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Dragon Unleashed : Emergence Of China As A Military Space Power

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Abstract

China has made rapid strides in developing its space capabilities and is in the process of integrating them in the war doctrines of People's Liberaton Army (PLA) to challenge any adversary in a future conflict. PLA recognises the importance of controlling space as a means of achieving true information dominance. It advocates the development of space capabilities as an essential pre-requisite for executing successful military campaigns and for maintaining the initiative on the battlefield. In line with this thinking, it has developed high resoluton imaging satellites, high bandwidth multi-band communication satellites, electronic intelligence (ELINT) constellations and an indigenous satellite navigation constellation called Beidou. These capabilities are not only force multipliers but also enable success in electronically controlled warfare regime. China also views the denial of an adversary's space systems as an essential component of information warfare and prerequisite for victory. It emerges that China's ambitious space plans will not only give China the confirmed strategic advantage but also alter the power dynamics in Asia and the world. China's emergence as a military space power has a direct bearing on India's security, its standing in the fraternity of nations and the security environment in Asia.

Key Words

Yaogan, Gaofen, Jilin, Shijian, Ludikancha Weixing, Tongxin Jishu Shiyan, Beidou, Fenghuo, Shentong, Tianlian and Hongyan.

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Introduction

China launched its first satellite in 1970 and today it has become a major space power with a wide array of satellites and an advanced family of rockets. It also has its own space station and has successfully conducted manned space flight missions. China's **White Paper** on space activities published in 2016 states that the country's space vision is "***to build China into a space power in all respects***[1]". To accomplish this, China has increased its spending on space technologies and activities. China's expenditure on space projects is second highest in the world[2].

In the PLA's strategic thought reflected in their pamphlet '***Science of Military Strategy***', the ability to control and exploit space, serves for both force enhancement and as a deterrent factor[3]. Therefore, establishing space dominance (*zhitianquan*) is an essential enabler for information dominance (*zhixinxiquan*) - a key pre-requisite for fighting wars under informationised conditions[4]. This alludes to China's intentions of using Space as a new war fighting domain[5]. To realise its intentions, China has been developing multiple types of space capabilities to include high resolution electro-optical (EO) sensors, Synthetic Aperture Radars (SAR), Electronic Intelligence (ELINT) sensors and navigation satellites. China is also investing heavily in the development of quantum communication satellites[6]. China is second only to USA in the number of operational satellites.

Apart from space based force enhancement applications, China is concurrently developing niche counter space capabilities, robust space situational awareness and quick launch capabilities. China realises that space dominance will be a vital factor in securing air, maritime and electromagnetic dominance and it will directly affect the course and outcome of future wars[7]. As per US Defence Intelligence Agency (DIA) report released in 2019, China is building space capabilities in a way to deter others from intervening in military conflicts in the Asia-Pacific region[8]. China's Military Space capabilities can be discussed under ISR (Intelligence, Surveillance and Reconnaissance), PNT (Position, Navigation and Timing), SATCOM (Satellite Communication) and counter space capabilities. Apart from this, there are allied

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fields to support and augment military operations from space to include meteorology, Space Situational Awareness (SSA) and Quick Response Mechanism (QRM).

Space Based Intelligence, Surveillance and Reconnaissance (ISR)

China employs a robust space-based ISR capability designed to enhance its worldwide situational awareness. It is used for civil and military remote sensing and mapping as well as terrestrial and maritime surveillance. Space-based ISR figures prominently in Chinese writings and is often considered a critical component in extending China's power projection capabilities. As China's military is increasingly employed to conduct operations farther from its mainland, the utility of space becomes all the more important. China has been working persistently towards gaining a strong foothold in the space arena in order to use it as a strategic outpost. String of advanced satellites with wide spectrum of ISR capabilities serves PLA as "eyes and ears" to keep a tab on the adversaries and complements its strategy of informationised warfare.

China began working on Space imagery in the mid 1960s, launching its first ISR satellite in 1975. Presently, China operates an extensive network of military satellites. Prominent satellite constellations for ISR applications are discussed in succeeding paragraphs.

