

DRAGON

ON HIGH GROUND

COUNTER-BALANCING CHINESE CAPABILITIES IN SPACE DOMAIN

TANMAY PATHAK

MP-IDSA MONOGRAPH SERIES

No. 108 OCTOBER 2026

DRAGON ON HIGH GROUND

COUNTER-BALANCING CHINESE CAPABILITIES IN SPACE DOMAIN

TANMAY PATHAK



MANOHAR PARRIKAR INSTITUTE FOR
DEFENCE STUDIES AND ANALYSES

मनोहर पर्रिकर रक्षा अध्ययन एवं विश्लेषण संस्थान

© Manohar Parrikar Institute for Defence Studies and Analyses, New Delhi.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photo-copying, recording or otherwise, without the prior permission of the Manohar Parrikar Institute for Defence Studies and Analyses.

ISBN: 978-81-687924-4-9

Disclaimer: The views expressed in this Monograph are those of the author and do not necessarily reflect those of the Institute or the Government of India.

First Published: October 2026

Price: Rs.325/-

Published by: Manohar Parrikar Institute for Defence Studies
and Analyses
No.1, Development Enclave, Rao Tula Ram
Marg, Delhi Cantt., New Delhi - 110 010
Tel. (91-11) 2671-7983
Website: <http://www.idsa.in>

Layout & Cover by: Geeta Kumari

Printed at: Pentagon Press LLP
206, Peacock Lane, Shahpur Jat
New Delhi-110049
Tel. (91-11) 26491568, 26490600
Fax: (91-11) 26490600
email: rajan@pentagonpress.in
website: <http://www.pentagonpress.in>

CONTENTS

<i>INTRODUCTION AND SCOPE</i>	05
 <i>Chapter 1</i>	
CHINA'S SPACE VISION AND DUAL-USE CIVIL SPACE CAPABILITIES	11
 <i>Chapter 2</i>	
CHINESE MILITARY CAPABILITIES IN SPACE	46
 <i>Chapter 3</i>	
THREAT ASSESSMENT FOR INDIA	63
 <i>Chapter 4</i>	
COUNTER-BALANCING WITH A MULTIPRONGED APPROACH	90
 <i>Chapter 5</i>	
CONCLUSION AND POLICY RECOMMENDATIONS	109

INTRODUCTION AND SCOPE

In the space domain, China has embarked on a sweeping 'National Strategic Integration' policy framework¹ to become the world's pre-eminent space power. Beijing views space as a warfighting domain and seeks to achieve space superiority as a cornerstone of its broader effort to establish information dominance, a prerequisite to enhancing its influence in modern and increasingly fractured geopolitics. To this end, it has rapidly developed, deployed, and operationalised advanced capabilities in space launch, satellites, and ground-based infrastructure spanning its civil, military, and commercial sectors.

Simultaneously, China has also focused its ambitious space programme to deepen relations with developing countries and expand its space architecture in support of military, commercial, and broader strategic gains. China's rapid progress in establishing a public-private, state-controlled space ecosystem in just a few decades poses a formidable technological and geostrategic challenge in the region. As it seeks to reshape international space governance and influence the development of technical standards, the ongoing pace of developments in space across the globe has inevitably turned it from the *final frontier* to the *first frontier*.

The rapid Chinese military expansion is also being witnessed in this domain, with the People's Liberation Army (PLA) expanding its space and ground-based assets to enhance battlespace awareness, operational coordination, and capacity for force projection. These capabilities improve their ability to monitor, target, and challenge adversarial forces across the Indo-Pacific. Over the past decade, China has launched more than 553 satellites,² significantly increasing its capacity for persistent surveillance, communications, and precision targeting in support of long-range strike systems. The Chinese have also demonstrated both ground- and space-based counter-space capabilities designed to deter and, in the event of a conflict, degrade enemy space assets. However,

as Beijing expands its military space capabilities for ‘intelligentised warfare and network-centricity’, it will also inevitably deepen its dependency on space assets, potentially creating vulnerabilities and exposing it to various counter-space threats.

From an Indian perspective, the issue is not simply that China has become a major space power. The more consequential issue is that China’s space capabilities are a product of the system inside a political and institutional system where civilian, commercial, and military functions often overlap. In practice, the same infrastructure, manufacturing base, data systems, and launch capacities that support scientific and commercial missions can also enhance military surveillance, targeting, command networks, and strategic leverage. That is why the nature of China’s space programme must be examined as a structural feature rather than as a narrow technical aspect, as it has direct implications for India. India’s space programme has traditionally been shaped by developmental utility for civil purposes and innovation focussing on civil applications of remote sensing, telecommunications, and meteorology while retaining strategic autonomy. Those remain enduring strengths. Yet the strategic context has changed, and India must now evaluate space not only as a developmental instrument but also as a contested strategic domain tied to deterrence, border surveillance, maritime awareness, military preparedness, and the resilience of critical national infrastructure.

The broader space environment reinforces the urgency of such a reassessment. ISRO’s *Indian Space Situational Assessment Report 2024* highlighted the intensity of global space activity and the growing importance of safe and sustainable space operations, reflecting how congested and operationally demanding the domain has become.³ For India, this means that future competition will unfold in an orbital environment where access, resilience, data security, and governance will matter as much as launch success alone.

The growing space capabilities with their dual-use nature allow China to gradually dominate both military and civil/commercial domains, occupying key orbital space and thereby posing a significant challenge to India’s national security.

This concern has military, economic, and governance dimensions. At the military level, a state that can launch frequently, sustain large constellations, provide independent navigation services, and generate persistent Earth observation acquires a major operational edge in intelligence, targeting, communication, and resilience. The US Department of Defence 2024 China Military Power Report reflects continuing concern over the steady expansion of China's military-relevant capabilities across multiple domains, including those that enable the PLA's strategic modernisation.⁴

At the economic and commercial level, outer space is becoming an arena of competitive market influence through launch services, broadband constellations, navigation ecosystems, remote sensing applications, and standards-setting. China's official white paper explicitly links the national space programme to economic and social development, industrial growth, and international cooperation, indicating that civil and strategic benefits are not treated as separate policy lanes. This raises the possibility that commercial success, regulatory positioning, and geopolitical influence may reinforce one another over time.

At the governance level, early-mover advantage in orbital infrastructure, user dependency, and international partnerships can shape future access to space and influence the rules under which space is used. From India's standpoint, the challenge is therefore not only a capability gap but the possibility of a future operating environment in which Chinese systems, standards, or dependencies constrain India's room for peaceful, commercial, and strategic expansion. The rapid expansion and dual-use character of the Chinese programme is thus central to the problem, because it makes strategic accumulation appear gradual, decentralised, and often outwardly civilian.

For India, the analytical question is not whether China's space programme is civilian or military in a strict binary sense. The more important question is how India can build its own capabilities in civilian, industrial, and commercial domains while simultaneously leveraging them for military usage and retaining its strategic autonomy on the 'high ground'.

SCOPE AND LIMITATIONS

The research focuses on the 2015–2025 period as the principal timeframe while incorporating historical context where necessary. This temporal frame is appropriate because it captures the period of intensified Chinese space reforms, the consolidation of BeiDou's global architecture, the growth of Chinese remote sensing and launch capabilities, and the operational maturity of major national projects such as Tiangong.⁵

The primary analytical lens is the India–China competition, while allied and comparative perspectives are integrated where relevant. The scope also extends to classified or opaque counter-space capabilities in an analytical sense, but with caution. Since many operational details remain undisclosed, the study will rely on open-source inferences, official assessments, credible government commentaries, think tank analyses, and peer-reviewed sources.

SIGNIFICANCE

The significance of this study lies in the fact that space has become foundational to both military effectiveness and socioeconomic stability. Satellite-based systems support navigation, logistics, communications, financial synchronisation, weather forecasting, disaster management, and intelligence. As a result, disruption in space can produce direct effects on national security, economic functioning, and social structures.

For India, the significance is particularly acute because the country faces a militarily superior continental rival, a changing maritime environment, and a rapidly evolving technological ecosystem in which both military and commercial space capabilities are becoming increasingly important. India is advancing its reforms and capacity building in space, but it must do so in a mission mode, as future leadership in geopolitics will be greatly dependent not only on military and economic heft but also on the ability to shape rules, standards, partnerships, and behaviour in orbit.

Notes:

- ¹ Tai Ming Cheung, “National Strategic Integration: How China Is Building Its Strategic Power,” *IGCC–MERICS Policy Brief*, UC San Diego Institute on Global Conflict and Cooperation/Mercator Institute for China Studies, La Jolla, October 26, 2023, <https://ucigcc.org/publication/national-strategic-integration-how-china-is-building-its-strategic-power/>.
- ² Jonathan McDowell, *Jonathan’s Space Pages: Satellite Catalog and Launch Log*, at <https://www.planet4589.org/space/jsr/> (Accessed April 1, 2026); Space Stats Online, “Orbital Launches by China” at <https://spacestatsonline.com/launches/country/chn> (Accessed April 1, 2026). McDowell’s catalog is the standard academic reference for verified orbital launch tracking.
- ³ Indian Space Research Organisation (ISRO), *Indian Space Situational Assessment Report (ISSAR) for 2024* (Bengaluru: ISRO, released April 22, 2025), https://www.isro.gov.in/ISSAR_2024.html. [Note: The document was formally released by ISRO Chairman Dr. V. Narayanan on April 22, 2025; the previous citation date of ‘May 29, 2025’ was the news-indexing date on the ISRO website, not the official release date.]
- ⁴ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024: Annual Report to Congress*, Office of the Secretary of Defense, Washington DC, December 2024.
- ⁵ State Council Information Office, People’s Republic of China, *China’s Space Programme: A 2021 Perspective*, Beijing, January 28, 2022.

CHINA'S STRATEGIC VISION FOR SPACE AND DUAL-USE SPACE CAPABILITIES

The story of China's ascent as a space power is not one of serendipitous scientific ambition. It is the product of deliberate, decades-long strategic planning that has steadily erased the boundary between civilian exploration and security dimensions. From the modest launch of Dong Fang Hong-1 in 1970 to the operational deployment of more than 1,450 satellites in orbit by April 2026, China has pursued space dominance with a consistency that few national endeavours can match. Understanding this trajectory, its doctrinal roots, institutional machinery, strategic objectives, and outward commercial reach is essential to any credible assessment of the threat China poses to India and the broader international space order.

DOCTRINAL EVOLUTION: FROM 'PEACEFUL USE' TO SPACE DOMINANCE

China's intellectual journey in space strategy began not with a grand proclamation but with a military lesson from the 1991 Gulf War. PLA strategists, observing the devastating effectiveness of American space-enabled precision warfare, concluded that future conflict would be decided by whoever controlled the information domain, and that the information domain was inseparable from space. The concept of 'informatisation' (xinxihua) was formally enshrined in PLA doctrine in 1993 and rapidly became the organising principle of the military's modernisation drive.⁶

By 2015, China's doctrinal evolution had matured into a frank acknowledgement of space as a warfighting domain. The 2015 Defence White Paper identified outer space as one of the 'new commanding heights in international strategic competition' and described revolutions in military affairs, informatised warfare, precision strike, and space-enabled operations as posing 'new and severe challenges to China's

military security.⁷ This idea was not theoretical as it coincided with the December 2015 establishment of the PLA Strategic Support Force (PLASSF), which consolidated space, cyber, electronic warfare, and psychological operations under a single command, signalling that Beijing had institutionally accepted space as a fifth operational domain on par with land, sea, air, and cyberspace.

At the core of PLA space doctrine lies the concept of ‘*zhìtiān quán*’ or space control, the Chinese corollary of air superiority doctrine. The authoritative Science of Military Strategy, in its 2020 PLA National Defence University edition, states unequivocally: ‘Without space control, information control is impossible, and consequently air control, sea control, and land control would quickly fall one after another.’⁸ Space supremacy, in PLA strategic thought, is not merely a combat enabler; it is the prerequisite for dominance across every other domain.

The 2021 Space White Paper (released January 2022) marked a further evolution, being the first Chinese space policy document to openly voice the ambition of becoming a global space leader, not merely a power. It emphasised self-sufficiency, the imperative of commercial space development driven by private innovation, and a five-year roadmap towards crewed lunar landings, cislunar operations, and on-orbit servicing.⁹ Simultaneously, it aligned China’s entire space programme, both civilian and military, with the Space Vision 2047: the target of becoming a ‘fully developed great power’ by the centenary of the People’s Republic, with space capability explicitly identified as an essential pillar.

The most significant shift came in April 2024, when Xi Jinping dissolved the PLASSF and elevated its constituent arms to direct Central Military Commission (CMC) subordination. The new PLA Aerospace Force (PLAASF), PLA Cyberspace Force, and PLA Information Support Force each report independently to the CMC, bypassing the intermediate command layers that had previously created friction in the hierarchy. Xi explicitly directed the new forces to ‘strengthen strategic capabilities in emerging fields, including deep sea, outer space, and cyberspace.’^{10,11} For India, this reorganisation is strategically consequential as it marks the transition from China’s space programme being a support function to being a warfighting arm with its own doctrine, budget priority, and command authority.

CIVIL-MILITARY FUSION (CMF): THE INSTITUTIONAL ENGINE

CMF (jūnmín rónghé) is frequently described as a policy; but for China, it is more accurately characterised as a systemic design feature. Xi Jinping elevated CMF to a national-level state strategy in 2015; and in 2017, he established the Central Commission for Integrated Military and Civilian Development (CCIMCD), a Party-level body chaired by Xi himself to oversee its implementation across all sectors. In space, CMF has deliberately blurred the distinction between civilian science and military capability, creating an ecosystem where a satellite's national registration as 'commercial' carries no reliable inference about its operational function.¹²

The organisational architecture of China's space programme reflects this fusion. At the apex, the State Council sets overarching national space policy, while the State Administration for Science, Technology and Industry for National Defence (SASTIND) oversees both the China National Space Administration (CNSA) and the defence S&T industrial base. The China Aerospace Science and Technology Corporation (CASC) serves as the primary contractor for launch vehicles (through CALT) and spacecraft (through China Academy of Space Technology (CAST)), operating under State-owned Assets Supervision and Administration Commission (SASAC) oversight but maintaining direct operational ties to the CMC's Equipment Development Department. CASC's sister organisation, the China Aerospace Science and Industry Corporation (CASIC), functions primarily as a defence contractor with specific responsibilities for missile systems and counterspace capabilities.¹³ More will be covered in subsequent chapters.

The BeiDou Navigation Satellite System exemplifies CMF in practice. Developed and operated primarily by CASC and its subsidiary CAST, BeiDou provides ostensibly civilian positioning services to over 30 countries,¹⁴ while simultaneously delivering encrypted military-grade precision to the PLA's precision-strike assets. Beginning in 2014, when the National Development and Reform Commission issued 'Document 60' opening China's space sector to private capital,¹⁵ a thriving ecosystem of new-space private actors Galaxy Space, LandSpace, Space Pioneer, Galactic Energy emerged, all operating under CMF obligations that require them to subordinate commercial development to national

security imperatives when directed. India has no equivalent legislative or institutional architecture compelling its private space sector to serve national security objectives, a structural asymmetry that compounds the capability gap.

STRATEGIC OBJECTIVES IN SPACE

China's space ambitions operate simultaneously across four strategic objectives that reinforce one another, making their disaggregation analytically misleading. The first is prestige and soft power. Under Xi's 'China Dream' of national rejuvenation, high-profile achievements like the Tiangong space station, Chang'e far-side lunar landings, and Tianwen-1 Mars mission serve a dual purpose as it projects technological leadership abroad but also legitimise (Chinese Communist Party) CCP governance domestically.¹⁶ The exclusion of China from the International Space Station by the United States Congress in 2011 served, paradoxically, to accelerate China's autonomous capability development, culminating in Tiangong's full operation by 2022 and positioning China as the only nation currently operating an independent crewed orbital platform.

The second objective is economic returns: the commercialisation of BeiDou navigation services, the marketing of Chinese launch vehicles on the international market, and the deployment of commercial imagery constellations such as the Jilin-1 series (300 satellites planned by 2027) that simultaneously generate revenue and provide intelligence value under CMF obligations.¹⁷ The third objective, which is most strategically significant for India, is military ISR and precision-strike enablement. China's ISR satellite fleet grew from 123 systems in 2018 to over 510 systems in December 2025, a near-tripling in seven years, providing near-persistent surveillance coverage of the Himalayas, the Indian Ocean region, and naval deployments in the Indo-Pacific.¹⁸

The fourth objective is deterrence and counterspace domain by developing and deploying the full spectrum of capabilities including kinetic Anti Satellite Test (ASAT), co-orbital interceptors, directed-energy, cyber, and electronic warfare to deny adversaries the space-based advantages upon which their military effectiveness depends. In PLA doctrine, targeted counterspace strikes against an adversary's C4ISR satellite architecture in the early phase of conflict are not a last resort

but a first-phase operational imperative, intended to ‘blind’ opposing forces before conventional operations commence.¹⁹

THE ‘SPACE SILK ROAD’: EXTENDING STRATEGIC INFLUENCE

China’s Belt and Road Initiative has a frequently underappreciated spatial dimension. The *Belt and Road Space Information Corridor*, formally codified in China’s 2016 Space White Paper and operationalised through subsequent National Development and Reform Commission (NDRC) planning, represents a structured effort to extend China’s satellite and ground infrastructure footprint across Belt and Road Initiative (BRI) partner nations, creating technical dependencies, data collection advantages, and diplomatic leverage that serve both commercial and military-intelligence objectives.²⁰

By 2024, more than 30 countries had signed agreements to embed BeiDou navigation infrastructure in national systems, including Pakistan, Nepal, Bangladesh, and Sri Lanka, all of which share land or maritime borders with India.²¹ Satellite exports to Venezuela (VENESAT-1), Nigeria (NigComSat-1R), and Pakistan (PAKSAT-MM1), combined with ground station construction in Namibia, Egypt, Ethiopia, and Argentina, have provided China with a global space monitoring, tracking, and control network that supplements its domestic Telemetry, Tracking and Command (TT&C) infrastructure and extends its military space domain awareness to the Western Hemisphere.^{22,23} China hosted the first China–Latin American and Caribbean States Space Cooperation Forum in April 2024, signalling a deliberate effort to institutionalise these relationships.

From India’s strategic perspective, the Space Silk Road poses a compound threat. BeiDou’s embedding in India’s neighbourhood creates intelligence collection vectors and data sovereignty vulnerabilities for partner nations, while China’s overseas ground stations, particularly the PLA-linked facility at Neuquén, Argentina, provide space domain awareness capabilities that can track Indian and allied satellite operations. The Space Silk Road is not merely a commercial enterprise, but it is a systematic expansion of China’s strategic intelligence and access architecture, draped in the language of development cooperation. India should consider a counter-engagement strategy offering competitive

satellite services, civil nuclear space applications, and reciprocal ground-station agreements to regional nations adopting an aggressive Indian space diplomacy.^{24,25}

A detailed mapping and analysis of Chinese capabilities both in civil and military fields may provide the required insight in its likely exploitation for enhancing and dominating its influence in modern geopolitics. The subsequent section attempts to take a dive, especially, to the dual-use nature of the Chinese space programme and its implications for India.

CHINA'S DUAL-USE CIVIL SPACE CAPABILITIES

Space: The *Unified Frontier*

The strategic *spacescape* of China in the 21st century can be defined by the increasing blurring of boundaries of its civil and military space programmes. The dual-use character of China's civil space capabilities is now a perfected mechanism which converts a declared peaceful programme into a coherent military capability without raising eyebrows among the international community. Successive Chinese writings reflect space activity as a contribution to science, economic development and the global commons. The same documents also mandate CMF as state policy, requiring civilian assets to be designed and operated in a manner that also yields military use; therefore, the PLA does not need to build a new/parallel architecture as it inherits one already in orbit.²⁶ For India, the historical separation between the Indian Space Research Organisation's civilian charter and the DSA's military mandate remains a legacy issue that may have operational consequences in the multidomain conflicts of the future, both along the land borders and in the maritime domain.

Under the central leadership and steered at the highest level with the newly formed PLA Aero Space Force (PLAASF), the Chinese space programme has acquired a *fused* 'intelligentised' architecture designed to secure space dominance (*zhìtíān quán*) as a key strategic imperative.²⁷ The Chinese practice of *junmín rónghe* (Military Civil Fusion) is not an externality of the programme; it is at the core of the system.²⁸ The question here is not whether to disaggregate 'civil' and 'military' elements, as they have been so precisely organised that they cannot be clearly disaggregated, but rather to focus on the *intent* that such massive

capability provides to China's decision-making, influence, and military apparatus. Today China has 1450 operational satellites and has recently applied at International Communication Union (ITU) for 2,03,000 satellites as part of a new LEO constellation similar to the Starlink programme of USA. From scientific exploration missions to classified surveillance programmes, a quick review of its space programmes provides an indicator of their breadth and scope as it races feverishly to outpace the world and gradually cement its strategic influence across the globe.

Table 1 : Human Spaceflight and Space Station Programmes

Nomenclature	Type	Purpose	Key Details (Latest Status)
Shenzhou Programme	Crewed spacecraft programme	Human spaceflight, docking, and astronaut transport	Dual-use. Potential military applications in orbital servicing and crewed strategic operations. Active missions through 2025–26.
Tiangong Space Station	Modular space station	Long-duration human presence and microgravity research	Dual-use. Potential military utility in ISR support, on-orbit servicing and strategic autonomy in crewed spaceflight. Fully operational since 2022.
Mengzhou	Next-generation crew spacecraft	Deep-space and lunar crew transport	Dual-use. Designed for future lunar missions and expanded deep-space operations. Under advanced development and testing for crewed lunar programme.
Lanyue Lunar Lander	Crewed lunar lander	Human lunar landing capability	Dual-use; central to China's planned Moon landing before 2030; hardware testing ongoing.

Sources: Data compiled from China Manned Space Agency, “China Focus”; David, “China Shakes Up Space Programs”; US Department of Defense, Military and Security Developments Involving the PRC; Jones, “China’s Crewed Lunar Program.”

Table 2 : Lunar and Cis-Lunar Programmes

Nomenclature	Type	Purpose	Key Details (Latest Status)
Chang’e Programme	Lunar exploration architecture	Lunar orbiters, landers, and sample return	Strategic; Chang’e-6 successfully returned far-side lunar samples in 2024; Chang’e-7 and 8 in preparation.
Chang’e-7	Lunar polar exploration mission	Survey south-pole resources (water/ice)	Strategic; planned for late 2026 launch.
Chang’e-8	Lunar infrastructure technology mission	ISRU and lunar construction technologies	Strategic; expected to test 3D printing and lunar technologies; planned in 2028.
International Lunar Research Station (ILRS)	Lunar base initiative (ILRS)	Permanent lunar infrastructure for Robotic and later crewed operations	Dual-use; 17 countries and 50+ research institutes; initial operational framework targeted around 2035.
DRO Earth–Moon Constellation	Cis-lunar communication/navigation system	Navigation and communications in Earth–Moon space	Dual-use; Supports future lunar logistics. Initial constellation deployment undertaken in 2025.

Sources: Data compiled from China Manned Space Agency, “Chang’e Space Program”; Jones, “China Delays Chang’e-7”; CNSA, “International Lunar Research Station Initiatives”; Advanced Space, “Cis-Lunar Constellation Constellation Milestones.”

Table 3 : Navigation, Timing, and Strategic Positioning Programmes

Nomenclature	Type	Purpose	Key Details (Latest Status)
BeiDou Navigation Satellite System	GNSS/PNT constellation	Navigation, timing, and positioning	Dual-use ; fully operational with 45 satellites

Sources: Data compiled from China Satellite Navigation Office, “BeiDou In-Orbit System Status”; United Nations Office for Outer Space Affairs, “BDS Constellation Progress”; US Department of Defense, Military and Security Developments Involving the PRC.

Table 4 : Deep-Space and Planetary Exploration Programmes

Nomenclature	Type	Purpose	Key Details (Latest Status)
Tianwen Programme	Deep-space exploration architecture	Planetary exploration	Strategic prestige ; interplanetary exploration covering Mars, asteroids and deep-space; active.
Tianwen-1	Mars orbiter and rover mission	Mars exploration	Civil; Tianwen-1 orbiter to Mars remains operational.
Tianwen-2	Asteroid/comet mission	Sample return and comet exploration	Civil (Tech demonstration) ; targets asteroid sampling and comet flyby operations; successfully launched in 2025.
Tianwen-3	Mars sample return mission	Return Martian samples to Earth	Strategic prestige ; planned around 2028.
SMILE Mission	ESA-China science mission	Solar wind and magnetosphere studies	Civil scientific collaboration ; Joint ESA-Chinese Academy of Sciences (CAS) mission scheduled on May 19, 2026 for deployment.

Sources: Data compiled from China National Space Administration, “Tianwen Exploration Roadmap”; Jones, “China’s Deep-Space Exploration Milestones”; European Space Agency, “SMILE Mission Tracker.”

Table 5 : Satellite Communications and Megaconstellation Programmes

Nomenclature	Type	Purpose	Key Details (Latest Status)
Guowang Constellation	LEO broadband mega constellation	Global satellite internet	Dual-use; state-backed to include ~13,000 satellites. Currently, 168 in orbit and deployment continues through 2025–26.
Spacesail/ Qianfan	Commercial SATCOM constellation	Broadband connectivity	Dual-use; commercially branded broadband constellation with potential state and civil integration; 126 satellites active.
Tianlian Relay System	GEO relay satellite network	Telemetry, tracking, and command relay	Dual-use; supports Tiangong. New Tianlian-II launches in 2025; active satellites are seven.
Hongyan	Broadband satellite system	IoT and communications	Dual-use; merged with Guowang.

Sources: Data compiled from China Satellite Network Group, “Guowang Constellation Status”; Jones, “China’s Megaconstellation Launches”; CASC, “Tianlian Relay Satellite Network Milestones.”

Table 6 : Reconnaissance, ISR and Military Space Programmes

Nomenclature	Type	Purpose	Key Details (Latest Status)
Yaogan Programme	ISR/reconnaissance satellite constellation	Earth observation, electronic intelligence (ELINT), maritime surveillance	Dual-use; widely assessed as a PLA ISR architecture, including SAR, optical and electronic intelligence satellites; 179 satellites are active.
Jianbing Series	Reconnaissance satellites	Electro-optical intelligence collection	Military; integrated with PLA strategic imaging and targeting systems; operational.
Gaofen Programme	High-resolution Earth observation	Imaging and mapping	Dual-use; military targeting and surveillance utility; 32 satellites are active.
TJS (Tongxin Jishu Shiyao)	Classified GEO satellites	SIGINT, missile warning, and space situational awareness	Military; linked to PLA EW, ELINT, and satellite inspection missions; 23 satellites are active.
Huoyan Early Warning Programme	Missile warning satellite architecture	Ballistic missile launch detection	Military; under deployment.
Yaogan-40/45 Series	Advanced ISR satellites	Electromagnetic and reconnaissance missions	Dual-use; associated with PLA ISR operations; active.

Sources: Data compiled from US Department of Defense, Military and Security Developments Involving the PRC; Union of Concerned Scientists, UCS Satellite Database; Secure World Foundation, Global Counterspace Capabilities; Jones, “China’s Military Space Network Operations.”

Table 7 : Experimental, Counterspace, and Dual-Use Programmes

Nomenclature	Type	Purpose	Key Details and Latest Status
Shijian Programme	Experimental satellite series	Orbital servicing, rendezvous, and refuelling	Dual-use; demonstrated proximity operations, towing and satellite servicing technologies with strong counterspace implications.
Shijian-25	Satellite servicing mission	Refuelling and life-extension testing	Dual-use; relevant to strategic satellite sustainment. Shijian-25 successfully docked with Shijian-21 in Jul 2025.
Shiyan Programme	Experimental tech satellites	Sensor and tech validation	Dual-use; for classified orbital experiments and emerging technologies; active deployments continue.
Shijian-6/Shiyan-24C	Proximity operations satellites	Orbital manoeuvring and rendezvous	Military; active and operational.
Shenlong Spaceplane Programme	Reusable orbital spaceplane	Reusable spacecraft and classified experiments	Dual-use; highly secretive analogous to X-37B concept; 4 th mission launched on 07 Feb 2026.
ASAT Programmes	Counterspace systems	Anti-satellite warfare capability	Military; includes kinetic, co-orbital, and electronic warfare; under development.

Sources: Data compiled from US Department of Defense, Military and Security Developments Involving the PRC; Secure World Foundation, Global Counterspace Capabilities; Jones, “China Launches Secretive Spaceplane”; Center for Strategic and International Studies, Space Threat Assessment.

Table 8 : Space Science and Advanced Technology Programmes

Nomenclature	Type	Purpose	Key Details & Latest Status
Micius (QUESS)	Quantum communications satellite	Quantum encryption research	Dual-use; operationally superseded by the Jinan-1 microsatellite.
DAMPE (Wukong)	Dark matter observatory	Cosmic ray and dark matter studies	Civil scientific mission; active
Einstein Probe	X-ray observatory	High-energy astrophysics	Civil scientific mission; active
ASO-S (Kuaifu-1)	Solar observatory	Solar flare and Coronal Mass Ejections(CME) monitoring	Civil scientific mission; active.
HXMT (Insight)	X-ray astronomy satellite	Observation of compact objects	Civil scientific mission; operational.

Sources: Data compiled from Chinese Academy of Sciences, “Strategic Priority Program on Space Science”; Jones, “China’s Space Science Programs”; European Space Agency, “Einstein Probe Cooperation.”

The space domain in China spans across six dual-use capabilities clusters, which are Launch infrastructure, Satellite navigation, Remote sensing and Earth observation, the Tiangong space station, the Chang’e and ILRS programme and lastly the commercial space ecosystem. It is important for us to map it, as each yuan spent in civilian space also generates, in part or in full, some military capacity.²⁹

LAUNCH INFRASTRUCTURE: FOUNDATION OF CHINESE SPACE PROGRAMME

China’s launch enterprise has grown significantly, and now it is the second most active in the world. The Long March family had completed approximately 640 cumulative launches by April 2026 with a 96.9 per cent success rate, and 2025 saw a national record of 92 orbital attempts,

of which 50 were commercial.³⁰ The cadence matters operationally as it determines China's ability to deploy and replenish large constellations under wartime attrition and provides redundancy against any first-strike calculus aimed at the Chinese space lift.

