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Article

# Mitigating the threat in space: Chinese military space capability and India's response

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## Abstract

*Space assets today play a pivotal node in modern warfare. In this context, the rapidly expanding Chinese space programme plays an instrumental role in supplementing the existing ground-based infrastructure and support Beijing's goals to win "Informationised local wars". The first section of the paper scrutinizes the Chinese stance regarding its space assets and how they can be employed for both offensive and deterrent purposes. Despite its claim of employing space assets for peaceful purposes, Chinese literature often advocates terms like "decisive first strike" and "information dominance". Furthermore, the speculated shift of the space programme from a support mechanism to an offensive tool has been explored. The second section brings up core structural differences between India and China in terms of their approaches to the use of space assets for military purposes. With an efficient command structure and the right ideology behind setting up the network in space, India can mitigate the Chinese threat and greatly reduce vulnerabilities in space. While the Indian space programme has made commendable advances to fulfil its military requirements, there's still a large functional void between ISRO and the military forces due to the inherent civilian nature of the former organisation. Institutional expansion for dedicated space-based military operations have been discussed through the past decade and the formation of an Integrated Space Cell offers promise. To tackle the offensive threat posed by China in space, the paper proposes a new model for deterrence through the concept of 'deterrence by denial'.*

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## Section 1:

### China's military space posture

In the era of Mao, China followed a policy of waging a "people's war", designed to fight low-sophistication, protracted warfare against more advanced invaders from the Chinese hinterland. However, over time this posture seems to have changed, particularly in the way China has approached its military space policy in modern times. Kulacki, in his paper on Chinese space policy, argues that Beijing is following the American model for development and structuring of its space capabilities rather than a lean, flexible and offensive model, which is usually the assumption.[1] However, there are exceptions which allude to a more offensive posture in space. It could be postulated that the motivation behind adopting an America like model for its space capabilities is the success the US has enjoyed with the model combined with the American approach towards China in space. Several countries, including China, took notice of the success of American space assets against Iraqi forces in the Gulf War in 1991. Additionally, instances like the non-provision of military grade GPS signal to the Indian forces during the Kargil War in 1999 by the US are also likely to have prompted the Chinese to create alternative systems in space to challenge US dominance, such as the creation of the Beidou Navigation System and the proposed Chinese space station.

China's Military Strategy of 2015 outlines Beijing's goals for winning "informationised local wars" and stresses on the importance of regional maritime operations.[2] The document emphasizes on the need for integration across command structure for "system vs system" dominance that leads to control of information in protracted military operations. There is a focus on the concept of "informationised warfare" in the document, with self-reliance advocated in this regard, which might explain the Chinese posture of creating its own capacity in key domains in space. The doctrine declares Chinese intentions to use outer space for peaceful purposes while being prepared to respond to threats against Chinese space assets. The strategy as a whole alludes to Chinese attempts to build infrastructure in space that focuses on providing a tactical advantage to military forces for terrestrial operations rather than using space as an offensive capability.

There are exceptions, however, to the theory that China is relying on space assets as a support mechanism for its military than as an offensive tool on its own. One of the most glaring displays of offensive strength has been the multiple weapons

tests conducted by China in space. While repeatedly claiming that China does not advocate for the use of weapons in space, China has conducted several Anti-Satellite (ASAT) tests. Beijing has tested a wide variety of weapons including hit-to-kill as well as directed energy blinding weapons and have launched co-orbital satellites that can allegedly be used as remote explosives and jammers. In 2018, a threat assessment report by the Director of National Intelligence of the US, estimated that not only will China reach operational capability on their counter-space weapons in the "next few years", they are also likely to use it in any military conflict to offset any adversarial advantages.[3] The report also indicates that Beijing has given importance to the integration of such counter-space capabilities with its military command structure so as to integrate counter-space assets with conventional military operations.

The Textbook for the Study of Space Operations, a publication by the PLA's Academy of Military Sciences (AMS), advocates the use of a decisive first strike in space to avoid protracted conflict and ensure dominance. The Science of Military Strategy (2013), another publication by the PLA's AMS, acknowledged the use of network warfare forces by the PLA.[4] These forces imply that the PLA has invested in network warfare capabilities and it is likely these have been used at various instances in peacetime, with some forces being part of the PLA while others are merely authorized by the PLA but do not comprise of PLA personnel. Such a statement while not directly implying the existence of offensive space capabilities, indicates Beijing's intention to adopt a strategy that binds elements of cyber, network, electronic and space-based warfare firmly with existing conventional structures. This text was one of the first admissions of the existence of such offensive forces, a departure from China's longstanding stated policy of non-aggression in cyberspace. It can be argued, based on the aforementioned developments, a declared Chinese policy of non-aggression in outer space does not imply the lack of development of capability as well as use in certain scenarios. The US, on multiple instances, has claimed that the Chinese interfered with the functioning of American space assets, using counter-space capabilities.[5]

Official documents on utilisation of space as well as their efforts at various international forums indicate that China is building its space assets as a tactical asset for its military. However, the progress made by Beijing in operationalising a counterspace capability cannot be ignored. What is certain is that China has begun the process of setting up an alternative set of infrastructures to the US in space that is likely to challenge their dominance. In doing so, China has also made its military a lot

more dependent on the availability of such capabilities, which serves as motivation for potential adversaries to target them. These vulnerabilities are augmented by China's current inability to comprehensively protect their satellites; the Chinese still do not possess capabilities such as space situational awareness, with several Chinese studies acknowledging vulnerability on this front.[6] It is also worth noting, that most Chinese texts that advocate the use of counter-space capabilities as an offensive weapon rather than a deterrent, do so against an established space network such as the US. The underlying objective is one of establishing dominance in space to assure a better-informed military rather than as a potential disruptor. The attacks on American satellites have also largely been directly over Chinese territory. It is likely that the Chinese have conducted these tests to assess whether their counter-space capabilities can enable their Anti-Area/ Access Denial (A2/AD) strategy in the maritime domain in South East and East Asia.

