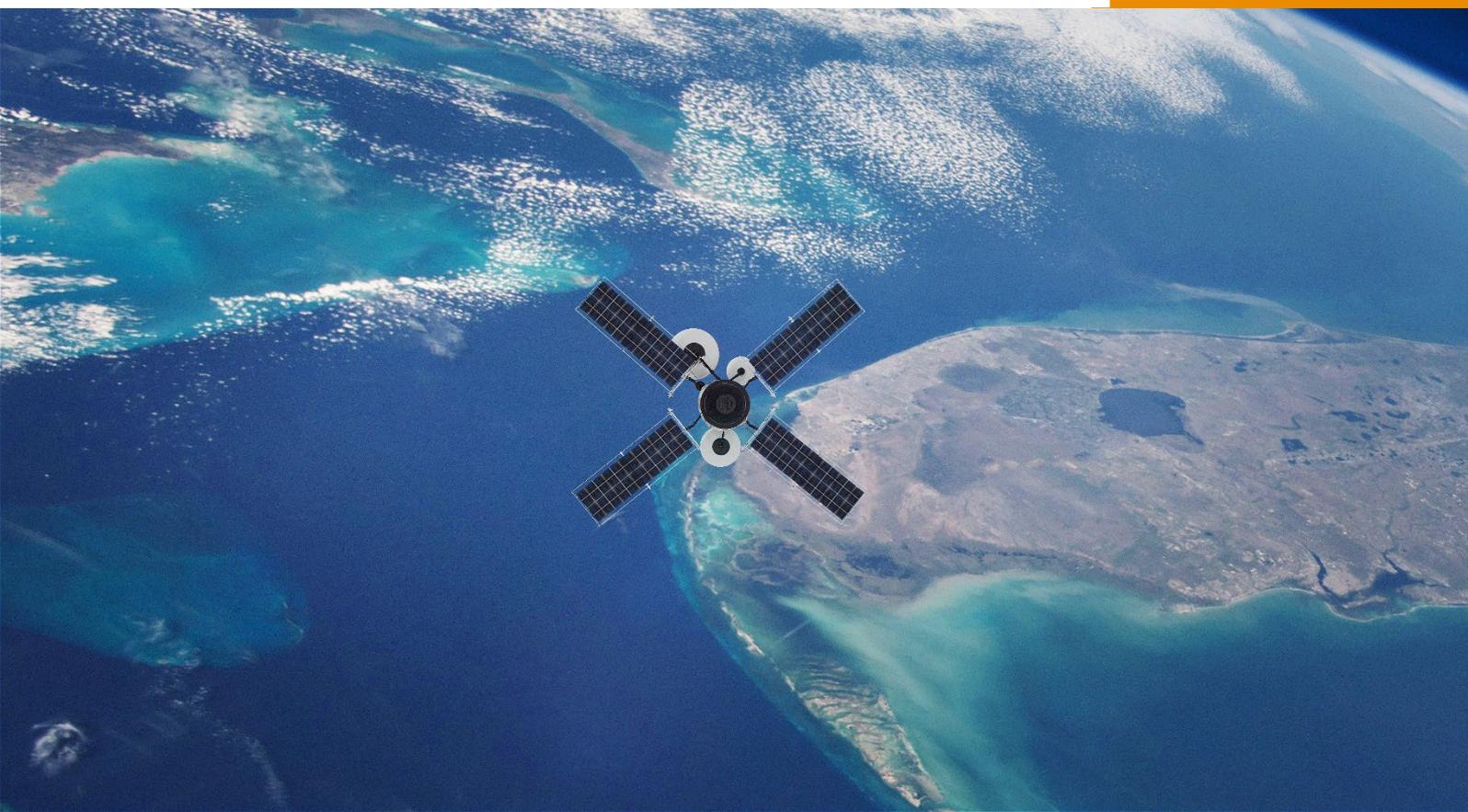