The key trends in the Chinese space programme are the shift from inland launch sites to coastal heavy-lift infrastructure. The increasing overlap of commercial launch facilities with military strategic needs, reusable launch systems, and sea-launch systems are being pursued to improve rapid-response capability, enhance survivability and operational flexibility, and, lastly, the expansion of ISR and navigation constellations to support integrated military operations. Six major launch sites primarily carry the weight for this capability, with two additional locations available/being developed. Jiuquan in the Gobi desert handles crewed missions and solid-rocket commercial flights. Taiyuan in Shanxi specialises in sun-synchronous orbits used by Earth-observation satellites. Xichang in Sichuan has carried out the most BeiDou launches and the bulk of geostationary missions. Wenchang on Hainan Island, added in 2014, has now been supplemented by the adjacent Hainan Commercial Spaceport, which conducted nine commercial launches in its first operational year in 2025.³¹ The dispersion across inland and coastal sites provides it with necessary redundancy besides orbital flexibility. On the other hand, India depends almost entirely on Sriharikota, with the Kulasekarapattinam Small Satellite Launch Vehicle site still under development.

The most significant qualitative shift has been in the reusability aspect, driven by CMF. Chinese have been closely observing the SpaceX missions, and Chinese firms like Landspace and Galactic energy are increasingly working towards reducing the cost while providing PLA with a resilient 'launch on demand capability'.³² The integration of PLA with civil establishments like CASA, SASTIND, etc has ensured joint vision, dedicated allotment of facilities, and strict scheduling of military satellites.

Table 9: China's Space Launch Infrastructure and Corresponding PLA Linkages³³

Launch Site/ Infra-structure	Payload Capacity	Significance	Status	Corresponding PLA Unit/ Base ID	Strategic/ Military Utility
Jiuquan Satellite Launch Centre	LM-2F: ~8.4T to LEO; LM-4C: ~4.2T to SSO	Oldest Chinese launch centre; crewed missions	Operational	Base 20/Unit 63600 ³⁴	Human spaceflight (Shenzhou; ICBM/ missile testing; rapid LEO response) ³⁵
Wenchang Space Launch Site	LM-5: ~25T to LEO; ~14T to GTO	Heavy-lift and lunar mission hub	Operational/ Expanding	Unit 63810 ³⁶	Heavy-lift CZ-5/CZ-7 missions; space station modules; deep-space and lunar trajectory optimisation ³⁷
Wenchang Launch Complex 301	Projected >70T to LEO	Future lunar heavy-lift infrastructure	Under Development	Direct Operational Control	
Xichang Satellite Launch Centre	LM-3B/E: ~5.5T to GTO	Primary GEO launch site	Operational	Base 27/Unit 63790 ³⁸	Beidou navigation; military COMSEC/ SATCOM; ASAT testing ³⁹
Taiyuan Satellite Launch Centre	LM-6A: ~4.5T to LEO	Main polar-orbit launch centre	Operational	Base 25/Unit 63710 ⁴⁰	ISR/SIGINT collection; polar reconnaissance; meteorological support; missile warning/ABM testing ⁴¹

Launch Site/ Infra-structure	Payload Capacity	Significance	Status	Corresponding PLA Unit/ Base ID	Strategic/ Military Utility
Hainan Commercial Space Launch Site	LM-8 and reusable launchers	Commercial and reusable launch expansion	Operational /expanding	HICAL (State-backed Enterprise) ⁴²	Low-cost LEO access; CZ-8/CZ-12 commercial variants; high-cadence constellation replenishment ⁴³
Dongfeng Commercial Space Innovation Test Zone	Projected ~12T to LEO	Reusable methane rocket testing	Under Development	Administered by Base 20 (Unit 63600) oversight.	Testing of LOX/methane rockets (Zhuque-2/3); Lijian series launches.
Haiyang Sea Launch Platform	Solid-fuel sea launches	Mobile launch capability	Operational	Managed via TSLC/ Aerospace Force Liaison ⁴⁴	Tactical rapid response; mega-constellation (SatNet/Qianfan) deployment; reusable rocket maritime recovery ⁴⁵

NAVIGATION (BeiDou BDS-3): THE PNT BACKBONE OF INTELLIGENTISED WARFARE

The completion of the BeiDou-3 constellation in 2020 was a significant moment for China’s strategic autonomy as it insulated its precision strike complex from foreign interference while extending accurate navigation, positioning, and timing capabilities to its commercial, scientific, economic, and military actors. The Indian Space Association’s analysis at the 2026 Def Space Symposium recorded 45 BeiDou navigation satellites in orbit by the end of 2025, including replacement and backup assets, compared with the Indian Regional Navigation

Satellite System's three operational satellites following recurring atomic clock failures.⁴⁶ The asymmetry is both functional and numerical, as BeiDou is global whereas NavIC is regional, with a coverage footprint of only 1,500 kilometres beyond the Indian landmass.

BDS-3 broadcasts a public service in the B1C, B2A, and B1I bands, and a restricted authorised service in the B3I and B3A bands available to the Chinese government and military.⁴⁷ Open-service positioning accuracy is officially stated to be within ten metres horizontally, with timing accuracy of 20 nanoseconds. The restricted military service achieves 0.1 metre tracking accuracy with two-way communication capability.⁴⁸ A unique feature inherited from the regional BDS-2 design is the short-message service wherein BDS users with appropriate transceivers can transmit text messages of up to a thousand Chinese characters per message via the geostationary satellites, with a throughput of approximately 18 million messages per hour. The military implication of this two-way capability is significant. It provides PLA units with an indigenous, encrypted command-and-control channel that does not depend on terrestrial communication or the Global Positioning System.⁴⁹

REMOTE SENSING AND EARTH OBSERVATION

If BeiDou is the most visible Chinese space programme, the Earth-observation constellation is the most operationally important. US Space Force estimates that there are 510 ISR-capable Chinese satellites in the orbit, witnessing a 927 per cent expansion in China's in-orbit ISR presence since 2015.⁵⁰ The figure includes satellites from three nominally distinct programmes: the civilian Gaofen series under the China High-Resolution Earth-Observation System (CHEOS); the Yaogan series, formally described as remote sensing and informally acknowledged across Chinese media and academia as military reconnaissance, and an ecosystem of commercial constellations led by the Jilin-1 system.

Table 10 Principal Chinese Earth-Observation Programmes and Military Functions

Series	Civilian Designation	Resolution/Type	Confirmed/Assessed Military Use
Gaofen 1–14	CHEOS, civilian	Sub-metre optical/SAR/hyperspectral	Border surveillance, target identification (LAC, SCS, IOR)
Gaofen-4/13 / 13-02	CHEOS GEO	15–50 m optical, persistent dwell	Aircraft-carrier tracking, naval surveillance over IOR
Yaogan 1–45	‘Remote sensing’	Optical, SAR, electronic intelligence (ELINT), ocean-surveillance triplets	Maritime ELINT/anti-ship targeting; missile cueing for DF-21D/DF-26
Yaogan-41	‘Remote sensing’ GEO	Sub-metre optical from 36,000 km	Indo-Pacific persistent vehicle-scale tracking
Ludi Tance-4	Civilian land-survey	20 m SAR from GEO (world-first)	All-weather wide-area ocean and littoral surveillance
Jilin-1	Commercial (Chang Guang)	0.3–0.5 m optical; 4K video; 115+ sats	Targeting imagery; Iran kill-chain; F-22 tracking experiment; 117 in orbit
Hainan-1 series	Commercial/academic	Optical + SAR + AIS-ELINT	Dedicated South China Sea persistent watch

Source: Author (Compiled from CMPR 2024; CSIS Aerospace Security 2024; Small Wars Journal Nov 2025; Yaogan-45 launch reporting (Sep 2025); CGSTL public disclosures

Three trends define the current progress. First, the transition from low Earth orbit to geosynchronous reconnaissance has produced platforms that are unique in their class. The Yaogan-41, launched in December 2023, is widely assessed as a sub-metre GEO optical satellite, capable of identifying car-sized objects across half of the Earth's surface from 36,000 kilometres altitude. The Ludi Tance-4 (Land Exploration-4), launched in August 2023, is the world's first GEO synthetic-aperture-radar (SAR) satellite, providing all-weather, day-and-night surveillance over the Indo-Pacific.⁵¹

Second, the Yaogan-30 ocean-surveillance triplets, modelled on the United States' Naval Ocean Surveillance System, allow the geolocation of warships through time difference of arrival measurements of their radio emissions, with revisit intervals measured in minutes rather than hours. Third, the commercial Jilin-1 constellation, comprising 117 active satellites, has compressed global revisit times to between 15 and 20 minutes, with planned expansion to 300 satellites. In September 2020, China's Chang Guang Satellite Technology released video imagery from the Jilin-1 Gaofen-3 satellite showing an aircraft being continuously tracked from orbit. Contemporary reporting identified the aircraft as an F-22 Raptor, although the identification was generally qualified as an assessment rather than independently verified. The episode demonstrated the potential of high-resolution commercial satellites to observe and track fast-moving aircraft, including low-observable platforms.⁵²

Tiangong Space Station: Enabling Counterspace in 'High Ground'

The Tiangong space station became fully operational in 2022 with the addition of the Wentian and Mengtian modules to the Tianhe core, which was launched in April 2021. The station orbits at an altitude of 340 to 450 kilometres with a total mass of about 70 tonnes. Although it is roughly one-sixth of the mass of the International Space Station, it is newer, modular, and Chinese-controlled in its entirety. It will be the world's only operational space station which is expected to remain in orbit beyond 2030.⁵³ More than a symbol of national prestige, it is also a high orbit test bed for co-orbital and proximity operations.

Dual-use features. Tiangong's dual-use character is encoded in its hardware. The station carries two robotic arms, a 10.2-metre Tiangong Robotic Arm on the Tianhe core module and a smaller arm on the Wentian module. Both arms can crawl across the station's exterior between docking adapters and can be combined for joint operations. They are designed to capture visiting spacecraft, transfer cargo, and assist extra-vehicular activities and, by extension, can also be used to inspect, manipulate, or relocate satellites. The Shijian-21 satellite, which grappled and relocated a defunct BeiDou satellite to a graveyard orbit in January 2022, belongs to the same technological lineage. The China Aerospace Studies Institute has observed that even Chinese media, academics, and bloggers agree with Western analysts that remote proximity-operations capabilities and robotic-arm technologies are dual-use.⁵⁴

The station also acts as a permanent Space Situational Awareness (SSA) node. Its exterior is equipped with multispectral cameras and infrared sensors that track and identify small objects in LEO. This persistent monitoring allows China to build a comprehensive catalogue of adversary satellite movements, providing it with the necessary intelligence to shape its own ASAT responses during times of conflict.

CISLUNAR AMBITIONS: COMPETITION FOR LUNAR RESOURCES

The Chinese Lunar Exploration Programme reflects a long-term strategic goal, namely, the occupation and utilisation of 'high ground' beyond Earth's orbit. The programme has progressed through four phases since 2007. The latest mission, Chang'e-7, is scheduled for launch aboard a Long March 5 rocket from Wenchang in late 2026, and is aimed at the illuminated rim of Shackleton Crater near the lunar south pole, the same region considered for NASA's Artemis crewed landings.

These robotic missions are precursors to two linked programmes, i.e., the Chinese crewed lunar landing planned before 2030 and the ILRS, planned for completion in two phases by 2035 and 2050. The ILRS was announced jointly with Russia in March 2021. Its formal members as of late 2025 include China, Russia, Belarus, Pakistan, Azerbaijan, Venezuela, South Africa, Egypt, Nicaragua, Thailand, Serbia,

Kazakhstan, and Senegal and the broader cooperation network reportedly includes more than 40 institutions.⁵⁵ ILRS Chief Designer Wu Weiren has publicly stated the goal of attracting 500 international research institutions and 5,000 researchers by 2035.

Table 11 Comparative Cislunar Architectures: Artemis Accords and ILRS^{56,57}

Parameter	Artemis Accords (US-led)	ILRS (China-Russia-led)
Launched	October 2020	March 2021 (MoU)
Members (mid-2025)	67 signatories including India, Japan, Australia, UK, France, Italy, UAE	13 confirmed states; 50+ institutions; Pakistan included
Lunar landing target	Artemis-3 crewed landing slipped to ~2027	Chinese crewed landing before 2030 (CMSA target)
Base/station target	Lunar Gateway operational; Artemis Base Camp by 2030s	Basic ILRS facility by 2035 at lunar south pole
Communications relay	LunaNet (NASA + ESA)	Queqiao-2 (operational); planned constellation
Governance	Non-binding political principles built on OST 1967	ILRS Cooperation Organisation; framework still emerging

Source: Author (Compiled from NASA Artemis Accords Office; Secure World Foundation tracking, September 2024; CNSA ILRS Guide for Partnership v1.0, June 2021; SpaceNews and CNSA Annual Briefing on Lunar Cooperation, September 2025)

COMMERCIAL SPACE AND THE NEW-SPACE ECOSYSTEM

China’s commercial space sector did not exist in any meaningful form before 2014. A series of reforms over the last decade has catapulted China into becoming a prominent space power. The 2014 National Development and Reform Commission Document 60 opened the launch and small-satellite sectors to private capital, followed by the 14th Five-Year Plan (2021-2025), which designated commercial space, satellite internet, and Earth observation as priority sectors. In 2023, commercial space was elevated to the status of a strategic emerging sector, the same designation initially applied to new-energy vehicles, semiconductors, and biotechnology.⁵⁸ The US Department of Defense’s 2024 China Military Power Report identifies five commercial launch firms—Galactic Energy, Deep Blue Aerospace, Space Pioneer, iSpace and Landspace—each developing reusable orbital launchers.⁵⁹ Commercial space firms in China numbered over 500 by late 2025.⁶⁰ Two megaconstellations dominate this strategic picture: ‘Guowang’ and ‘Qianfan’. They are not merely commercial rivals of Starlink but resilient C4ISR platforms designed to survive and operate in a contested orbital environment.

Table 12 Chinese LEO Megaconstellations (April 2026)

Constellation	Operator / Backer	Target Size	Launched (Apr 2026)	Strategic Profile
Guowang	China SatNet (state)	13,000	~ 168	State backbone; SATCOM, PNT, ISR; military priority
Qianfan/G60	Shanghai SpaceCom (municipal)	15,000	~ 126	Direct Starlink competitor; foreign telecom MoUs (‘Sailspace’)

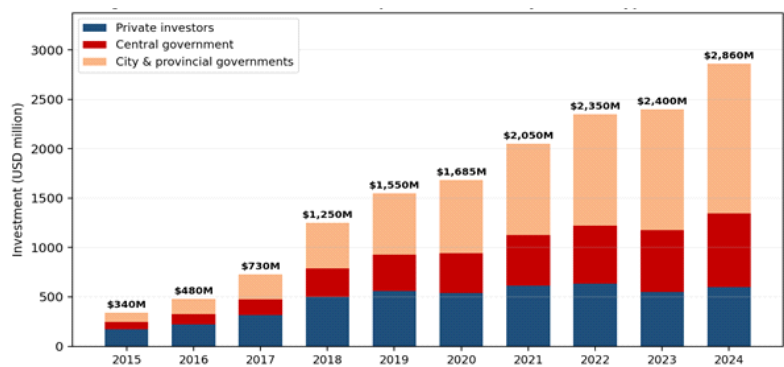
Constellation	Operator / Backer	Target Size	Launched (Apr 2026)	Strategic Profile
Honghu-3	Hongqing / Landspace	10,000	Initial test satellites	Low-orbit (340–550 km); commercial broadband
Geespace	Geely Auto	6,000	~ 64	IoT, PNT, autonomous driving, dual-use timing
GalaxySpace	Private	1,000	Initial test satellites	LEO broadband demonstration platform
Three-Body Computing	ADA Space + state partners	2,800 (planned)	Initial test satellites	In-orbit AI computing constellation

Source: Author (Compiled from CNSA quarterly briefings; Connectivity Technology, Nov 2025; Wikipedia: cross-checked with launch logs; China in Space, Jack C., updated April 2026; CMPR 2024)

Guowang, the state-led national network operated by China SatNet, targets 13,000 satellites in two orbital shells at altitudes of around 1,145 and 1,160 kilometres. By April 2026, the constellation had passed 200 satellites in orbit, making it China's largest. Guowang plans to launch 310 satellites in 2026, 900 in 2027, and 3,600 every year from 2028 onwards. The constellation includes both broadband-internet satellites and dedicated experimental-technology satellites that Western analysts assess as carrying signals intelligence, navigation augmentation, and reconnaissance payloads.⁶¹ Qianfan (Thousand Sails) targets 15,000 satellites, with the first phase of 1,296 satellites and 126 having been launched by April 2026. It is actively being marketed under the Sailspace brand, with MoUs signed with telecommunications operators in the initial six markets across Asia, Africa, and Latin America.

The space industry in China has been driven by government programmes led by state-owned enterprises like CASC, CASIC and China SATCOM, as well as government agencies like CNSA and SASTIND. Its rise in space cannot only be attributed to simply the result of higher spending. It is the result of a well-thought-out and engineered financing architecture that combines long-horizon state planning, provincial industrial policy, military-civil fusion, guided private capital, infrastructure-first investment, and simultaneous demand creation. The result is a hybrid ecosystem where both state-owned and commercial companies operate within a state-directed strategic framework while they still benefit from extensive demand from the market yet remain competitive. China has officially not released any budgetary figures for its space programmes. In 2024, Euroconsult estimated Chinese government space spending at roughly US\$19–20 billion, the second-largest national space budget in the world after the United States (~US\$80 billion) (see Figure 1) and almost 1.6 times the figure of 2022.⁶² Besides the estimated state spending, the private sector has gradually overtaken the state since 2014.

Figure 1 : Chinese Commercial _Space Investment by Investor Type, 2015-2024



Source : Author (Compiled from Orbital Gateway Consulting tracker (in Roll and Du Bois, Redshift, September 2025); IISS Charting China, August 2025; ION Analytics/Mergermarket, May 2025)

Chinese space tech firms can be divided into three main categories: Manufacturing & Launches, Operations and Services and applications. The private sector has not been barred from entry; however, only for military programmes, it requires additional approvals. It is estimated that around 40% of total funding for Chinese space startups originates from the government, another 40% indirectly from private VC/PE funds, and the rest comes from private investors (insurance companies etc).⁶³

Five key patterns⁶⁴ can be recognised in its funding strategy.

The adoption of the triple helix model, which has bound the provincial governments, academic institutions, and private startups into dense regional aerospace hubs. Beijing, Shanghai, Xi'an, Chengdu, Wuhan, Wenchang, Guangzhou, and Jinan have each been built around an interconnected mesh of state R&D institutes, top-tier, and licensed private firms encompassing academic excellence, manufacturing depth and state funding into a single innovation engine. An example of its growing commercial space ecosystem is the firm Chang Guang Satellite Technology Limited (CGSTL), which has flooded the market with its earth-observation (EO) data, obtained from its own satellites, driving down the price from US\$70 per square kilometre to US \$4 per square kilometre, edging out various international firms out of business.⁶⁵

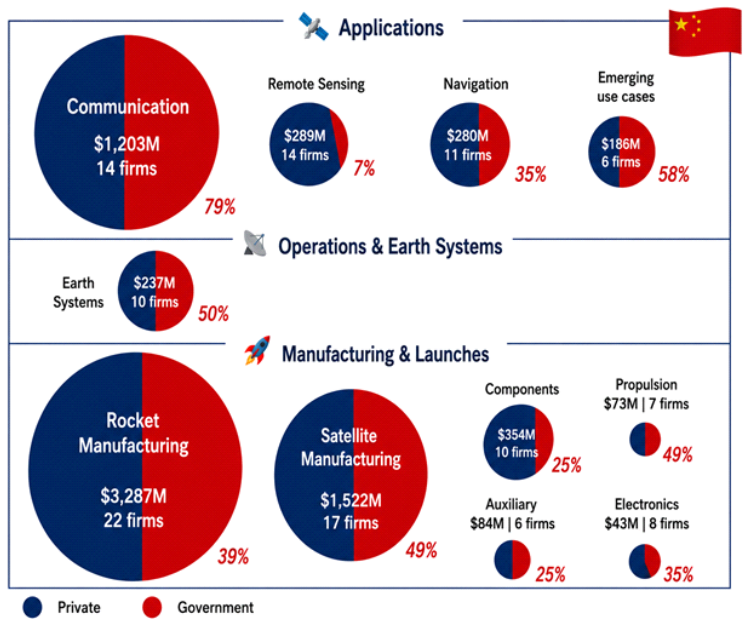
Adoption of **need-based capital injections** based on the priority and importance of the project, e.g., to avoid slippage in deadlines laid down by ITU for its Guowang and Qianfan megaconstellations (SATCOM segment), it infused extra capital of \$1 billion in 2024 alone to rapidly accelerate additional launches and thereby secure its spectrum footprint in orbit.

State-mandated CMF eliminates the requirement to establish separate space supply chains for military and civil purposes. As a constitutional mandate, dual-use technologies are inherently accessible to the PLA, while private companies gain access to government R&D facilities, testing ranges, and launch sites, thereby reducing the capital expenditure (CapEx) for private startups to reach orbit.

Leveraging the Space Silk Road initiative to augment its domestic demand for the private sector by utilising preferential state financing, loans, and grants to fund the space programmes of developing nations.

Domestic demand generation is a crucial factor to keep the system running and has been ensured at the forefront by state-owned customers like CASC, CASIC, the PLAASF, China SatNet (Guowang), and Shanghai SpaceCom (Qianfan), guaranteeing large-scale offtake for launches and mitigating risk faced by private space firms to sustain in high-capital-investment ventures.

Figure 2 Space Tech Funding in China: Private Vs. State



Source: Compiled from SpaceAmbition Substack, April 25, 2025

China did not attempt to replicate the US space model exactly. It built a state-guided commercial ecosystem optimised for scale, manufacturing depth, infrastructure expansion, and strategic coordination.

The Civilian Foundation of Military Space Power

The six dual-use clusters examined in this chapter share a common architecture. Each is publicly framed as a civilian project but is

institutionally designed under CMF and, when assessed in operational terms, has direct implications for India. Launch infrastructure provides the cadence and reconstitution capacity that gives every other capability its operational meaning. BeiDou supplies the precision-guidance backbone for theatre-level and strategic strike. The Earth-observation constellation provides persistent, all-weather, day-and-night targeting picture that converts long-range missiles from threat in being into operational weapons. Tiangong supplies a sovereign human spaceflight platform, a dual-use robotic-arm laboratory, and a soft power instrument that recruits Global South partners. Chang'e and the ILRS extend the Chinese strategic horizon to the cislunar horizon and the resource-bearing lunar south pole. The commercial new-space ecosystem provides resilient, attritable, resistant mass.⁶⁶

At the foundation lies the human resource capital which the Chinese state has been able to channelise through a high degree of MCF in the last decade. The fusion of State, public, private, and commercial academic cum research institutes is designed towards a common national purpose. This academic-creative-innovation pipeline converts ideas into implementable projects with an active monitoring and direct feedback system. A network of these research institutes is spread all over, backed by the state, including the military, and remains the backbone for the longevity of the space ecosystem. Of particular interest is the educational setup of PLA Aerospace Force (ASF). The ASF continues to depend on the Space Engineering University (SEU) in Beijing to educate its officers and Non Commissioned Officers (NCOs). SEU operates three principal campuses in Beijing at Huairou, Changping, and Shahe and comprises a graduate school, an Aerospace Command college, Aerospace Technology, Aerospace Information, and Aerospace Service Colleges, an aerospace NCO school, and a basic teaching department. The university hosts two national key laboratories: the National Key Laboratory of Laser Propulsion and Applications and the National Laboratory of Electronic Information Equipment Systems. Beyond these, SEU maintains several important specialised labs and facilities, including the Aerospace Simulation Training Centre, the Aerospace Science and Technology Innovation Centre, the Deep-Space Exploration Network Antenna Array, the Aerospace Measurement and Operation Control and Comprehensive Application Platform, the Aerospace Measurement and Control Station,

and the National Nuclear High-Based Integrated Technology Research Base. As part of CMF, SEU also offers student access to talent-development programmes such as the ‘Qian Xuesen Space Technology Experimental Class’ and provides China Aerospace Foundation Space-Fund awards to students with top grades, overall performance, or notable achievements in international, national, or military-wide subject knowledge and innovation competitions in the space domain.⁶⁷

Table 13 State-Owned and Military

Institute/Organisation	Primary Responsibility/Specialisation
CASC	The lead contractor for the space programme; develops Long March rockets, Shenzhou spacecraft, and the Beidou constellation
ASIC	Specialises in missile systems, tactical weaponry, and small-satellite launch vehicles (Kuaizhou)
PLA Aerospace Force (PLAASF)	Formed from the 2024 reorganisation; responsible for the operational deployment and defence of space-based assets.
Academy of Military Sciences (AMS)	High-level strategic research on space doctrine, systems engineering, and multi-domain integration.
SASTIND	The government body that regulates and coordinates the defence industry and facilitates military-civil fusion.

Table 14 Research Institutes

Institute/Organisation	Primary Responsibility/Specialisation
National Space ScienceCentre (NSSC)	Part of the CAS; plans and manages national space science missions and deep-space exploration.
Aerospace Information Research Institute (AIR)	Focuses on remote sensing, satellite data processing, and spatial information systems.
CAST	A subsidiary of CASC responsible for the design and manufacturing of the majority of Chinese satellites.

Table 15 Educational (The ‘Seven Sons’)

<u>Institute/Organisation</u>	<u>Primary Responsibility/Specialisation</u>
Beihang University	China's premier aerospace university; focuses on high-end aeronautics, astronautics, and rocket propulsion.
Harbin Institute of Technology (HIT)	Known for satellite design, robotics, and close ties to the military–industrial complex.
Harbin Engineering University (HEU)	Specialises in ship design, marine engineering, nuclear energy, and underwater acoustics with defence-linked space applications.
Northwestern Polytechnical University (NWPUP)	Specialises in UAVs, aeronautical materials, and space structural engineering.
Beijing Institute of Technology (BIT)	Specialises heavily in aerospace engineering, weapon systems, and autonomous technologies.
Nanjing University of Aeronautics and Astronautics (NUAA)	Specialises in civil aviation, helicopter design, and aerospace engineering.
Nanjing University of Science and Technology (NUST)	A leader in materials science, optics, and launch dynamics critical to space and defence programmes.

Table 16 Private/Commercial

<u>Institute/Organisation</u>	<u>Primary Responsibility/Specialisation</u>
LandSpace Technology	A leader in the private sector; focused on developing reusable liquid-fuelled rockets (Zhuque series).
Galactic Energy	Provides low-cost commercial launch services for small and medium satellites.
Space Pioneer (Tianbing Tech)	Develops liquid-propellant launch vehicles and advanced aerospace propulsion systems.
CAS Space	A commercial spin-off from the Chinese Academy of Sciences; offers orbital launch services.
Interstellar Glory (iSpace)	Focuses on commercial carrier rockets and reusable suborbital shuttle technology.

The key analytical takeaway for India is that countering Chinese space capabilities cannot anymore advance on the siloed and distinct civilian-military space programmes. Adoption of a dual-use matrix is a critical strategic requirement. The chapters that follow examine the explicit military space capabilities, the resulting threat assessment for India, and the counter-strategy as a way ahead.