**Organisation of China's military space capabilities**

Akin to several western space programmes, the Chinese space programme was inaugurated under the auspices of the PLA, specifically the Second Artillery Corps. The Second Artillery Corps is the force in the PLA responsible for China's strategic missile arsenal, for both nuclear and conventional strike capabilities. Only in 1993, China created the China National Space Administration (CNSA), which on paper has the mandate to govern all civilian space activity. This was done in an attempt to provide a civilian governmental front to China's space activities, to make procurement and technology transfer from the West an easier task. It has often been argued that the CNSA is merely a coordinating body within the Chinese space setup, creating no real technological capability on its own.

On the military front, in 2015, China setup the Strategic Support Force (SSF), which has reportedly taken over the responsibility of several space capabilities from the Second Artillery Corps. According to a study by RAND Corporation, the setting up of such a force is another indicator of Beijing's desire to use its space capabilities as an enabler of its concept of "informationized wars" rather than a disruptive tool.[7] While the SSF appears not to have been given the status of an independent service, as is the case in US and Russia, it is considered the focal point for all outer space and cyberspace based information gathering with other wings of the military being consumers of such intelligence. The SSF brings China's cyberspace and network warfare, electronic warfare and space capabilities under a single branch of the

military. This combination of weapons with the SSF, acting as a supporting mechanism to all branches of the Chinese military, displays Beijing's desire to integrate the information component in entirety with all of its military operations. The combination of offensive capabilities such as EW and network warfare, and information gathering capabilities in space reinforce the belief that China aims to fight through short regional skirmishes in an A2/AD, enabled with complete information dominance.

**Space Assets and Informationized Warfare**

Inroads towards a comprehensive space-based framework are pivotal for the Chinese A2/AD strategy, especially in the West Pacific theatre. The Chinese Yaogan constellation of satellites provides Electronic Intelligence (ELINT), Synthetic Aperture Radar (SAR) and Electro-Optical (EO) capabilities for the Chinese approach to "fight and win local wars under informationized conditions".[i] Gathering electronic footprints by means of ELINT satellites surveilling in discrete formations is the primary step for the same. The coarse ELINT estimates act as cues for the SAR and EO satellites to provide imagery in order to counter infiltration or undesired presence by means of any array of surface and undersea operations. A robust surveillance system lays the groundwork for the enabling of an A2/AD bubble in tandem with conventional Air and Naval operations. Early warning satellites, combined with non-military state power are effective in the creation of bubbles where "information dominance" is possible.[8] The launches of TJS 1 and TJS 2 satellites have filled the void in the Early Warning capabilities for the Chinese Ballistic Missile Defence system. The Chinese Integrated Air Defence System (IADS) also employs the space based inputs to supplement the A2/AD strategy.

The Chinese ambitions to press for a holistic surveillance system in the Indo-Pacific have been reflected by its aggressive satellite launches in quantitative terms to secure strategic interests in its sphere of influence. Out of a total of 24 ELINT satellites operational as a part of the Yaogan constellation, the final twelve satellites have been launched in a span of  months between September 2017 and April 2018.[ii] Insights into the planar orientation of the constellation further indicates a shift from the conventional formation of three satellites to a six satellite formation in the January 2018 launch of Yaogan 30. A six satellite formation aids increasing the footprint coverage between the 35 degrees North and South latitudes and thus, comprehensively monitor electronic footprint around sensitive regions of strategic

i. EO and SAR satellites are used to provide satellite imagery. EO satellites have passive payloads and thus, can't provide imagery during cloud coverage and in the absence of daylight unlike SAR sensors which provide all weather imagery even during the night.

ii. Electronic Intelligence or ELINT satellites are primarily launched in a specific formation of three satellites with respect to orbital planes in order to ensure broader coverage during a fly-by.

significance like Taiwan, the Korean peninsula, Japanese southern waters, Guam and other regions across the Indian Ocean. Additionally, the shift from conventional Low Earth Orbit to the 500 Km Sun Synchronous Orbit (SSO), used to place the Ludikancha Weixing (LKW) satellites launched this year, adds to the Chinese attempts for comprehensive surveillance.[9] A study conducted by International Strategic and Security Studies Programme at IISc. Bengaluru to monitor the amount of electronic emissions captured by five Yaogan triplets revealed a 32 per cent emission capturing capacity by the frequency of satellite revisits over Taiwan by the 15 satellites. The current framework thus, provides adequate satellite visit frequency to ensure long range coverage, however, further investments are needed to seek parity with short distance requirements.[10]

## Role of Chinese ELINT Satellites

China has created a regional ELINT framework by supplementing the ground, air and sea based ELINT sensors with a roster of ELINT satellites placed in a particular formation to enhance emission coverage for a robust surveillance system. However, integrating the space-based infrastructure into broader Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) system remains as a prime target to have an edge in "Informationised Warfare". Furthermore, technical writings from PLA affiliated sources have pressed towards a system employing ELINT sensors along with radar systems.[11] Inroads towards enhancing a terrestrial space support infrastructure have also been made to perform functions like signals transmission, reception, processing and status monitoring.

The PLA Strategic Support Force is primarily responsible for Electronic Warfare and tactical Electronic Support Measures. Its 1999 project for 10 coastal stations in Shandong province indicates an inclination towards maritime engagement in electronic warfare. China also has an array of ground stations spanning across the globe in countries like Kenya, Namibia, Pakistan and Argentina.

