

The Support of China's Space Based Capabilities to Its Naval Operation

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Introduction

Traditionally, China is viewed as a land power, that geography and security factors basically constrain its ability and desire to develop naval power. China has a very long border and related disputes, but, nowadays, it has resolved its border disputes with most of its land neighbors including Russia and Vietnam etc., however, the disputes with its maritime neighbors over maritime territories have not been resolved.¹ It implies the constraining effect has declined as continental threats have eased and as threats to China's expanding maritime interests have become more salient.²

¹ Nai Li, "The Evolution of China's Naval Strategy and Capabilities : From "Near Coast" and "Near Seas" to "Far seas,"" in Phillip C. Saunders, eds., *The Chinese Navy : Expanding Capabilities, Evolving Roles*(Washington D.C. : National Defense University,2011), p.131.

² See Michael A. Glosny and Phillip C. Saunders, "Correspondence: Debating China's Naval Nationalism," *International Security*, Vol. 35, No. 2, Fall 2010, p.168.

In 2018, China had record oil and gas imports and remains the number one crude oil importer in the world after surpassing the United States in 2017 and is the number two natural gas importer, behind Japan, according to the International Energy Administration.³ China is particularly reliant on unimpeded SLOCs like the South China Sea and Strait of Malacca. In 2016, approximately 80 percent of China's oil imports and 11 percent of natural gas imports transited the South China Sea and Strait of Malacca.⁴ For China, it is beyond doubt that there are mounting demands for oil and gas year by year, and this, by the way, became one of the source of insecurity of China. The maritime security is obviously crucial to China's persistent economic growth and so as to the ruling legitimacy of CCP. The so-called "Malacca Dilemma" seemed to provide a maritime strategic rationale to push China rethinking its national strategy, in the meantime, China needs to find ways to

³ "China - Oil and Gas," *Export.Gov*,
<https://www.export.gov/article?id=China-Oil-and-Gas> (Accessed 2019/10/10)

⁴ Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China*, May 15, 2017, p.43.
https://www.defense.gov/Portals/1/Documents/pubs/2017_China_Military_Power_Report.PDF?ver=2017-06-06-141328-770 (Accessed 2019/10/1).

remedy the feeling of insecurity arose from those facts.

Nowadays, the type of warfare has transited to information warfare, the application of information technology in all aspects of military operations is even more prominent. Learning from the experiences of major campaigns, the substantial space capabilities are crucial to the key matters of informationized warfare like long-range precision strikes, C4ISR(Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance), A2/AD (anti-access –area denial), and joint force integration and communications dominance. Although China still sticks to the strategic guideline “active defense,” China also announced, in this white paper, to revise its basic point of preparation of military struggle to be capable of “winning informationized local wars” with an emphasis on “maritime military struggle.” Therefore, when China desires to achieve the goal of “win the maritime military struggle” under the informationized circumstance, how to leverage its sophisticated space technology to improve the C4ISR and joint operation capabilities will be the major hurdle needs to overcome.

In 2009, China's State Councilor Dai Bingguo officially interpreted the term “China's core interests” as: 1. to maintain its fundamental system and state security; 2. state sovereignty and territorial integrity; 3. the continued stable development of

the economy and society.⁵ From this interpretation, in addition to maintaining an steady energy supply to achieve the stable development of the economy, how to secure the sovereignty issue is another important dimension for China. Normally, Taiwan, South China Sea, Tibet, and Xinjiang refer to the sovereignty issues in this term of China's core interests. Taiwan as well as the South China sea are always seen as the most controversial ones among those sovereignty issues, and China routinely vowed it will never give up an inch of its territory- whether Taiwan or the South China Sea. In this context, China will have to demonstrate its presence in the crucial area or sea lanes in the peacetime, and flex its military muscle to the rival when necessary, this implies that China needs a capable navy to complete these missions, and, in the context of modern warfare, the space power is definitely the backbone of the capable navy.