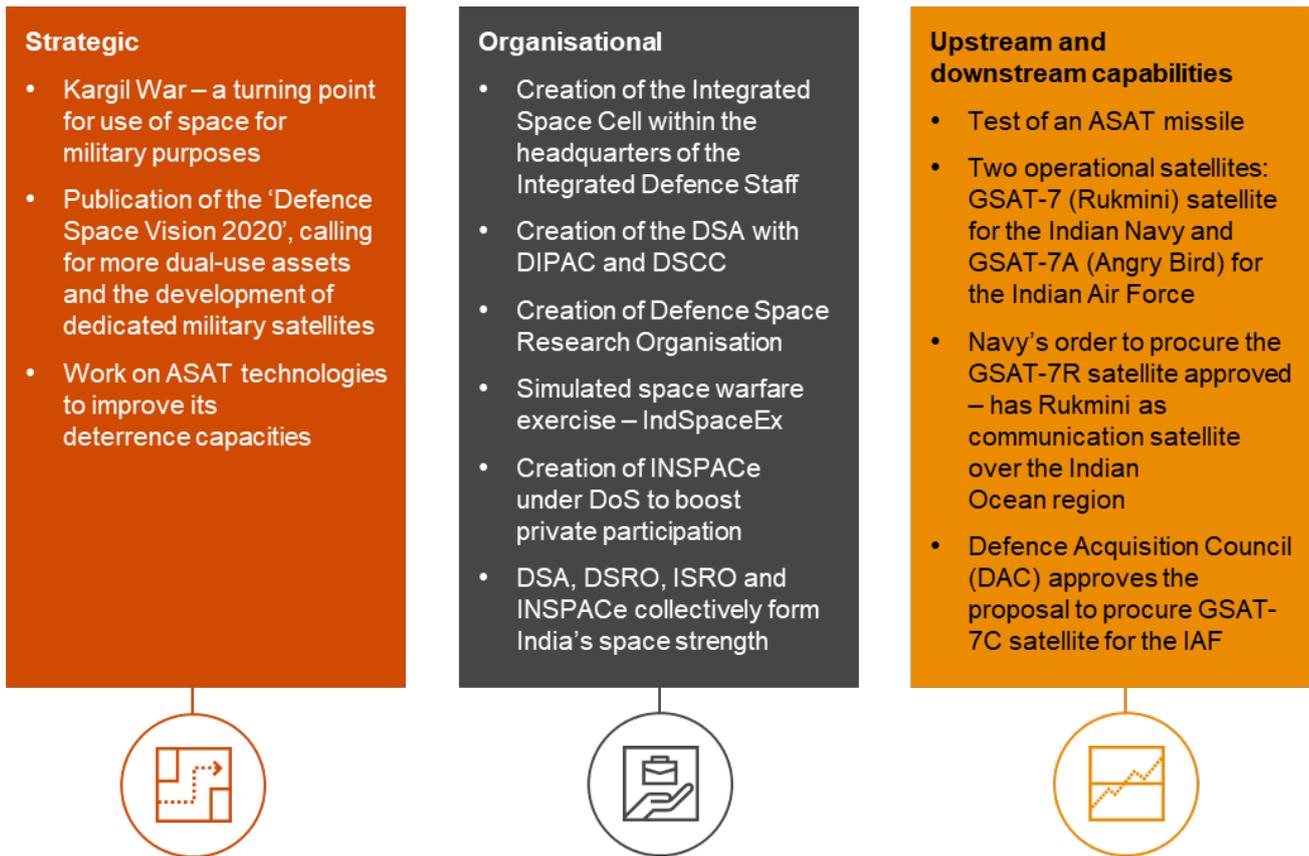