Chinese Space-Based ELINT capabilities receive a major boost from the alleged "piggyback" sensors mounted as secondary payloads on Chinese satellites in LEO and GEO.[iii] The scope and the intent towards the same have been stated in a paper by China Aerospace Science and Industry Corporation (CASIC) affiliated authors as:

> *"In the information age, the utilization of electronic reconnaissance satellites to obtain intelligence has become an important method [of*

iii."Piggyback" payloads serve as secondary sensors on a satellite mission. Such payloads often serve usually experimental purposes, however, as portrayed in the given scenario, they primarily execute discreet missions disguised beneath the primary payload.

> *doing so]. Geostationary electronic reconnaissance satellites provide unique advantages and are being increasingly emphasized…Using geostationary satellite platforms to engage in electronic reconnaissance is useful for the large coverage ranges available for obtaining electronic information in the air, including terrestrial and other radar signals, communications signals, satellite telemetry, etc. It also allows for the continuous, long-term surveillance of target areas; obtaining intelligence in real-time to provide rapid electronic intelligence for diplomatic and strategic military decisions."* [12]

The possibility of the same contributes to the edge in the field of intelligence due to additional footprint coverage that goes significantly unmonitored due to the discreet nature of the payloads. Furthermore, primary payloads in the GEO hold significance by providing wider coverage for holistic surveillance. Unavailability of published studies in the public domain coupled with distinct orbital configurations for an array of satellite launches in the past decade indicate towards a strong primary payload presence for ELINT purposes.[13] Chinese sources further indicate towards merging the airborne communications and ELINT payloads into combined hardware which helps monitor global communications for strategic purposes. By means of trimming the deficit faced by on-ground infrastructure by onboard processing units embedded in the payloads.

The intelligence inputs provided by the space-based ELINT sensors extend their utility towards both offensive and deterrent procedures of the PLA ranging from the conventional Air and Naval operations in the Indo-Pacific to the intricate Anti-Ship Ballistic Missile System and the Ballistic Missile Defense systems[iv] A comprehensive system of the given nature implementing the A2/AD strategy further opens ground for competent counter-space capabilities by potential adversaries are discussed separately in the paper.

Indo-Pacific is a territory of high strategic interests for China. An intricate layout of arterial trade routes coupled with disputed islands dotting the whole region attract substantial investment into deterrent assets in case of any hostile intrusion. Owing to the absence of contour matching procedures unlike in the case of land-based targets, a comprehensive ASBM attack or defence system requires space assets' inputs in fields of missile early warning, target reconnaissance, precision guidance, missile telemetry and creation of a digital battleground.

iv. Nuclear deterrent capabilities are subjected to ELINT proficiency in GEO owing to the requirement of surveillance beyond regional coverage.

Considering the expanse of conflicted territories across land and sea, especially the rugged Himalayan regions making up the majority of it, substantial investments to secure intelligence are an instrumental requisite. While the Chinese exploits in the field have been discussed in detail in the section, the Indian ELINT capabilities are more restricted to ground and air-based assets including radar stations and a fleet of Airborne Warning and Control System (AWACS) aircrafts. However, the unavailability of dedicated space-based assets may not raise significant alarm due to more regional nature of Indian intelligence gathering missions which are further backed by an 'adequate' remote sensing programme. Additionally, India is scheduled to launch EMISAT on 1st April 2019 which is listed to carry a payload which will give India electronic intelligence capabilities over the seas in the form of message interception from ships.[14] In the maritime domain, satellites like GSAT-7 launched in 2013 aid the naval operations by extending communication services. While the capabilities don't directly aid intelligence gathering, it helps provide appropriate co-ordination within the naval infrastructure for concrete surveillance procedures.

## Chinese counter-space power

Beijing's roadmap for the development of a counterspace capability was highlighted in a book by Colonel Li Daguang, published by the National Defense University (NDU) of China. The book proposed a phased approach to development of a counter-space capability, with the development of a limited combat capability in space by 2010 and an advanced offensive capability beyond that which would be capable of incapacitating all "enemy space vehicles that fly in space above our sovereign territory".[15] The book makes mention of preventing US-Taiwan integration on defense systems using ASAT capabilities. This sheds light on the Chinese objective of winning localized wars using an A2/AD bubble and explains the attention given to using counterspace weapons for blacking out US satellites. It is unlikely that the US military will undergo naval operations around Taiwan without having complete remote sensing vision and command and control assets in place.

Other notable publications by the NDU highlight the need for covert development of offensive counterspace capabilities due to international sentiment on the issue. They also call for the use of a first strike during times of crisis, targeting command and control centres of the opponent to cripple their ability to carry out any military operations in the theatre of combat. These publications recommend using a shock and awe strategy as a last resort in times of emergency and coordinating a

terrestrial troop response to take advantage of the information and command and control blackout for a decisive victory.[16] Journal articles enlist GPS and centralized, space-based Command and Control structures as key targets, describing possible weapon systems that China could develop to conduct offensive strikes against these targets and indicating that these weapons are likely already under development.[17] A notable omission from these publications is countering the use of defensive strategies by an opponent in space such as redundancy and mega-constellations, however, these can be excused given that most of the publications referred to were published before 2007.