Notes:

- ⁶ Anthony H. Cordesman and Joseph Kendall, “Chinese Space Strategy and Developments,” in *Chinese Strategy and Military Modernization in 2016: A Comparative Analysis*, Centre for Strategic and International Studies, Washington DC, 2016, p. 427.
- ⁷ People’s Republic of China, *China’s Military Strategy*, State Council Information Office, Beijing, May 2015, at <http://eng.mod.gov.cn/xb/Publications/WhitePapers/4887928.html>. (Accessed Mar 13, 2026).
- ⁸ *Science of Military Strategy* (‘beuf’), PLA National Defense University Press, 2020 edition; translated excerpts available via China Aerospace Studies Institute (CASI), Air University, at <https://www.airuniversity.af.edu/CASI/>; cited in U.S.–China Economic and Security Review Commission, “The Final Frontier: China’s Ambitions to Dominate Space,” Chapter 7 in *2025 Annual Report to Congress*, USCC, Washington DC, November 2025, p. 376 (Accessed Mar 14, 2026).
- ⁹ State Council Information Office, People’s Republic of China, *China’s Space Programme: A 2021 Perspective*, Beijing, January 28, 2022. This is China’s fifth space white paper, following editions in 2000, 2006, 2011, and 2016.
- ¹⁰ Xi Jinping, address to the National People’s Congress PLA and PAPF delegation session, 14th National People’s Congress, March 2024, quoted in U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024: Annual Report to Congress*, p. 9.
- ¹¹ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2025: Annual Report to Congress* (Washington DC: Office of the Secretary of Defense, 2025), p. 19. The PLASSF was formally dissolved on April 19, 2024 and replaced by three independently CMC-subordinate forces: the PLA Aerospace Force (PLAASF), the PLA Cyberspace Force, and the PLA Information Support Force.
- ¹² Fatoumata Diallo, “China’s Military-Civil Fusion in Space: Strategic Transformations and Implications for Europe,” *EuroHub4Sino Policy Paper 2025/9*, Institute for Security and Development PolicyEuroHub4Sino, Stockholm, June 2025, pp. 2–3

- ¹³ Mark Stokes, Ian Easton, Gabriel Alvarado, and Emily Weinstein, *China's Space and Counterspace Capabilities and Activities*, U.S.–China Economic and Security Review Commission/Project 2049 Institute, March 30, 2020, pp. 59–65.
- ¹⁴ State Council Information Office, People's Republic of China, *China's Space Programme: A 2021 Perspective*, Beijing, January 28, 2022, Section IV; Most Farjana Sharmin, "China's Increasing Space Power and India–China Orbital Competitions: Implications in the Indo-Pacific with a Focus on South Asia," *Journal of Indo-Pacific Affairs*, November–December 2023, pp. 53–79.
- ¹⁵ U.S.–China Economic and Security Review Commission, "The Final Frontier: China's Ambitions to Dominate Space," Chapter 7 in *2025 Annual Report to Congress*, USCC, Washington DC, November 2025, p. 388; Brigadier Anshuman Narang (Retd), "Red Dragon in Orbit: Mapping China's Civil-Military Space Ecosystem," presentation at ISpA Indian DefSpace Symposium, New Delhi, April 23, 2026.
- ¹⁶ Kevin Pollpeter, "Space, the New Domain," *RAND Corporation Working Paper*, Santa Monica CA, RAND Corporation, March 2015; Kamil Golemo, "The Dragon's Reach: China's Quest for Space Dominance," *Astropolitics: The International Journal of Space Politics & Policy*, 22 (1–2), (2024), pp. 84–101, DOI: 10.1080/14777622.2024.2378711.
- ¹⁷ Golemo, "The Dragon's Reach," 90–95.
- ¹⁸ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2024*, p. 64; Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, SWF, Broomfield CO, April 2024, pp. 1–22 to 1–28; U.S.–China Economic and Security Review Commission, "The Final Frontier," *2025 Annual Report*, p. 375.
- ¹⁹ *Science of Military Strategy*, PLA National Defense University Press, 2020 edition; Kevin Pollpeter, Michael Chase, and Eric Heginbotham, *The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations*, RAND Corporation, Santa Monica CA, 2017, pp. 45–62.
- ²⁰ State Council Information Office, People's Republic of China, *China's Space Activities in 2016* (Beijing, December 27, 2016), Section V, "International Exchanges and Cooperation"; Select Committee on the Chinese Communist Party, U.S. House of Representatives, "Pulling Latin America into China's Orbit", *Staff Report*, U.S. House of Representatives, Washington DC, (2024).
- ²¹ State Council Information Office, *China's Space Programme: A 2021 Perspective*, Section IV; Most Farjana Sharmin, "China's Increasing Space Power," *Journal of Indo-Pacific Affairs*, November–December 2023, pp. 53–79; U.S.–China Economic and Security Review Commission, "The Final Frontier," *2025 Annual Report*, pp. 377–378.
- ²² Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, SWF, Broomfield CO, April 2024, pp. 1–29 to 1–35; ODI Global,

- “China’s Expanding Role in Space in Africa: Geostrategic Implications,” *ODI Report*, Overseas Development Institute, London, 2024; U.S.–China Economic and Security Review Commission, “The Final Frontier,” *2025 Annual Report*, pp. 382–386.
- ²³ Select Committee on the Chinese Communist Party, U.S. House of Representatives, “Pulling Latin America into China’s Orbit”, *Staff Report*, U.S. House of Representatives, Washington DC, 2024.
 - ²⁴ Namrata Goswami and Peter A. Garretson, *Scramble for the Skies: The Great Power Competition to Control the Resources of Outer Space*, Lexington Books, Lanham MD, 2020, pp. 187–205; Brian Harvey, *China in Space: The Great Leap Forward*, 2nd ed. , Springer Praxis Books, Cham, 2020, ISBN 978-3-030-19587-8.
 - ²⁵ Ajey Lele, *Space Security and Global Cooperation*, Pentagon Press/KW Publishers, New Delhi, 2019; see also Rajeshwari Pillai Rajagopalan, ed., *India in Space: Between Utility and Geopolitics*, Routledge, New Delhi, 2022.
 - ²⁶ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024: Annual Report to Congress*, pp. 92–95.
 - ²⁷ United States Space Force, “Space Threat Fact Sheet,” April 2026.
 - ²⁸ Fatoumata Diallo, “China’s Military-Civil Fusion in Space: Strategic Transformations and Implications for Europe,” *EuroHub4Sino Policy Paper 2025/9*, Institute for Security and Development Policy/EuroHub4Sino, Stockholm, June 2025, pp. 5–11, DOI: 10.31175/eh4s.2ca6; Tate Nurkin and Stephen Rodriguez, *China’s Advance in Space*, ASPI Special Report, Australian Strategic Policy Institute, Canberra, December 2023, pp. 14–18.
 - ²⁹ Kevin Pollpeter, “China’s Space and Counterspace Capabilities,” in *Security in Space: Strategic Perspectives*, NIDS International Symposium on Security Affairs Proceedings, National Institute for Defense Studies, Tokyo), 41–56; 117-140, Dec 2024
 - ³⁰ List of Long March Launches, “Cumulative Statistics as of 25 April 2026,” compiled from CNSA and Space Flight Now launch logs; Andrew Jones, “Record Launches, Reusable Rockets and a Rescue: China Made Big Strides in Space in 2025,” *Space.com*, December 24, 2025.
 - ³¹ China National Space Administration (CNSA), 2025 Year-End Press Briefing, January 2026; “China Completes 50 Commercial Space Launches in 2025,” *Global Times*, January 20, 2026.
 - ³² U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2025: Annual Report to Congress*; Jonathan Roll et al., “Redshift: The Acceleration of China’s Commercial and Civil Space Enterprise and the Challenge to America,” *Commercial Space Federation/Arizona State University NewSpace Initiative*, September 2025, 38–45.
 - ³³ Jack C, China in Space, Substack, <https://www.china-in-space.com/p/chinas-launch-sites-and-rockets>, May 2025, What are the orbital launch sites of

China?, <https://proximareport.com/articles/launch-sites-china/>, Feb 2024, Orbital Radar, <https://orbitalradar.com/spaceports/jiuquan?>

- ³⁴ Peter Wood and Alex Stone, “China’s Ground Segment: Building the Pillars of a Great Space Power”, Montgomery, AL: China Aerospace Studies Institute, 2021.
- ³⁵ United States Space Force, “Space Threat Fact Sheet,” April 2026
- ³⁶ Wood, Stone and Lee, China’s Ground Segment: Building the Pillars of a Great Space Power, 2021
- ³⁷ Ibid
- ³⁸ Kristin Burke, “The PLA’s New Base for Space Situational Awareness—Opportunities and Challenges for the U.S.,” China Aerospace Studies Institute, September 11, 2023, <https://www.airuniversity.af.edu/CASI/Display/Article/3498588/>; U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China* 2024, pp. 48–51 (PLA Aerospace Force structure and base organisational details).
- ³⁹ United States Space Force, “Space Threat Fact Sheet,” April 2026
- ⁴⁰ Kristin Burke, “PLA Aerospace Force Base 37: An Open-Source Case Study,” China Aerospace Studies Institute, September 16, 2024, Base 25 Personnel and Organizational Structure Update, AL: China Aerospace Studies Institute, 2026; Refer Footnote 9
- ⁴¹ “The PLA’s New Base for Space Situational Awareness—Opportunities and Challenges,” CASI, September 11, 2023.
- ⁴² Hainan International Commercial Aerospace Launch Co., Ltd. (HICAL), “Wenchang Commercial Space Launch Site Status,” accessed April 9, 2026
- ⁴³ Sun Haitian, “Hainan’s Commercial Space Industry Gathers Momentum,” *People’s Daily*, December 23, 2025, <https://en.people.cn/n3/2025/1223/c90000-20405777.html>
- ⁴⁴ Riyaz ul Khaliq, “China Launches New Satellites into Space from Sea,” Anadolu Agency, March 23, 2026, <https://www.aa.com.tr/en/asia-pacific/china-launches-new-satellites-into-space-from-sea/3875380>
- ⁴⁵ “China’s First Reusable Liquid Rocket Test Offshore Platform Set for Operation,” *Xinhua News Agency*, January 23, 2026, <https://www.chinadaily.com.cn/a/202601/23/WS697319cda310d6866eb35682.html>.
- ⁴⁶ Anshuman Narang, Brig., Red Dragon in Orbit: Mapping China’s Civil-Military Space Ecosystem, presentation at the Indian Space Association DefSpace Symposium, New Delhi, April 23, 2026, slides 18–20.
- ⁴⁷ BeiDou Navigation Satellite System Office, “BDS-3 Constellation Status,” Beijing, July 2020; Yang Yuanxi et al., “Introduction to BeiDou-3 Navigation Satellite System,” *Navigation* 66 (1), 2019, pp. 7–18.

- ⁴⁸ China Satellite Navigation Office, *BeiDou Navigation Satellite System Open Service Performance Standard, Version 3.0*, CSNO, Beijing, 2021, Annex A.
- ⁴⁹ Weiguang Gao et al., “High-Precision Services of BeiDou Navigation Satellite System (BDS): Current State, Achievements and Future Directions,” *Satellite Navigation*, 5 (19), June 2024.
- ⁵⁰ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024*, pp. 63–65 (ISR satellite constellation expansion); U.S.–China Economic and Security Review Commission, “The Final Frontier: China’s Ambitions to Dominate Space,” Chapter 7 in *2025 Annual Report to Congress*, p. 375; Swope and Bingen, *Space Threat Assessment 2024*, pp. 8–12; Insightful Geopolitics, “India-China Space ISR Gap: Widening Reality or Strategic Smokescreen?,” March 17, 2026, by Cdr Sandeep Dhawan.
- ⁵¹ Swope and Bingen, *Space Threat Assessment 2024*, pp. 8–9 (Yaogan-41 and Ludi Tance-4 GEO optical and SAR capabilities); U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024*, pp. 63–64; Andrew Jones, “China’s Ludi Tance-4 Is the World’s First Geostationary SAR Satellite,” *SpaceNews*, August 14, 2023.
- ⁵² Liu Zhen, “China is sending more of its Gaofen satellites into space. Here’s why,” https://www.scmp.com/news/china/military/article/3105209/china-sending-more-its-gaofen-satellites-space-heres-why?utm_source=chatgpt.com (Accessed Apr 18, 2026)
- ⁵³ Mrigakshi Dixit, “China reveals 198-ton ‘six-module’ plan for Tiangong space station as ISS era ends”, at <https://interestingengineering.com/space/china-reveals-six-module-plan-for-tiangong>, (Accessed May 01, 2026).
- ⁵⁴ Kristin Burke, China’s SJ-21 Framed as Demonstrating Growing On-Orbit Servicing, Assembly, and Manufacturing (OSAM) Capabilities, China AeroSpace Studies Institute, September 2021
- ⁵⁵ Wang Yue et al., “Design and Application Prospect of China’s Tiangong Space Station,” *Space: Science & Technology*, 3, June 2023, article 0035.
- ⁵⁶ China National Space Administration, *International Lunar Research Station (ILRS) Guide for Partnership, Version 1.0*, CNSA, Beijing, June 2021; Wu Weiren (ILRS Chief Designer) remarks at the International Lunar Exploration Conference, Hefei, September 2024; Andrew Jones, “China Aces Test of Next-Gen Lunar Capsule and Rocket,” *SpaceNews*, February 11, 2026; *SatNews*, “China Advances 2030 Lunar Timeline with Successful Long March 10 Integrated Test,” February 11, 2026.
- ⁵⁷ Compiled from Andrew Jones, “ILRS membership tracking series”, *SpaceNews*, 2023–2025; (Accessed March 2026); CNSA Annual Briefing on International Lunar Cooperation, Sept 2024. Andrew Jones, “China’s Moon Base Plans Are Getting More Real,” *SpaceNews*, January 6, 2026.

- ³⁸ CNSA, *Major Tasks Schedule for 2026*, Beijing, November 2025; “2025 Yearender: China Space Delivers another Year of Exciting Achievements,” *Xinhua/Global Times*, December 26, 2025.
- ³⁹ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024*, pp. 95–97 (Guowang/SatNet constellation and dual-use signals intelligence payloads); Roll et al., “Redshift,” pp. 38–44, 52–58.
- ⁴⁰ Erik Green, “China’s Commercial Space Sector”, *IIS*, August 21, 2025.
- ⁴¹ Larry Press, “Chinese LEO Satellite Internet Update: Guowang, Qianfan, and Honghu-3,” *CircleID*, September 03, 2026; John Hendricks, “The Constellation Is the Weapon”, *Global Recon*, May 11, 2026.

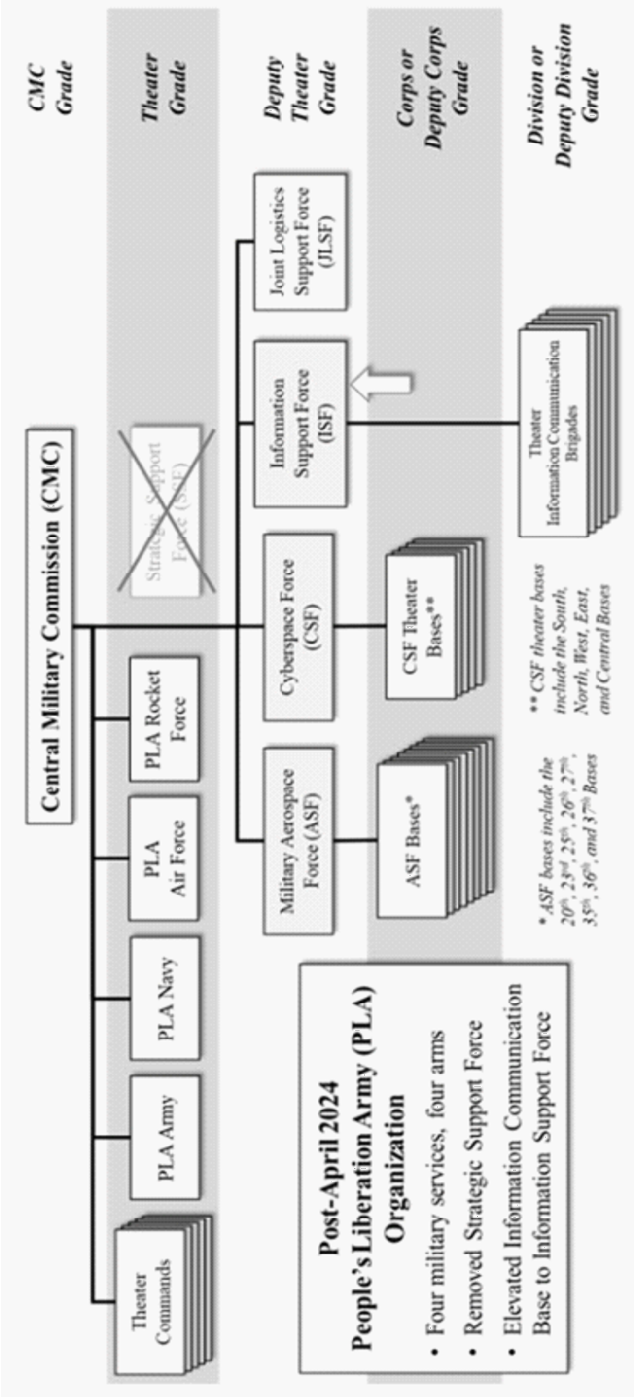
CHINESE MILITARY CAPABILITIES IN SPACE

On April 19, 2024, the PLA formally dissolved the Strategic Support Force, an integrated arm established in December 2015, and reconstituted its space, cyber, and information-warfare functions into three separate ‘arms’ each directly responsible to the CMC: the PLAASF, Cyberspace Force, and ISF.⁶⁸ From a strategic perspective, the reorganisation is a major step towards the restructuring of China’s military space command over the past three decades because it formally elevates space from a *support* function to a *warfighting* arm and shortens the PLA-CMC decision loop in space in support of operations along the LAC or in the IOR.⁶⁹

ORGANISATIONAL ARCHITECTURE: THE PLA AEROSPACE FORCE

The PLAASF is a deputy-theatre-grade arm headquartered in Beijing’s Haidian District, with a deputy-theatre-grade commander and a political commissar⁷⁰. It reports directly to the CMC and is not under the command of theatre commands.⁷¹ Operationally, it inherits the entirety of the former SSF Space Systems Department and is built around seven ‘space ground bases’, erstwhile part of the dissolved General Armament Department.⁷²

Figure 3: Organogram: Post April 2024 PLA



Source: The Jamestown Foundation, Issue 9, April 26

Base 23 (Unit 63680) at Jiangyin, Jiangsu, operates the Yuanwang-class ocean telemetry vessels and is the PLA's only oceanic TT&C formation (Telemetry, Tracking, and Command—a vital communications framework used by space agencies and satellite operators to control spacecraft. It serves as the 'central nervous system' for every mission, facilitating constant, two-way data exchange between the ground station and the satellite in orbit). **Base 25** (Unit 63710, Taiyuan) launches polar and sun-synchronous reconnaissance payloads and supports anti-ballistic-missile interceptor testing. **Base 26** (Unit 63750, Xi'an Satellite Control Centre, with the Beijing Aerospace Flight Control Centre) is the land-based backbone of China's worldwide TT&C network. **Base 27** (Unit 63790, Xichang) launches the bulk of GEO and BeiDou payloads and exercises operational control over the Wenchang heavy-lift complex on Hainan. **Base 36** (Unit 32026, Kaifeng) handles space R&D, testing, and evaluation, including counter-space technologies. **Base 37** (Unit 32035, Lintong, Xi'an) is the SSA and missile early warning hub, with sub-locations in Chongqing, Urumqi, Jinan, and Hangzhou and large phased-array radars in Qinghai and Yunnan previously operated by the PLA Air Force.⁷³ **Base 35** (Battlefield Environment Support, Wuhan) was the original BeiDou ground-segment and geospatial intelligence base but was transferred in April 2024 to the new Information Support Force, signalling that the ASF is the *operational* core, while geodetic (providing latitude, longitude, and elevation data) and battlefield-environment functions are held with the ISF.⁷⁴

Mission and Force Employment.⁷⁵ As per the PLA's revised 2024 space-operations teaching materials, the ASF's mission set remains the same as mentioned in the 2013 Lectures on the Science of Space Operations: deterrence operations, space blockade operations, offensive operations, defensive operations, and space information support and assurance operations. Deterrence operations may be conducted by the ASF alone or jointly, and span four escalation levels: warnings, force posturing, space exercises, and punitive strikes. Space blockades are offensive measures employed when the PLA judges that it holds the advantage at any level, i.e, tactical, campaign, or strategic. Offensive operations are mainly strategic in scope and fall into two categories: ground-to-space and space-to-ground. Ground-to-space attacks against satellites rely chiefly on spectrum-based weapons for either soft or

hard kills, while direct-ascent ASAT missiles are treated as a deterrent. Space-to-ground options include 'ground-space-ground' strategic strikes, such as orbital bombardment weapons. Defensive operations may be conducted from the ground or from space; ground-based defences involve joint counter-missile efforts to protect Chinese launch sites and tracking vessels, whereas space-based defences have been identified as the most challenging to execute.

Post the disbandment of the SSF in 2024, the number of bases largely remains the same; however, changes are underway as various responsibilities are being redrawn between ISF, CSF, and ASF for space operations. The ASF will continue to remain in control of operating dedicated military satellites in orbit and will remain the point of contact when acquiring battlefield information from reconnaissance, ocean surveillance, early warning and detection, meteorological, and mapping satellites.

ANTI-SATELLITE (ASAT) CAPABILITIES

China today is feverishly developing a diversified and potent counter-space inventory as it looks to counter the leading power, i.e, the USA. The direct-ascent kinetic foray by the PLA traces its lineage to the DN-1 (Dong Neng series of missiles for ASAT missions) missile that on 11 January 2007 destroyed the defunct Fengyun-1C weather satellite. The Defence Intelligence Agency (DIA) of the USA assessed in 2022 that 3,000+ trackable fragments and many tens of thousands of lethal non-trackable pieces remained in orbit, making the test the single largest debris-generating event in the history of spaceflight.⁷⁶ As per the Secure World Foundation's April 2025 report, the subsequent tests of the DN-2 in May 2013 and the DN-3 series in October 2015, July 2017, and February 2018 established the capability as 'likely mature and operationally fielded' against low Earth orbit and 'experimental or developmental' against medium and geostationary orbits.⁷⁷ Chinese have consistently described these flights as 'mid-course missile-interception' trials, a deliberate ambiguity that preserves treaty deniability while developing an ASAT capability.⁷⁸

The more consequential capability is the launch of the **Shijian-21** (SJ-21) January 2022, which docked with the defunct BeiDou-2 G2 navigation spacecraft and towed it some 3,000 km beyond the standard graveyard altitude and is stated as the only confirmed *non-cooperative*

satellite capture in the geostationary belt.⁷⁹ In January 2025, China launched **Shijian-25** (SJ-25), officially a ‘fuel replenishment and life-extension verification’ platform; by mid-2025 COMSPOC, Slingshot Aerospace and Integrity ISR commercial firms tracked SJ-25 entering a co-planar orbit with SJ-21 and making close approaches indicative of the first on-orbit refuelling demonstration in GEO, while the suspected GEO inspector **TJS-3** (Tongxin Jishu Shiyan-3 is a classified Chinese military and intelligence satellite launched in December 2018 into Geostationary Earth Orbit which functions as an inspector and rendezvous and proximity operations spacecraft) moved to within one degree of latitude of SJ-21 in a supporting role.⁸⁰ The dual-use ambiguity is the hidden capability here as the same robotic arms, docking interfaces and proximity manoeuvring service civilian satellites can also grapple, disable or push an adversary asset out of operational orbit. The US DIA in 2022 explicitly observed that ‘space-based robotic-arm technology could be used in a future system for grappling other satellites.’⁸¹

India’s response through Mission Shakti on March 27, 2019 demonstrated a direct-ascent intercept against a 740-kg Microsat-R target at approximately 283 km altitude using a modified Prithvi Defence Vehicle Mark-II launched from Abdul Kalam Island. The intercept was a technology demonstration confined to a narrow LEO envelope, and India presently has no demonstrated reach against medium or geostationary orbits and no operational co-orbital or robotic-arm capability comparable to the Shijian series.⁸² In a future conflict, the kinetic ASAT capability may be reserved for signalling and worst-case, denial against ISR. The co-orbital threat is the more critical operational concern, because India’s high-value military communication satellites, GSAT-7, GSAT-7A, and GSAT-7B, are placed within the demonstrated SJ-21/SJ-25/TJS cruise envelope and have limited manoeuvring fuel reserves to evade adversary action. The non-debris-generating co-orbital threat is also harder to deter because no debris is produced and attribution can be more easily denied.

ELECTRONIC WARFARE CAPABILITIES

As per another US DIA’s 2022 assessment, the PLA has been ‘routinely incorporating in its exercises jamming and anti-jamming techniques that probably are intended to deny multiple types of space-based communications, radar systems, and GPS navigation support to military

movement and precision-guided munitions employment,' and that China 'probably is developing jammers dedicated to targeting SAR, including those aboard military reconnaissance platforms,' along with Satellite Communications (SATCOM) jammers spanning the C, X, Ku, Ka and extremely-high-frequency (EHF) bands used by military networks.⁸³ A C4ADS investigation published in November 2019 catalogued more than 600 instances of GPS spoofing in Shanghai's Huangpu River and other Chinese ports, where commercial vessels' AIS positions were spoofed and they revolved around fictitious geometric 'circles' centred on oil terminals and government installations, demonstrating a counter-surveillance signature distinct from earlier denial-of-service by jamming.⁸⁴ Indian western-sector GNSS users have also reported periods of denial during the May 2025 confrontation with Pakistan.⁸⁵

The EW threat is two-sided. Offensively against India, PLA jammers can degrade NavIC, GPS-aided munitions, the Indian Regional Navigation Satellite System (IRNSS) L5/S-band terminals on Indian fighters and helicopters, and the C/Ku-band uplinks of the GSAT-7 family satellites. The same architecture can suppress Indian Cartosat, RISAT, and Earth Observation Satellite (EOS) imagery during a Northern Front flare-up. Crucially, jamming is *reversible* and therefore likely to be used as a first step because the escalation costs are perceived to be low. India's anti-jam hardening on military SATCOM, the M-Code-equivalent encrypted military service on the second-generation NavIC (NVS) constellation now being deployed, and a dedicated SAR-deception detection capability for RISAT/EOS missions are therefore prerequisites, not luxuries.

DIRECTED-ENERGY WEAPONS

Reports also confirm that China possesses 'multiple ground-based laser weapons of varying power levels to disrupt, degrade, or damage satellites,' with current capability against satellite sensors and a projection that 'by the mid- to late-2020s China may field higher-power systems that extend the threat to the structures of non-optical satellites.'⁸⁶ The ODNI's 2025 Annual Threat Assessment reiterated that Beijing has 'already fielded ground-based counter-space capabilities, including EW systems, directed-energy weapons, and anti-satellite missiles intended to disrupt, damage, and destroy target satellites.'⁸⁷ Open-source imagery

analysis has identified specific facilities in Xinjiang (Bohu and Korla) carrying ground-based satellite-laser systems, only reinforcing Chinese publications by its researchers at the Changchun Institute of Optics describing 50–100 kW satellite-blinding experiments dating back to 2005–06.⁸⁸ Chinese open scientific literature continues to publish on high-power microwave (HPM) and laser concepts that, while not described as counter-space weapons in the papers themselves, are clearly applicable to satellite optics and bus electronics.⁸⁹

Indian electro-optical reconnaissance satellites like Cartosat-3 routinely overfly Chinese and adjacent territory and are within the LEO envelope of any ground-based dazzler. India operates no comparable ground-based counter-space Directed Energy Weapon (DEW) capability, and the response options are restricted to satellite hardening (filtered optics, baffled sensors, pre-tasking blackout), operational manoeuvre, and acceleration of own indigenous high-energy-laser research under the DRDO DURGA-II / KALI-5000 lineage. The strategic implication is that *first-day-of-war* sensor blinding is the most likely activity because it imposes some degree of ISR loss on India without producing debris and without crossing a clear kinetic threshold.

CYBER CAPABILITIES AGAINST SPACE INFRASTRUCTURE

The most recent and notable incident is the February 24, 2022 cyber attack on Viasat's KA-SAT modems, which used Acid Rain wiper malware to disable approximately 30,000 terminals across Europe, including Ukrainian military command nodes as the Russian invasion began. The US Cybersecurity and Infrastructure Security Agency (CISA) issued a joint advisory urging hardening of all satellite-communications networks.⁹⁰ In September 2025, CISA, the NSA, the FBI, and partner agencies attributed a global compromise of telecommunications and network-service providers, including Viasat itself, to PRC state-sponsored actors collectively termed '**Salt Typhoon**,' 'Operator Panda', and overlapping clusters.⁹¹ The CMPR 2024 also observed a complementary '**Volt Typhoon**' campaign inside US communications, energy and water infrastructure that could plausibly extend to space ground-segment networks during conflict; the report also identifies Chinese-speaking groups targeting drone-manufacturing supply chains in Taiwan, with overlap into satellite-component vendors.⁹²

Table 17 PLA Counter-Space Capability (2025–26)

Type	System/ Designator	Status (2025–26)	First Demonstrated	Primary Effect
Direct-ascent KKV (LEO)	SC-19/ DN-1	Operational, mobile launchers	11 Jan 2007 (FY-1C)	Kinetic; massive debris
Direct-ascent KKV (MEO/GEO)	DN-2/ DN-3	Experimental / developmental	May 2013; Oct 2015–2018	Kinetic; deep-orbit reach
Co-orbital/ Rendezvous and Proximity Operations (RPO) (GEO)	SJ-17, SJ-21, SJ-25; TJS-3/TJS-10	Operational; refuelling tested 2025	SJ-17 (2016); SJ-21 grapple Jan 2022	Grapple, tow, disable, refuel
Co-orbital/ RPO (LEO)	Shiyan-24C; SJ-6 05A/B; Shenlong RSV	Operational	SY-24C/SJ-6 RPO Jan–Apr 2024	‘Dogfighting’; sub-satellite release
Ground-based laser (dazzle)	Bohu, Korla (Xinjiang)	Limited operational	Reported 2005–06	Reversible sensor blinding
Electronic warfare	GNSS jam/spoof; SAR jammers; SATCOM jam	Operational, multiple bands	Since 2018	Reversible and deniable
Cyber (ground segment)	Salt Typhoon; Volt Typhoon	Operational	Ongoing since 2007	Disruption/control

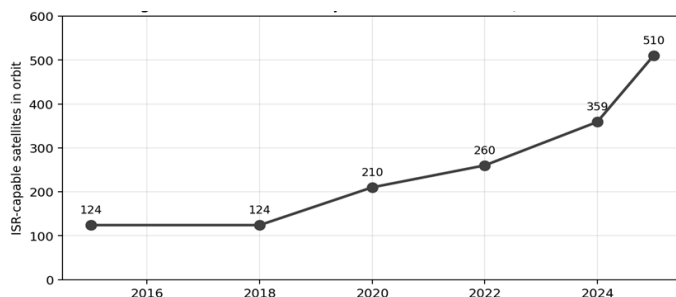
Source: *Author (Compiled from DLA (2022); SWF Global Counterspace Capabilities (April 2025); CSIS Space Threat Assessment (April 2025); CMPR 2024; ODNI 2025 Annual Threat Assessment*

The Indian Space Research Organisation's ground network, the Master Control Facility at Hassan, the ISTRAC nodes at Bengaluru, Lucknow, Sriharikota, Mauritius, Brunei, and Biak (Indonesia) must be treated as high priority targets with the same hardening standard equivalent to nuclear facilities. Supply-chain hardening against Chinese-sourced commercial-off-the-shelf electronics in small-satellite payloads, an Indian space-sector SOC under CERT-In with red-team access to ISRO/IN-SPACe operators, and a routine penetration-testing schedule for the NavIC ground segment are immediate requirements. The Viasat episode is the operational template and a coordinated cyber-and-kinetic action could blind Indian battlefield SATCOM in the first hour of a conflict with China.