Yaogan ISR Constellation

The Yaogan satellites, launched by China from 2006 onwards, provide it global surveillance capability. These satellites are completely owned and controlled by PLA and form an important component of its Anti-Access Area Denial (A2AD) strategy. The Yaogan constellation comprises 31 satellites, which are a mix of Electro Optical (EO), Synthetic Aperture Radar (SAR) and Electronic Intelligence (ELINT) satellites[9]. Details of Yaogan constellation are given below :-

a. *Triplet Clusters of ELINT Satellites* : There are six triplet clusters of ELINT satellites that enable coarse tracking of targets such as an Aircraft Carrier Group (ACG). These satellites pick up electronic transmissions and are able to locate the position of targets by triangulation method. Considering the mission life of these satellites to be 5-7 years,

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atleast four such clusters are likely to be currently operational viz Yaogan 17 (A,B,C), Yaogan 20 (A,B,C), Yaogan 25 (A,B,C) and Yaogan 31 (A,B,C).

b. *Broad Area Coverage EO Satellite Cluster* : This cluster comprises EO satellites at an altitude of 1200 Km. They have a broad swath and a medium resolution of 3 to 10m. Four such satellites are likely to be currently operational viz Yaogan 15, 19, 22 and 27[10].

c. *High Resolution EO Satellite Cluster* : This cluster comprises satellites at an altitude of 630 Km and with a resolution of 1 to 3 m. Four satellites are likely to be currently operational in this cluster viz Yaogan 4, 7, 24 and 30.

d. *SAR Cluster* : These satellites utilise a high resolution radar to capture images both during day and night. Six such satellites are likely to be currently operational viz Yaogan 18, 21, 23, 26, 28 and 29.

Ludikancha Weixing (LKW) Satellites

The LKW series of satellites comprises four military satellites launched by China between 2017 and 2018. These satellites have been placed at an altitude of 500 Km and are very similar to the Yaogan high resolution EO satellites.

New Yaogan Theatre ELINT Constellation

China has launched four triplets of this ELINT constellation known as Yaogan-30 between 2017 to 2018. These triplets have been placed at an altitude of 600 Km and an inclination of 35 degrees. This constellation will provide constant electronic surveillance to China over land and sea covering Taiwan, Korean peninsula, Japan's southern waters, Guam, ASEAN countries and Indian Ocean[11].

Gaofen Satellites

The Gaofen series comprises both EO and SAR high resolution satellites, capable of providing imagery with sub-meter resolution. The Gaofen family of high resolution Earth Observation satellites are part of the China High-definition Earth Observation System (CHEOS) meant for

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civilian purposes, with the first satellite launched in 2013. While these were developed for non-military usage but their payload and resolution render them dual applicability. Nine Gaofen satellites are currently operational.

Jilin Satellites

Jilin satellites are designed to be light weight commercial remote sensing satellites with high definition (HD) video and EO sensors of approximately metric resolution and are being fabricated by Chang Guang Satellite Technology Company. Presently six satellites are in orbit, however future plan of launching 60 satellites by 2020 and 138 by 2030 will bring the revisit capability to 10 minutes. These satellites also have dual applicability, for both civil and military usage.

Shijian Satellites

Owned and operated by China's Academy of Space Technology[12], these satellites have a variety of configurations and missions. Although some have been used for civilian purposes, many appear to be having military ISR payloads due to their orbital characteristics and the secrecy surrounding their launches. Some Shijian satellites are also utilised to experiment contemporary technologies like ion and electric propulsion, Signal Intelligence (SIGINT), missile tracking payloads and counter space applications like Rendezvous and Proximity Operations (RPO).

Tongxin Jishu Shiyan (TJS) Early Warning Satellites

From 2016 onwards, China has launched two satellites of the TJS series in the geo-stationary orbit. These satellites will provide early warning of the launch of ballistic missiles. Thus, bridging the gap in China's early warning capability for their Ballistic Missile Defence (BMD) programme[13].

Space Based Position, Navigation and Timing (PNT)

The 1991 Gulf War and subsequent US military operations illustrated the value of the Global Positioning System (GPS) for troop movements, force tracking and precision guidance. This prompted other countries to develop their own satellite navigation systems. Today, satellite navigation services are critical to military and civilian users worldwide, with applications in land,

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air and sea navigation, munition guidance, surveying and mapping, search and rescue, tracking and numerous other applications.

In 1994, Chinese government gave the go-ahead for the development and deployment of an experimental satellite navigation system called '**Beidou-1**'. The first pair of satellites, known as Beidou-1A and Beidou-1B, were launched in 2000 and a third backup satellite Beidou-1C in 2003, making the system fully operational. The Beidou-1 services became available to civilian users in 2004. Thus, China became the third country in the world after USA and Russia to have deployed an operational Space-based navigation and positioning network. Subsequently, **Beidou-2** was planned with ten satellites. By 2012, Beidou-2 started providing regional positioning services covering China and Asia Pacific region. It has two kinds of services, a civilian service with positional accuracy of 10 meters, velocity accuracy of 0.2m/s and timing accuracy of 50 nano seconds. Strategic users are provided better accuracies.