China has tested a vast variety of counterspace weapons, both hard-kill and soft-kill in nature. A 2013 paper by Chinese scientists from the Changchun Institute of Optics, Fine Mechanics and Physics, which is considered to be a part of the Chinese military space research network, claimed that China successfully tested a blinding laser on a low-orbit satellite in 2005 itself.[18] The veracity of China's claims of having a directed energy blinding weapon were verified when the US admitted that their reconnaissance satellite was blinded by lasers in orbit above China in 2006.[19] Aside from directed energy weapons such as the ones mentioned above, Beijing has also conducted several hard-kill weapons tests, most notably one in 2007 which successfully hit a Chinese weather satellite in Low Earth Orbit (LEO). The Chinese also tested their DN-2 ASAT missile in 2013 which has the capability to target satellites in "nearly geosynchronous orbit", threatening the full spectrum of satellite resources which were earlier assumed to be invulnerable as weapons capabilities were thought to be limited to the LEO.[20] Reports suggest, China has developed a potential co-orbital ASAT capability as well. In 2013, Chinese satellites displayed an ability to manoeuvre in close spaces and a robot arm was used, which Beijing claims is for servicing satellites and clearing space junk, experts are confident it could be used to tamper with enemy satellites and interrupt their functioning.[21]

The PLA's focus on asserting information dominance has led to the integration of network warfare and electronic warfare capabilities for counterspace operations as well, likely under the ambit of the SSF. The warning signs of an advanced cyber capability against space assets came through exercises conducted by China as early as 2007 and 2008. US satellites were hacked into in both these exercises and in the former, satellite communication with ground stations was interrupted for 12 minutes, displaying China's ability to suspend critical information flow of the enemy in times of conflict.[22] Beijing has continued to develop and test

these capabilities. In 2014, an American imaging satellite was hacked and was prevented from transferring remote imaging for 2 days to ground stations for processing.[23]

Such Denial of Service (DOS) attacks fit into China's plans for short, decisive victories in information dark situations for the enemy, even to transfer functions onto redundant capabilities, it would take precious time that could be used by the Chinese military to conduct offensive operations with superior information, playing into the strategy laid out in several Chinese doctrines. The only aspect that is yet to be executed is China's ability to coordinate such attacks to create an A2/AD bubble in a region, which is the PLA's eventual objective especially in maritime conflicts fought around the Chinese mainland or island groups.

To create such a bubble against a network of satellites would require not just the possession of such counterspace capabilities, but target acquisition and circumvention of defense measures. Target acquisition requires comprehensive Space Situational Awareness (SSA) capabilities,[v] which China does not possess at the moment and is unlikely to be operational in the near future. Hence, while the Chinese currently have the capability to interrupt normal functions of certain critical space-based infrastructure, it is unlikely they can create information dark zones for large satellite networks such as the ones the US possesses; they may still have the ability to acquire a tactical edge through their capabilities for short periods of time.

## Section 2:

### India's military space ambitions

The Doklam crisis, a India-China military standoff on Bhutanese territory, was a reminder of the importance of integrating space-based assets with military command structures. Satellite imagery was crucial in identifying Chinese infrastructure construction in areas of strategic interest to India. The situation prompted New Delhi to reassess the appropriation of its space-based capabilities, designating the Indo-Tibetan Border Police (ITBP), a paramilitary force responsible for protecting much of the border with China, as the nodal agency for the GSAT-6 satellite.[24] This move allows the paramilitary unit direct access to data rather than sending requests to ISRO, previously responsible for distributing data on the satellite largely dedicated for the armed forces.

While the move is a welcome step in making access to critical data easier for the required forces, it displays the glaring need for a doctrine as well as a capacity

v. The US military defines space situational awareness as the requisite current and predictive knowledge of the space environment and the operational environment upon which space operations depend as well as all factors, activities, and events of friendly and adversary space forces across the spectrum of conflict.

appropriation mechanism. India has a limited capacity dedicated to the military, with most of India's space-based assets being dual use in nature. With ISRO being a purely civilian-administered institution, questions and concerns over the lack of a space organization for defence in India have arisen. The first move to rectify this gap came in the form of the formulation of the Integrated Space Cell (ISC). The ISC is an agency operated by the tri-services in coordination with ISRO and the Department of Space and is responsible for operation of dual-use satellites providing critical information to the military. The solution sought to reduce the time taken for providing crucial information for the armed forces to act upon, however, the ISRO, through its various centres, still controls the satellites and gathers data with the military having little technology or know-how on how to carry out the process themselves. This structure becomes particularly troublesome when data on a particular region is required for operational planning on-ground at the unit level, with the request and subsequently the information having to travel up and down the chain of command.

There have been multiple appeals for the setting up of a defence space organisation, possibly in the form of an Aerospace Command, to rectify this situation. Four significant aspects need to be considered namely, creating capability to harness existing ISRO capabilities for military uses, forming a command structure for efficient distribution of data, coordinating with ISRO and DRDO for the creation of space and ground infrastructure tailor made for the military's needs and creating deterrence and response mechanisms to threats by adversaries.

## India's doctrine on the use of space for defence

The Indian Armed Forces, while being comparatively late, have announced that they intend to form a cyber defence and a space defence agency and claim that the process to do so has begun in the 2017 Joint Doctrine.[25] The military plans to create a "triad" of capabilities in an integrated command structure comprising of cyber, space and "special operations", with these units likely to be set up under the Integrated Defence Staff and serve all three services of the Indian Armed Forces. Despite the vision being set out, the doctrine does not mention how these capabilities will be set up or used in combat. A paper presented at the Centre for Joint Warfare Studies, a Ministry of Defence think tank, suggests that the three capabilities would have independent commands with a communication grid established between them.[26] The paper recommends a study of the US Space Command structure, alluding to a top-down approach for creation of an Aerospace unit. However, this is in

contradiction to a recent statement made by the Chief of Army Staff, General Bipin Rawat, who asserted that the Armed Forces will follow a bottom-up approach to integration with regiment level exercises for cyber and space capabilities already underway.[vii]

The conversation around setting up an Aerospace Command is not a new one, the Indian military spoke of setting up an Aerospace Command as long ago as 2005, when then Air Chief Marshal, S.P. Tyagi admitted that such a command would be set up.[27] In another interview in 2005, a DRDO official close to the Chief of the DRDO at the time claimed that such a command would be set up independently to ensure effective coordination with all of the three tri-services;[28] the prevailing thought at the time was that such a command would be set up under the Indian Air Force. Since then, there has been little evidence of progress on the setting up of such a command, or on setting up of a military space organisation and it is unclear when the 2017 doctrine would come to fruition.