Figure 6: Defence space domain in India



Source: PwC analysis; secondary sources

Space defence domain in India

Recently, there has been a significant movement towards opening up India's space security through the creation of the DSA and IN-SPACE, an investment and promotion body for the space sector.

Both organisations will facilitate capacity building of the sector for both civilian and military application. While IN-SPACE primarily looks into the promotion and authorisation of space activities in India for private civilian industry, the DSA caters to military requirements through the private sector operating in the nation.

The Indian space industry has developed a multidimensional approach for using outer space for both strategic and operational purposes. However, there is a need to develop mechanisms for the promotion of home-grown innovation and industrial output in defence space systems (both in the public and private sector) that will enable India to make technology advances and build next-generation systems that provide an edge in Command, Control, Communications, Computers, Intelligence, Information, Surveillance, and Reconnaissance (C4ISR).

Strategic evolution:

The Kargil War was a turning point that led India to realise the need for satellites for situational awareness and reliable intelligence information relay. With time, space capabilities in India improved under the umbrella of ISRO, but they were not fully exploited by the defence services as ISRO's focus remained on civilian and societal benefits. However, lately, in the last publication of the 'Defence Space Vision 2020', the Government emphasised the integration of defence and space by calling for more dual-use assets and the development of dedicated military satellites.

Organisational updates:

The Government of India brought together experts from all three services and ISRO to create an Integrated Space Cell within the Integrated Defence Staff. Subsequently, the creation of the DSA, the Defence Cyber Agency (DCA), and the Armed Forces Special Operations Division (AFSOD) was approved by the Prime Minister.

Upstream and downstream capabilities:

In March 2019, India successfully tested an anti-satellite (ASAT) test, which was jointly developed by Defence Research and Development Organisation (DRDO) and ISRO. The success of this mission has put India among the countries like China, Russia, and the United States, which were successful in testing anti-satellite missiles.⁶ To enhance the capabilities of the Indian Armed Forces, the Defence Acquisition Council (DAC) approved the Acceptance of Necessity (AoN) for capital acquisition proposals for defence services amounting to INR 8,357 crore. The DAC has also cleared the AoN for the procurement of a GSAT 7B satellite in March 2022.

To integrate its Navy with satellite communication channels, the Ministry of Defence (MoD) approved the development of indigenous satcom terminals. These systems are usually housed on warships, submarines and naval planes.⁷ Further, these systems will be manufactured in India under the Make-II category of the Defence Acquisition Procedure as per the in-principle approval given by MoD. The combined strength and value proposition of each of the space stakeholders – the DSA, DSRO, ISRO, NewSpace India Limited (NSIL), and IN-SPACe – can take India's space and defence capabilities to new heights.