The **Beidou-3**, China's next generation worldwide Beidou constellation project commenced in 2017. Beidou-3 is envisaged to have 35 satellites and will be fully operational for global coverage by 2020[14]. The Beidou constellation also offers text messaging and user tracking through its Short Message Service (SMS), to enable mass communications for specific Beidou users and provide additional command and control capabilities for PLA[15]. Director of China Satellite Navigation Office, had quoted that they are aiming for positional accuracy of 2.5m, which will further be improved to centimeter level with additional ground stations[16].

Beidou was originally designed exclusively for military purpose in order to reduce reliance on foreign PNT services. However, it has now turned into a commercial opportunity with its expanding reach. Chinese government has enunciated policy measures to ensure Beidou integration with current PNT based applications in civilian domain. It has coverage along the Belt and Road Initiative (BRI) countries, thereby incurring massive income for China by providing Beidou services to participating nations.

Satellite Communication (SATCOM)

China's initial Command, Control and Communication (C3) modernisation efforts were focused on developing a robust and secure terrestrial network of fiber optic cables, mobile radios and

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data-links. However, after realising the importance of space during the gulf war of 1991, China enhanced the scope of modernisation by including space applications in its modernisation plans. China has been investing in advanced space based communication capabilities, as nearly all of China's strategic goals and military plans rely on information dominance. The prosecution of Anti-Access Area-Denial (A2AD) strategy is impossible without an advanced space based and terrestrial C3 network. The development of China's communication satellites started at the beginning of 1970s and their first communication satellite in the geostationary earth orbit (GEO) was launched successfully in 1984. Initially, the technical threshold of Chinese communication satellite payloads was much lower than that of advanced countries, however they have gradually developed critical payload technologies like high power transponders, on-board processing, multi-beam antennas, controllable spot-beams, shaped-beam antennas and inter-satellite relay capabilities.

China is currently using a large number of communication satellites for both its civilian and military requirements. Civilian Chinese operators providing SATCOM services are Asia Broadcast Satellites (ABS), Asia Satellite Telecommunication Company (Asia Sat), China Telecommunication Broadcast Satellite Corporation (China Sat) and also from Hong Kong based Asia Pacific Satellite Company (AP Star series). Fabrication of satellites is being done by Chinese agencies like China Great Wall Industrial Corporation (CGWIC), China Aerospace Science and Technology Corporation (CASC) and by foreign vendors like Hughes, Lockheed Martin etc. Altogether, China utilises hundreds of transponders in C, Ku and Ka band for servicing its enormous civil and military SATCOM requirements.

China's specific defence SATCOM requirements are also being met by PLA operated satellites[17]. CASC has developed the **Fenghuo (FH)** and **Shentong (ST)** series of military communication GEO satellites to provide secure voice and data communications for military users. Fenghuo is a family of tactical communications satellites. These satellites are used to support a theatre-level C3 network called '***Qudian***'[18]. Fenghuo satellites provide C and UHF band communications. Shentong is a family of strategi c communication satellites, providing secure voice and data communications in the C and Ku band.

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The mission life of a GEO satellite is normally planned for ten years. Accordingly, replacement satellites are launched. Going by the date of launch, it is evident that ***presently China has 5-7 dedicated satellites to meet its military communication requirements apart from hiring transponders, from a vast array of civil satellites***.

China launched its first data relay satellite, **Tianlian** (TL)-1, in April 2008. It was followed by **TL-1A** in 2008, TL-1B in 2011, TL-1C in 2012 and TL-1D in 2016, to complete global coverage for its data relay system. In March 2019, China launched its first satellite of the TL-2 series, a new family of bigger, more capable data relay satellites to link ground controllers with Chinese Shenzhou spacecraft capsule and China's planned space station[19].

China has been making a focussed effort to develop niche capabilities in the SATCOM domain in order to fill its present capability voids and further gain a technological edge in space over its adversaries. China's state-owned satellite operator 'China Satcom' currently operates a fleet of ten GEO communication satellites. It has been making huge investments in the development of high-throughput satellites (HTS) and Low Earth Orbit (LEO) satellite constellation for communications. It had launched **SJ-13** (**Shijian-13**) or **ChinaSat-16** to test electric propulsion for future satellite buses. **ChinaSat-18** is a HTS slated to be launched in 2019. China Satcom is also part of a joint venture for development of the '***Hongyan'*** constellation of 320 small satellites to provide LEO communication services. With present and future planned array of sophisticated satellites, China Satcom is gearing up to support the country's ambitious Belt and Road Initiative (BRI), thereby highlighting the strategic nature of the entire programme[20].