## Assessing Indian capabilities for military use

On 27th March 2019, Prime Minister Narendra Modi announced that India had successfully tested an ASAT weapon by shooting down a live satellite in the LEO.[29] The project was codenamed Mission Shakti and has been carried out by the DRDO and appears to be entirely indigenous. In doing so, India has joined the US, China and Russia in having successfully tested an ASAT weapon. Even though the details are unclear so far, it appears to have been a kinetic kill ASAT weapon that India launched. The test comes after several appeals over the last decade for India to test its own ASAT weapon to deter China in space. In so far, New Delhi had maintained a policy of not wanting to weaponise even in the face of aggression from other countries, however, this test indicates a shift in stance.

The test seems likely to have been done by using the Agni-V missile in combination with the radar systems from the Prithvi Air Defence System. This estimate is based on claims made by former DRDO chief V.K Saraswat that India had the "building blocks", namely the above-mentioned components, necessary to develop an ASAT weapon.[30] There had been questions raised over the apparent lack of a verification mechanism- India appeared to not have an expendable satellite to test on in the LEO and there is still no word on what satellite was used for the test.

This launch puts several doubts on India's counter-space deterrent capabilities to bed. While India's intentions for the test still remain to be known, it

vi. The US military defines space situational awareness as the requisite current and predictive knowledge of the space environment and the operational environment upon which space operations depend as well as all factors, activities, and events of friendly and adversary space forces across the spectrum of conflict.

raises two possibilities for India's attempt to negotiate a treaty on the Prevention of Arms Race in Outer Space (PAROS). It indicates that either India has given up on the hope of a consensus on forming such a treaty in the future; or fears that such a treaty when negotiated might form a Nuclear Non-Proliferation Treaty (NPT) based club of powers having ASAT weapons and hence can negotiate to be a part of this group of countries.

Aside from the test, there has been little formal documentation on the space capabilities for defence use that India intends to develop. The Technology Perspective and Capability Roadmap (TPCR) 2010, a document by the Integrated Defence Staff Headquarters, was a marked departure from India's policy on space. The document stated that India would develop ASAT capabilities "for electronic or physical destruction of satellites in both LEO (up to 2,000-km altitude above earth's surface) and GEO-synchronous orbits."[31] The document was quickly taken off the website of the Ministry of Defence, with a replacement coming in 2013 which called for the deployment of "watchdog satellites" to protect space infrastructure- making no mention of ASAT capabilities.[32]

India has a host of competent dual-use capabilities in its arsenal. It has made significant headway in the remote sensing and imaging sphere, acquiring round-the-clock, and all-weather capabilities through technology transfer agreements. India has also expanded its ground station network vastly, adding a station in Vietnam recently in return for providing Vietnam images for the South East Asian region. The IRNSS constellation, which is close to being functional pending the successful launch of one more satellite, will provide the Indian military navigation and positioning capabilities across a large region where a majority of the Armed Forces' operations span. The GSAT-6 and the GSAT-7 are communication satellites dedicated to military use, for which the military is acquiring a large quantity of satellite phones for reliable communication to remote outposts.

The India military has already begun integrating such capabilities, gearing towards information warfare threats and utilising electronic and information technology assets of their own on the battlefront. An analysis of five military exercises by India, beginning from 2004, reveals the Indian Armed Forces' capability of operationalising information warfare techniques for short wars. The Indian military during the exercises showed an ability to use UAV and satellite imagery to track

adversary movements and significant advancements in the ability to integrate sensors into warfare systems.[33]

India has a host of capabilities and infrastructure in place to serve most military needs owing to the technological prowess of ISRO. However, New Delhi needs to put its weight behind the creation of a competent defence space agency, which will be able to process and disseminate data gathered from space assets and resolving a complicated flow of requests and information to allow the military to utilise such capabilities efficiently to gain a tactical advantage on the battlefield. Additionally, there needs to be a mechanism set up to create space infrastructure tailor made for the Armed Forces; to ensure there is enough coordination between commanders who are likely to benefit from such capabilities and the scientists developing them at ISRO. While there is a threat on the Chinese front that does need to be addressed, India's other major military rival, Pakistan, possesses very little by way of military space infrastructure, giving the Indian Armed Forces a considerable strategic advantage if space assets are used effectively as force multipliers.

## Addressing the threat from China

It is unlikely that two nuclear weapon states will have a protracted conflict, especially given the size of militaries of both the countries in question. It is likely however, to have short, localised skirmishes for control of strategically important acreage, whether on land or at sea. This plays into Beijing's military objectives, providing them with the opportunity to press their advantage in the information warfare domain. It is imperative that New Delhi recognises the threat posed by China's capabilities and is able to mitigate the strategic advantage it gives the PLA. It is also no secret that the Indian administration does not find a solution that involves weaponizing space as a desirable alternative to mitigate the threat posed.