RECONNAISSANCE AND INTELLIGENCE (ISR) CONSTELLATION

The PLA Aerospace Force is built around an ISR backbone whose size has almost tripled in six years. The CMPR records 510 ISR-capable Chinese satellites in orbit up to December 2025, a 927 per cent expansion in total Chinese on-orbit assets since 2015 and notes that the PLA 'owns and operates about half of the world's ISR systems.'⁹³ The military backbone is the **Yaogan** series (remote sensing), with optical, SAR, and electronic-intelligence variants under the **Jianbing** programme. The signature contribution to PLA strike chains comes from the **Yaogan-30 ocean-surveillance triplets**, which allow the PLA to geolocate warships with revisit intervals measured in minutes rather than hours in the Indo-Pacific.⁹⁴

Figure 4 : China's ISR- Capable Satellite Growth, 2015-2025



Source: Author Compiled from DoD CMPR 2018–2024; Pollpeter, NIDS Symposium 2024; Gen. Stephen Whiting (USSPACECOM), congressional testimony, March 2024)

The transition to GEO reconnaissance has also produced enhanced capabilities, such as **Yaogan-41** (December 2023), which is widely assessed as a sub-metre GEO optical satellite capable of identifying car-sized objects across half the Earth's surface from an altitude of 36,000 km. **Ludi Tance-4** (August 2023) is the world's first GEO SAR satellite, delivering all-weather, day-and-night surveillance over the Indo-Pacific.⁹⁵ The Jilin-1 constellation, operated by Chang Guang Satellite Technology (designated as commercial satellites), now exceeds 115 active satellites, has compressed global revisit times to 15 to 20 minutes, and has been openly used to provide targeting imagery to Pakistan and Iran in 2024–25.⁹⁶

The 2025 US/Israel–Iran conflict and India's own **Operation Sindoor** (May 7–10, 2025) demonstrated that PRC commercial-satellite ISR has crossed the threshold from an internal intelligence asset to an exportable commodity. Lt Gen Rahul R. Singh, Deputy Chief of the Army Staff, publicly stated at a FICCI seminar on July 4, 2025 that China had provided Pakistan with 'live inputs', including satellite imagery and real-time targeting support during the four-day confrontation.⁹⁷ Until the operationalisation of India's Space-Based Surveillance Phase-III programme, approved by the Cabinet Committee on Security on October 10, 2024 with an outlay of approximately ¹ 26,968 crore, India will operate under omnipresent surveillance by PRC ISR, not only at the LAC and IOR but along the Western Front.⁹⁸

SATCOM FOR THE PLA

PLA SATCOM is built around three overlapping layers. The Tianlian data-relay series, now in its second generation with Tianlian-II launches in 2025, provides near-continuous beyond-line-of-sight connectivity for LEO reconnaissance and crewed missions. The Shentong and Fenghuo platforms, together with the cover-designated ChinaSat / Zhongxing-2E launched in August 2021, provide secure C-band and Ku/Ka-band tactical SATCOM for theatre-command operations. Simultaneously, this dedicated military layer is being overlaid by two megaconstellations: Guowang with an ITU filing of approximately 12,992 satellites and Qianfan with an ITU filing of up to 15,000 satellites.⁹⁹

India's dedicated military SATCOM systems—GSAT-7 *Rukmini* (Indian Navy, 2013), GSAT-7A (Indian Air Force, 2018), the forthcoming GSAT-7R / CMS-02 (LVM-3, late 2025), and GSAT-7B (Indian Army)—provide service-specific channels but offers limited LEO resilience. A Chinese co-orbital inspector or a kinetic strike against a single GEO bird can degrade an entire service's tactical communications simultaneously. The 52 satellite SBS-III programme is a useful starting point, but the strategic shortfall is a military SATCOM constellation in LEO that can absorb kinetic attrition. The competitive marketing of Qianfan in Bangladesh, Sri Lanka, Nepal, Myanmar, and the Maldives is a parallel geo-economic threat, as ground station co-location and gateway dependency in those countries amounts to a Chinese SATCOM perimeter on India's periphery.

RPO

Beyond the headline SJ-21/SJ-25 GEO docking event, the PLA ASF has been quietly assembling a deep RPO portfolio. **Shijian-17**, launched in November 2016, conducted repeated GEO close-approach manoeuvres with multiple Chinese satellites and is the first Chinese platform publicly assessed to carry a robotic arm. **TJS-3** (December 2018) released a sub-satellite that has since performed independent rendezvous activities and in January 2025 moved to within one degree latitude of SJ-21 in a supporting GEO inspection role.¹⁰⁰ **TJS-10** (launched 2024) manoeuvred to within 25 km of TJS-3 over May 2024, an unusually tight close-approach for two Chinese satellites and a clear rehearsal of inspector-on-inspector combination.¹⁰¹ In LEO, US Space Command in March 2025 publicly described 'dogfighting practice' involving three Chinese Space platforms (**Shiyan-24C**; SY-24C-01/02/03) conducting corkscrew manoeuvres around **Shijian-6 05A/B** in January 2024, with closest approach inside one kilometre.¹⁰² In December 2023 to September 2024, the **Shenlong** reusable space plane separately released six sub-satellites during its orbital phase and manoeuvred and possibly captured an object before returning to Earth after 268 days in orbit.¹⁰³

India's Space Docking Experiment (SpaDeX), launched aboard PSLV-C60 on December 30, 2024 and successfully docking on 16 January 2025 with re-docking demonstrated in April 2025, was a critical

indigenous milestone explicitly acknowledged in the SWF April 2025 report. SpaDeX is, however, a civil LEO docking experiment using two ~220-kg spacecraft, and it does not represent a GEO inspection-grade capability comparable to the Shijian/TJS/Shiyan fleet. The gap in geostationary proximity operations is a significant asymmetry in the Indian counter-space inventory. It may require a dedicated indigenous GEO inspector demonstrator, a high-thrust electric-propulsion bus capable of sustained orbital manoeuvre, and an organisationally distinct *On-orbit Servicing, Assembly and Manufacturing* (OSAM) programme under the DSA rather than under ISRO's civil charter.

EMERGING TECHNOLOGIES IN SPACE: AI, QUANTUM, ROBOTICS, AND EDGE COMPUTING

PLA is increasingly focussing on new generation emerging technologies, particularly focussing on AI, quantum computing, robotics, and edge computing in all domains, including Space. The **Mozi** (Micius/QUESS) quantum-science satellite, launched in August 2016, established the first space-relayed quantum key distribution (QKD) link with the Beijing–Vienna intercontinental QKD demonstrated subsequently in 2017–18. The **Jinan-1** micro-nano quantum satellite, launched in July 2022, delivered key-generation rates roughly two orders of magnitude higher than Micius, and in March 2025 Chinese and South African researchers reported a Beijing–Stellenbosch QKD link of approximately 12,900 km, the first inter-hemispheric demonstration using a microsatellite relay, generating up to 1 Mbit of secure keys per pass.¹⁰⁴ Parallel to quantum networks, the PLA Academy of Military Sciences and CASIC are integrating onboard artificial-intelligence inference for autonomous target recognition, while CASC has demonstrated robotic-arm operations both on the Tiangong space station and through the Shijian counter-space lineage. The Three-Body Computing Constellation ('ADA Space'), with 12 in-orbit AI-compute satellites, was launched in May 2025 and has a planned end-of-state 2,800-satellites. It is the first publicly disclosed Chinese effort to push operationalisation of '*edge computing in orbit*', eliminating downlink latency for target-recognition tasks across the Yaogan/Gaofen fleet¹⁰⁵, thereby significantly compressing the Observe – Orient – Decide – Act (OODA) loop.

India's quantum-communications programme (DRDO's QuEST and ISRO's QSAT proof-of-concept ground experiments) is presently at a nascent stage, though an indigenous quantum satellite is targeted for around 2026–27, placing India approximately six to eight years behind the Chinese space-quantum architecture. The strategic deficit is sharper in edge-AI in orbit since India has not announced an equivalent of the Three-Body Computing Constellation, and the IN-SPACe-led commercial-sector reform programme has not yet produced an Indian on-orbit AI-inference demonstrator. Closing these gaps will require a combined DRDO-ISRO-IN-SPACe roadmap, with milestone-based funding and monitoring at the highest level.

SYNTHESIS: THE INDIA–CHINA ASYMMETRY

Analysed critically, the PLA Aerospace Force has adopted a doctrine of 'space dominance through asset ascendancy and denial to the adversary,' in which counter-space, ISR, and SATCOM are operationalised together to enable precision strikes against high-value adversary assets while simultaneously degrading the adversary's own space-enabled C4ISR. The first publicly acknowledged Indian wartime exposure to this architecture occurred during Operation Sindoor from May 07–10, 2025, when China's 'live inputs' to Pakistan, including BeiDou military-grade PNT and Jilin-1 commercial imagery, were operationalised within the Pakistani targeting cycle in real time. The episode crystallised, for the Indian military community, that the threat is no longer prospective. The subsequent chapter assesses this threat to facilitate the formulation of a coherent counterstrategy by all stakeholders and national strategy planners.

Notes:

- ⁶² Euroconsult/Novaspace, *Government Space Programmes 2024 Edition*, Euroconsult, Paris, December 2024, summarised in Statista, "Global Governmental Spending on Space Programmes of Leading Countries 2024," https://www.statista.com/statistics/745717/global-governmental-spending-on-space-programs-leading-countries/?srsltid=AfmBOoofvjL6TM6s87SvoLffpms0K_EyoJsAdcRy6dL6NZbqB-xe6S81 (Accessed May 2026).

- ⁶³ Denis Kalinin, “China: Private Space Ecosystem of the Rising Superpower,” *SpaceAmbition* (Substack / DeepTech.Asia), https://spaceambition.substack.com/p/china-private-space-ecosystem-of?utm_source=publication-search, April 25, 2025
- ⁶⁴ Jonathan P. Roll and Oliver J. Du Bois, “The Acceleration of China’s Commercial and Civil Space Enterprise and The Challenge to America”, Commercial Space Federation, September 2025.
- ⁶⁵ “Today’s Reality Check of the State of Chinese Commercial Space”, China Space Monitor, at <https://substack.com/@chinaspacemonitor/note/c-248346735>, GIS Frontiers, (Accessed April 25, 2026), <https://mp.weixin.qq.com/s/jIaejSE9v7tD1xxDpMukIQ>; see also Roll et al., “Redshift,” pp. 60–65 (CGSTL pricing and market impact on global EO competitors
- ⁶⁶ Chinese Lunar Exploration Programme, “Phase IV: Construction of the International Lunar Research Station,” CNSA roadmap, June 2021 (V 1.0); Wu Weiren remarks at International Lunar Exploration Conference, Hefei, September 2024.
- ⁶⁷ “PLA Aerospace Power: A Primer on Trends in China’s Military Air, Space, and Missile Forces 5th Edition”, *CASI*, May 26, 2026, pp. 178–191.
- ⁶⁸ Matt Bruzese and Peter W. Singer, “Farewell to China’s Strategic Support Force. Let’s Meet Its Replacements,” *Defense One*, April 28, 2024, <https://www.defenseone.com/ideas/2024/04/farewell-chinas-strategic-support-force-lets-meet-its-replacement/396143/>.
- ⁶⁹ John Costello, “PLA Military Aerospace Force: On the Frontier of Innovation and Competition,” *China Brief (Jamestown Foundation)*, 25 (13), July 11, 2025, <https://jamestown.org/pla-military-aerospace-force-on-the-frontier-of-innovation-and-competition/>.
- ⁷⁰ J. Michael Dahm, “A Disturbance in the Force: The Reorganization of People’s Liberation Army Command and Elimination of China’s Strategic Support Force,” *The Jamestown Foundation*, 24 (9), April 26, 2024, <https://jamestown.org/wp-content/uploads/2024/04/CB-V-24-Issue-9-April-26.pdf>
- ⁷¹ U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2024: Annual Report to Congress*, pp. 117–22.
- ⁷² John Costello, “PLA Military Aerospace Force: On the Frontier of Innovation and Competition”.
- ⁷³ China Aerospace Studies Institute (CASI), *The PLA Aerospace Force’s Base 37: An Open-Source Case Study*, Air University, Maxwell AFB, AL, September 16, 2024, pp. 8–14.
- ⁷⁴ Kenneth W. Allen and Cristina L. Garafola, “The Reorganization of China’s Space Force: Strategic and Organisational Implications,” *The Diplomat*, May 6, 2024.

- ⁷⁵ “PLA Aerospace Power: A Primer on Trends in China’s Military Air, Space, and Missile Forces 5th Edition”, pp. 178–191, CASI, 26 May 2026
- ⁷⁶ Defense Intelligence Agency, *Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion*, DIA, Washington, DC, March 2022, pp. 14, 17.
- ⁷⁷ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, ed. Victoria Samson and Laetitia Cesari, SWF, Washington, DC, April 2025, pp. 1–1 to 1–17.
- ⁷⁸ DIA, *Challenges to Security in Space*, pp. 14.
- ⁷⁹ Theresa Hitchens, “China’s SJ-21 ‘Tugs’ Dead Satellite Out of GEO Belt,” *Breaking Defense*, January 26, 2022; DIA, *Challenges to Security in Space*, pp. 17.
- ⁸⁰ Center for Strategic and International Studies (CSIS), Aerospace Security Project, *Space Threat Assessment 2025*, CSIS, Washington, DC, April 2025.
- ⁸¹ DIA, *Challenges to Security in Space*, pp. 17.
- ⁸² Ashley J. Tellis, *India’s ASAT Test: An Incomplete Success*, Carnegie Endowment for International Peace, Washington, DC, April 15, 2019; Press Information Bureau (Government of India), “DRDO Briefing on Mission Shakti,” April 6, 2019.
- ⁸³ DIA, *Challenges to Security in Space* (2022), pp. 12–13; Office of the Director of National Intelligence (ODNI), *2025 Annual Threat Assessment of the U.S. Intelligence Community*, ODNI, Washington, DC, March 25, 2025), pp. 9–10.
- ⁸⁴ C4ADS, *Above Us Only Stars: Exposing GPS Spoofing in Russia, Syria, and China*, C4ADS, Washington, DC, 2019; Mark Harris, “Ghost Ships, Crop Circles, and Soft Gold: A GPS Mystery in Shanghai,” *MIT Technology Review*, November 15, 2019, <https://www.technologyreview.com/2019/11/15/131940/ghost-ships-crop-circles-and-soft-gold-a-gps-mystery-in-shanghai/> (Accessed on Apr 7, 2026)
- ⁸⁵ Cdr Sandeep Dhawan (Retd), “India–China Space ISR Gap: Widening Reality or Strategic Smokescreen?” *Insightful Geopolitics*, March 17, 2026, <https://insightful.co.in/2026/03/17/india-china-space-isr-gap-widening-reality-or-strategic-smokescreen/> (Accessed on Apr 13, 2026)
- ⁸⁶ DIA, *Challenges to Security in Space*, pp. 17–18.
- ⁸⁷ ODNI, *2025 Annual Threat Assessment*, pp. 9–10.
- ⁸⁸ Decker Eveleth, “The Bohu Laser Facility, Part 2: Operations,” *Arms Control Wonk*, July 2022; Richard D. Fisher Jr., testimony on “China’s Progress with Directed Energy Weapons,” *U.S.–China Economic and Security Review Commission*, February 23, 2017.
- ⁸⁹ CSIS, *Space Threat Assessment 2025*, p. 9.
- ⁹⁰ Cybersecurity and Infrastructure Security Agency (CISA), Federal Bureau of Investigation (FBI), and National Security Agency (NSA), *Strengthening*

Cybersecurity of SATCOM Network Providers and Customers, Joint Cybersecurity Advisory AA22-076A, March 17, 2022.

- ⁹¹ CISA, NSA, FBI, and partner agencies, *Countering Chinese State-Sponsored Actors' Compromise of Networks Worldwide to Feed a Global Espionage System*, Advisory AA25-239A, September 3, 2025; "Viasat Identified as Victim in Chinese Salt Typhoon Cyberespionage, Bloomberg News Reports," *Reuters*, June 18, 2025; "Viasat Confirms 'Unauthorized Access' After Bloomberg Report of Salt Typhoon Impact," *Via Satellite*, June 18, 2025.
- ⁹² U.S. Department of Defense, *CMPR 2024*, pp. 119–22; CSIS, *Space Threat Assessment 2025*, p. 8.
- ⁹³ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2025: Annual Report to Congress*; see also "DoD Report: China's ISR Fleet Swells to 510+ Satellites, 'Informatized' Warfare Accelerates," *SatNews*, December 24, 2025.
- ⁹⁴ Stokes, Alvarado, Weinstein and Easton, *China's Space and Counterspace Capabilities and Activities*, USCC, March 30, 2020, pp. 110–12; S. Chandrashekar and Soma Perumal, *China's Constellation of Yaogan Satellites and the ASBM: January 2015 Update*, National Institute of Advanced Studies, Bangalore, January 2015, pp. 14–22.
- ⁹⁵ DoD, *CMPR 2024*, pp. 113–15; Clayton Swope, "No Place to Hide: A Look into China's Geosynchronous Surveillance Capabilities," *CSIS*, January 19, 2024.
- ⁹⁶ Tate Nurkin et al., *China's Remote Sensing*, prepared for the U.S.–China Economic and Security Review Commission, December 16, 2024; Brig. Anshuman Narang (Retd), "Red Dragon in Orbit," *ISpA Indian DefSpace Symposium*, New Delhi, April 23, 2026.
- ⁹⁷ Lt Gen Rahul R. Singh, remarks at FICCI seminar, New Delhi, July 4, 2025, reported in *Deccan Chronicle*, "China Helped Pakistan with 'Live Inputs', Army Says," July 5, 2025; "China Used Pakistan as 'Live Lab' During Operation Sindoor," *Outlook India*, July 5, 2025.
- ⁹⁸ Press Information Bureau (Government of India), "Cabinet Committee on Security Approves Space-Based Surveillance Phase-III," October 10, 2024; "How Launch of ISRO's Heaviest Satellite Will Boost India's Space-Based Military Capability," *The Tribune* (Chandigarh), October 28, 2025.
- ⁹⁹ Andrew Jones, "China Conducts Pair of Long March Launches for Thousand Sails and Guowang Megaconstellations," *SpaceNews*, April 2026; CircleID, "Chinese LEO Satellite Internet Update: Guowang, Qianfan, and Honghu-3," December 2025; DoD, *CMPR 2024*, pp. 116–18.
- ¹⁰⁰ CSIS, *Space Threat Assessment 2025*, pp. 7–8.
- ¹⁰¹ *Ibid.*, p. 7. Citing analysis by Integrity ISR and LSAS Tec, May 2024.

- ¹⁰² Theresa Hitchens, “Counter-Space Capabilities Advancing Around the Globe: Secure World Foundation,” *Breaking Defense*, April 2025; CSIS, *Space Threat Assessment 2025*, p. 7.
- ¹⁰³ CSIS, *Space Threat Assessment 2025*, p. 7.
- ¹⁰⁴ Yang Li et al., “Microsatellite-Based Real-Time Quantum Key Distribution,” *Nature* (online publication, March 19, 2025); USTC Press Release, “USTC Demonstrates Successful Satellite-Enabled Quantum Key Distribution,” *Chinese Academy of Sciences*, March 25, 2025.
- ¹⁰⁵ Andrew Jones, “China Launches First of 2,800 Satellites for AI Space Computing Constellation,” *SpaceNews*, May 14, 2025, <https://spacenews.com/china-launches-first-of-2800-satellites-for-ai-space-computing-constellation/>.

THREAT ASSESSMENT FOR INDIA

Space capabilities are increasingly becoming important in national security affairs and a key metric for measuring the Comprehensive National Power (CNP) of a country. The domination of conflicts on land, sea, and air across every key domain will be controlled from space. Victory in future multi-domain, network-centric conflicts, in an increasingly volatile geopolitical environment, necessitates retaining control of space while disrupting an adversary's space capabilities. A rapidly modernising dual-use space fleet that is expanding at a fast pace with a growing PLA ASAT envelope reaching geostationary orbit, operational co-orbital capture capability, an ISR fleet exceeding five hundred satellites with persistent cover, on-orbit AI and edge compute compressing the sensor-to-shooter loop and a Sino-Pakistani collusive partnership that places Chinese space capabilities directly on India's western front creates a threat matrix to Indian space assets and in turn to India's peaceful rise. The following sub-sections attempt to assess the implications of specific Chinese space capabilities and map India's vulnerabilities to analyse the emerging threat to India.

IMPLICATIONS OF CHINESE SPACE CAPABILITIES

Dual-Use Ambiguity of Launch Infrastructure. The dual-use yield of this infrastructure operates at three levels. Strategically, the rate of launch determines China's ability to reconstitute its space architecture under attack, where in 2025 alone China deployed 311 commercial spacecraft, as reusability shifts the cost equation in favour of more launches with the same resources. China demonstrated an orbital-launch tempo of approximately one mission every 28 hours during the first week of January 2026, when six orbital missions were conducted from four launch sites.¹⁰⁶ This cadence is supported by the diversification of launch sites, especially the Hainan Commercial Space Launch Site, which allows the PLA to maintain its classified launch schedule while commercial activities proceed at their pace. At the tactical level, the

diversity of vehicles permits payload-tailored insertion, e.g. Long March 6A for sun-synchronous reconnaissance, Long March 8A for proliferated LEO, Long March 5B for the heaviest geosynchronous platforms. India, by contrast, conducted only five orbital launches in 2024 and lost EOS-09 (RISAT-1B) on 18 May 2025 in the PSLV-C61 third-stage anomaly, delaying its Space-Based Surveillance Phase III architecture. The asymmetry therefore is not only in technical sophistication but in the cadence and redundancy.

Beidou Enabling Intelligentised Warfare. BeiDou supplies the precision-guidance backbone for PLA Rocket Force munitions, including the DF-21D, DF-26, DF-17, and the DF-27 hypersonic glide-vehicle profile, and synchronises sensor-to-shooter loops across the PLA's system-of-systems doctrine. The 2025 Israel—Iran Twelve-Day War provided the first confirmed combat case-study of BeiDou's adoption by Iran, as it had completed migration of its missile-guidance packages from GPS to encrypted BeiDou signals, thereby integrating a foreign navigation system into a military kill chain in operational conditions.¹⁰⁷ For India, the implications are that BeiDou's adoption across the Belt and Road footprint, including Pakistan, has produced a satellite-navigation dependency in countries on India's periphery whose military Techniques, Tactics & Procedures (TTPs) are likely to be reorganised around it. China's short-message capability gives PLA Western Theatre Command formations a redundant communication path during contingencies along the Line of Actual Control, which does not require ground stations.

ISR Capabilities. The 2025 Israel–Iran war and the May 2025 Operation Sindoor in the Indian theatre demonstrated that China's commercial satellite ISR has crossed the threshold from a strategic intelligence asset to an operational targeting tool exportable to partners. As per Brigadier Anshuman Narang, 129 imaging passes by Chinese commercial satellites were undertaken over the Pahalgam region between January and April 2025. In West Asia, the Chinese provided Iran with necessary surveillance cover to plan targeting of US bases. Recently, the Chinese have also launched EO satellites for Pakistan, but a detailed analysis of their orbital angle (between 20° and 40°) indicates deliberate loss of global coverage to gain persistent coverage over our western borders.¹⁰⁸

Cislunar Domain. It has three layers, all of which are dual-use. First, resource positioning: the lunar south pole holds the most accessible water-ice deposits, and the Shackleton crater's illuminated rim provides near-continuous solar power; whoever establishes infrastructure first sets the operational norms for adjacent zones. Second, communications and navigation: Queqiao-2 and a planned constellation of three to four lunar communications satellites will provide China with cislunar C2 independent of NASA's LunaNet. Third, governance: the ILRS Cooperation Organisation provides an alternative legal architecture to the Artemis Accords, challenging Western-led norms on space traffic management and resource rights. For India, a signatory of the Artemis Accords, the expansion of ILRS represents a strategic challenge to ensuring equitable access to lunar resources and maintaining a presence in the future cislunar economy.

Commercial Space Ecosystem. Four key features of this ecosystem matter for India. First and foremost is the race to deploy these satellites in these numbers, which is driven by a larger strategy of 'orbital pre-emption'. In December 2025, China submitted a request to the ITU for orbital resources for an additional 2, 03,000 satellites. These large constellations provide China with a 'resilience by numbers' advantage, making them virtually immune to any ASAT actions and thereby neutralising the deterrent value of India's 2019 ASAT test. In addition, the 'CMF legislation places explicit obligations on private firms to support military requirements when called upon, even if their day-to-day commercial operations are independent. The US Defence Department's 2024 report identifies the Chang Guang, Spacety, and Galaxy Space cluster as the principal Chinese counterpart to Planet Labs, Maxar, and BlackSky in the imagery market, but with a structurally different relationship to military demand.¹⁰⁹ Megaconstellations of the Guowang and Qianfan scale provide intrinsic counter-space resilience, as jamming or attacking individual satellites will yield negligible degradation, and the constellation can be reconstituted at the launch cadence China possesses. Lastly, the marketing of Qianfan into India's neighbourhood also poses a competition challenge for Indian downstream service providers and a sovereignty challenge for partner countries that would become dependent on Chinese ground station infrastructure. India's response—the IN-SPACE-led commercial-sector reform programme launched in 2020, the Indian Space Policy 2023, the ¹ 1,000-crore venture-capital fund announced in Budget 2024 and the December 2024 announcement of a 52-satellite SBS Phase III

programme—remains modest relative to the Chinese commercial ecosystem.

INDIA'S VULNERABILITIES IN SPACE

Five Indian vulnerabilities are systemic. The first is GPS dependency. Indian military precision-strike weapons, civil aviation, the BSE-NSE timing layer, and the entire telecommunications backbone all rely on the US-provided GPS. The IRNSS, now branded NavIC, was conceived as a sovereign alternative, but the constellation has suffered recurring atomic clock failures since 2017, with the IRNSS-1F failure of March 2026 reducing the operational fleet to three satellites from an authorised seven. The second-generation NVS series with imported Swiss rubidium clocks is being rolled out, and ISRO has committed to launching at least three additional NVS satellites by the end of 2026. However, achieving the full nine-satellite global-coverage configuration is a 2030 objective at the earliest.¹¹⁰

The asymmetry is not just numerical but functional. BeiDou is a 45-satellite global constellation broadcasting open and encrypted military services across the entire surface of the Earth, while NavIC is regional, with a coverage footprint of approximately 1,500 kilometres beyond the Indian landmass, and remains absent from the chipsets of mainstream consumer electronics. Until the NavIC signal achieves chipset adoption in commercial smartphones manufactured in India, the country's navigation autonomy is conditional on United States goodwill, providing the GPS Standard Positioning Service. In any contingency where Washington's strategic priorities diverge from India's, this dependency could become a critical constraint on Indian operational autonomy.¹¹¹

The second vulnerability is the ageing of legacy assets. India's GSAT-7 (Rukmini, launched in 2013) and GSAT-7A (2018) anchor naval and air-force military communications, respectively, and several Cartosat and RISAT platforms are operating beyond their design life. The May 18, 2025, loss of EOS-09 (RISAT-1B) on PSLV-C61 following a third-stage anomaly widened the all-weather imaging gap at the very time Operation Sindoor unfolded.¹¹² Indian planners had to compensate by purchasing from international firms.¹¹³ The structural problem is not the loss of any single satellite but the rate at which India can replenish, which falls well behind the Chinese cadence.

The third vulnerability is concentration. India's highest-value strategic assets, including the GSAT-7 series, GSAT-32, IDRSS data relays, and the GSAT-N series, are positioned in geostationary orbit at fixed longitudes, where they are easier to track, harder to manoeuvre, and difficult to evade detection by Chinese geostationary surveillance platforms. Yaogan-41, a GEO optical satellite launched in December 2023, can identify car-sized objects across Indo-Pacific from an altitude of 36,000 kilometres. Ludi Tance-4 (Land Exploration-4), launched in August 2023, provides all-weather SAR coverage of the same theatre. In operational terms, every Indian GEO platform is under continuous Chinese observation.¹¹⁴ The Indian Space Domain Awareness Mission (Project NETRA) is being expanded to track objects beyond geostationary orbit, but its present sensor footprint cannot match the depth or persistence of Chinese SSA infrastructure operated from PLA ASF Base 37 at Lintong.

The fourth vulnerability is commercial scale. Indian commercial space firms are at a nascent stage in terms of launch cadence, satellite manufacturing throughput, and downstream services revenue. India's commercial space sector also reached approximately 350 firms by the end of 2025, compared with more than 460 in China, but the difference lies primarily in launch cadence: China conducted 92–93 in 2025¹¹⁵, whereas India conducted only five orbital attempts.

The fifth and arguably most important is the possibility of 'supply chain poisoning' as India's space sector is in the midst of its most ambitious expansion. The number of space startups has risen from a handful in 2020 to more than 330, with ISRO partnering with over 450 Indian companies, and the sector is at the cusp of launching the SBS-III programme with 52 military satellites, of which 31 are to be built by private primes.¹¹⁶ Yet beneath these figures lies a structural fragility. Indian satellites still carry significant imported content at the subsystem level, and that dependency is concentrated in precisely the high-value components that determine whether a spacecraft works at all.

By ISRO's own accounting, Indian launch vehicles are roughly 90 per cent indigenous, with the remaining ten per cent being mostly electronics; satellites, by contrast, remain 50 to 55 per cent import-dependent.¹¹⁷ This divergence is strategically significant because a satellite's value resides not in its bus but in its payload and subsystems. ISRO retains genuine

indigenous capability across several core subsystems, but in the fast-growing private sector, the dependency is more acute, when a privately built spacecraft assembled from an imported attitude-control module, foreign solar cells, European thrusters, and an imported onboard computer remains vulnerable when the IP is controlled abroad.¹¹⁸

Table 18 : Critical Satellite Subsystems: Indigenous Capability vs Import Dependence

Critical Subsystem	Mission-Critical Function	Indigenous Capability vs. Import
Atomic clocks (RAFS)	Provides nanosecond-level timing essential for satellite positioning, navigation and timing (PNT). Loss of the onboard atomic reference can render a navigation satellite unable to provide its intended PNT service, although other functions may remain operational.	First-generation NavIC clocks were imported (SpectraTime, now Safran). ¹¹⁹ An indigenous Rubidium Atomic Frequency Standard (iRAFS) has flown since NVS-01 (May 2023); NVS-01 also carries a redundant, imported Safran-made RAFS as backup on the same satellite. ¹²⁰ Import Point: independent OSINT tracking and ISRO's own late-2025 tender for 40 additional imported RAFS units indicate continued reliance on imported clocks — this is better sourced to open tracking and procurement records than to an "ISRO source" statement. ¹²¹
Onboard processor/ computer	Performs onboard computation, navigation, guidance and control, command functions, and spacecraft/vehicle data handling.	Indigenous: ISRO/SCL VIKRAM1601 (16-bit, in launch-vehicle avionics since 2009) and VIKRAM3201 (32-bit; first production lots delivered March 2025). ¹²² Import point: some private-satellite onboard computers are reported to be imported. ¹²³ Public evidence establishes this capability principally for launch-vehicle avionics and the POEM orbital platform; it should not be interpreted as proof that all Indian satellite onboard computers or their semiconductor components are fully indigenous.