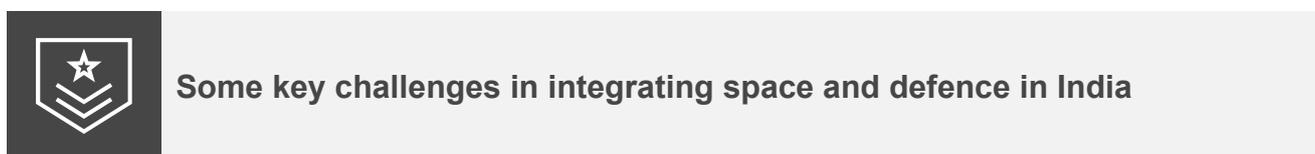


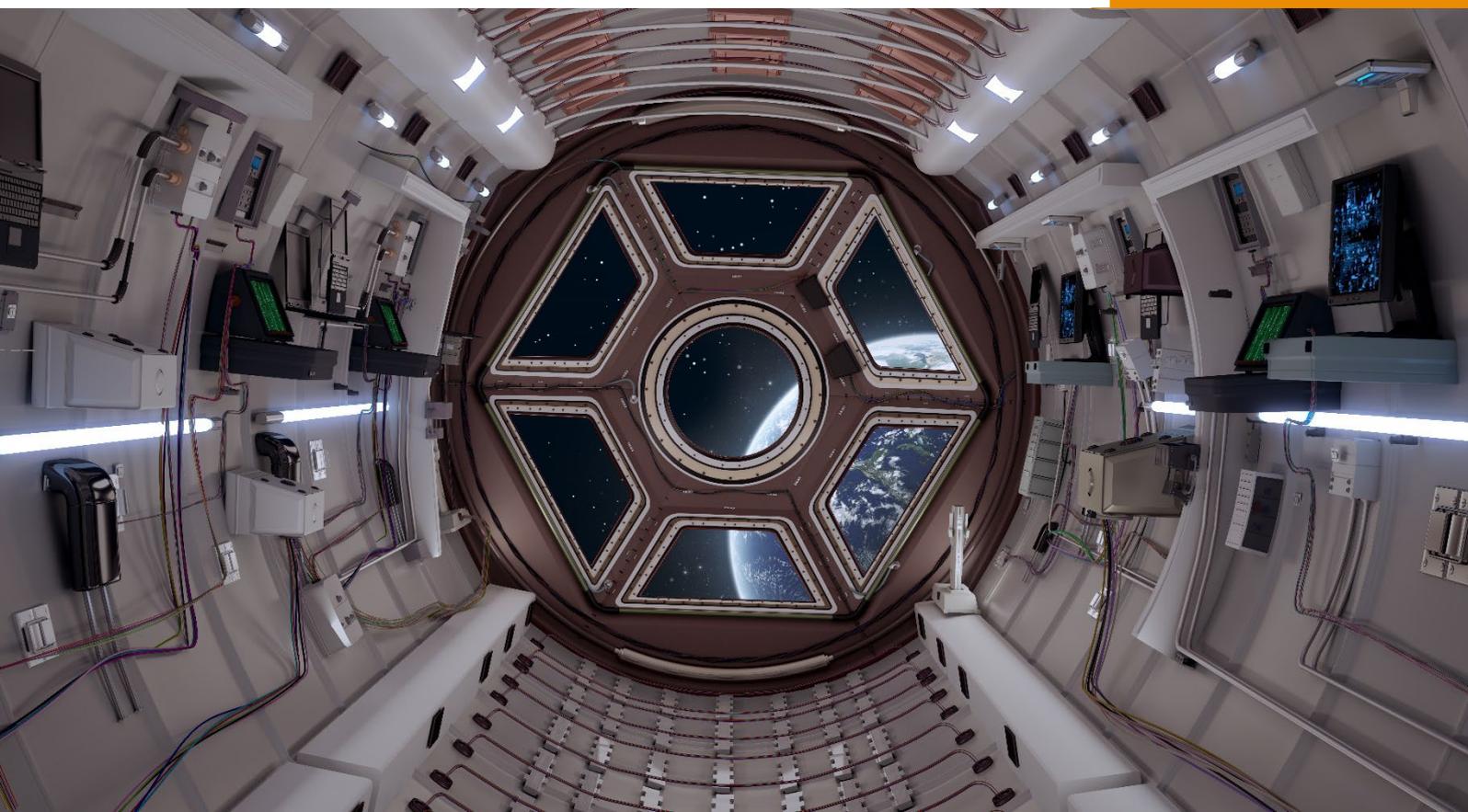
Figure 7: Key challenges in integrating the space ecosystem with defence

 National Space Strategy	<ul style="list-style-type: none">• The National Space Strategy needs to be finalised at the earliest.• The National Defence Space Strategy with whole-of-nation approach will leverage space for defence.
 Functional silos	<ul style="list-style-type: none">• Enhanced collaboration across stakeholders in the defence space domain, with clear inter-governmental responsibilities and data sharing to access cutting-age space technologies.
 Promulgate space policies across domains	<ul style="list-style-type: none">• Passing of the Space Activities Bill will promote private sector investment.
 Long defence procurement procedures	<ul style="list-style-type: none">• The existing defence procurement procedures are complex and lowest cost (L1) dependent. This does not allow the defence forces to quickly harness and adopt cutting-edge space technologies offered by private and other institutions.
 Prioritisation of technology	<ul style="list-style-type: none">• Includes R&D strategy for technology identification frameworks.• Enables space tech planning and acquisition from public and private sectors.