Keeping these factors in mind, India could follow the route of deterrence through denial as a strategy to insulate itself from Chinese aggression in space, as alluded to by former Air Force Officer M.P. Anil Kumar.[34] Glenn Snyder, in his book on the two forms of deterrence, defines deterrence through denial as, "the capability to deny the other party any gains from the move which is to be deterred".[35] The theory was originally proposed keeping conventional military conflict in mind, but can also be adapted for space based deterrence. The model being proposed focuses on reducing the strategic gains that can be made by China through aggression in space, thus 'denying' them any advantage in a conflict. This model assumes that any

offensive in space leading to the interruption of critical services would come either during or immediately before any conflict on earth between the two nations. The concept will have to be evolved by putting various practices and infrastructure in place for an effective deterrent. The military space ecosystem in India is still at a nascent stage, this needs to be leveraged to give India an upper hand. New Delhi has the opportunity to grow the ecosystem keeping the threat in mind and adapting it to mitigate such a threat proactively whereas other countries such as the US will counter it reactively. The model proposed by the authors hinges on 4 pillars to build an effective and sustainable deterrent in space:

**Continuing to build dual-use infrastructure**: Analysts have lamented the lack of dedicated infrastructure that the military has in space. Given Chinese capabilities, the paucity of dedicated assets may work in India's favour and the authors argue that New Delhi should continue to push this policy forth. Dual-use assets make target acquisition for deployment of counterspace weapons by the PLA more difficult. The Government Accountability Office of the US asserted that "hosted" payloads on commercial satellites may be the way to go to mitigate threat, with the Department of Defense already putting this strategy into effect with 3 hosted payloads launched.[36] With partitioning and encryption of such payloads on civilian or commercial satellites possible, data security threats are eliminated and the concept has the added advantage of managing satellites launches and capability distribution more flexibly .The strategy is likely to be effective as in most conflicts countries hesitate to attack civilian infrastructure particularly when responsibility can be easily attributed, as will be the case in space. Dual-use assets will reduce the risk of a Chinese first-strike as a precursor to a conflict and give the Indian Armed Forces uninterrupted support from space for a longer duration.

**Working towards redundancy:** In any system, redundancy greatly reduces the risk of a denial of service attack if switching to redundant capabilities is possible in a short period of time. Pragmatically, India will take time to build redundancy as it is still in the phase of growing its military space capabilities and is likely to prioritise growth over redundancy, however, certain practices can be put in place to facilitate such a concept when India's military space program matures. Creating a mechanism to enable the concept of an Operationally Responsive Space (ORS) is key for India. ORS involves assessing requirements of on-ground units and repurposing capabilities to augment such needs in a short span of time. It requires coordination between command units and for the capabilities to operate on the same standard so that

repurposing is possible. The ability to do so will be essential as a reaction to any counterspace measure taken; an effective mechanism is thus likely to deter the counterspace move in the first place. Mega-constellations of nano-satellites is another possible alternative to mitigate a counterspace threat. Such a form of infrastructure could be adopted from the offset for creating certain support functions in space for the military. Analysis by Secure World Foundation suggests that such a move would reduce vulnerabilities drastically but is likely to trade quality of service provided, hence this could be used for functions with comparatively low bandwidth requirements and higher margins for error.[37]

**Ensuring entanglement:** Entanglement involves the sharing of space-based capabilities with strategic allies to increase the cost of any offensive measure for an aggressor as it may aggrieve a non-party to the conflict. The US National Security Space Strategy alludes to such a concept, albeit advocating for multilateral governance rather than share capacity building.[38] China too has undertaken entanglement measures, using the leasing model for certain capabilities. Being a pioneer in launching capabilities and technology for several requirements, India could look to form such coalitions with a host of nations, with many of whom it already has strong relations for cooperation in outer space. Potential allies could be France- with whom India shares a deep relationship on space cooperation, Israel- which has the advantage of having the same technology on certain critical infrastructure as India and Japan- with whom India shares common interests in South and East Asia and a growing strategic partnership. Recently, Japan and India have committed to a bilateral space dialogue, the first meeting of which is scheduled to be held in March 2019. The intent to use the space-based assets of both nations is clear with the joint statement by the heads of government of the two countries calling for cooperation in areas such as Maritime Domain Awareness. Reports suggest that ISRO and the Japan Aerospace Exploration Agency (JAXA), are looking to share surveillance data on Chinese ships to ensure that both countries have access to multiple data sources in South, South-East and East Asia. Japan's endeavour to set up a Space Situational Awareness system could also be of potential benefit for India if it wants to move towards a deployable ASAT weapon. Such cooperation lays the building blocks for entanglement between two countries with similar civilian as well as military interests in space, and a strong military relationship in the region.

In March 2019, India also signed an agreement with CNES, the French Space agency, to cooperate on a joint Maritime Surveillance system beginning in May 2019. This will begin with data sharing and joint development of algorithms for data analysis between the two nations. In the future, the two countries expect to launch a constellation of LEO satellites operated jointly that give high resolution images of ship movement across the globe and particularly in the Indian Ocean Region. This along with the agreement with the Japanese is a large step towards ensuring entanglement in the surveillance and maritime domain awareness domains, capabilities that will aid the militaries of India in tracking and countering Chinese naval action in the South China Sea, East China Sea and the Indian Ocean Region.

India could look to offer certain capabilities to nations which are yet to develop the technology, to ensure entanglement, however, there would have to be a certain degree of ownership transferred to the partner nation for such a model to work. It is unlikely that capabilities such as communication would be shared to start with, but areas like remote sensing and imaging, and surveillance and early warning could be areas where India may work with strategic partners for shared ownership.