Critical Subsystem	Mission-Critical Function	Indigenous Capability vs. Import
Attitude control (star sensors, reaction wheels, gyros)	Determines and controls spacecraft orientation and pointing. Accurate attitude control is essential for payload pointing, communications, navigation and imaging performance.	Indigenous: ISRO's Inertial Systems Unit (IISU) designs and builds Inertial Navigation Systems, Attitude Reference Systems, Rate Gyro Packages and reaction-wheel-class actuators. ¹²⁴ Import point: imported (French) attitude-control units are used in private satellites e.g. Dhruva Space's 2023 agreement with France's Comat for reaction wheels and a Solar Array Drive Mechanism. ¹²⁵
Power (solar cells/ panels)	Generates, conditions and stores electrical energy required for operation of spacecraft buses, payloads and communications systems.	Indigenous: Bharat Heavy Electricals Limited (BHEL) supplies space-grade solar panels and Li-ion batteries confirmed for CMS-03 and NISAR; the Chandrayaan-3 contribution documented in company sources is batteries and titanium-alloy tank components, not solar panels. ¹²⁶ Import point: high-efficiency triple-junction cells are also sourced from abroad. AZUR SPACE (Germany) is a leading global supplier of such cells, though its specific use on an Indian private satellite is an inference from general market position rather than a documented instance. ¹²⁷
Propulsion/ thrusters	Provides orbit raising, station keeping, attitude/orbit manoeuvres, collision avoidance and, where designed, end-of-life disposal capability.	Indigenous: ISRO propulsion; Bellatrix Aerospace's RUDRA green-propulsion payload flew on POEM-3, and Manastu Space's Vyom 2U thruster fired on POEM-4 (31 December 2024). ¹²⁸ Import point: imported European thrusters (e.g. Exotrail, France) are used in private satellites -Exotrail signed Hall-effect propulsion contracts with Pixxel, Dhruva Space and XDLINX Labs in February 2026. ¹²⁹

Critical Subsystem	Mission-Critical Function	Indigenous Capability vs. Import
Optical payload/ precision optics	Determines image resolution and data quality-the strategic output of an imaging satellite.	Indigenous: ISRO's Laboratory for Electro-Optics Systems (LEOS), Bengaluru, under the U R Rao Satellite Centre builds its own imaging optics. Import point: the most precise $\lambda/20$ surface finish is reported to be unavailable in the Indian private sector (machines achieving $\lambda/4$ exist), where startups often import lenses. ¹³⁰
GNSS receiver/ RF front-end	Tells the satellite its own position in orbit.	Indigenous: ISRO and DRDO use Indian-built receivers. DRDO has commissioned Bengaluru-based Accord Software and Systems to develop a fully indigenous NavIC receiver chip. ¹³¹ Import point: one reported case describes RF front-ends as Taiwanese-sourced and a private satellite using a low-cost (~US\$13), non-space-qualified Chinese GNSS unit. ¹³² Caveat: this remains a single documented instance in one journalistic account.

Note: Status reflects publicly reported information as of May 2026. The word ‘reported’ indicates a claim drawn from the cited investigation about a typical private satellite rather than an independently confirmed, universal practice across all Indian satellites.

Nothing demonstrates the cost of import dependency more starkly than India’s own regional navigation system, NavIC. ISRO has since begun flying an indigenous Rubidium Atomic Frequency Standard, first proven on NVS-01 in May 2023. Yet as late as 2025, the Space Applications Centre still floated a tender for 40 space-qualified clocks open, in practice, only to established foreign suppliers because the indigenous clock itself depends on imported components¹³³.

The root cause is structural rather than technical. Unlike NASA, which contracts out 75 to 85 per cent of its budget to private firms, universities

and laboratories, ISRO has historically been a ‘make’ organisation that designs and builds in-house¹³⁴. Venture capital, meanwhile, rewards end-to-end satellite and launch ‘primes’ over the unglamorous makers of gyroscopes, star trackers, reaction wheels, and precision optics. No subsystem-only company appears among India’s top-funded space startups, and a domestic-content mandate cannot enforce what the industrial base has not yet produced.¹³⁵

The key lesson is that capability, not the ‘Made in India’ label, is what confers autonomy. Each imported subsystem, like a navigation clock, a pointing system, or simulation software such as Ansys, is a single point of failure that an adversary or a supplier’s government could exploit. The principle was made concrete during the 2026 Persian Gulf War as the US invoked ‘shutter control’, as it directed licensed operators to withhold satellite imagery on national-security grounds, and the US geospatial providers released no imagery of the conflict zone to any non-US customer.¹³⁶

ESCALATION DYNAMICS

Three theatres frame the Indian threat picture: the Northern Borders, where PLA Yaogan optical satellites and Ludi Tance-4 GEO SAR provide persistent watch over the Line of Actual Control; the Western Front, where Chinese ISR, BeiDou navigation, and military satellite communications have been imported into Pakistani military architecture; and the IOR, where commercial Chinese constellations augment PLA Navy (PLAN) maritime targeting. Persistent surveillance by Chinese satellites raises the bar for strategic military planners to hide their intent and retain escalation control, besides loss of critical intelligence in all stages of battle. A sample snapshot of ISR coverage (Figure 5) of Chinese satellites across four locations, i.e., Chushul, Gurez, Rajouri, and Tawang, indicates the key challenge for the Indian military in planning and execution of operations.

Figure 5 : Planning Parameters

Period Covered:May 29–June 3, 2026

Sensor types: IMINT, SARINT, ELINT, IR INT,
HYPERSPECTRAL INT, OPTICAL, SAR

Constellations: JILIN-IMINT, Yaogan-SAR, Yaogan-ELINT,
SuperView NEO ½, JILIN-1, Yaogan-IMINT, LKW,
ZY(Ziyuan)-IMINT, Shijian-ELINT, Gaofen 11

Blackout : Aggregated period during which none of the
Windows elected satellites can observe the location and
blackout duration is greater than 10 minutes

Chushul : 28 x Blackout Windows (2162 Satellite Transits)			
Date	Start Time (IST)	End Time (IST)	Duration
29 May 2026	20:18:59	20:29:37	0:10:38
	20:49:14	21:00:58	0:11:44
	22:37:30	22:49:32	0:12:02
30 May 2026	23:01:17	23:11:37	0:10:20
31 May 2026	01:33:40	01:44:32	0:10:52
	10:16:41	10:32:34	0:15:53
	15:03:46	15:18:20	0:14:34
	16:44:59	16:59:02	0:14:03
	19:36:54	19:55:05	0:18:11
	21:53:22	22:08:56	0:15:34
	22:35:53	22:46:45	0:10:52

Chushul : 28 x Blackout Windows (2162 Satellite Transits)

Date	Start Time (IST)	End Time (IST)	Duration
01 Jun 2026	14:26:51	14:38:28	0:11:37
	20:42:32	21:08:53	0:26:21
02 Jun 2026	00:48:13	01:04:31	0:16:18
	01:27:24	01:39:54	0:12:30
	09:06:49	09:20:22	0:13:33
	12:26:13	12:36:52	0:10:39
	14:02:44	14:18:16	0:15:32
	21:09:25	21:22:19	0:12:54
03 Jun 2026	00:30:22	00:40:39	0:10:17
	12:40:48	12:59:30	0:18:42
	14:19:21	14:38:56	0:19:35
	15:33:45	15:43:56	0:10:11
	16:02:05	16:15:47	0:13:42
	17:19:46	17:34:35	0:14:49
	17:41:57	17:56:31	0:14:34
	18:52:47	19:16:17	0:23:30
	19:24:36	19:36:26	0:11:50

Gurez : 27 x Blackout Windows (2056 Satellite Transits)

Day	Start Time (IST)	End Time (IST)	Duration
29 May 2026	23:43:18	23:59:49	0:16:31
30 May 2026	00:16:49	00:29:12	0:12:23
	19:49:58	20:00:57	0:10:59
	23:00:30	23:10:55	0:10:25
31 May 2026	01:32:50	01:43:46	0:10:56
	10:15:54	10:32:38	0:16:44
	15:12:07	15:23:27	0:11:20
	16:44:07	16:58:22	0:14:15
	19:37:29	19:54:14	0:16:45
	21:52:20	22:08:05	0:15:45
	22:35:01	22:46:25	0:11:24

Gurez : 27 x Blackout Windows (2056 Satellite Transits)

Day	Start Time (IST)	End Time (IST)	Duration
01 Jun 2026	01:41:05	01:53:38	0:12:33
	14:26:03	14:47:05	0:21:02
	20:42:17	21:05:11	0:22:54
	22:34:06	22:45:46	0:11:40
02 Jun 2026	01:20:17	01:45:43	0:25:26
	10:36:57	10:50:48	0:13:51
	14:01:55	14:15:27	0:13:32
	16:07:35	16:22:14	0:14:39
	21:08:39	21:21:14	0:12:35
03 Jun 2026	00:29:51	00:39:51	0:10:00
	10:06:05	10:29:21	0:23:16
	14:18:56	14:39:00	0:20:04
	15:33:29	15:45:11	0:11:42
	16:01:12	16:15:50	0:14:38
	17:19:38	17:33:17	0:13:39
	17:41:12	17:55:58	0:14:46

Rajouri : 25 x Blackout Windows (2134 Satellite Transits)

Day	Start Time (IST)	End Time (IST)	Duration
30 May 2026	00:16:34	00:28:55	0:12:21
	19:49:42	20:00:24	0:10:42
	23:00:15	23:10:39	0:10:24
31 May 2026	01:32:40	01:43:29	0:10:49
	02:06:38	02:22:36	0:15:58
	10:20:21	10:33:02	0:12:41
	15:12:32	15:23:20	0:10:48
	16:44:07	16:58:04	0:13:57
	19:37:18	19:54:06	0:16:48
	21:52:17	22:07:57	0:15:40
01 Jun 2026	14:25:49	14:46:58	0:21:09
	16:06:07	16:16:07	0:10:00
	20:41:52	21:04:16	0:22:24

Day	Start Time (IST)	End Time (IST)	Duration
02 Jun 2026	01:20:02	01:45:36	0:25:34
	10:36:45	10:51:14	0:14:29
	14:01:42	14:14:39	0:12:57
	16:07:07	16:21:50	0:14:43
	19:26:58	19:41:27	0:14:29
	21:08:24	21:21:17	0:12:53
03 Jun 2026	14:19:14	14:38:52	0:19:38
	15:33:49	15:45:24	0:11:35
	16:01:03	16:16:15	0:15:12
	17:17:10	17:32:36	0:15:26
	17:40:57	17:55:36	0:14:39
	18:18:36	18:29:45	0:11:09

Tawang : 32 x Blackout Windows (2567 Satellite Transits)

Day	Start Time (IST)	End Time (IST)	Duration
29 May 2026	20:13:04	20:23:16	0:10:12
	23:47:08	23:57:40	0:10:32
30 May 2026	07:57:25	08:07:33	0:10:08
	12:11:11	12:25:21	0:14:10
	18:52:46	19:04:08	0:11:22
31 May 2026	03:17:39	03:30:25	0:12:46
	09:36:22	09:47:06	0:10:44
	13:00:46	13:12:41	0:11:55
	13:37:38	13:55:39	0:18:01
	14:07:27	14:29:16	0:21:49
	15:23:39	15:36:31	0:12:52
	18:48:59	19:00:21	0:11:22
	19:22:54	19:33:58	0:11:04

Tawang : 32 x Blackout Windows (2567 Satellite Transits)

Day	Start Time (IST)	End Time (IST)	Duration
01 Jun 2026	03:37:02	03:50:01	0:12:59
	09:43:03	09:54:29	0:11:26
	12:28:36	12:42:02	0:13:26
	13:43:50	13:56:55	0:13:05
	23:01:13	23:13:57	0:12:44
02 Jun 2026	03:35:15	03:47:25	0:12:10
	07:01:33	07:12:34	0:11:01
	07:56:33	08:09:12	0:12:39
	08:55:11	09:09:30	0:14:19
	11:53:15	12:07:01	0:13:46
	14:28:45	14:43:30	0:14:45
03 Jun 2026	07:14:29	07:25:35	0:11:06
	07:50:04	08:06:43	0:16:39
	10:19:23	10:30:06	0:10:43
	10:33:04	10:48:46	0:15:42
	11:51:17	12:05:53	0:14:36
	13:31:03	13:43:58	0:12:55
	14:02:56	14:16:36	0:13:40
	17:01:53	17:11:58	0:10:05

Source: Author (Compiled from pulseorbital website at <https://scope.pulseorbital.com>)

The Chinese-to-Indian ISR ratio over the LAC sits at roughly 35:1 by satellite count, and is substantially more lopsided when the revisit rate is factored in. The overwhelming coverage by Chinese satellites denies Indian forces an adequate window for undertaking manoeuvres by ground forces without being detected and makes it difficult to achieve tactical or operational surprise along either the LAC or the LC. Similar is the situation in IOR. The implication for Indian doctrine is that space domain awareness, deception, and ground-based concealment are must, in the interim, across all theatres including IOR. As space has become a key accelerant of conflict on the ground, it has also acquired a conflict dimension of its own, and a few structural features make stability in the space environment during a Sino-Indian crisis particularly fragile. The first is dual-use ambiguity. A Shijian-class proximity manoeuvre approaching an Indian GEO asset, a Korla laser dazzling event against an Indian reconnaissance satellite, or a BeiDou-spectrum jamming operation along the Line of Actual Control cannot be cleanly classified as an armed attack under existing legal frameworks, yet each can degrade Indian operational capability. The threshold below which interference is permissible, and above which it constitutes an act of war, remains undefined in international law and unspecified in Indian doctrine.¹³⁷ Dual-use platforms compound this ambiguity—a Tiangong robotic arm, a Shijian-21 grappling system, or a Three-Body Computing Constellation AI-inference satellite each has a peaceful primary mission and a wartime alternative use that can be activated through software or payload reconfiguration without an observable change in the host platform.

The second is the use-it-or-lose-it pressure. Both China and India know that the early hours of a conflict offer the highest counterspace payoff. Direct-ascent ASAT systems, ground-based lasers, and cyber operations against ground stations all benefit from pre-emption. Once an adversary has dispersed its assets, hardened its ground segment, and activated its alternative communication paths, the marginal effectiveness of counterspace strikes falls sharply. The PLA Aerospace Force's organisational separation under the CMC in April 2024 has compressed the request-to-strike decision cycle by addressing the previous SSF's shortcomings.

The third is the absence of crisis communication mechanisms specific to space. India and China operate no space-domain hotline equivalent to the Sino-Russian or US–Russian Memoranda on the notifications of launches that have governed nuclear-strategic stability since the late 1980s. A Chinese satellite manoeuvre approaching an Indian asset, an Indian launch trajectory passing near a Chinese GEO platform, or a debris event from any source cannot be deconflicted in real time. The risk is not outright war but an inadvertent escalation resulting from misinterpreted technical signals.¹³⁸ A Sino-Pakistan-coordinated counterspace operation during a major sub-conventional crisis could disrupt Indian situational awareness without a provable direct Chinese role.

CASE STUDIES: US–IRAN CONFLICT AND PAHALGAM ATTACKS

On February 28, 2026, the United States and Israeli forces launched almost nine hundred coordinated strikes within 12 hours against Iranian missile, air-defence, military, and leadership targets, and the campaign continued until Apr 9, 2026, based on the doctrinal precedent set by Operation Midnight Hammer during the Twelve-Day War.¹³⁹ Space-enabled targeting was decisive across both campaigns. Commercial SAR imagery from Capella Space, ICEYE, and Synspective and high-resolution optical imagery from Maxar (now Vantor) and Planet sustained battle-damage assessment cycles measured in hours rather than days; the United States Space Force Geosynchronous Space Situational Awareness Programme (GSSAP) repositioned to support targeting and post-strike damage assessment.¹⁴⁰ Iranian counter-space activity was confined to widespread GPS spoofing and jamming concentrated around Tehran and Bandar Abbas, while Iranian missiles drew on BeiDou augmentation where available.¹⁴¹ Five lessons translate directly to the Indian threat assessment. First, commercial earth-observation satellite services were mobilised at conflict tempo, demonstrating that no major state can rely solely on its military satellites alone. Second, mid-conflict GPS spoofing on a regional scale is now routine. Third, satellite-network cyber attacks of the Viasat KA-SAT type remain a credible escalation option. Fourth, resilient PNT is now a critical operational requirement, not an aspiration. Fifth, offensive non-kinetic counter-space options, ranging from cyber operations to

electronic warfare and directed-energy, must complement any kinetic actions.

Space also became a key conduit for the Pahalgam attacks on April 22, 2025 by Pakistan wherein it leveraged commercial satellite imagery to plan, organise intelligence, and execute the terrorist attacks. At least a dozen high-resolution satellite orders for the Pahalgam meadow region were placed through the BSI/Maxar portal. These data requests spiked in February 2025, with an additional surge just 10 days before the attack.¹⁴² Security experts also suspect that the commercial imagery was used by the terrorist groups for ‘geospatial recce,’ allowing them to map strategic locations, track troop deployments, and plan evasion and ambush routes around the Anantnag district without being detected. Alongside geospatial mapping, intelligence sources indicated that terrorists used Chinese-made satellite phones and encrypted applications to communicate with their handlers in Pakistan while in the Pahalgam area.¹⁴³ Subsequently, during the launch of Operation Sindoor, Pakistan was able to monitor Indian military movements with the help of Chinese space capabilities, confirming the high probability of collusion in any future conflict.

THE ONE FRONT SPACE THREAT: CHINA-PAKISTAN CONVERGENCE

Sino-Pakistani space cooperation, in Operation Sindoor, was not the first time, but has been developing into a strategic vector since 2018. In February 2025, the China Manned Space Agency announced that a Pakistani astronaut would join a future Tiangong crew, making Pakistan the first non-Chinese state to do so and converting symbolic cooperation into a deeper national coupling.¹⁴⁴ The PRSS-1 optical reconnaissance satellite, built by the CAST, which provides approximately one-metre resolution, was launched for Pakistan in July 2018. PakSat-MM1R, a strategic communications satellite, followed on a Long March 3B from Xichang in May 2024, while another small lunar Cubesat, ICUBE-Q, was deployed on Chang’e-6 in May 2024 as the first Pakistani interplanetary payload. In 2022, Pakistan signed an agreement granting access to BeiDou’s authorised service signal, and by 2023, Pakistani military platforms had begun fielding BeiDou-3 receivers operating on the encrypted military B3A waveform.¹⁴⁵ The operational implication

was visible in April 2025. At the ISpA DefSpace Symposium in April 2026, Brigadier Anshuman Narang (Retd.) further asserted that the PLA ASF had passed one hundred and 29 satellite images of Pahalgam to Pakistani interlocutors between January 1 and April 22, 2025. His observation, largely based on Open Source Intelligence (OSINT), acquires plausibility against the broader pattern of Chinese ISR augmentation of Pakistani targeting architecture, as recent reports indicate that BeiDou's encrypted short message service (RDSS) is being integrated into the Pakistani PL-15 air-to-air missile and selected stand-off munitions. The provision of satellite communication equipment by China to Pakistan is also underway. Recently, 'Ultra Sets,' initially meant for the Pakistan Army, may have found its way into the hands of terrorists, assisting them in carrying out the Pahalgam attacks and evading security forces. An article in the *Economics Times* highlighted that 'these devices operate on radio waves for message transmission and reception, and are linked to a control station across the border. The messages are compressed and transmitted via Chinese satellites to a master server in Pakistan'¹⁴⁶.

ECONOMIC AND COMMERCIAL THREAT VECTORS

The fourth threat vector is economic and commercial. BeiDou has expanded across the Belt and Road footprint and now anchors a parallel positioning architecture used by states whose military doctrine is being reorganised around Chinese standards. In late 2025, Iran completed the migration of its missile-guidance packages from GPS to encrypted BeiDou signals during the Twelve-Day War with Israel, marking the first publicly confirmed combat use of a foreign GNSS for sovereign military operations and a precedent that other partners on the Indian periphery are surely observing.¹⁴⁷ Pakistan has progressively deepened its BeiDou ground-station agreements; Sri Lanka, Bangladesh, and Myanmar are also following at varying paces. The strategic effect, after a decade, is likely to be a layer of Chinese-controlled sovereign positioning in the IOR periphery that future Indian military planners will have to factor in and prepare counteractions for.

In commercial communications, Shanghai SpaceCom is marketing the Qianfan low-Earth-orbit broadband constellation to telecommunications operators in six initial markets across Asia, Africa,

and Latin America under the Sailspace brand, with memoranda of understanding signed for wholesale resale. The Qianfan constellation includes both broadband-internet satellites and dedicated experimental-technology satellites that Western analysts assess as carrying signals-intelligence, navigation-augmentation, and reconnaissance payloads.

The combination of dual-use BeiDou penetration, Sailspace-marketed broadband resale, satellite-export diplomacy through CGSTL, and ground-infrastructure access produces a strategic effect comparable to the Belt and Road's terrestrial footprint. For India, the longer-term concern is sovereignty, as partner countries whose telecommunications backbones, banking timing and military communications run on Chinese-controlled space infrastructure may become structurally less available as security partners during a Sino-Indian crisis.¹⁴⁸

Net assessment. The Sino space threat is not a future contingency but a present operational reality. Four of the seven vectors given in the table are assessed as high or medium-high risk, with first-order combat consequences in any LAC, IOR, or Sino-Pakistan-coordinated crisis. These Chinese capabilities span across all key domains of both the civil and military spheres. The threat has unfolded recently during Operation Sindoor, and its full spectrum can be assessed from the ongoing conflicts in Ukraine and Iran, which are being closely observed by the PLA. As India's space-domain capabilities enhance, so will its dependence and vulnerabilities, requiring effective counter-strategies that address every vector identified in the table simultaneously. A programme that hardens against PNT denial while leaving the ground segment exposed, or that closes the ISR gap without addressing kinetic capabilities, will result in limited resilience but not strategic equilibrium.

Table 19 Sino-Indian Space Threat Matrix

Threat Vector	Chinese Capability	Indian Vulnerability	Threat Level
PNT denial	BeiDou-3 + GPS jam/spoof	4 NavIC sats; GPS dependence	High
ISR targeting	Yaogan, Jilin-1, GEO SAR	12 recon sats; SBS-3 incomplete	High
Co-orbital ASAT	Shijian-21/25; robotic arms	Static GEO assets; no manoeuvre	Low
Directed-energy	Korla, Bohu lasers; BGSe crystal	EO sat sensors; no countermeasures	Medium
Cyber on ground segment	PLA Cyberspace Force; supply chain	Concentrated TT&C nodes	High
Commercial / BRI pull	Sailspace, BeiDou export, Pakistan	IOR neighbourhood dependency	Medium
Allied ground segment	Cyber, laser dazzle, SCS interdict	Five Eyes nodes; Pine Gap reliance	Medium-High

Source: Compiled from CMPR 2024; SWF 2026 Counterspace Report; CSIS Aerospace Security 2024; Insightful Geopolitics ISR Gap Analysis (March 2026); ISpA Red Dragon (April 2026); Defence Security Asia (February 2026).

Notes:

- ¹⁰⁶ “China’s Rocket Factory Finds a Second Gear: 2026 Launch Cadence”, KeepTrack.space, April 2026 <https://keeptrack.space/deep-dive/china-launch-cadence-2025-2026>.
- ¹⁰⁷ Defence Security Asia, “Chinese Eyes, Iranian Fists: How PLA Satellites Powered Iran’s Kill Chain Against Israel in the 2025 Twelve-Day War,” February 16, 2026.
- ¹⁰⁸ COMSPOC_OPS @COMSPOC_OPS, “Pakistan’s PRSC-EO3: An unusual orbit for an optical satellite”, at https://x.com/COMSPOC_OPS/status/2052513564619874630 (Accessed on May 3, 2026)
- ¹⁰⁹ Tate Nurkin et al., China’s Remote Sensing, OTH Intelligence Group LLC, submitted to the U.S. China-Economic and Security Review Commission, December 2024
- ¹¹⁰ Indian Defence Research Wing, “NavIC ‘Clock Crisis’ after IRNSS-1F Failure: ISRO Adopts Dual Strategy of Indigenous Development and Foreign Procurement,” April 20, 2026, <https://idrw.org/navic-clock-crisis-after-irNSS-1f-failure-isro-adopts-dual-strategy-of-indigenous-development-and-foreign-procurement/>; Adithya Pani, “Analyzing Effects of ISRO’s NVS-02 Navigation Satellite Failure on NavIC Users,” *Substack*, February 2025, <https://adithyapani.substack.com/p/analyzing-effects-of-isros-nvs-02>.<https://gk365.in/current-affairs-articles/science-technology/navic-irNSS-1f-atomic-clock-failure-india-gps-independence-2026/>
- ¹¹¹ Anshuman Narang, Brig., Red, Dragon in Orbit: Mapping China’s Civil-Military Space Ecosystem, ISpA DefSpace Symposium, New Delhi, April 23, 2026, slides 22–27.
- ¹¹² ISRO, “PSLV-C61/EOS-09 Mission Update,” press statement, May 18, 2025; “What Caused ISRO’s PSLV-C61 Mission to Fail Midway,” *The Print*, May 18, 2025, <https://theprint.in/Insightful-Geopolitics/India-China-Space-ISR-Gap-Widening-Reality-or-Strategic-Smokescreen/>; <https://insightful.co.in/2026/03/17/india-china-space-isr-gap-widening-reality-or-strategic-smokescreen/> 17 March 2026; The Week (India), “ISRO EOS-09 Mission Failure: What Are the Alternatives for India in the Earth Observation Space?,” 19 May 2025.
- ¹¹³ Chethan Kumar, “Operation Sindoor: Domestic Strategic Space Assets and Foreign Commercial Satellites Used by Armed Forces”, *Times of India*, May 13, 2025, <https://timesofindia.indiatimes.com/india/operation-sindoor-domestic-strategic-space-assets-foreign-commercial-satellites-used/articleshow/121118997.cms>
- ¹¹⁴ Centre for Strategic and International Studies, “No Place to Hide: A Look into China’s Geosynchronous Surveillance Capabilities,” April 22, 2024;

Yaogan-41 GEO optical orbit data via Jonathan McDowell's Space Activities database.

- ¹¹⁵ Indian Space Association, India Space Sector Decadal Report 2024 (New Delhi: ISpA, 2024); Indian National Space Promotion and Authorisation Centre (IN-SPACe), *Annual Report 2024–25*, IN-SPACe, Ahmedabad, 2025); Jeff Foust, "SpaceX, China Drive New Record for Orbital Launches in 2025," *SpaceNews*, January 4, 2026, <https://spacenews.com/spacex-china-drive-new-record-for-orbital-launches-in-2025/>
- ¹¹⁶ V. Narayanan, remarks at the International Manufacturing Summit, reported in "85% of ISRO Mission Systems Now Built by Indian Industries: Chairman V. Narayanan," Illustrated *Daily News*, November 6, 2025; Cabinet Committee on Security approval reported in "Modi Government Approves Rs 27,000 Crore Worth Spy Satellites for Space Surveillance," *Deccan Herald*, October 2024.
- ¹¹⁷ Karan Kamble, "India's Space Sector Is Booming. Its Supply Chain Is Almost Entirely Foreign," *Swarajya*, March 8, 2026 (updated May 3, 2026), citing ISRO data and V. Narayanan's remarks at the Nano Electronics Roadshow, IISc Bengaluru, March 2025.
- ¹¹⁸ Kamble, "India's Space Sector Is Booming". These subsystem origins are reported for a typical privately built Indian satellite; ISRO retains indigenous capability in several of the same categories (see Table 18 and notes thereto).
- ¹¹⁹ Every first-generation NavIC (IRNSS-1A to 1G) satellite carried three rubidium clocks, all imported from the Swiss firm SpectraTime, later absorbed into France's Safran. "NavIC's Clock Crisis, And The Indian Clocks That Could Fix It," *Swarajya*, April 11, 2026.
- ¹²⁰ "Inside the box: New NavIC clock outperforms previous generation," GPS World, November 17, 2025; "NavIC's Clock Crisis," *Swarajya*, April 11, 2026 — confirms NVS-01 carries both the indigenous iRAFS and a redundant Safran-made RAFS.
- ¹²¹ "NavIC 'Clock Crisis' After IRNSS-1F Failure: ISRO Adopts Dual Strategy of Indigenous Development and Foreign Procurement," Indian Defence Research Wing (IDRW), April 20, 2026 — reports SAC's late-2025 tender for 40 space-qualified imported RAFS units.
- ¹²² "India boosts space self-reliance with new indigenous integrated circuits for launch vehicles," *The Tribune*, August 23, 2025; "ISRO & Semiconductor Laboratory Develop 32-Bit Microprocessors For Space Applications," Indian Defence News, March 2025; "Vikram 32," Wikipedia, accessed August 2026.
- ¹²³ Karan Kamble, "India's Space Sector Is Booming. Its Supply Chain Is Almost Entirely Foreign," *Swarajya*, March 8, 2026 (updated May 3, 2026) — "the onboard computer is imported," describing a typical Indian private satellite; single-sourced claim.