⁶ <https://timesofindia.indiatimes.com/blogs/rakshakindia/space-power-security-matrix-for-india-part-1/?frmap=yes>

⁷ <https://www.tribuneindia.com/news/nation/navy-warships-to-get-indigenous-satcom-terminals-410979#:~:text=The%20SATCOM%20terminals%20connect%20the,Limited,%20a%20public%20sector%20undertaking.>

Way forward





Priority technology areas in space defence

India's integrated defence and space capabilities need to be based on the priority areas.

Figure 8: Priority technology areas in space defence

Priority areas	ISR ¹ (including navigation)	Communication	Infrastructure	SSA ²	Miniaturisation	Countermeasures
Capabilities	Imagery data fusion and onboard image processing	High-bandwidth jam-resistant communication links	Ground infrastructure to support automation	SSA enablers in radar, optical or collaborative models	Integrated circuit systems for miniaturisation	Ground-based Positioning, Navigation and Timing (PNT) jammers
	Remote sensing and navigation	Interoperable, multi-band TTC ground stations	Automation in planning and data analysis	Own space resources protection and hardening mechanisms	Nano/micro satellites	Ground and space-based laser tech
	Improved pointing ability	Tactical data relay satellite mechanisms	Launch facilities including launch-on-demand	Co-orbital and formation flying arrangements	Onboard processing and basic analysis mechanisms	High-power microwave technology
	SAR imagery and quick analysis	Automated bandwidth management and power distribution	Mobile/offshore launch facilities	Improved PNT mechanisms	Self-healing, heuristic and regenerative designs	Multi-band SATCOM jammers

Space for defence
 Defence of space
 Both

¹Intelligence, Surveillance and Reconnaissance (ISR); ²Space situational awareness