**Be Ready to Punish:** A noteworthy critique of Snyder's theory has been the lack of any punishment capability. Paul Davis asserts that without any means of punishment, it is unlikely that deterrence through denial is sustainable when the stakes are raised.[39] He argues that when the stakes are high, without any means to punish aggression, the adversary would undertake offensive action even if the strategic gains are minimal. Looking at it mathematically, even if the strategic gain side of the equation is reduced, not having any means to punish would amount to multiplying the cost side of the equation, thus ensuring that the gains, however little, will outweigh the cost of aggression. It is, therefore, necessary that India possess at least an ancillary capability, possibly through its ballistic missile defence system which tests in the US have shown can be adapted as an ASAT capability.[vii] With the success of the March 2019 test, India has shown that they have the capability to deploy at least a limited punishment based deterrent if the stakes are raised drastically which will certainly worry Beijing. The possession of such a capability significantly raises the cost of aggression for China considering the high level of dependence of their military on space based infrastructure and the low gains from an attack on Indian assets due to the usage of the deterrence through denial model.

## Conclusion

vii. Refers to the 2008 ASAT test by the US using its Aegis Ballistic Missile Defense system to hit USA-193 in LEO.

Chinese literature and actions illustrate the objective of winning short conflicts in areas of information dominance for the PLA. China have set up an elaborate network of surveillance and early warning through space-based assets and seek to eliminate any adversary's ability to acquire information of the tense region through their own satellites. Beijing is focussed on integration of Chinese space and network capabilities to ensure effective usage in military operations.

However, the Chinese threat is largely geared towards a model of infrastructure such as the one US has in space. The PLA's strategy also centres around dominance of maritime regions with an emphasis on the Taiwanese Straits in several Chinese military texts. Indicating that these strategies are largely thought out for a forceful reunification of Taiwan and to ensure the US does not interfere in such a situation. India is still in the nascent stages of its growth of military space infrastructure. While the threat isn't as imminent for India, the Doklam standoff indicates areas where China could press its strategic advantage in space. India has the advantage of understanding the Chinese threat as it grows its military space programme and must work in a manner that mitigates the threat and reduces vulnerabilities.

Effective implementation of the model proposed combined with the creation of an Aerospace Command could help reduce vulnerabilities drastically. India needs to ensure that it mitigates threat by creating a network that is tougher to impact using China's current capabilities. Additionally, it is important to conduct a comprehensive technical threat assessment of Chinese capabilities and study forms and theatres of warfare in which space and network centric assets would provide them a significant edge. India, unlike the existing military space powers, has the benefit of developing their defence space network when threats are largely apparent and must use this to model a network that mitigates such threats while providing the military with robust and flexible services.

## References


1. Kulacki, Gregory. "An Authoritative Source on China's Military Space Strategy." Union of Concerned Scientists. March 14, 2014. Accessed August 20, 2018. https://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/China-s-Military-Space-Strategy.pdf.
2. China's Military Strategy (2015)." Jamestown Foundation. May 2015. Accessed August 20, 2018. https://jamestown.org/wp-content/uploads/2016/07/China's-Military-Strategy-2015.pdf.
3. Coats, Daniel R. "Worldwide Threat Assessment of the United States Intelligence Community." Director of National Intelligence. February 13, 2018. Accessed August 18, 2018. https://www.dni.gov/files/documents/Newsroom/Testimonies/2018-ATA---Unclassified-SSCI.pdf.
4. McReynolds, Joe. "China's Evolving Perspectives on Network Warfare: Lessons from the Science of Military Strategy." Jamestown Foundation. April 16, 2015. Accessed August 20, 2018. https://jamestown.org/program/chinas-evolving-perspectives-on-network-warfare-lessons-from-the-science-of-military-strategy/.
5. "NRO Confirms Chinese Laser Test Illuminated U.S. Spacecraft." SpaceNews.com. December 10, 2014. Accessed August 21, 2018. https://spacenews.com/nro-confirms-chinese-laser-test-illuminated-us-spacecraft/.
6. Chase, Michael S., Jeffrey Engstrom, Tai Ming Cheung, Kristen Gunness, Scott W. Harold, Susan Puska, and Samuel K. Berkowitz, China's Incomplete Military Transformation: Assessing the Weaknesses of the People's Liberation Army (PLA). Santa Monica, CA: RAND Corporation, 2015. https://www.rand.org/pubs/research_reports/RR893.html. Also available in print form. Refer to 115-116
7. Pollpeter, Kevin L., Michael S. Chase, and Eric Heginbotham, The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations. Santa Monica, CA: RAND Corporation, 2017. https://www.rand.org/pubs/research_reports/RR2058.html. Also available in print form.
8. Military and Security Developments Involving the People's Republic of China 2018. Annual Report to the Congress. Office of the Secretary of Defense. May 16, 2018. Accessed August 23, 2018. https://media.defense.gov/2018/Aug/16/2001955282/-1/-1/1/2018-CHINA-MILITARY-POWER-REPORT.PDF.
9. Ibid 9