The Evolution of China's Naval Strategy

China's navy strategy is evolving. The People's Republic of China(PRC) was founded in 1949, since then to1980s, the concept of naval strategy is so called "near-coast defense." The near-coast defense strategy refers to the defense of up to a

⁵ "Dai Bingguo (戴秉國): The Core Interests of the People's Republic of China," *China Digital Times*, <https://chinadigitaltimes.net/2009/08/dai-bingguo-%E6%88%B4%E7%A7%89%E5%9B%BD-the-core-interests-of-the-prc/> (Accessed 2019/10/9)

dozen or so nautical miles of waters that extend seaward from China's coastline and the land territory of about 300 kilometers that stretches inland from the coastline.⁶ During that period, defense of the homeland and its littoral water is no doubt the China's top strategic priority for its navy. The updated concept of near-seas active defense was first proposed by Deng Xiaoping in July 1979, it was further fleshed out by Liu Huaqing as "defend actively, operate in the near seas" and treated as a China's new naval strategy in 1987.⁷

"The Science of Military Strategy 2013," issued by the Academy of Military Sciences of the People's Liberation Army of China, emphasizes the importance of being able to "strike out" when confronted by "military intervention" from outside powers in conflicts originating within the First Island Chain, i.e., the "Near Seas."⁸ For operational bounds and space, near-seas active defense is defined as covering : 1. The first island chain, which stretches from the Kurile islands through the islands of Japan ,Ryukyu Archipelago, Taiwan , and the Philippines to Borneo Island; 2. The Yellow Sea, East China Sea, and South China Sea, or the three near seas within the inner rims for the first island chain; 3. Sea areas adjacent to the

⁶ Nai Li, op. cit., p.111.

⁷ Nai Li, op. cit., p.116.

⁸ *The Science of Military Strategy* (Beijing : *The Academy of Military Science*, 2013).

outer rims of this island chain ,and those of the north Pacific.⁹ The main objective of near seas defense is to defend China's territorial and jurisdictional disputes in the seas directly adjacent to the Chinese mainland, or to keep the United States from interfering with China's offshore military operations.¹⁰

Chinese military developments have occurred along two vectors, one that is concerned with coastal defense and the traditional emphasis on national sovereignty, and another, more recent, concerning power projection capabilities and protection of its sea lines of communication further from shore.¹¹ China's sense of insecurity of its sea lines of communication partly came from a number of Western "strategists" writing that in

⁹ Nai Li, op. cit., p.116. However, in the china's defense white paper, it used the name of "off-shore waters defense" instead of "near seas defense"; some scholars refer the off-shore waters to the area between China's coast line and the second island chain including Philippine Sea. See Michael McDevitt, "China's Far Sea's Navy: The Implications of the "Open Seas Protection", " *Mission*, https://www.cna.org/cna_files/pdf/China-Far-Seas-Navy.pdf, p.2. (Accessed 2019/10/1)

¹⁰ Michael McDevitt, op. cit.

¹¹ Mcdevitt, M., Vellucci Jr., F., "The evolution of the People's Liberation Army navy: the twin missions of area-denial and peacetime operations," in G. Till, P. Bratton (eds.), *Sea Power and the Asia-Pacific: The Triumph of Neptune?* (London : Routledge,2012), pp.75-76.

time of conflict the way to bring China to its knees is to cut its sea lanes.¹² In 2005, the U.S. consulting firm Booz Allen Hamilton came up with the phrase “string of pearls” in a report entitled “Energy Futures in Asia”, it alleged that China was adopting a “string of pearls” strategy of bases stretching from the Middle East to southern China. These “pearls” were naval bases or electronic eavesdropping posts built by the Chinese in Myanmar, Bangladesh, Pakistani and Sri Lanka. The purpose was to project its power overseas and protect its oil shipments.¹³ This is also a fact reflects that China begins to transit the conservative “local strategy” toward a active “global strategy”, to comply with this strategy change, the operation area extends from near seas to far seas.

China's far seas (also called open seas)ambitions was spelled out in the“China's Military Strategy 2015” :

With the growth of China's national interests...the security of overseas interests concerning energy and resources, strategic sea lines of communication (SLOCs), as well as institutions, personnel and assets abroad, has become an imminent issue. ...

In line with the strategic requirement of offshore waters defense and open seas protection, the PLA Navy (PLAN)

¹² Michael McDevitt, op. cit., p.5.