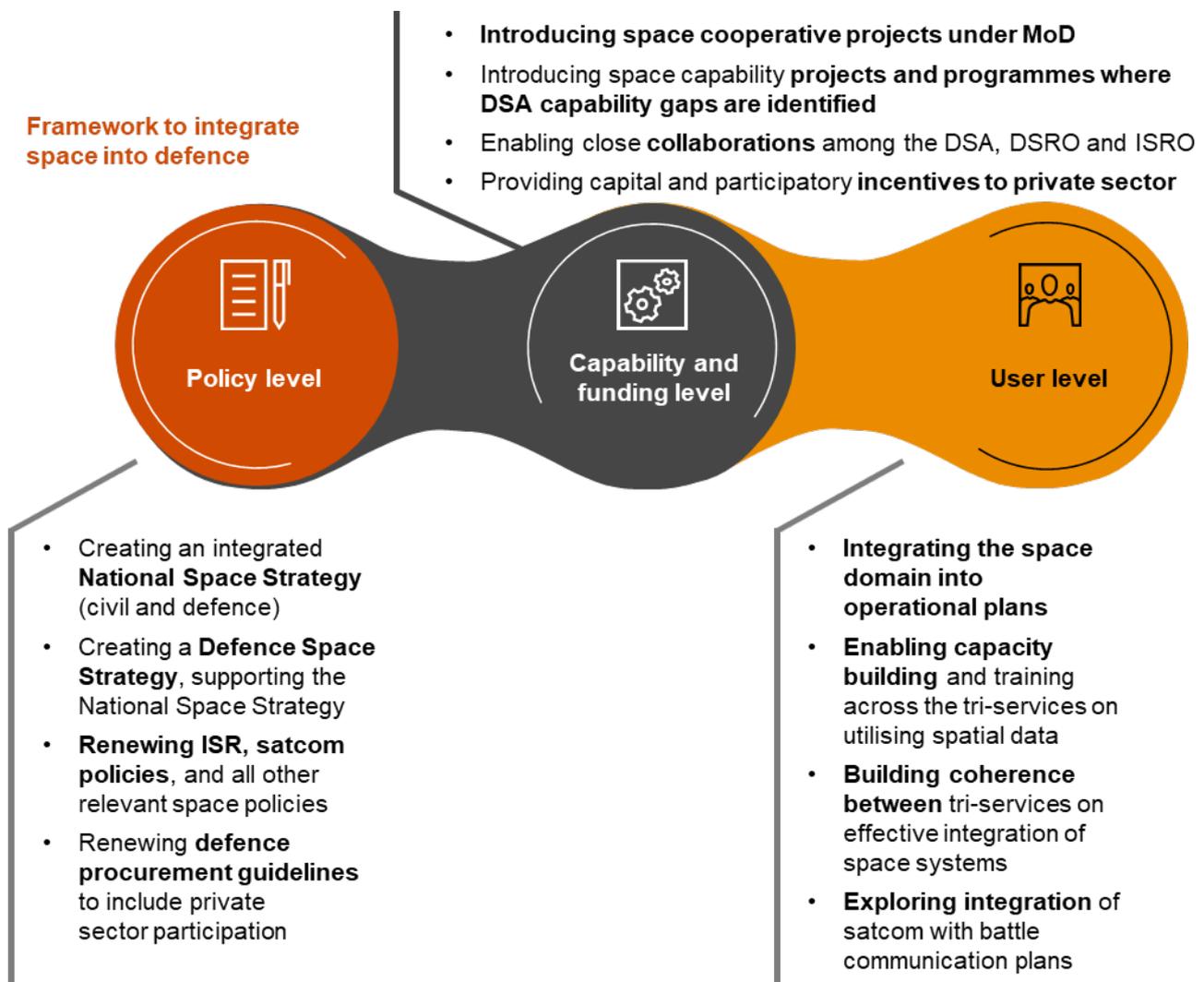




Focus areas for integration of space with defence

The integration for space and defence would require focus on critical areas of policy, capability and user level. The combined focus on these areas can enable faster and wholistic integration of the space and defence domains.

Figure 9: Proposed focus areas to integrate space and defence



Policy level

India needs a well-defined national space and defence space strategy with a clear vision and strategic goals laid out for the next decade. It is therefore relevant to recognise space as a strategic domain for national security and converge space and defence issues by adopting a military–civil fusion mindset on space and space-enabled technologies. Some key areas to focus on with respect to integrating the policy framework are mentioned below:

- pass the resolution on the draft Space Activities Bill
- pass the draft new Remote Sensing Policy
- pass the draft new the Satcom Policy

- pass resolutions and laws to ease development and ownership of intellectual property rights (IPRs)
- take measures to enhance ease of doing business for increased private sector participation
- provide separate budget allocation for prospective military space commands.

Capability and funding level:

As private sector participation in space programmes in India is still at a nascent stage, the MoD must promote collaboration on projects and programmes where capability gaps are identified. Further, the MoD and DoS need to facilitate collaboration between the DSA, DSRO, ISRO and IN-SPACE to enable indigenous development and enhancement of the military capabilities of our Armed Forces.

End-user level

The defence stakeholders, predominantly the MoD and allied institutes, must take conscious action to ensure full utilisation of space in the defence domain. A military–civil fusion mindset across the Armed Forces is key to ensure collaboration and increase technology integration in space for defence services.