- ¹²⁴ ISRO Inertial Systems Unit (IISU), official unit description, isro.gov.in / vssc.gov.in, accessed August 2026.
- ¹²⁵ “Dhruva Space and Comat ink Memorandum of Agreement for supply of Reaction Wheels, SADM and Space-grade Solar Arrays,” Dhruva Space press release, February 16, 2023; “COMAT expands its Space Capabilities with a New Partnership with Dhruva Space,” Comat, September 22, 2023.
- ¹²⁶ BHEL, “BHEL Achieves Major Landmark with Deployment of Space Grade Solar Panels and Batteries on GSAT-10 Satellite,” bhel.com; “BHEL Powers ISRO’s CMS-03 with Indigenous Solar Panels and Li-Ion Battery,” SolarQuarter, November 4, 2025; “BHEL Powers India’s Space Leap: Supplies Solar Panels and Battery for Historic ISRO-NASA NISAR Mission,” Indian Masterminds, August 10, 2025; “BHEL Powers India’s Space Ambitions, Plays Key Role in ISRO Missions Including Chandrayaan-3,” Indian PSU, June 2026 documents Li-ion batteries and titanium-alloy tank components for Chandrayaan-3, not solar panels specifically.
- ¹²⁷ AZUR SPACE Solar Power GmbH, company product/history pages, azurspace.com, accessed August 2026, general market-leadership credentials only; no Indian-satellite-specific sourcing instance identified independently.
- ¹²⁸ IDRW describes RUDRA 1.0 HPGP on POEM-3 lineage; “Mumbai-Based Manastu Space Successfully Tests Green Propulsion System ‘Vyom 2U’ in Orbit by Onboard ISRO’s POEM-4,” The Defense News, January 1, 2025.
- ¹²⁹ “Exotrail Secures Major Propulsion Contracts with Indian Space Firms During Presidential Visit,” SatNews, February 17, 2026; “Exotrail Signs Major Contracts with Three Indian Space Companies as Macron Visits India,” SpaceWatch.Global, February 18, 2026; “Pixxel selects Exotrail thrusters to steer its satellites in orbit,” The Tribune, February 17, 2026.
- ¹³⁰ Karan Kamble, “India’s Space Sector Is Booming,” Swarajya, March 8, 2026, “machines capable of achieving a $\lambda/4$ surface finish exist in India, but the $\lambda/20$ standard is not available in the private sector,” attributed to Eon Space Labs co-founder Punit Badeka.
- ¹³¹ “DRDO commissions Bengaluru firm to develop indigenous NavIC receiver chip,” Communications Today, July 12, 2024; “Home-grown firm chips in for India’s satellite navigation push” (Manjeera Digital Systems), Deccan Herald.
- ¹³² Karan Kamble, “India’s Space Sector Is Booming,” Swarajya, March 8, 2026 “in at least one documented case involving a private satellite builder” a \$13 Chinese GNSS unit was used; “the crucial RF front-ends are Taiwanese, and space-grade COCOM-limit-removed chips cost upwards of \$2,000 each.” No independent second source identified for either figure.
- ¹³³ “NavIC ‘Clock Crisis’ After IRNSS-1F Failure: ISRO Adopts Dual Strategy of Indigenous Development and Foreign Procurement,” Indian Defence Research Wing (IDRW), April 20, 2026; the Space Applications Centre tender

for 40 space-qualified Rubidium Atomic Frequency Standards was floated in late 2025.

- 134 R. A. Mashelkar, Ajay Shah, and Susan Thomas, “Rethinking Innovation Policy in India” (2024), as discussed in Kamble, “India’s Space Sector Is Booming.” NASA contracts out 75–85 per cent of its budget to external firms, universities, and laboratories; ISRO remains predominantly an in-house ‘make’ organisation.
- 135 Kamble, “India’s Space Sector Is Booming.” No subsystem-only firm appears among India’s top-funded space startups (per Tracxn data cited therein), and the SBS-III domestic-content mandate is constrained by the limits of the existing industrial base.
- 136 Chaitanya Giri, “The Gulf War Just Exposed India’s Space Dependency Problem,” *Swarajya*, April 10, 2026. ‘Shutter control’ denotes the United States government’s authority – as licensing regulator and largest customer of its commercial remote-sensing industry – to direct licensed operators to restrict the collection or distribution of satellite imagery on national-security grounds.
- 137 Kevin Pollpeter, “China’s Space and Counterspace Capabilities,” in *Security in Space: Strategic Perspectives*, NIDS International Symposium 2024 Proceedings, NIDS, Tokyo, 2024, pp. 41–56.
- 138 Bharat Karnad, “Space Hotline Between New Delhi and Beijing: A Long-Overdue Confidence-Building Measure,” IDSA Comment, August 2024; UN COPUOS Working Paper on Long-Term Sustainability Guidelines (2024).
- 139 “2026 Iran War,” *Encyclopaedia Britannica*, <https://www.britannica.com/event/2026-Iran-war> (Accessed May 2026); “US, Israel Bomb Iran: A Timeline,” *Al Jazeera*, 28 February 2026; “Iran Update Evening Special Report: March 2, 2026,” Institute for the Study of War / American Enterprise Institute, 2 March 2026; Council on Foreign Relations, “U.S., Israel Attack Iranian Nuclear Targets — Assessing the Damage,” 25 June 2025.
- 140 “Satellite Images Appear to Show Fresh Damage to Iran’s Natanz Nuclear Facility Complex,” *Times of Israel*, 3 March 2026, citing Vantor imagery; Maxar Technologies / Vantor handout imagery, June 2025 and March 2026; David Albright et al., “Post-Attack Battle Damage Assessment,” Institute for Science and International Security (ISIS), 2025–2026.
- 141 Capella Space, ICEYE, and Synspective commercial SAR imagery archives, June 2025–March 2026; ODNI Annual Threat Assessment 2025; CSIS Aerospace Security Project, *Space Threat Assessment 2025*, on GPS spoofing trends; Samson and Brett, *Global Counterspace Capabilities 2026*, Secure World Foundation, 2026; Inside GNSS, “GNSS Interference Now a Constant of Modern Conflict, SWF Annual Report Finds,” April 8, 2026

- ¹⁴² Soumya Pillai, “Orders for Pahalgam satellite images from US firm peaked two months before attack”, *The Print*, May 09, 2025.
- ¹⁴³ “Pahalgam Attack: Did Pakistani terrorists use Chinese satellite phones and apps to evade Indian surveillance?”, Apr 28, 2025, <https://www.moneycontrol.com/world/pahalgam-attack-did-pakistani-terrorists-use-chinese-satellite-phones-and-apps-to-evade-indian-surveillance-article-13007310.html>
- ¹⁴⁴ China Manned Space Agency/Global Times, “China’s Space Station to Welcome 1st Ever Foreign Astronaut,” February 28, 2025; Xinhua, “Two Pakistani Astronauts Selected for China’s Space Mission Training,” April 22, 2026
- ¹⁴⁵ “Why Pakistan’s Military Switched From the US-Owned GPS To The Chinese Bei Dou Navigation System?”, Resilient Navigation & Timing Foundation, March 2022, <https://rntfnd.org/2022/03/22/why-pakistans-military-switched-from-the-us-owned-gps-to-the-chinese-beidou-navigation-system-global-village-space/>
- ¹⁴⁶ “A Chinese shadow falls on Pahalgam terror attack case”, *Economic Times*, April 30, 2025.
- ¹⁴⁷ Defence Security Asia, “Chinese Eyes, Iranian Fists: How PLA Satellites Powered Iran’s Kill Chain Against Israel in the 2025 Twelve-Day War,” February 16, 2026; SpaceNews, “Iran Completes Migration to BeiDou for Military Applications,” late 2025; Quwa Defence, “Pakistan’s New Communications Satellite – PakSat MM1,” December 6, 2024, <https://quwa.org/pakistan-defence-news/pakistans-new-communications-satellite-paksat-mm1/> (confirming BeiDou L-band SBAS integration in PakSat-MM1, launched May 30, 2024)
- ¹⁴⁸ Frank Rayal, “China’s LEO Megaconstellations: Closing the Gap in the Global Space Race,” May 24, 2025; Shanghai SpaceCom Sailspace marketing materials, 2025; Jeff Foust, “China Launches Fourth Batch of Thousand Sails Megaconstellation Satellites,” *SpaceNews*, January 23, 2025, <https://spacenews.com>.

COUNTER-BALANCING CHINESE SPACE CAPABILITIES WITH A MULTIPRONGED APPROACH

The analysis till now has clearly established that China's space programme is not merely a scientific endeavour but a strategically calibrated instrument of national power, undergirded by CMF and aimed squarely at achieving dominance in any future conflict. China's counterspace capabilities are designed to neutralise the adversary's space-based capabilities upon which modern militaries and civilian economies critically depend.¹⁴⁹ For India, the implications are both immediate and existential. Countering such a multi-dimensional challenge demands a response that is equally comprehensive and one that weaves together enhanced space domain awareness, architectural resilience, active deterrence, electronic and cyber hardening, normative diplomacy, alliance-building, and industrial self-reliance into a coherent national space strategy.

This chapter articulates a multipronged counter-strategy from an Indian perspective, drawing upon India's extant capabilities, emergent doctrinal thinking from the Defence Space Agency, lessons from the Russia–Ukraine conflict's space dimension, the Mitchell Institute's Competitive Endurance framework, and the collaborative structures available through the Quad, bilateral partnerships, and multilateral institutions.^{150,151} The asymmetry between China's 92 orbital launches in 2025 and India's five, between China's 1450 satellites and India's 100, and between China's total space investment at nearly eight times India's space budget of approximately ₹ 13,000 crore is quite stark. No single line of effort is adequate on its own, and a comprehensive approach demands simultaneity across all aspects. However, matching China 'brick by brick' will only exhaust India's efforts. Instead, the adoption of a smarter approach through the prioritisation of specific dimensions^{152,153} of space programme may provide the required direction without totally neglecting lesser priority aspects even if at reduced scales.

Space Domain Awareness (SDA) Enhancement

SDA constitutes the foundational pillar upon which every other element of space security rests. Without the ability to detect, track, characterise, and attribute activities across all orbital profiles, from low Earth orbit to geostationary orbit and into cislunar space, deterrence remains hollow, and defensive measures are reduced to reactive guesswork. As the Mitchell Institute's Space Endurance Workshop (2024) underscored, avoiding operational surprise is the foremost tenet of competitive endurance in space.¹⁵⁴

India's current SDA architecture, while growing, remains inadequate for the scale of the emerging challenge. The ISRO-led Network for Space Object Tracking and Analysis (NETRA), initiated in 2019, tracks debris and provides conjunction alerts for India's operational satellites. The ISSAR-2025, released by ISRO Chairman Dr. V. Narayanan in April 2026, documented over 1.6 lakh close-approach alerts globally, with ISRO executing 14 collision-avoidance manoeuvres in LEO and four in GEO.¹⁵⁵ This underscores the urgency of robust, autonomous SDA. India's current SDA architecture comprises three elements. First, ISRO's Project NETRA (Network for Space Objects Tracking and Analysis), with an initial outlay of ₹ 400 crore. Its sensors include the Multi-Object Tracking Radar (MOTR) at Sriharikota; optical telescopes at Ponmudi (Kerala), Mount Abu (Rajasthan), and Leh (Ladakh), and the Directorate of Space Situational Awareness and Management (DSSAM) in Bengaluru as the fusion node, capable of tracking debris objects down to ten centimetres in low-Earth orbit. In 2025, work on a new phased-array radar at Chandrapur, Assam, commenced under the expansion programme.¹⁵⁶

A critical new challenge has emerged from US policy shifts. In December 2025, President Trump's Executive Order 'Ensuring American Space Superiority' paved the way for monetising SSA data and space traffic management services that the US Department of Defence had previously provided without charge.^{157,158} This has prompted well-founded calls within India's strategic community for an indigenous 'Bharat Space Objects Catalogue'¹⁵⁹, which will be a sovereign capability independent of the geopolitical goodwill of any

external power. As the Observer Research Foundation has argued, India's present ground-based tracking capabilities are 'woefully ineffective' for meeting near-term military SDA objectives.

India must build a three-tier SDA architecture. The first tier involves expanding the ground-based sensor network covering optical telescopes, phased-array radars, and passive radio-frequency sensors, distributed across the Indian mainland, island territories (Andaman and Nicobar, Lakshadweep), and diplomatically negotiated overseas sites. The second tier requires commercial augmentation: a dedicated constellation of SDA micro-satellites in LEO and MEO, capable of monitoring co-orbital threats, RPO activities, and electromagnetic signatures in real time. Indian private-sector capability exists here. On January 14, 2025, Bengaluru-based startup Digantara launched SCOT (Space Camera for Object Tracking), the world's first commercial space surveillance satellite into a sun-synchronous orbit, capable of tracking objects as small as 5 cm. Digantara holds a ¹ 150-crore annual contract with the Ministry of Defence to develop a constellation of LiDAR satellites capable of detecting hostile proximity manoeuvres in real time, with the satellites linked into Project NETRA.¹⁶⁰ The third tier demands extending SDA to the geosynchronous belt and cislunar space, where China's Shijian-21 and Shiyao-12 satellites have already demonstrated co-orbital manoeuvring capability.¹⁶¹

Interoperability is the force multiplier. India should deepen data fusion with the US Combined Space Operations Centre (CSpOC), Japan's Space Operations Group, France's Commandement de l'Espace, and Australia's Defence Space Command. The Quad Space Act, introduced in the US Congress in September 2025, explicitly directs the Secretary of Defence to identify in-orbit cooperation opportunities among Quad partners, a legislative foundation for formalised SDA sharing that India must actively leverage.¹⁶²

RESILIENCE AND REDUNDANCY OF INDIA'S SPACE ARCHITECTURE

India's space architecture's vulnerability stems from concentration: a relatively small number of high-value, exquisite satellites performing critical functions in predictable orbits. China's counterspace arsenal is specifically designed to exploit such concentration. The PLA's 'active

defence' doctrine, as articulated in the Science of Military Strategy (2020), envisions a surprise first strike against an adversary's critical space nodes to achieve information dominance before kinetic hostilities commence.¹⁶³ Resilience therefore demands a paradigm shift from few large assets to many smaller, distributed, and rapidly replenishable ones.

The Space-Based Surveillance Phase III (SBS-3) programme represents India's most significant step in this direction. Approved by the Cabinet Committee on Security in October 2023 with a budget exceeding ¹ 26,968 crore (approximately \$3 billion), SBS-3 envisages deploying 52 dedicated military surveillance satellites by 2029, of which 21 will be built by ISRO and 31 by Indian private firms like Ananth Technologies, Centum Electronics, and Alpha Design Technologies.¹⁶⁴ These satellites will carry synthetic aperture radar for all-weather imaging, thermal infrared sensors for night-time detection, electro-optical payloads, and AI-enabled autonomous analytics capable of identifying and sharing target data within the constellation in real time. The full constellation is expected to be operational by the end of 2029.

Beyond surveillance, the proliferated LEO strategy must encompass communications, navigation augmentation, and electronic intelligence. On-Orbit Servicing, Assembly, and Manufacturing (OSAM) is also an important field, enabling satellite refuelling, repair, and rapid reconstitution after an attack, and must receive dedicated investment. ISRO's Space Docking Experiment (SpaDeX) in 2025 demonstrated foundational rendezvous and docking capability, but operational OSAM requires sustained R&D funding and international partnerships.

Ground segment hardening is equally vital. The Defence Satellite Control Centre (DSCC) in Bhopal and Defence Imagery Processing and Analysis Centre (DIPAC) in Delhi are the twin nerve centres of India's military space operations and require geographically distributed, physically hardened, and cyber-resilient backup facilities. Concentration means vulnerability: a single well-executed cyber intrusion or electromagnetic attack against these nodes could degrade the entire constellation. Geographic dispersal to secondary control nodes and mandatory zero-trust cybersecurity architectures are essential. Hosting of payloads on commercial satellites, disaggregation of functions across multiple platforms, and using well-known civilian communication satellites to maintain deniability and dilemma for targeting by adversary

can further reduce single-point-of-failure risks during crisis.¹⁶⁵ India should also consider establishing a Bharat Space-ISAC (Information Sharing & Analysis Centre) under the National Critical Information Infrastructure Protection Centre (NCIIPC), with statutory information-sharing obligations as required internationally.¹⁶⁶

Launch-on-Demand (LoD) capability is the ultimate guarantor of reconstitution and sustained capabilities. The Small Satellite Launch Vehicle (SSLV), capable of placing 500 kg into LEO with a turnaround time as short as 72 hours and minimal infrastructure, provides nascent LoD capacity. Development of mobile transporter-erector-launcher-based, ship-based, and air-launched small-satellite delivery would enhance survivability of India's replenishment infrastructure by reducing its vulnerability to adversary targeting of fixed spaceports at Sriharikota and Kulasekarapattinam.¹⁶⁷

ACTIVE DETERRENCE AND SPACE CONTROL CAPABILITIES

A credible counter-strategy must be able to impose costs in space as a final resort. India's 2019 Mission Shakti demonstrated a direct-ascent ASAT capability, placing India among four nations with proven counterspace kinetic systems. Yet this capability addresses only one narrow part of the threat spectrum. China's counterspace operations concept, as documented in PLA pamphlets and analysed by the China Aerospace Studies Institute, envisions a layered offensive starting with covert cyber and electronic warfare in the pre-hostilities phase, escalating through co-orbital RPO interference and directed-energy dazzling, and culminating in kinetic strikes only if lower-rung options prove insufficient.^{168,169} India's DA ASAT alone provides limited deterrence because responding to a non-kinetic, non-attributable Chinese attack with a debris-producing missile strike would be strategically disproportionate and could violate international agreements.

India must develop a full-spectrum counterspace capability, with a deliberate preference for non-kinetic, reversible effects. This includes ground-based and space-based electronic attack systems (uplink and downlink jammers, GNSS jammers, SAR jammers); offensive cyber capabilities targeting adversary satellite command-and-control links; and directed-energy weapons (laser dazzlers, HPM systems) for temporary

or permanent disabling of hostile sensors. The DRDO and the Centre for High-Energy Systems and Sciences (CHESS) have been developing DEW systems, with the Ministry of Defence prioritising 300 kW-class weapons development in 2022, but operational deployment remains distant.¹⁷⁰

The concept of ‘defending forward’—deploying bodyguard or guardian satellites in close proximity to critical national assets—merits priority investment. Such satellites, equipped with manoeuvre capability and electronic countermeasures, could intercept or deflect approaching co-orbital threats. The role of strategic ambiguity in the non-attribution of counterspace operations also serves as a deterrence tool: the adversary’s uncertainty about whether India possesses and is willing to employ a particular capability can itself forestall aggression. India’s national space deterrence doctrine must define red lines, proportional response options, and escalation management protocols. As Raksh Mantri Rajnath Singh emphasised, ‘Space assets in LEO have taken combat to a new high,’ and credible deterrence requires both demonstrated capability and declared intent.¹⁷¹

The role of deliberate ambiguity deserves specific attention. Every major space power that has developed counterspace capabilities, i.e., the United States, China, Russia, and France, maintains deliberate ambiguity about the full extent and operational availability of those capabilities. France’s Commandement de l’Espace, established in September 2019, has publicly stated that will develop ‘active defence’ space capabilities while declining to specify their nature. The Indian Defence Space Agency’s Mission Def Space programme has engaged multiple private-sector firms in developing indigenised counterspace intelligence, SSA, and directed-energy technologies through iDEX challenge mechanisms. The Nirbheek programme’s directed-energy and electronic-attack streams should maintain the same strategic ambiguity that is standard practice among peer space powers. Satellite manoeuvrability now demonstrated through SpaDeX and envisaged in bodyguard satellite concepts should be incorporated into SBS-3 from the inception.^{172,173}

Therefore, it is essential that China’s Three Warfare strategy of legal, psychological, and media warfare be countered holistically as it extends into the space domain through pre-conflict narrative building, satellite-

enabled disinformation, and contested claims over space resources.¹⁷⁴ India must counter this cognitive dimension by developing space forensics capabilities for attribution, maintaining high-cadence SDA for deterrence by detection, and orchestrating counter-narratives through its own satellite communication and media infrastructure.¹⁷⁵

ELECTRONIC WARFARE AND CYBER COUNTER-MEASURES

The Russia–Ukraine conflict has provided a real-world demonstration of electronic warfare and cyber operations against space systems. Russian GPS jamming of Ukrainian forces, attempted spoofing of commercial GNSS signals, the Viasat KA-SAT ground-terminal cyber attack of February 2022, and sustained efforts to disrupt Starlink terminals illustrate that the electromagnetic and cyber domains are inseparable from space security.¹⁷⁶ For India, the three lessons are stark and urgent.

First, NavIC must be hardened with anti-jam and anti-spoof capabilities. The India's military's continuing dependence on GPS for precision targeting represents a critical vulnerability. Alternative Positioning, Navigation and Timing (Alt-PNT) programmes, including terrestrial eLoran, fibre-optic timing networks, and inertial navigation fusion, must be mandated alongside satellite-based PNT by the DSA. Second, encrypted SATCOM hardening is imperative. India's military communications satellites (GSAT-7 series) must transition to quantum-resistant encryption as quantum computing threatens current standards. Deployment of QKD over satellite links would ensure that military commands remain secure against current and future adversary capabilities.¹⁷⁷

Third, the India Space Cyber Security Guidelines 2026, released by CERT-In and SIA-India at the DefSat Conference in February 2026, represent a positive regulatory step.¹⁷⁸ These guidelines provide a structured framework for cyber defence across all layers—spacecraft bus, payload, ground segments, and inter-satellite links. However, guidelines must translate into enforceable standards, mandatory penetration testing for all defence-related space systems, real-time threat intelligence sharing between ISRO, DSA, and CERT-In, and a dedicated

Space Cyber Operations Wing within the proposed Space Command. The lesson from recent conflicts, including the Iran theatre, where Chinese satellite support to Iranian forces was documented, reinforces the point that passive cyber defence alone is insufficient, and active cyber operations against adversary ground-control infrastructure must form part of India's counter-space toolkit.¹⁷⁹

INTERNATIONAL NORMS AND LEGAL FRAMEWORKS

Satellite cybersecurity is the third pillar of electronic warfare and cyber counter-measures. Academic research presented at ACM CCS 2025 in Taipei by researchers from the University of California San Diego and the University of Maryland demonstrated that unencrypted IP traffic from 39 geostationary satellites, including military and government communications, voice calls, SCADA traffic, and ATM transaction data, could be intercepted using equipment costing only \$800.¹⁸⁰ The existing legal architecture governing outer space, centred on the 1967 Outer Space Treaty, prohibits placing weapons of mass destruction in orbit but is conspicuously silent on conventional weapons, non-kinetic counterspace systems, co-orbital RPO activities, and the precise definition of 'peaceful use.'¹⁸¹ This lacuna has been exploited by all major space powers to develop counterspace capabilities under the guise of dual-use technology and 'scientific experimentation.' The Liability Convention (1972) and Registration Convention (1975) provide limited recourse, while the Moon Agreement (1984) remains unratified by any major space-faring nation. The Open-Ended Working Group on Prevention of an Arms Race in Outer Space (PAROS), established by UNGA Decision 79/512 in 2024, held its second substantive session in Geneva in July 2025.¹⁸²¹⁸³ Fundamental divisions persist, as China and Russia advocate a legally binding treaty (the draft PPWT), while the United States and allied nations prefer voluntary norms and Transparency and Confidence-Building Measures (TCBMs), citing insurmountable verification challenges. India's position has traditionally supported a multilateral, non-discriminatory, and verifiable instrument, while simultaneously preserving its freedom of action for self-defence.

India should side with the normative agenda on two parallel fronts. First, it should champion TCBMs as interim steps, including pre-notification of orbital manoeuvres, enhanced registration of dual-use

objects, and voluntary moratoriums on debris-generating ASAT tests. Second, the Artemis Accords provide a values-based coalition for cislunar governance. With 67 signatories as of May 2026, the Accords establish norms for transparency, interoperability, emergency assistance, and resource extraction that directly counter China’s alternative ILRS framework, which counts only a dozen-odd members, many of them are Chinese strategic partners.^{184,185}

Table 20 Comparative Overview – Artemis Accords vs. ILRS Framework

Parameter	Artemis Accords (US-led)	ILRS (China–Russia-led)
Nature	Non-binding principles; voluntary participation	Cooperative framework; bilateral MoUs with ILRSCO
Membership (May 2026)	67 nations incl. India, Japan, all 23 ESA members	~13 confirmed national participants
Governance Basis	Outer Space Treaty; rules- based, open order	China-centric coordination; norms undisclosed
Resource Extraction	Permitted with safety zones; OST-consistent	Permitted; governance framework undefined
Data Sharing	Mandatory open scientific data release	Limited; no public transparency provisions
India’s Position	Signatory since June 2023	Not a member

Source: US Department of State; Secure World Foundation; SpacePolicyOnline.com; ESA.

India’s strategic objective within the Artemis framework should be to push the non-binding accords progressively toward enforcing transparency obligations, pre-notification for proximity operations near other signatories’ assets, standardised debris reporting, and shared cislunar domain awareness. Absence from UNGA resolution like earlier

by India, is not a solution while seeking a conditional moratorium pledge linked to Chinese reciprocity on co-orbital RPO transparency and explicitly preserving non-kinetic counterspace options would address the concerns.

ALLIANCE-BASED COUNTER-STRATEGIES

No single nation can independently counter the pace and scope of China's growing space capabilities. Alliance-based strategies will enable deterrence, divide investments, create strategic dilemmas, and more importantly, make everyone a stakeholder for the adversary. The Quad provides the most promising multilateral platform. The Quad Foreign Ministers' Meeting in Washington (July 2025) reaffirmed commitment to a free and open Indo-Pacific and deeper cooperation across technology, cyber, and maritime security.¹⁸⁶ The bipartisan Quad Space Act introduced in the US Congress in September 2025 identifies in-orbit cooperation opportunities with Quad nations, providing legislative backing for SDA fusion, interoperability exercises, and complementary capability development.¹⁸⁷

While the anticipated 2025 Quad Leaders' Summit in New Delhi did not materialise amid US–India trade frictions, working-level cooperation is still taking place.¹⁸⁸ Japan's Space Operations Group and Australia's Defence Space Command are natural partners for India's DSA. AUKUS Pillar II, encompassing quantum technologies, AI, cyber, and space-domain integration, offers India potential technology access even outside formal membership.¹⁸⁹ Bilateral frameworks may provide additional windows like the India–US Space Situational Awareness Agreement (April 2022), the India–France TRISHNA earth-observation mission and joint space exercises, and the India–Japan Lunar Polar Exploration (LuPEX) mission, representing building blocks of an alliance-reinforced space architecture.

The Indian Navy's Space Vision 2025–2040, released at the Commanders' Conference in 2025, outlines a fifteen-year roadmap for integrating the full spectrum of space-based capabilities into naval operations.¹⁹⁰ This doctrinal milestone aligns with allied maritime space strategies and enhances interoperability across the Indian Ocean Region. India must also engage other countries like UK's National Space Operations Centre and Canada's space surveillance programmes to

create a truly global SDA mesh. The objective is a combined space operating picture that denies any adversary the confidence to strike, first providing the much-needed shared awareness umbrella that also acts as an extended space deterrence.

INDUSTRIAL AND TECHNOLOGICAL COUNTER-MEASURES

Counter-strategy ultimately rests on the industrial base. India joined the Missile Technology Control Regime (MTCR) on June 27, 2016 as its thirty-fifth member, the Wassenaar Arrangement on December 8, 2017 as the forty-second participating state, and the Australia Group on January 19, 2018 as the forty-third member. China is absent from all three regimes. This membership asymmetry is India's most underleveraged industrial-base advantage. Sustained deterrence and resilience are ultimately contingent upon industrial capacity, which is the ability to design, manufacture, launch, and replenish space assets at a pace and cost that outstrips attrition rates. However, the agreements constrain the very development of this system. India's space ecosystem has undergone transformative expansion since the National Space Policy 2023, which laid down the roles of ISRO (R&D), IN-SPACe (regulation), and NSIL (commercialisation).¹⁹¹ The private sector's entry has been energised, though to a limited extent, by the iDEX and DefSpace initiatives comprising 75 defence space challenges, which provide demand signals from the armed forces. Startups, including Pixxel (hyperspectral imaging; NRO contract), Skyroot (Vikram launch vehicle programme), Agnikul (3D-printed engines), and Digantara (debris tracking), are evolving from technology demonstration to operational capability.^{192,193} A first-time launch of a unique multi-sensor satellite fusing SAR and optical imaging, by domestic firm Galaxeye in the world is a milestone and a further marker of this maturing indigenous private earth-observation capabilities.

Export controls on dual-use space technology governed by ITAR, EAR, and the Wassenaar Arrangement continue to constrain India's access to advanced components.¹⁹⁴ India must pursue twin-track strategies: negotiating technology transfer agreements with France, Japan, and Russia, while simultaneously building indigenous capacity in radiation-hardened processors, space-grade Monolithic Microwave

Integrated Circuit (MMIC) chips, cryogenic heavy-lift engines, and advanced electric propulsion. The SBS-3 programme's allocation of 31 satellites to private industry represents a crucial test case for whether India's commercial sector can deliver defence-grade space hardware on time and at scale.

Restricting Chinese investment in South Asian space ventures is also an equally necessary defensive measure. China's Belt and Road Initiative has extended to space infrastructure in Pakistan, Sri Lanka, and Bangladesh, including satellite manufacturing, ground stations, and remote-sensing data partnerships, potentially creating potential intelligence-collection platforms in India's strategic neighbourhood free of cost.¹⁹⁵ India should diplomatically aggressively advocate within multilateral export-control regimes for tighter scrutiny of Chinese dual-use space technology transfers to the subcontinent, while offering its own capacity-building assistance to regional partners through SAARC, thereby countering the 'Space Silk Road' with an Indian alternative grounded in transparency and mutual benefit.