10. S. Chandrashekar and N.Ramani, "China's Space Power & Military Strategy – the role of the Yaogan Satellites," ISSSP Report No. 02-2018. Bangalore: International Strategic and Security Studies Programme, National Institute of Advanced Studies, July 2018.Accessed 23 August, 2018.
11. Jun Z., Jianhua Z., Jiansha Y., Tao Z., Dongpo Z., (2010). Semi-physical Simulation of Integrated Reconnaissance System of Radar and Communication Signals, Shipboard Electronic Countermeasure, pp.56-64.
12. Qiaozhong D., Weiqiang Z. (2009). Research on ELINT Satellite Techniques in GSO, Electronic Warfare, p.13.
13. Easton I., Stokes M.A. (2011). China's Electronic Intelligence Satellite Developments: Implications for U.S. Air and Naval Operations, Project 2049 Institute.p.11.
14. "India launching electronic intelligence satellite on April 1". Economic Times. March 24, 2019. https://economictimes.indiatimes.com/news/science/india-launching-electronic-intelligence-satellite-april-1/articleshow/68539756.cms
15. Pillsbury, Michael P. An Assessment of China's Anti-Satellite and Space Warfare Programs, Policies and Doctrines. Report. January 19, 2007. Accessed August 22, 2018. https://www.uscc.gov/sites/default/files/Research/An Assessment of China's Anti-Satellite and Space Warfare Programs.pdf.
16. Ibid
17. Ibid
18. Fisher Jr. R.D. (2018). China's Global Military Power Projection Challenge to the United States. Testimony Before the House Permanent Select Committee on Intelligence, United States House of Representatives. Accessed 24 Aug. 2018. https://intelligence.house.gov/uploadedfiles/hpsci_fisher_testimony_5_17_18.pdf
19. Meeks, Woodrow Anthony, Lt. Colonel. "Peace through Mutually Assured Survival - Global Transparency through Ubiquitous Satellite Imagery." Air War College. February 13, 2014. Accessed August 24, 2018. http://www.au.af.mil/au/awc/awcgate/cst/bh_2014_meeks.pdf.
20. Gertz, Bill. "China Tests Anti-Satellite Missile." Washington Free Beacon. November 09, 2015. Accessed August 24, 2018. https://freebeacon.com/national-security/china-tests-anti-satellite-missile/.
21. Cheng, Dean. "The PLA's Interest in Space Dominance Testimony before US-China Economic and Security Review Commission." The Heritage Foundation.

February 18, 2015. Accessed August 24, 2018. https://www.uscc.gov/sites/default/files/Cheng_Testimony.pdf.

22. Harrison, Todd, Kaitlyn Johnson, and Thomas G. Roberts. "Space Threat Assessment 2018." A Report Of The CSIS Aerospace Security Project. 2018. Accessed August 26, 2018. https://aerospace.csis.org/wp-content/uploads/2018/04/Harrison_SpaceThreatAssessment_FULL_WEB.pdf.
23. Ibid 25
24. Javaid, Azaan. "After Doklam Standoff, ITBP Gets Satellite Control to Keep Eye on China Border." Https://www.hindustantimes.com/. October 29, 2017. Accessed August 28, 2018. https://www.hindustantimes.com/india-news/after-doklam-standoff-itbp-gets-satellite-control-to-keep-eye-on-china-border/story-EXygJamCUO27JCQRdZJ8qJ.html.
25. "Joint Doctrine Armed Forces." Integrated Defence Staff. 2017. Accessed August 30, 2018. https://www.ids.nic.in/IDSAdmin/upload_images/doctrine/JointDoctrineIndianArmedForces2017.pdf.
26. Singh, Ranjit, Brigadier. Unified Commands in the Indian Armed Forces: Imperative for Integrated Warfighting. Centre for Joint Warfare Studies. Issue brief. New Delhi: Centre for Joint Warfare Studies. 2016. Accessed August 30, 2018. https://cenjows.gov.in/pdf/Layout_Unified Comd by Brig Ranji_03-04-17.pdf.
27. Jayaraman, K. S. "Indian Government Set To Create Aerospace Command." SpaceNews.com. December 28, 2015. Accessed August 30, 2018. https://spacenews.com/indian-government-set-create-aerospace-command.
28. Ibid
29. Miglani, Sandeep., Das, Krishna N. "India shoots down satellite in space; Modi hails major breakthrough". Reuters. March 27, 2019. https://in.reuters.com/article/india-satellite-mission-shakti/india-shoots-down-satellite-in-space-modi-hails-major-breakthrough-idINKCN1R80I6
30. Unnithan, Sandeep. ""India Has All the Building Blocks for an Anti-satellite Capability"." India Today. April 27, 2012. Accessed August 31, 2018. https://www.indiatoday.in/india/story/agni-v-drdo-chief-dr-vijay-kumar-saraswat-interview-100405-2012-04-27.
31. (2010). Technology Perspective and Capability Road Map, India.HQ Integrated Defence Staff, Ministry of Defence- Removed from public domain
32. (2013). Technology Perspective and Capability Road Map, India. HQ Integrated Defence Staff, Ministry of Defense.

33. Ladwig W.C.III. (2008). A Cold Start for Hot Wars? International Security. Vol. 32. No. 3. p. 158-190.

34. Moltz J.C. (2012). Asia's Space Race. Columbia University Press. p. 130.

35. Snyder G.H. (1959). Deterrence by Denial and Punishment. Woodrow Wilson School of Public and International Affairs, Center of International Studies, Princeton University.

36. (2018). DOD's Use of Commercial Satellites to Host Defense Payloads Would Benefit from Centralizing Data. United States Government Accountability Office.

37. Weeden, Brian. "Space Architecture Choices and Physical Dependencies." Secure World Foundation. April 14, 2009. Accessed September 1, 2018. https://swfound.org/media/205433/spacearchitec-bw-ndu-2009.pdf.

38. (2011). National Security Space Strategy- Unclassified Summary. US Department of Defense.

39. Madhumathi, D.S. "ISRO, French space agency seal agreement on maritime security". The Hindu. March 6,2019. https://www.thehindu.com/news/national/isro-french-space-agency-seal-agreement-on-maritime-security/article26449883.ece

40. Davis, Paul K. Toward Theory for Dissuasion (or Deterrence) by Denial: Using Simple Cognitive Models of the Adversary to Inform Strategy. Working paper. January 10, 2014. Accessed September 1, 2018. https://www.rand.org/content/dam/rand/pubs/working_papers/WR1000/WR1027/RAND_WR1027.pdf.