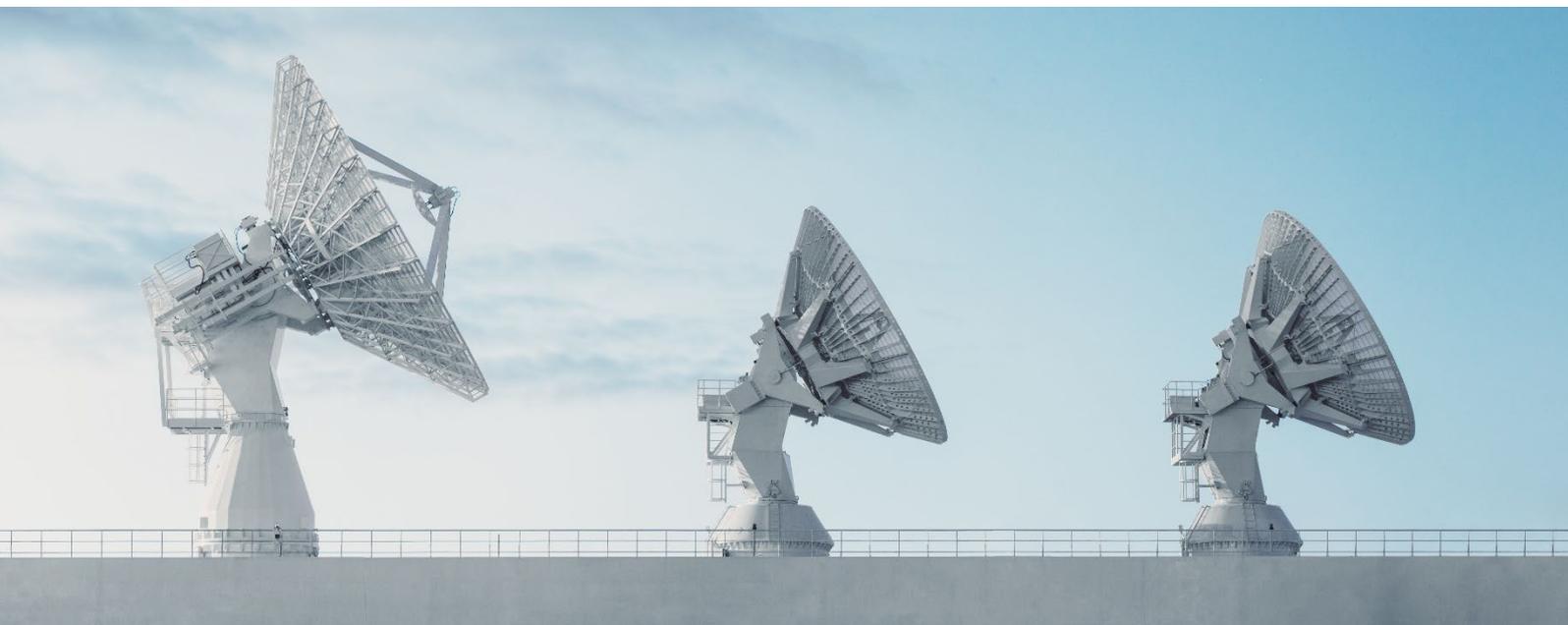
Identification of military needs and applications in space is essential, especially in the areas of space-border communication, hyperspectral imagery and intercontinental ballistic missile (ICBM) detection systems. The identified applications can be mass manufactured by Indian private industry.

Actions for the space defence domain

Strategic actions: The Indian space sector, including military and civilian, should focus on a shared vision to create a national space strategy. India is a leading player in the space industry. With the right impetus and recognition of the sector as a strategic domain, the sector, through its industry players, can fulfil the needs of the Armed Forces. Well-defined strategies around civilian and defence space will align the industry with key focus areas for capability building and future growth.