The importance of secure communication for the armed forces cannot be overemphasised. The recent developments in Quantum communications could potentially prove to be of immense significance for ultra-secure communication network and the Chinese have been researching in this field extensively. Quantum Cryptography can be used to transmit secret messages between two points by 'Quantum Key Distribution' method in which photons are used to transfer the data[21]. Chinese have adopted the twin approach of attempting quantum communications using both optical fibres (terrestrial) and outer space. They established a 712 Km Quantum communication link in November 2016 between Hefei and Shanghai[22] and to enhance the ranges, launched a 'Quantum Experiment at Space Scale' (QUESS) or '***Micius***', a 500 Kg

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satellite into LEO on 16 Aug 2016[23]. Micius satellite is a technological demonstrator for hack-proof communication and China's National Science Center has announced the launch of additional quantum satellites to realise a secure network for both civilian and defence applications.

China is pursuing parallel programmes for military and civil communication satellites. China continues to launch new satellites to replace its aging satellites and increase its overall satellite communications bandwidth, capacity, availability and reliability. Adequate, robust and reliable satellite communication will enhance PLA's C3 capabilities especially while operating in remote and inaccessible areas where terrestrial communications are difficult. Dedicated military communication satellites will also enhance the reach and footprint of PLA Navy in the Indian Ocean region.

Meteorological and Oceanographic Satellites

China owns and operates ten domestically produced **Fengyun** (FY) and **Yunhai** meteorological satellites. China's oceanography satellites, **Haiyang** (HY) carry payloads such as radar altimeters, microwave scatter meters, ocean colour scanners and multi-channel microwave radiometers for real-time views of oceans and coastal zones for scanning biological resources, pollution monitoring and monitoring of estuaries, bays and navigation routes. The China Meteorological Administration supports both civilian and military customers with meteorological data and weather forecasts[24].

Chinese Space Station (CSS)

Chinese government started the manned space programme in under 'Project 921' with an objective of developing manned spaceflight capabilities and ultimately a full fledged Space Station. The programme was planned in three stages, first sage was sending humans to space, second stage involved the establishment of a space station and lastly the development of reusable launch vehicle. These objectives were to be accomplished within three decades. Due to lack of technological know how about manned space flight and station, China took extensive assistance from Russia. **Tiangong-1**, whose name translates to 'heavenly abode' was the first space lab module launched in 2011. It was developed as an elementary prototype space station to master the rendezvous, docking and other operations. These included life and work

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support, safety facilities for humans, experiments and maintenance, which are required to establish a full-fledged space station. **Tiangong-2** was launched in 2016. A permanent CSS is likely to come up by 2022[25]. CSS will be the third manned space station after the now retired Mir of erstwhile Soviet Union and the currently operational International Space Station (ISS) which is also likely to be decommissioned by 2024. CSS will be aided by two robotics arms of 15m length and will be supported by Tianlian data relay satellites. CSS will offer opportunity to launch micro satellites and conduct dual use space missions. While China is claiming that it shall provide a stepping stage to moon, asteroid mining and future space exploration, but its military utilisation for various space and counter space applications cannot be ruled out[26].

China's Counter Space Capabilities

China's counter space developments are coherently and asymmetrically designed to mainly counter a far more technologically advanced adversary's capability. China is pursuing an array of counter space projects, which include direct ascent anti-satellite missiles, co-orbital anti-satellite systems, directed energy weapons (DEW), cyber attack capabilities and ground based satellite jammers[27]. During a conflict, China would employ a combination of "hard attacks", which use kinetic methods to cause permanent and irreversible destruction of a satellite or ground support infrastructure and "soft attacks", which use non-kinetic methods to temporarily affect the functionality of a satellite or ground systems. These have been discussed in the succeeding paragraphs.

Direct Ascent Anti-Satellite (ASAT) Missiles

In January 2007, China tested a direct ascent kinetic-kill missile (SC-19) against a defunct FY-1C weather satellite[28]. The test demonstrated China's ability to strike satellites in LEO. Since then, China has conducted four anti-satellite tests for engaging targets in LEO (160-2000 Km altitude) in between 2010 to 2014. On May 13, 2013, China is reported to have tested a direct ascent ASAT weapon at an altitude of 10,000 Km. It was a cold test with no impact or debris. It is expected that this rocket could be made to reach 30,000 Km to threaten GEO satellites.