Semiconductor supply chains deserve special attention. Space-grade electronics depend on a handful of fabrication facilities globally, and any disruption, whether from geopolitical sanctions, natural disasters, or adversary action, can cascade into satellite production delays. The India Semiconductor Mission (ISM), notified on December 21, 2021 with a ¹ 76,000 crore outlay, is the foundational industrial-base instrument. By December 2025, ten semiconductor and display projects worth ¹ 1.60 lakh crore have been approved across six states; however, no dedicated Space-Grade Semiconductor Sub-Mission had been provided for. Space-grade chips, i.e., radiation-hardened FPGAs, mixed-signal Application-Specific Integrated Circuit (ASICs), power management ICs, and high-speed analogue-to-digital converters, are distinct from commercial-grade chips in their hardening requirements, lot traceability standards, and environmental qualification procedures. A dedicated Space-Grade Semiconductor Sub-Mission, co-developed with international partners and with ISRO's Semiconductor Laboratory at Chandigarh, can address the fundamental input-supply vulnerability identified in the previous chapter, as the entire Indian satellite manufacturing sector is dependent on imported radiation-hardened components from the United States, Europe, and Japan, all of which

could be disrupted in an escalatory crisis. A Production-Linked Incentive scheme for space systems on the model of existing Production Linked Incentive (PLI) schemes for electronics, mobile manufacturing, and drones should be approved.^{196,197} India's Semiconductor Mission must be aligned with space programme requirements, ensuring domestic foundry capacity for radiation-hardened chips and FPGAs that underpin military satellite payloads.

In summation, countering China's space capabilities is not a single-domain, single-instrument challenge. It demands orchestrated, simultaneous action across the technological, doctrinal, diplomatic, industrial, and alliance dimensions. The emerging space architecture must be designed not merely to survive a first strike but to deny the adversary the confidence that such a strike could succeed, thereby protecting India's sovereign interests and safeguarding access to the ultimate high ground for generations to come. Three lessons¹⁹⁸ from leading space-faring nations can help us to sharpen our own strategy. Japan's Space Activity Act of 2016 and Space Resources Act of 2021 provide legal certainty for private operators without creating a new regulatory burden. The United Kingdom's National Space Strategy of September 2021 directly linked a £1.4 billion ten-year investment commitment to a commercial launch target of one thousand commercial small satellites per year by 2030, with four licensed launch sites. Australia's Defence Space Strategy of March 2022 established a Defence Space Command with a dedicated budget authority separate from the joint force, a structural model India should replicate by converting the Defence Space Agency into a full Defence Space Command. France's Commandement de l'Espace, established in September 2019 and re-energised with an announcement of active defence capability development in 2023, is the doctrinal model for the ambiguity-preserving counterspace posture India needs. Overall, every peer space-faring nation has, in recent years, established a military space command, a national space strategy, and a dedicated industrial-base. India should attempt to execute and integrate all three by the end of this decade.^{199,200,201} A careful sequencing of the seven-track counter-strategy at the national level is essential to achieve the desired security objectives for India in the space domain.

Notes:

- ¹⁴⁹ U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China: Annual Report to Congress*, Office of the Secretary of Defense, Washington, DC, 2023, pp. 93–98.
- ¹⁵⁰ Col Charles S. Galbreath, USSF (Ret.) and Col Jennifer K. Reeves, USAF (Ret.), *Ensuring a Spacepower Advantage in Prolonged Competition: Findings and Recommendations from the Space Endurance Workshop*, Mitchell Institute for Aerospace Studies, 2024, pp. 6–25.
- ¹⁵¹ Lessons from the Russia–Ukraine conflict's space dimension: GPS jamming, Viasat KA-SAT ground-terminal cyber attack (February 2022), Starlink resilience under electronic warfare, and commercial augmentation of military space capabilities.
- ¹⁵² Payload Space, “2024 Orbital Launch Attempts by Country,” January 2025, <https://payloadspace.com/2024-orbital-launch-attempts-by-country/>; Payload Space, “China Breaks Its Own Yearly Launch Record,” December 2025, <https://payloadspace.com/china-breaks-its-own-yearly-launch-record/>.
- ¹⁵³ United States Department of Defense, *Military and Security Developments Involving the People's Republic of China 2025*, Office of the Secretary of Defense, Washington DC, December 2025, as summarised in SatNews, “DoD Releases 2025 China Military Power Report,” December 24, 2025.
- ¹⁵⁴ Col Charles S. Galbreath and Col Jennifer K. Reeves, *Ensuring a Spacepower Advantage in Prolonged Competition: Findings and Recommendations from the Space Endurance Workshop*, Mitchell Institute for Aerospace Studies, Arlington, VA, 2024, pp. 7–16.
- ¹⁵⁵ Indian Space Research Organisation, *Indian Space Situational Awareness Report 2025 (ISSAR-2025)*, Bengaluru, ISRO, April 8, 2026, https://www.isro.gov.in/Indian_Space_Situational_Awareness_Report_2025.html.
- ¹⁵⁶ ISRO, “Space Situational Assessment Report 2024,” Executive Summary, May 2025; Drishti IAS, “NE'TRA Project and Space Junk,” current affairs analysis, 2024, “Chandrapur to Host India's First Space Debris Monitoring Radar under ISRO's Project NE'TRA,” 2025, <https://assamink.net/detailstory.php?l=115>.
- ¹⁵⁷ Pranav R. Satyanath, “India Must Build Its Own Space Object Catalogue,” *Observer Research Foundation*, January 30, 2026, <https://www.orfonline.org/expert-speak/india-must-build-its-own-space-object-catalogue>.
- ¹⁵⁸ Executive Order 14369, “Ensuring American Space Superiority,” signed by President Donald J. Trump, December 18, 2025, revising Space Policy Directive-3 to replace “free of direct user fees” with “for commercial and other relevant use”, *Federal Register* 90 (245), December 23, 2025, p. 59585.

- ¹⁵⁹ Pranav R. Satyanath, India Must Build Its Own Space Object Catalogue, *ORF*, January 30, 2026.
- ¹⁶⁰ “India’s Strategic Counter-Surveillance Initiative,” *India Strategic*, June 14, 2025. Digantara Aerospace’s Space Camera for Object Tracking (SCOT) tracks objects as small as 5 cm in Earth’s orbit; “India Will Soon Have Its Own Satellites to Monitor Spy Satellites,” *The Print*, June 14, 2025; “Defence Ministry to Deploy Satellite Constellation to Counter Surveillance Threats,” Indian Defence Research Wing, June 13, 2025.
- ¹⁶¹ China Aerospace Studies Institute, *PLA Counterspace Command and Control*, Air University, Maxwell AFB, AL, 2023, analysing SSF’s operational chains for DA-ASAT, co-orbital, and directed-energy systems.
- ¹⁶² Jacqueline Feldscher, “House Bill Introduced to Boost In-Orbit Cooperation for Quad States,” *Payload Space*, September 16, 2025, <https://payloadspace.com/house-bill-introduced-to-boost-in-orbit-cooperation-for-quad-states/>.
- ¹⁶³ Xiao Tianliang, ed., *Science of Military Strategy*, National Defence University Press, Beijing, 2020), chapters on space warfare strategy and strategic employment of space forces.
- ¹⁶⁴ “India Eyes 52 Military Satellites by 2029 to Counter China’s Orbital Dominance,” *Orbital Today*, July 3, 2025; Ajay Lele, “India’s SBS-3 Programme: A Test Case for Private Industry’s Active Engagement,” *Raksha Anirveda*, July 14, 2025; “52 Satellites for Border, Ocean Watch: India Ramps Up Defence Surveillance,” *Business Standard*, June 30, 2025.
- ¹⁶⁵ Air Vice Marshal (Retd.) S. Khot, “Interview on DSA expansion, bodyguard satellites, and proposed Space Command architecture”, *ISpA Knowledge Series*, 2024.
- ¹⁶⁶ Space Information Sharing and Analysis Centre (Space ISAC), <https://spaceisac.org/>; Sandra Erwin, “The Race to Defend Satellites from Cyberattacks,” *SpaceNews*, November 2025, <https://spacenews.com/deloittes-payloads-will-test-whether-satellites-can-defend-themselves/>. The Space ISAC reported a 118 percent surge in space-related cyber incidents in the first eight months of 2025 compared with all of 2024, with approximately 117 publicly reported incidents from January through August 2025.
- ¹⁶⁷ Brig. (Retd.) Anshuman Narang, “Red Dragon in Orbit,” presentation at *Indian Space Association (ISpA) Conference*, 2024, slides 42–55, covering India’s counterspace capability gaps and LoD requirements.
- ¹⁶⁸ Tian Anping, Huyan Jianye, et al., *China’s Aerospace Security Strategic Concept*, People’s Liberation Army Press, Beijing, 2016, chapters on space deterrence and strategic offensive operations.
- ¹⁶⁹ China Aerospace Studies Institute, *PLA Counterspace Command and Control*, Air University, Maxwell AFB, AL, 2023, describing the People’s Liberation Army’s sequenced employment of counterspace effects, progressing from

reversible cyber and electronic attack through co-orbital and directed-energy operations to kinetic strikes as a last resort.

- ¹⁷⁰ Brian Weeden and Victoria Samson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, Secure World Foundation, Broomfield, CO, April 2024, chapters on China and India.
- ¹⁷¹ Rajnath Singh, Minister of Defence, addressed Defence Services Staff College, Wellington, 2025: "Space assets in LEO have taken combat to a new high." See "Space Assets in LEO Have Taken Combat to a New High: Rajnath," *Deccan Herald*, 2025.
- ¹⁷² DSA Mission DefSpace Programme, official challenge portfolio overview; Group Captain H. N. Prasanna, Defence Space Agency, "Mission DefSpace: Updates and Way Forward," Session 7, Indian DefSpace Symposium 2026, Manekshaw Centre, New Delhi, 15 April 2026. Mission DefSpace has engaged multiple private-sector firms including Digantara through iDEX/DSA challenge mechanisms for indigenised counterspace intelligence and SSA capabilities.
- ¹⁷³ CSIS Aerospace Security Project, Space Threat Assessment 2025, ed. Clayton Swope, Kari A. Bingen, and Makena Young, Centre for Strategic and International Studies, Washington DC, April 2025, pp. 42–55 (GPS jamming and counterspace activities). The report documents steady-state PLA EW and cyber activities against Indo-Pacific infrastructure.
- ¹⁷⁴ Elsa B. Kania, "The PLA's Latest Strategic Thinking on the Three Warfares," *China Brief* 16 (13), Jamestown Foundation, Washington, DC, August 22, 2016, on the People's Liberation Army concept of public-opinion, psychological, and legal warfare and its projection into emerging domains, including space.
- ¹⁷⁵ Liang Qiao and Wang Xiangsui, *Unrestricted Warfare*, PLA Arts Publishing House, Beijing, 1999, on information warfare and pre-kinetic cognitive shaping operations.
- ¹⁷⁶ Brian Weeden and Victoria Samson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, Secure World Foundation, Broomfield, CO, April 2024, on Russian GPS jamming and the February 2022 Viasat KA-SAT modem cyberattack; see also Clayton Swope et al., *Space Threat Assessment 2025*, Centre for Strategic and International Studies, Washington, DC, April 2025.
- ¹⁷⁷ "Strengthening India's Defence Capabilities Through Space," *Indian Aerospace and Defence Bulletin*, May 12, 2026, <https://www.iadb.in/2026/05/12/strengthening-indias-defence-capabilities-through-space/>.
- ¹⁷⁸ CERT-In and SIA-India, *India Space Cyber Security Guidelines 2026*, released at DefSat Conference & Expo 2026, New Delhi, February 26, 2026.

- ¹⁷⁹ “How Chinese Satellites Have Boosted Iran’s War Effort,” *Economist Times*, April 19, 2026; Can Kasapoglu, “The War Above the War: How Chinese Satellites Support Iran,” Hudson Institute, May 2026
- ¹⁸⁰ University of California San Diego, Centre for Networked Systems, “Satellites Are Leaking the World’s Secrets: Calls, Texts, Military and Corporate Data,” 2025, <https://cns.ucsd.edu/satellites-are-leaking-the-worlds-secrets-calls-texts-military-and-corporate-data/>; UCSD Today, “The Sky Is Full of Secrets: Glaring Vulnerabilities Discovered in Satellite Communications,” October 2025, <https://today.ucsd.edu/story/the-sky-is-full-of-secrets-glaring-vulnerabilities-discovered-in-satellite-communications>. The research, presented at ACM CCS 2025 in Taipei, demonstrated interception of unencrypted IP traffic from 39 GEO satellites using commercially available equipment totalling under \$800.
- ¹⁸¹ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty), opened for signature January 27, 1967, 18 UST 2410, 610 UNTS 205, Article IV.
- ¹⁸² “Developments Under PAROS: Securing Outer Space,” *Modern Diplomacy*, February 28, 2026, <https://moderndiplomacy.eu/2026/02/28/developments-under-paros-securing-outer-space/>.
- ¹⁸³ United Nations General Assembly, Decision 79/512 (2024), establishing a single Open-Ended Working Group on the prevention of an arms race in outer space in all its aspects, with substantive sessions scheduled through 2028.
- ¹⁸⁴ U.S. Department of State, “Artemis Accords,” updated May 2026. As of May 7, 2026, sixty-seven nations are signatories following Paraguay’s accession, <https://www.state.gov/artemis-accords>.
- ¹⁸⁵ ILRS Cooperation Organisation members include Russia, Venezuela, Belarus, Pakistan, Azerbaijan, South Africa, Egypt, Nicaragua, Thailand, Serbia, Kazakhstan, and Senegal. See “Gold: With 52 Members, Artemis Accords Now Represent Global Consensus,” *SpacePolicyOnline.com*, December 21, 2024; Secure World Foundation, *Lunar Space Cooperation Initiatives*, updated May 2026.
- ¹⁸⁶ “Joint Statement from the Quad Foreign Ministers’ Meeting in Washington,” U.S. Department of State, July 1, 2025, <https://www.state.gov/releases/office-of-the-spokesperson/2025/07/joint-statement-from-the-quad-foreign-ministers-meeting-in-washington>.
- ¹⁸⁷ Jacqueline Feldscher, “House Bill Introduced to Boost In-Orbit Cooperation for Quad States,” *Payload Space*, September 16, 2025, <https://payloadspace.com/house-bill-introduced-to-boost-in-orbit-cooperation-for-quad-states/>.

- ¹⁸⁸ “Optimism for the Future of the Quad,” *GIS Reports*, February 17, 2026. The planned 2025 Quad Leaders’ Summit in New Delhi did not materialise amid heightened U.S.–India trade tensions.
- ¹⁸⁹ AUKUS Pillar II encompasses advanced capabilities including quantum technologies, artificial intelligence, cyber, and space-domain integration. See Australian Department of Defence, *AUKUS Advanced Capabilities Fact Sheet*, 2024.
- ¹⁹⁰ Indian Navy, *Space Vision 2025–2040*, released at the Naval Commanders’ Conference, 2025, outlining the framework and roadmap for utilisation of space-based capabilities in support of naval operations over fifteen years.
- ¹⁹¹ Government of India, Department of Space, *Indian Space Policy 2023*, April 2023, clarifying roles of ISRO (research and development), IN-SPACe (authorisation and regulation), and NSIL (commercialisation).
- ¹⁹² ISpA and Ernst & Young, *Developing the Space Ecosystem in India: Focusing on Inclusive Growth*, October 2022; updated projections in 2024 estimate India’s space economy reaching \$44 billion by 2033.
- ¹⁹³ SIA-India and ISpA, *Valuation and Fundraising in Aerospace Startups: TRL vs. MRL – India’s Road to Space Industrialization*, 2024.
- ¹⁹⁴ Wassenaar Arrangement, *List of Dual-Use Goods and Technologies and Munitions List*, updated December 2024, categories covering satellite components, launch vehicle technology, and space-grade electronics.
- ¹⁹⁵ SIA-India, “Submission to IN-SPACe on Space Growth Strategy,” 2024; ISpA, Nasscom, and Deloitte, *Exploring Opportunities for India in Space*, 2024.
- ¹⁹⁶ Press Information Bureau, Government of India, “India Semiconductor Mission 2.0,” announcement in Union Budget 2026–27, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2224839>; PIB, India Semiconductor Mission 2.0 Fact Sheet, February 2026, <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2026/feb/doc202627782101.pdf>
- ¹⁹⁷ Press Information Bureau, Government of India, “Programme for Development of Semiconductors and Display Manufacturing Ecosystem in India,” notified December 21, 2021, with a total outlay of ¹ 76,000 crore; PIB, “Cabinet Approves One More Semiconductor Unit under India Semiconductor Mission (ISM),” 2024
- ¹⁹⁸ UK Government, “National Space Strategy,” September 2021; Japan Cabinet Office, “Act on Launching Spacecraft etc. into Outer Space and Controlling Spacecraft etc. (Space Activity Act),” Act No. 76 of 2016; Government of Australia, Department of Defence, “Defence Space Strategy,” March 2022; French Ministry of Armed Forces, Commandement de l’Espace, established September 2019.

- ¹⁹⁹ SIA-India/Gateway House, “Unlocking India’s Space Economy: A Regulatory Handbook,” January 2025; IN-SPACe, “SSLV Technology Transfer: HAL-L&T Manufacturing Consortium,” IN-SPACe Official Communication, 2024.
- ²⁰⁰ Rajeswari Pillai Rajagopalan and Narayan Prasad, eds., *Space India 2.0: Commerce, Policy, Security and Governance Perspectives*; ORF Special Report 2017, “India and the Quad Space Working Group,” October 2025, <https://www.orfonline.org/>.
- ²⁰¹ Jatan Mehta, “India’s Space Launch Ambitions vs Current Reality,” *Indian Space Progress*, jatan.space, 2025–26; ISRO, “Next Generation Launch Vehicle (NGLV): Programme Overview,” official ISRO communication, 2025.
- ²⁰² U.S. Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2025*, Office of the Secretary of Defense, Washington, DC, December 23, 2025, <https://media.defense.gov/2025/Dec/23/2003849070/-1/1/1/ANNUAL-REPORT-TO-CONGRESS-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2025.PDF>

CONCLUSION AND POLICY RECOMMENDATIONS

SUMMARY OF FINDINGS: THE DUAL-USE THREAT MATRIX

The central argument that China's space programme cannot be differentiated into discrete civilian and military tracks and hence poses a security challenge is established. The CMF doctrine has been adopted as a strategic feature designed to maximise the value of every yuan, every asset, and every orbital slot. The military dimension of the threat is also unambiguous. Developments in this regard are laid down in the US Department of Defense's Annual Report to Congress on Chinese Military Power, December 2025. It confirms that Beijing's operational satellite fleet has expanded to more than 1,189 spacecraft, of which more than 510 are ISR-capable platforms supporting PLA targeting, representing an on-orbit growth of approximately 927 per cent since 2015.^{202,203} Its institutional reforms place the newly reorganised PLA ASF at the forefront of China's space policy goals adopted at the highest level. The counterspace capabilities have also been layered into its 'kill web', from the ASAT test in 2007 to the demonstrated co-orbital RPO of Shijian-21's in January 2022 while towing a defunct BeiDou satellite to graveyard orbit and, most strikingly, executing the world's first satellite-to-satellite refuelling in geosynchronous orbit between Shijian-21 and Shijian-25 between June and November 2025.^{204,205} The Secure World Foundation's Global Counterspace Capabilities report confirms that China operates the world's most diverse full-spectrum counterspace arsenal.²⁰⁶ In the PNT segment, BeiDou-3 now broadcasts a military-grade B3A signal with sub-metre accuracy, with growing demand and expansion across the globe.²⁰⁷ The ILRS, jointly led by China and Russia, has drawn 17 national and institutional signatories by April 2025²⁰⁸, providing a viable alternative to the current normative order.

The cumulative threat is therefore not a singular system but an integrated surveillance-strike-denial strategy that operates seamlessly across civil, commercial, and military domains. The dual-use ambiguity is a strategic feature which India must counter through building capabilities and developing a resilient asymmetric architecture.

STRATEGIC ASSESSMENT: WHERE CHINA LEADS, WHERE IT LAGS, AND INDIA'S WINDOW

China leads decisively in four areas: first, on-orbit ISR mass, ground infrastructure, and revisit rates, with the PLA now operating more than 510 military ISR-capable satellites;²⁰⁹ second, in demonstrated counterspace capabilities, including GEO RPO, on-orbit refuelling, and reusable spaceplanes; third, in global PNT deployment through BeiDou across more than 140 countries; and fourth, in its fully developed commercial ecosystem.

India's window is narrow but real. The Indian space economy is projected to grow from \$8.4 billion in 2022 to \$44 billion by 2033 and \$100 billion by 2040.²¹⁰ The Union Cabinet on February 21, 2024 opened up 100 per cent FDI across the space value chain.²¹¹ The Joint Military Space Doctrine, released in September 2025, formally recognises space as a warfighting domain.²¹² However, two structural weaknesses bracket this window. First, ISRO's launch infrastructure is restricted to Sri Harikota, while the second site is still under development, resulting in a comparatively lower launch cadence, coupled with recent mishaps affecting its reliability. PSLV-C61 failed on May 18, 2025 due to a third-stage chamber-pressure anomaly, losing the EOS-09 C-band SAR satellite.²¹³ PSLV-C62 failed again on January 12, 2026, losing the DRDO-built EOS-N1 (Anvesha) hyperspectral satellite, resulting in two consecutive failures of a vehicle with a previously near-spotless 32-year record. Also critical is the PNT backbone of NavIC, which is operationally non-functional. The failure of the rubidium atomic clock aboard IRNSS-1F on March 13, 2026 reduced the operational constellation to three position-capable satellites, below the four-satellite minimum for autonomous position fixes.²¹⁴ By comparison, China's BeiDou-3 operates 45 active satellites with 100 per cent global service availability, and Pakistan has had access to BeiDou's military-grade B3A signal since 2018.

The second aspect is the funding of India's space programme. India's Department of Space received INR 13,705.63 crore in the Union Budget 2026-27 (approx \$1.57 billion).²¹⁵ Against varying estimates of China's \$15-20 billion annual space outlay, this roughly ten-to-one asymmetry means India must counter through strategic prioritisation, allied/international frameworks, and an energised commercial ecosystem, and, most importantly, continued policy support and funding by the GoI.

POLICY RECOMMENDATIONS

Enact the Space Activities Act. India's space programme has operated since 1972 under delegated executive authority without any parliamentary legislation. A revised version of Draft Space Activities Bill is under inter-ministerial consultation as of mid-2026.²¹⁶ The need for the Bill arises from the fact that policies do not have the force of law in a court, and a structural legal vacuum deters institutional investment and insurance for private companies and prevents IN-SPACe from asserting regulatory authority over non-government entities.²¹⁷ France, the UK, Australia, Japan and South Korea all enacted space legislation before or simultaneously with the creation of their space commands. India must follow the same sequencing. The Space Activities Act should vest sovereign liability in the Government of India, establish a tiered indemnification model as adopted in other countries such as the US, grant IN-SPACe required statutory licensing, monitoring and enforcement powers, include a dedicated IP-protection clause allowing commercialisation of ISRO-generated IP, provision space insurance, and mandate dual-use missions.

Mandate Alternative PNT and Mitigate GPS Dependence. The NavIC failure has created a strategic vulnerability²¹⁸. India must undertake parallel actions, i.e., launch NVS-03 and NVS-04 replacements at the earliest, fitted with the indigenous Indian Rubidium Atomic Frequency Standard (iRAFS) demonstrated by the Space Applications Centre (SAC), Ahmedabad, to eliminate dependence on imported clocks²¹⁹. It should also fund dedicated satellites for armed forces requirements and critical national infrastructure by 2030 and earmark dedicated fund reserves for the LoD replacement of any failed satellite within 90 days. Japan's Quasi-Zenith Satellite System (QZSS) provides a positive model where a seven-satellite regional augmentation

constellation offers sub-centimetre accuracy as GPS backup, making the Japanese Self Defence Forces near-immune to single system PNT failure/denial.²²⁰

Accelerate SBS-III. The operationalisation of CCS-approved SBS-III constellation needs to be fast-tracked, especially after lessons from Operation Sindoor, where China reportedly provided Pakistan with near-real-time satellite imagery of Indian military assets, using its Jilin-1 commercial constellation. SBS-III must be treated as the baseline foundation for ISR requirements and we should follow-on with SBS-IV on similar lines as done in US SDA Proliferated Warfighter Space Architecture (PWSA) programme²²¹, where the public-private co-development is being exploited to achieve scales.

Spectrum Reform. The SatCom Industry Association (SIA-India) and the Telecom Regulatory Authority of India (TRAI) have both recommended that satcom spectrum be assigned administratively rather than auctioned.²²² This may require the introduction of a specific law in the Draft Space Activities Act and policy formulation by the Department of Telecommunications. It must be laid down through a notification, aligned with the ITU Radio Regulations Article 11 on filing process, to give domestic satcom operators certainty of tenure and thereby the investment certainty needed to build national strategic constellations.

Demand Generation Through Open Data Policy. It is estimated that the government remains the major consumer of EO data and assets, which are consumed internally, i.e., by the government itself, generating little external demand for private EO operators. Take the case of EU's Copernicus programme, which allows access to full, free, and open data from the Sentinel constellation, thereby generating a downstream EO economy estimated at €2.3 billion.²²³ India may need to adopt a similar policy wherein all EO data beyond a 24 hour embargo window are released under an open licence to domestic players. It will catalyse the nascent GEOINT as a service sector (including Pixxel, GalaxEye, SatSure, and KaleidEO) in the civil domain and reduce annual expenditure on foreign EO data purchases.

Diversifying International Partnerships. India's strategic alignments in space must extend beyond the Quad architecture. With the Artemis

Accords now at 67 signatories as of May 07, 2026,²²⁴ India should attempt to adopt a multipronged approach to formalise bilateral space-security arrangements. This should start by deepening its rover cooperation with Japan into a full Lunar Exploration Partnership and co-funding R&D within the 24 themes of JAXA's Phase-2 Strategic Space Fund.²²⁵ With France, India should co-develop an SSA/EW bilateral data-sharing protocol under their ongoing €6 billion LPM 2024-2030 programme.²²⁶ It should establish a framework with Australia to formalise IOR SSA data exchange between the DSA and the Defence Space Command. With Israel, it should establish an India–Israel Space Security Working Group for dual-use ISR, directed-energy and small-sat integration. India should also look to leverage the newly established Korea AeroSpace Administration, established in May 2024, and the Korea Positioning System (KPS)²²⁷, which is under development, as natural interoperability partners for NavIC redundancy. Simultaneously, India should also pursue a treaty agreement within the Quad framework for combined space operations. The Quad SSA commitment of September 2024 and the TRUST/iCET expansion of February 2025 should not remain only aspirational.²²⁸ India should seek formal CSpO membership, a ten-nation Combined Space Operations initiative established by the US, UK, Australia, Canada, and France and now including Germany, Italy, Japan, Norway and New Zealand, at least as an observer initially, and graduating to partner status by 2029.²²⁹

Cislunar SDA. The race to the Moon and its resources has begun and has large ramifications for expansion even beyond the Moon. China's ILRS programme is heading towards a basic operational status by 2035, while India has planned its Bhartiya Lunar base as part of its Space Vision 2047. India can also participate in the Western cislunar architecture led by the US by providing sensors/satellites, even at a limited scale, to remain relevant and maintain influence over the future cislunar security architecture. Exploring the feasibility of signing an MoU as part of the US's LunaNet programme to contribute to the SDA domain over the next five years will provide India with the necessary presence in the cislunar domain.

National Space Deterrence Doctrine. The September 2025 Joint Military Space Doctrine formally recognises space as a warfighting

domain but stops short of defining red lines, response options, and escalation management.²³⁰ India needs an unclassified deterrence policy statement that defines its red lines ranging from kinetic attacks on Indian space assets and persistent jamming of NavIC or SATCOM during hostilities to RPO operations. It must also set out proportional response options across the spectrum, from diplomatic protest to cyber, counter-space and even kinetic responses. An India–China space-domain hotline and an annual declassified report to be tabled in Parliament on the threat environment will convey India’s intent, reduce the space for misunderstanding and act as a deterrent.

Steer UN Norms on Space Behaviour. With Russia’s April 24, 2024 veto of the US–Japan PAROS resolution blocking any further progress on this issue²³¹, India can propose and steer at the UN a concrete set of transparency and confidence-building measures involving mandatory pre-notification of close-proximity manoeuvres, a moratorium on debris-generating direct-ascent ASAT tests and mandatory registration compliance for dual-use rendezvous satellites to bring greater transparency and accountability among space-faring nations.

STRUCTURAL REFORMS

DSA to Space Forces Command. The Defence Space Agency was always conceived as an interim structure on the path to a full Space Command²³². Established in 2019 and headquartered in Bengaluru, the agency operates as a tri-service body under the Integrated Defence Staff. It manages military satellite operations and imagery by integrating the DIPAC in Delhi and the DSCC in Bhopal. Despite being led by a two-star Air Vice Marshal and handling significant space defence assets, the DSA’s primary weakness is structural. It lacks representation on the Space Commission, India’s ultimate decision-making authority for space. Although the National Security Adviser was added to the Commission, the DSA and the Integrated Defence Staff remain excluded, forcing the military to advocate for its space requirements through indirect channels. The September 2025 Joint Military Space Doctrine provides the necessary doctrinal setup, but the institutional transition must follow a concrete timeline. As Adhitya Kothandapani has argued, India’s security posture requires a US SWAC-equivalent force-design centre to drive military requirements proactively.²³³ It will need a gradual build-up of

infrastructure, formalisation of decision architectures under CCS/NSA, and more importantly, trained, dedicated human resources to execute various functions.

Reorganisation of Space Bodies. ISRO's continuing dual role as both developer and de facto operator affects its role as scientific researcher and developer vs a management role. It crowds out private sector opportunities and creates conflicting interests. The institutional responsibilities can be separated, with ISRO focussing on future capability development and high-risk frontier missions (NGLV, BAS, planetary science, deep-space exploration, advanced propulsion, iRAFS clocks), while NewSpace India Limited (NSIL) takes full responsibility for operational launch services, technology transfer and commercial satellite manufacturing. NSIL's commercial satellite-manufacturing pipeline, including private players like Pixxel, SatSure, etc can also be further expanded to build a resilient and indigenous ecosystem. In the case of the Space Commission also, in its current form, it is an advisory body to the Department of Space, with ISRO playing the lead role. It can be considered to be reconstituted as a cross-ministerial National Space Council under the Prime Ministers Office (PMO), modelled on the US National Space Council chaired by the vice president with the NSA, CDS, Secretary DoS, IN-SPACe Chair, NSIL MD, Secy Dept of Telecom plus the DSRA Director and three private-sector members on an invite basis.