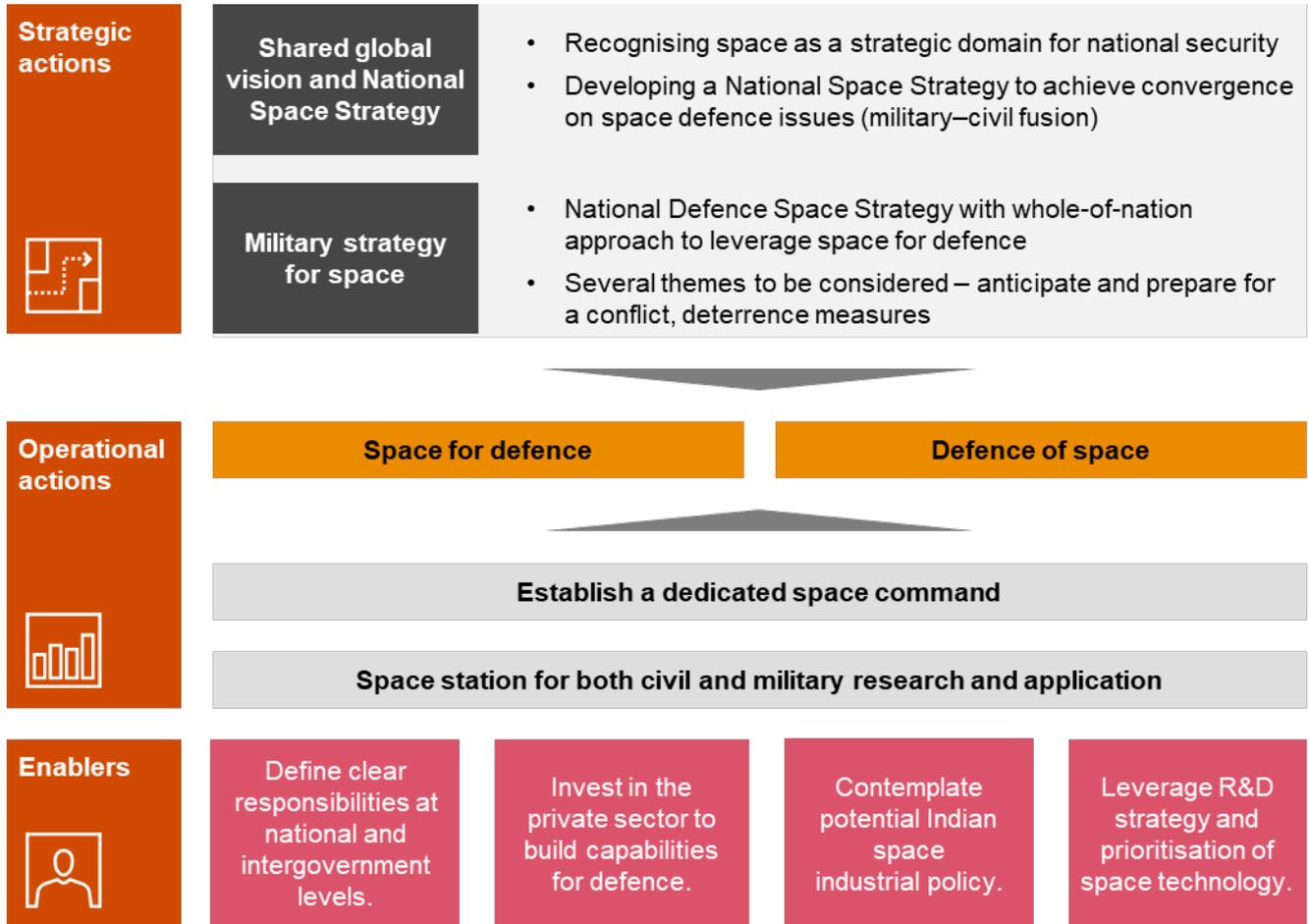
Operational actions: Key operational actions through re-organised operating models and collaborative frameworks with industry bodies are critical to allow free flow of space technologies across the military and civilian domains for both space for defence and defence of space. The Government can look into the possibilities of establishing a dedicated space command and a futuristic space station for military and civilian research and application purposes.

Enablers: The industry requires clear intergovernmental collaborative frameworks, investments, policies and an R&D strategy to fully exploit the sector and allow the nation to build and drive capabilities in both the military and civilian domains.



An integrated approach is key to building and driving a robust strategy and capabilities in the space defence domain.

Figure 10: Shared vision to create a National Space Strategy



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SatCom Industry Association (SIA-India) is a not-for-profit body created to represent the interests of the satellite communication ecosystem in India.

As a vibrant body, SIA-India represents satellite operators, satellite systems, launch vehicles, ground and terminal equipment manufacturers and suppliers, satellite-based IOT/M2M solution providers, space startups, innovation hubs, academic institutions, law firms and provides interface with Government, Regulators, Policymakers and domestic & international standards' bodies.

As 'Thought Leaders' for the satellite communications ecosystem, we aim to present the industry's interest at the highest Government levels for policy-making, regulatory and licensing matters.

Data Classification: DC0 (Public)

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GG – October 2022 - M&C 23150