Co-orbital Anti-Satellite Systems

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These systems consist of a satellite armed with a weapon such as an explosive charge, fragmentation device, kinetic energy weapon, laser, radio frequency weapon, jammer or robotic arm. Once a co-orbital satellite is close enough to a target satellite, the co-orbital satellite can deploy its weapon to interfere with, disable or destroy the target satellite. Co-orbital satellites also may intentionally crash into the target. These systems provide several advantages over direct ascent anti-satellite weapons, including their ability to be used to target satellites in every orbital regime, generate less debris, conduct attacks without geographic limitations and limit escalation, as many co-orbital attack options are reversible and offer plausible deniability. Chinese satellites have conducted co-orbital manoeuvres in 2008, 2010 and 2013. On July 20, 2013, China launched three satellites : the Shiyan-7 (SY-7), Chuangxin (CX-3) and Shijian-15 (SJ-15). SY-7 initially flow close to SJ-15, then it changed orbit, coming closer to CX-3. SY-7 also carried a robotic arm which the Chinese claimed was for proving in space manipulation technologies. However, in anti-satellite role, it could also be utilised to alter the orbit of target satellites or cause damage to them[29].

Directed Energy Weapons (DEW)

China has been committing substantial resources to research and development (R&D) for directed energy weapons, including those that could be used for anti-satellite missions, since the 1990s. DEWs can deliver concentrated energy along a line of sight trajectory at or near the speed of light to damage or destroy equipment, facilities and personnel. In 2006, China is suspected to have fired a laser at a US satellite, resulting in a temporary degradation of its functionality.

Cyber Attack

The Chinese are also developing systems to degrade or damage data links that connect satellites to ground stations[30]. Space dominance can be achieved if a key satellite is shut down, its mission payload is pointed in the wrong direction or it is unable to communicate at critical moments. Indeed, this may be a preferable option, since attribution may be difficult and such approaches are unlikely to generate space debris. PLA during a conflict would attempt to conduct cyber attacks against satellites and ground-based facilities that interact with satellites. These, cyber attack capabilities are an integral part of China's counter space capabilities.

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Ground Based Satellite Jammers

Since the mid-2000s, China has acquired a number of foreign and indigenous ground based satellite jammers, which are designed to disrupt an adversary's communications with a satellite by overpowering the signals being sent to or from it. PLA may employ jammers to degrade or deny an adversary's satellite link during operations.

Quick Responce Mechanism (QRM) or Launch on Demand (LoD)

QRM or LoD can be described as the ability to place satellites into the orbit at very short notice during time of crisis and combat operations. The LoD capability includes development of command and control system, spacelift system and small satellites with various payloads. It entails the use of small and agile launch platforms to rapidly deploy many small satellites to do the job of one large satellite. This requires a change in philosophy from performing missions with single, large, highly reliable, high priced satellites to many small, low performance, inexpensive satellites. China has developed the **Kuaizhou**[31] series of solid fuel rocket system for LoD capability.

Space Situational Awareness (SSA)

With space emerging as a key enabler of successful war fighting, militaries across the world have become watchful of events in space which may impact their assets. Situational awareness of space is thus a critical 'must have' not only for defensive and offensive space operations but even for successive military operations on ground[32]. The US Strategic Command (USSCOM) defines SSA as "the requisite current and predictive knowledge of space events, threats, activities, conditions of space systems, their status, capabilities, constraints and employment to current and future, friendly and hostile space faring countries to enable commanders, decision makers, planners and operators to gain and maintain space superiority across the spectrum of conflict." The USSCOM thus aptly identifies that space superiority is a must for future wars and that SSA is a key enabler to space superiority.

China has not officially acknowledged its SSA capabilities. However, it is expected to have a network of phased array radars for tracking objects in LEO at Jiangxi, Hainan, Xuanhua,

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Changchun, Henan, Kunming, Kashi and North West China[33]. China also operates Yuangwang tracking ships for increasing its coverage. In 2013, China commissioned a tracking station at Ngari, in the Tibetan Autonomous Region (TAR) which is expected to provide coverage to China over all Indian satellites[34]. A similar facility has also been commissioned by China in Patagonia, Argentina, which is believed to be utilised for tracking US military satellites[35].

Conclusion

The Chinese Space Programme is one of the world's most active, advanced and successful space programmes. China has rapidly developed advanced C4ISR (Command, Control, Communication, Computer, Intelligence, Surveillance and Reconnaissance) capabilities, an advanced manned space programme and a robust SSA network. The Chinese believe that as important as it is to possess advanced space based C4ISR capabilities[36], it is equally important to deny these capabilities to their opponents in a combat situation. This is of paramount importance for gaining information superiority. Thus, China is developing systems and technologies that can interfere with or disable vital space-based navigation, communication and intelligence satellites of an adversary. The strides made by China in its space and counter-space capabilities pose a potential threat to India's space assets and national security.

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