IN-SPACe as Regulator. IN-SPACe was designed as a single window for authorisation and promotion. It cannot exercise genuine regulatory power without statutory backing. The Space Activities Act must vest IN-SPACe with licensing, monitoring, inspection and penalty authority distinct from ISRO. The ₹1,000 crore IN-SPACe-SIDBI Venture Capital Fund must be tripled to ₹3,000 crore as India's space-economy ambition rises, supplemented by the ₹500 crore for Technology Adoption Fund and should be aligned with the TRL/MRL maturity matrix prepared by experts.

Dedicated Space Defence R&D Infrastructure. The proliferation of AI, Quantum and Robotics requires revitalising DSRA by an integrated approach of civil and military experts, starting with establishing Centres of Excellence at IITs/ NITs with a dedicated five-year corpus and an annual joint ISRO-DRDO Mission DefSpace 2.0

programme, covering co-orbital ASAT, the 30 kW laser DEW platform already demonstrated by DRDO, plasma propulsion, and quantum communication.

iDEX-DefSpace. Mission DefSpace launched 75 space-domain challenges in December 2022. By February 2025, iDEX had signed 430 contracts across all domains and procured 43 items worth ₹2,400+ crore, demonstrating that the model works.²³⁴ For space specifically, Mission DefSpace 2.0 must raise the iDEX Technology Development Fund ceiling from ₹50 crore to ₹150 crore per project (space-domain), align with the ADITI sub-scheme's ₹25 crore grant window,²³⁵ commit MoD to procuring at least 25 per cent of qualifying iDEX-space winners as production orders, and mandate a 60-day maximum from High Powered Selection Committee (HPSC) endorsement to contract signature. The US CASR, which pre-positioned commercial SDA capability with a \$1.1 million pilot and scaled to a \$7.5 million FY 2026, demonstrates that government frameworks can catalyse private capability at minimal initial cost, with commercial firms bearing the development risk.²³⁶

Defence Acquisition Procedure. The Defence Acquisition Procedure 2020 has no dedicated space acquisition category. The draft DAP 2026 (Amendment) must insert a 'Space Acquisition' chapter with suitable clauses for procuring satellites by the forces, a dual-use procurement template permitting civilian missions to carry defence payloads under a classified annex, and fast-track procedures requiring timelines of 24 months from Request For Proposal (RFP) to operational delivery for LEO satellites, compared with the current 48–72 month average.

COMMERCIAL SECTOR

Sovereign Anchor-Customer Model. A key transformative commercial intervention available is the creation of a sovereign anchor-customer Earth-Observation procurement contract. The US NRO Electro-Optical Commercial Layer (EOCL) of May 2022, which awarded Maxar/Vantor up to \$3.24 billion and BlackSky up to \$1.02 billion over ten years, anchored the US commercial EO sector and provided the revenue base for both firms to invest in next-generation constellation capacity.²³⁷ India's equivalent can be a DSA/IN-SPACe-led '10-Year Indian GEOINT Procurement Window' of ₹10,000 crore

or more, to be awarded competitively among leading Indian private firms like Pixxel, GalaxEye, KaleidEO, SatSure, and PierSight ecosystem. This would create the demand certainty needed to de-risk Series-B and Series-C funding rounds for the entire sector.²³⁸

Patient Capital. The Antariksh Venture Capital Fund (AVCF) became operational on 10 November 2025 with a ₹1,000 crore corpus and a ticket size of ₹10–60 crore targeting approximately 40 startups.²³⁹ This was a necessary step but falls short to cater to the growing requirements. It is recommended that the fund be tripled to ₹3,000 crore by FY 2028, with a parallel ‘Space Sovereign Patient Capital’ vehicle modelled on Japan’s ¥1 trillion JAXA Strategic Space Fund, which is a 10-year, theme-based fund and is doubling its space-transport allocation from ¥36 billion to ¥63 billion in Phase 2. Similarly, South Korea’s 27 per cent year-on-year increase in the Korean Aero Space Administration (KASA) budget to \$665 million reflects the strategic effort by nations to invest in space capabilities, an approach India should also adopt to support its growing space ambition.

Space Ecosystem. Three fiscal instruments can propel India’s 350+ startups to global relevance. First, a PLI scheme for space manufacturing, explicitly highlighted by SIA-India President Subba Rao Pavuluri in his February 2026 submission, which seeks a ¹ 5,000 crore incentive pool over five years targeting satellite buses, propulsion modules, RF payloads, and precision optics.²⁴⁰ Second, GST rationalisation. The current 12–18% on space hardware creates working-capital lock-up of approximately ¹ 400 crore annually across the sector, and a single 5 per cent rate for space-certified components may ease the flow. Third, the space-insurance regime proposed by the Spaceport SARABHAI suggests mandatory participation by LIC/GIC, with a ¹ 2,000 crore corpus, and integration with the Space Activities Act, to be operationalised within 12 months of legislative enactment of the Space Activities Act²⁴¹

Ground Infrastructure. The SSLV Launch Complex at Kulasekarapattinam, Tamil Nadu, with a ₹985.96 crore project cost, is targeted for commissioning in FY 2026-27 at a capacity of 20–25 SSLV launches per year.²⁴² This is essential for the private launch sector but is still insufficient for India’s orbital requirements. Two further spaceports need to be planned and sanctioned in the next Budget cycle

to include Andaman and Nicobar Islands for near-equatorial inclination missions, and a Third Launch Pad at SDSC-SHAR for the NGLV (Soorya), targeting a 30-tonne LEO payload.²⁴³

State-Level Space Industrial Clusters. Karnataka is targeting 50 per cent of India's national space market, Tamil Nadu's Space Industrial Policy 2025 sets a ₹10,000 crore investment target. Gujarat, Andhra Pradesh, Maharashtra, and Telangana all have drafts or enacted policies.²⁴⁴ This inter-state competition for investment is healthy but must be coordinated at the national level with the Chief Secretaries of all space-active states as members to prevent regulatory fragmentation, allow the sharing of infrastructure costs for testing facilities, and create a coherent national supply chain. France's Aerospace Valley (Toulouse-Bordeaux) and Israel's Rafael-IAI dual-hub model offer proven templates for state-national coordination of a concentrated industrial cluster.

ISRO Intellectual Property Rights (IPR) Monetisation and Technology Transfer. ISRO's IPR portfolio covering cryogenic propulsion, SAC earth-observation payloads, IRNSS atomic-clock housings, heat shield composites and SSLV modular design represents a vast un-monetised public asset. The IN-SPACe technology-transfer framework initiated in September 2023 (five SAC technologies transferred) and the 2025 SSLV Transfer of Technology to the HAL-L&T consortium are the models for industrialising at scale. Every ISRO mission can be accompanied by a Technology Commercialisation Plan mandating transfer within 24 months of mission success, with a laid down 30% industry revenue-share flowing back to a dedicated ISRO Technology Development Fund.²⁴⁵

Direct-to-Device SATCOM and Broadband Availability.

Direct-to-Device (D2D) satellite communication, which has been commercially validated by Starlink, is a good model for the existing 150 million unconnected people. It will also act as a strategic asset for disaster response and remote military operations. Under the 100% FDI route operationalised in February 2024,²⁴⁶ India must fast-track spectrum allocation and landing-rights approvals for D2D operators, mandate state telecom-private satcom co-investment for rural coverage, and classify satcom infrastructure as critical national infrastructure under the NCIPC framework.²⁴⁷

HUMAN RESOURCE DEVELOPMENT

India's directly space-linked skilled workforce stands at approximately 22,000 across ISRO, enterprises, and startups, with the broader aerospace sector at approximately 45,000.²⁴⁸ Reaching the \$44 billion economy target by 2033 and the Space Vision 2047 goal of \$100 billion requires a minimum eight-fold expansion of the skilled workforce.²⁴⁹ The sector currently attracts only 1.3% of global space capital despite being the world's fourth-largest space programme.²⁵⁰ A few lines of effort in this direction can be taken to prepare the human resource for this endeavour.

Indian Institute of Space Science and Technology (IIST) Network Expansion. The IIST, Thiruvananthapuram, can be expanded with a second campus dedicated to military space (co-located with DSA/ISFC at Bengaluru) and a third focused on commercial space applications (Tamil Nadu, leveraging the Kulasekarapattinam cluster). We should target a higher intake of graduates every year across all campuses in these niche domain.

Defence Space Educational and Training Institute (DSETI). CDS General Anil Chauhan during third edition of the Indian DefSpace Symposium in 2025 said that humanity is on the 'cusp of an era' where space is emerging as a new domain of warfare. He pitched for developing a 'space culture', which could entail developing doctrines, research and dedicated warfare schools. DSETI should be operationalised and affiliated with IIST, offering training programmes for tri-Service officers and civilian scientists. The curriculum can include space operations, counterspace, satellite communications jamming and anti-jamming, space law, orbital mechanics, and Space war-gaming, which will prepare the much needed trained manpower for DSA as it transitions to ISFC.

IN-SPACe PhD Fellowship Programme. An aggressive push for research can be undertaken by offering PhD fellowships targeting five priority domains which are atomic frequency standards (iRAFS succession), AI-based onboard processing for EO satellites, plasma propulsion for LEO manoeuvring, quantum communication for secure SATCOM, and RF payload design for electronic intelligence (ELINT). It will enable availability of qualified manpower resources for Indian

Space across the growing industry. In addition, a formal Space Industry Skill Council under the Ministry of Skill Development and Entrepreneurship should be established with ISpA and SIA-India as members, to prepare certified technicians in fields of propulsion, avionics, composites, precision optics, and software-defined radio by 2030.

Diaspora Return Programme. India's space diaspora at NASA, ESA, JPL, SpaceX, Planet Labs, and Maxar represents an important reservoir of expertise. A tax-incentivised return programme modelled on Israel's Returning Scientists scheme, which offers a 5-year tax exemption plus a research grant of up to \$1.2 million, can assist in developing both public and private industry.

Tri-Service Common Space Cadre. Currently, no dedicated tri-Service space cadre exists in the Indian armed forces, and officers are seconded to DSA from the parent service without a structured career path. A common cadre with mandatory ISRO and IN-SPACe rotational tours, a dedicated grade structure from Lieutenant to Major-General equivalent, and a Space Operations Speciality should be created, enabling the future DSA-to-ISFC transition.

Annual IndSpaceEx and International Exchanges. India should institutionalise an annual space exercise/war game to enhance its bilateral exchanges with USSPACECOM, French CDE Toulouse, and the JASDF Space Operations Group. Observer participation in the CSPO Global Sentinel exercise, for which India sent its first representative in 2024, should progress to active participation by 2027, which will provide an understanding of each other's space capabilities and, more importantly, operational practices.

CIVIL-MILITARY SYNERGY FOR SPACE VISION 2047

China's Civil-Military Fusion is coercive and party-directed. India, with its democratic structure, should draw on the democratic architectures developed by the US, EU, and Japan, where civilian-controlled programmes allow greater diffusion, breaking silos to deliver military capabilities.

Shared Infrastructure. ISRO launch pads, the Indian Deep-Space Network (IDSN), and ground stations must be made available to private and military users as per laid-down tariffs and governed by

IN-SPACe. Conversely, private SDA networks of Digantara's OC-7 E1 commercial tracking satellite, Bellatrix's orbital transfer vehicles, and Dhruva Space's ground-station network must feed into the Defence Space Operations Centre as authorised contributors under a data-sharing framework governed by the Space Activities Act.

Dual-Use at Inception. Every flagship civil programme must carry a 'military utility' approved by the National Space Council and the DSA before financial sanction. Each NGLV launch should carry a mandatory hosted-payload slot for DSA-specified secondary missions, optimising costs and resources while keeping the ambiguity.

Single SDA Common Operating Picture. India's Space Situational Awareness is currently spread over various sources, which include project NETRA (DoS), IS4OM (ISRO), Digantara OC-7, DSA's own limited sensors, and occasional data feeds from the US. These must be consolidated into a single SDA Common Operating Picture under the Defence Space Operations Centre, ingesting commercial, governmental, and allied data streams in a unified fusion engine.

Binding Capability Roadmap. The capability roadmap brought out by ISpA-VIF Space Vision @ 2047 must transition from a wish-list into an endorsed binding capability roadmap, with monitoring and reviews by the PMO. Suggested critical milestones and clearly defined responsibilities, if implemented, will ensure progress in a time-bound manner. Each milestone must have a declared budget line, and JAXA's Strategic Space Fund's rolling mechanism provides a template for India's own Space Vision implementation fund.

- SBS-III full constellation (21+31 satellites) – ISRO & DSA by 2029
- Seven/Nine-satellite NavIC at full coverage – DoS /SAC by 2028
- DSA reorg to Indian Space Forces Command (ISFC) – DMA/ MoD by 2027
- Kulasekarapattinam SSLV Launch Complex – DoS/ISRO by 2026-27
- NGLV Soorya(30-tonne LEO payload) – ISRO/NSIL by 2031/ 32

- Cislunar SDA satellite on orbit – ISRO/DSRA by 2030
- India in CSpO as formal partner – MEA & MoD by 2029
- Crewed lunar mission – ISRO by 2040

Conclusion

The Chinese ISR/Comn mega constellations, BeiDou-3's global network, and the ILRS together demonstrate that China has consolidated a fully dual-use space architecture that India cannot match satellite-for-satellite or yuan-for-rupee. India does not need to match China, but it needs to deny China a decisive advantage through various asymmetric levers, including a resilient, proliferated LEO architecture for ISR, an autonomous PNT capability, the implementation of the Artemis Accords with a future permanent Combined Space Operations seat²⁵¹ and a credible, declared deterrence doctrine backed by demonstrated counterspace capability across kinetic, non-kinetic, and cyber spectrums.

Critical milestones should be laid down and tracked by the National Security Council Secretariat and subject to parliamentary review. The future of India's space programme must therefore be conceived not as a continuation of ISRO's development heritage but as a national security imperative on the order of the nuclear programme of the 1970s. The cost of inaction will not be measured in commercial losses alone, but will also impact adversely on all domains of national security. Therefore, a mission-mode approach to the space domain is critical to enable India's rise in the modern world.

Notes:

²¹⁵ SatNews, "DoD Report: China's ISR Fleet Swells to 510+ Satellites, 'Informatized' Warfare Accelerates," December 24, 2025, <https://news.satnews.com/2025/12/24/dod-report-chinas-isr-fleet-swells-to-510-satellites-informatized-warfare-accelerates>.

²¹⁴ COMSPOC Commercial Space Operations Center, "SJ-21 and SJ-25 RPO Activity," July 11, 2025, <https://comspoc.com/blog>. Multiple optical sensor observations confirmed visual merge of both objects between 2–6 July 2025.

- ²⁶ Andrew Jones, “China’s Shijian Spacecraft Separate After Pioneering Geosynchronous Orbit Refuelling Tests,” *SpaceNews*, December 1, 2025, <https://spacenews.com/chinas-shijian-spacecraft-separate-after-pioneering-geosynchronous-orbit-refueling-tests>.
- ²⁶ Brian Weeden and Victoria Samson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, Secure World Foundation, Washington, DC, April 2024, <https://swfound.org/counterspace>. The annual survey confirms China operates the world’s most diverse full-spectrum counterspace arsenal including DA-ASAT, co-orbital RPO, directed energy, electronic warfare, and cyber systems.
- ²⁷ China Satellite Navigation Office (CSNO), BeiDou Navigation Satellite System White Paper (Beijing: CSNO, May 2025), <https://www.beidou.gov.cn>. Cumulative BDS-compatible chip shipments surpassed 2.3 billion units by end-2024.
- ²⁸ China National Space Administration (CNSA), “International Lunar Research Station Attracts More Partners,” Press Release, April 24, 2025, <https://english.www.gov.cn/news/202504/24>. As of April 2025, 17 national and institutional signatories had joined the ILRS framework.
- ²⁹ U.S. DoD, Military and Security Developments Involving the People’s Republic of China 2025, cited in “Beijing’s operational satellite fleet has expanded to more than 1,189 spacecraft,” *SatNews*, December 24, 2025, <https://news.satnews.com/2025/12/24/dod-report-chinas-isr-fleet-swells-to-510-satellites-informatized-warfare-accelerates>.
- ²⁰ FICCI-EY / IN-SPACe, India Space Economy Report: \$44 Billion by 2033, FICCI, New Delhi, October 2023, <https://indbiz.gov.in/indias-space-economy-to-reach-us44-billion-by-2033-ficci-ey-report>. The longer-horizon target of \$100 billion by 2040 was cited by IN-SPACe Chairman Pawan Goenka.
- ²¹ Press Information Bureau, “Cabinet Approves Amendment in the Foreign Direct Investment (FDI) Policy on Space Sector,” February 21, 2024, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2007876>. 100% automatic route for components & ground segment; 74% automatic for satellite manufacture; 49% automatic for launch vehicles.
- ²² SP’s Naval Forces, “Joint Military Space Doctrine,” September 2025, <https://www.spsnavalforces.com/experts-speak/?id=835&h=Joint-Military-Space-Doctrine>. Released at the 16th Combined Commanders’ Conference, 16 September 2025.
- ²³ “PSLV-C62 Anomaly: ISRO Investigates Roll Disturbance during Third Stage of EOS-N1 Mission, Says Chairman Dr V. Narayanan,” *NewsOnAir (Prasar Bharati)*, January 12, 2026, <https://www.newsonair.gov.in/pslv-c62-anomaly-isro-investigates-roll-disturbance-during-third-stage-of-eos-n1-mission-says-chairman-dr-v-narayanan/>; and “PSLV Suffers Stage-3 Failure in ISRO’s First 2026 Launch,” *Business Standard*, January 12, 2026.

- ²¹⁴ Indian Defence News, “Atomic Clock Fails on ISRO’s NavIC Navigation Satellite: Three Satellites Left as India Races to Rebuild,” March 2026, <https://www.indiandefensenews.in/2026/03/atomic-clock-fails-on-isro-navic.html>. The IRNSS-1F clock failed on March 13, 2026.
- ²¹⁵ Business Today, “Budget 2026: ISRO Sees Modest Funding Hike for 2026–27 as Department of Space Gets Rs 13,705 Crore,” February 1, 2026, <https://www.businesstoday.in/union-budget/news/story/budget-2026-isro-sees-modest-funding-hike-for-2026-27-as-department-of-space-gets-rs-13705-crore-514032-2026-02-01>. This represents a 2.16% increase over the FY2025–26 estimate of Rs 13,416.20 crore.
- ²¹⁶ Government of India, Press Information Bureau, “Space Activities Bill — PIB Backgrounder,” 2017, <https://pib.gov.in>. The 2017 draft Space Activities Bill has not been tabled in Parliament; as of May 2026 a revised draft is under inter-ministerial consultations; CSDR, “A New Draft for the Space Activities Bill: Amidst a Sea-Change in India’s Space Sector,” May 2025, <https://csdronline.com/blind-spot/a-new-draft-for-the-space-activities-bill-amidst-a-sea-change-in-indias-space-sector>. Citing IN-SPACe Chairman Pawan Goenka, *The Indian Express*, May 25, 2025.
- ²¹⁷ Ambassador Rakesh Sood, remarks at Spaceport SARABHAI Panel Discussion on the Artemis Accords, 2024.
- ²¹⁸ Ajey Lele, NavIC: India’s “jinxed” navigational programme, or a cornerstone of India’s misplaced space priorities?, *The Space Review*, March 2026, <https://www.thespacereview.com/article/5185/1>
- ²¹⁹ Swarajya, “NavIC’s Clock Crisis, and the Indian Clocks That Could Fix It,” March 2026, <https://swarajyamag.com/technology/navics-clock-crisis-and-the-indian-clocks-that-could-fix-it>.
- ²²⁰ “Japan to complete 7-orbiter geolocation system”, *SatNews*, December 2025, <https://satnews.com/2025/12/02/japan-to-complete-7-orbiter-geolocation-system/>
- ²²¹ U.S. Space Development Agency, press release, “Space Development Agency Makes Awards to Build 72 Tracking Layer Satellites for Tranche 3,” December 19, 2025, <https://www.sda.mil/space-development-agency-makes-awards-to-build-72-tracking-layer-satellites-for-tranche-3>; U.S. Space Development Agency, “Proliferated Warfighter Space Architecture (PWSA),” <https://www.sda.mil>.
- ²²² SatCom Industry Association (SIA-India), Shaping India’s Space Sector Growth Strategy: Submission to IN-SPACe 2024; TRAI, Recommendations on the Allocation/Assignment of Spectrum for Satellite-Based Communication Services, Telecom Regulatory Authority of India, November 18, 2024
- ²²³ “Enhance European Competitiveness”, Copernicus, <https://topreasons.copernicus.eu/enhance-european-competitiveness>

- ²²⁴ NASA, “NASA Welcomes Paraguay as 67th Artemis Accords Signatory,” May 7, 2026, <https://www.nasa.gov/artemis-accords>; and U.S. Department of State, “The Artemis Accords” (67 signatories as of May 2026), <https://www.state.gov/artemis-accords>
- ²²⁵ “Overview of the Space Strategy Fund (SSF)”, Japan Aerospace Exploration Agency(JAXA), Space Strategy Fund Department, April 2026, https://fund.jaxa.jp/content/uploads/Overview_of_The_SpaceStrategy_Fund.pdf
- ²²⁶ “France may spend nearly 6 billion Euros in Space Military Domain from 2024 to 2030”, *Team Interstellar*, April 2023, <https://interstellar.news/security-politics/france-may-spend-nearly-6-billion-euros-in-space-military-domain-from-2024-to-2030/>
- ²²⁷ “Korea Positioning System (KPS)”, Korea Aerospace Research Institute, <https://www.kari.re.kr/eng/contents/199>
- ²²⁸ White House (Biden Administration), “Fact Sheet: 2024 Quad Leaders’ Summit,” September 21, 2024, <https://bidenwhitehouse.archives.gov/briefing-room/statements-releases/2024/09/21/fact-sheet-2024-quad-leaders-summit>; Principal Scientific Adviser, Government of India, “US–India TRUST Initiative (formerly iCET),” February 13, 2025, <https://www.psa.gov.in/icet>.
- ²²⁹ U.S. Space Command, “Joint Statement from Combined Space Operations (CSpO) Principals’ Board,” Press Release, December 2025, <https://www.spaceforce.mil>.
- ²³⁰ India Strategic, “India’s Military Space Doctrine,” September 2025, <https://www.indiastrategic.in/indias-military-space-doctrine>.
- ²³¹ NUJS Centre for Aviation and Space Laws, “Open-ended Working Group,” 2024, <https://nujs.edu/casl/tag/open-ended-working-group>. Russia vetoed the US–Japan PAROS resolution at the UN Security Council, April 24, 2024.
- ²³² Air Vice Marshal D V Khot (Retd) interview to monograph on “Weaponisation of Space and Implications for India” by Col Kaushik Ray, April 2025, <http://hdl.handle.net/10603/634199>
- ²³³ Adithya Kothandapani, “The Follower’s Dilemma: The Cost of Chasing China in Space,” *Substack*, May 25, 2026. Articulates India’s reactive posture and proposes a SWAC-SDA force-design model as the antidote.
- ²³⁴ Ministry of Defence Annual Report 2024–25, iDEX cumulative metrics: 549 problem statements; 619 participating startups/MSMEs; 430 contracts signed; 43 items worth 1 2,400+ crore procured by February 2025, <https://idex.gov.in/annual-return>
- ²³⁵ IMPRI Impact and Policy Research Institute, “Acing Development of Innovative Technologies with iDEX (ADITI) Scheme 2024,” <https://imprinsights.in/acing-development-of-innovative-technologies-with-idex-aditi-scheme-2024>

- ²³⁶ Air & Space Forces Magazine, “Space Force Commercial Reserve Fleet Moves Out of Pilot Phase,” December 23, 2025, <https://www.airandspaceforces.com/space-force-commercial-reserve-fleet-out-of-pilot-phase>
- ²³⁷ National Reconnaissance Office, Press Release, “NRO Awards Electro-Optical Commercial Layer Contracts,” May 25, 2022; confirmed in Via Satellite, “NRO Awards Imagery Contracts to Maxar, BlackSky, and Planet Worth Billions,” May 2022, <https://www.satellitetoday.com/government-military/2022/05/25/nro-awards-imagery-contracts-to-maxar-blacksky-and-planet-worth-billions>.
- ²³⁸ Tracxn, “Space Tech in India–2026 Market & Investments Trends,” April 2026, <https://tracxn.com/d/explore/space-tech-startups-in-india>; Speciale Invest, “Looking Back at 2025: How Our Space Economy Startups Evolved,” December 2025, <https://www.specialeinvest.com/post/looking-back-at-2025-how-our-space-economy-startups-evolved>
- ²³⁹ India’s First Dedicated Venture Capital Fund for Space Startups Gains Momentum, Department of Space, April 1, 2026, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2247865®=48&lang=2>
- ²⁴⁰ SatCom Industry Association (SIA-India), “The Indian Space Industry: Key Highlights from 2025,” 2026, <https://www.sia-india.com/corner/the-indian-space-industry-key-highlights-from-2025>. SIA President Subba Rao Pavuluri quote on PLI and GST reform.
- ²⁴¹ Eshaan Bansal, Financial Risk Coverage of India’s Commercial Space Launch Industry, Spaceport SARABHAI Report, January 2024.
- ²⁴² Swarajya, “Kulasekarapattinam Spaceport in Tamil Nadu Targeted for Commissioning in FY27: Centre,” 2025, <https://swarajyamag.com/infrastructure/kulasekarapattinam-spaceport-in-tamil-nadu-targeted-for-commissioning-in-fy27-centre>
- ²⁴³ India TV News, “National Science Day: From Gaganyaan to Chandrayaan-4, India’s Roadmap to Become Superpower by 2035,” February 28, 2026, <https://www.indiatvnews.com/science/national-science-day-on-february-28-saturday>
- ²⁴⁴ “Tamil Nadu unveils Space Industrial Policy 2025, eyes Rs 10,000 crore investment and jobs”, *The Economic Times*, April 18, 2025, <https://economictimes.indiatimes.com/tech/technology/tamil-nadu-unveils-space-industrial-policy-2025-eyes-rs-10000-crore-investment-and-jobs/articleshow/120398673.cms?from=mdr>
- ²⁴⁵ Press Release, “Parliament Question: Technology Transfer To Industry”, Department of Space, December 11, 2025, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2202458®=48&lang=2>
- ²⁴⁶ India Brand Equity Foundation (IBEF), “India Amends Policy, Allowing 100% FDI in the Manufacture of Satellite Components,” February 23, 2024,

<https://www.ibef.org/news/india-amends-policy-allowing-100-fdi-in-the-manufacture-of-satellite-components>

- ²⁴⁷ Press Release, “India’s Space Ecosystem Gets Cyber Shield as SIA-India, CERT-In Release Joint Guidelines”, Min of Electronics & IT, February 26, 2026, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2233122®=3&lang=1>
- ²⁴⁸ Space Insider, “India’s Expanding Space Economy Generates Jobs, Drives Innovation and Bolsters Inclusion,” May 12, 2025, <https://spaceinsider.tech/2025/05/12/indias-expanding-space-economy-generates-jobs-drives-innovation-and-bolsters-inclusion-study-finds>
- ²⁴⁹ FICCI–EY/IN-SPACE, *India Space Economy Report: \$44 Billion by 2033*, FICCI, New Delhi, October 2023, <https://indbiz.gov.in/indias-space-economy-to-reach-us44-billion-by-2033-ficci-ey-report>
- ²⁵⁰ “Can India’s \$13 Billion Spacetechn Sector Truly Scale with Just 1.3% of Global Capital?” *Business Today*, May 19, 2026, <https://www.businesstoday.in/magazine/deep-dive/story/can-indias-13-billion-spacetechn-sector-truly-scale-with-just-1-3-of-global-capital-532176-2026-05-19>.
- ²⁵¹ “<https://www.sda.mil>; and on the SBS-III imperative after Operation Sindoor, “Post-Operation Sindoor, India Ramps Up Military Surveillance with Global Satellite Partnerships,” *Swarajya*, July 21, 2025.

China's civil-military fused space expansion has transformed orbit into a contested strategic theater, presenting a structural rather than a purely technological challenge in the region. This monograph attempts to map all civil and military Chinese space capabilities and examines how it has operationalised space as a warfighting domain leveraging Military Civil Fusion. By fielding a comprehensive counterspace arsenal and deploying highly integrated dual-use system including BeiDou navigation, pervasive ISR constellations, and the Tiangong space station, Beijing has managed to obfuscate the boundary between civilian and military space tracks. Analysing a mix of indigenous and global space sources, various western intelligence assessments from 2015–2025, the research details India's vulnerabilities in Space Domain Awareness (SDA), PNT resilience, and industrial capacity. For India an integrated counter-strategy addressing electronic/cyber hardening, deterrence mechanisms, legal-diplomatic frameworks, and industrial self-reliance is critical including a Space Activities Act, autonomous PNT, and a declared space deterrence doctrine. A dominating presence in Space domain is critical for future growth of India and hence India should focus on denying China a decisive operational advantage rather than engaging in a satellite-for-satellite arms race.

Brig Tanmay Pathak is a serving Indian Army Officer from Infantry. He has extensive operational experience in High Altitude along Line of Control, Line of Actual Control, Deserts and Counter Terrorism Operations, as well as in training appointments. He has worked as a Research Fellow at Manohar Parrikar Institute for Defence Studies and Analyses (MP-IDSA) during 2025 and 2026. He is currently posted in J&K. Brig Tanmay Pathak holds a M.Sc. degree in Defence and Strategic Studies from Madras University and M.Phil from Punjab University, Chandigarh.



MANOHAR PARRIKAR INSTITUTE FOR
DEFENCE STUDIES AND ANALYSES
मनोहर पार्रिकर रक्षा अध्ययन एवं विश्लेषण संस्थान

Manohar Parrikar Institute for Defence Studies and Analyses

No.1, Development Enclave, Rao Tula Ram Marg,

Delhi Cantt., New Delhi - 110 010

Tel.: (91-11) 2671-7983

Website: <http://www.idsa.in>