¹³ Juli A. MacDonald, *Energy Futures in Asia: Final Report*(Booz-Allen & Hamilton, 2004)

will gradually shift its focus from “offshore waters defense” to the combination of “offshore waters defense” with “open seas protection,” and build a combined, multi-functional and efficient marine combat force structure. The PLAN will enhance its capabilities for strategic deterrence and counterattack, maritime maneuvers, joint operations at sea, comprehensive defense and comprehensive support.

It is necessary for China to develop a modern maritime military force structure commensurate with its national security and development interests, safeguard its national sovereignty and maritime rights and interests, protect the security of strategic SLOCs and overseas interests, and participate in international maritime cooperation, so as to provide strategic support for building itself into a maritime power.

Note : Emphasis was put by author.

While there is a strategist specify the term “four seas and two oceans.” for both the near and far seas, The “four seas” refer to the Bohai Gulf, Yellow Sea, East China Sea and South China Sea—i.e., the Near Seas. The “two oceans” are shorthand for the Pacific Ocean and Indian Ocean.¹⁴ The main

¹⁴ Ryan Martinson, Katsuya Yamamoto, “ How China's Navy Is Preparing to Fight in the 'Far Seas',” *The National Interest*, July 18, 2017, <http://nationalinterest.org/feature/how-chinas-navy-preparing-fight-the-fa>

responsibility of far seas protection is to safeguard China's expanding interests overseas, such as the protection of sea lanes of communication and Chinese businesses abroad. Moreover, a key function of far seas operations is to "deny the adversary entry to the near seas."



Fig. 1 Major Sea Lines of Communication in Asia.

Source: Office of the Secretary of Defense, *Annual Report to Congress: Military Power of the People's Republic of China* (Washington, D.C., 2009), p. 4.

A PLA senior officer, who is in charge of strategic planning, provided three major considerations to explain why china shifts its focus from 'offshore(near) waters defense' to a combination of 'offshore waters defense' and 'open(far) seas

protection' : ¹⁵

First, from a national strategic perspective, China needs to build a strong navy to efficiently maintain and protect national maritime rights and interests.

Second, from the perspective of the world's new revolution in military development, a very clear trend of demand for long-range precision weapons and equipment has emerged. This enlarges the potential scale of the ocean battlefields.

Third, from the perspective of the realistic security challenges, which require a navy that has the capability to accomplish a variety of military tasks including effectively maintaining the sovereignty of territory, as well as protecting overseas security interests.

The support of space based capabilities to naval operation

Along with the growing significance and sophistication of information technology, and the increasing pace of weaponry revolution, information and space technology play a vital role in the campaign. Nowadays, the long-range, precise, unmanned weapons and equipment are becoming increasingly popular. China's scholar urges a continual reform and innovation in

¹⁵ "SCIO briefing on White Paper on China's Military Strategy,"

China.org.cn, May 26, 2015,

http://china.org.cn/china/2015-05/26/content_35665618_3.htm(Accessed 2019/10/2)

order to seize the “high ground” theory, with particular emphasis on “understanding outer space, using outer space, defending outer space, and fighting in outer space.” At the same time, they also urge the development of an outer-space information counter-measures system, as “an information advantage depends on an outer space advantage.”¹⁶

The new generation of operation concepts and systems, such as integrated C4ISR, powered by information technology, have helped the military to identify and target distant forces and communicate with its force. However, the function of C4ISR needs information or data provided by space system, so that space system is regarded as a critical part of C4ISR, also called as “system of system.” In other words, establishing space dominance is an essential component of achieving information dominance, who lose space domination, then will lose the ability to win information-led warfare. Consequently, the space is viewed as a 'new strategic high ground,' in war and becoming a center of gravity for 21st Century information-led warfare.

The strategic value of space assets in modern war can be understood by the statistics : ¹⁷

¹⁶ Yue Guiyun, Chen Xiaoyang, and Li Jingxu, “Considerations on Some Important Issues on New Joint Operations in the Future,” *China Military Science*, 2012, pp.134–136.

¹⁷ Charles D. Lutes and Peter L. Hays, *Toward a Theory of Spacepower*

- in the Gulf War, the United States used 52 military satellites
- in Kosovo, the United States and NATO used 86 satellites
- in the Iraq war, U.S.-UK forces used over 100 satellites.

Moreover, for the 2003 Iraq war, the United States relied on satellites for 95 percent of reconnaissance and surveillance information, 90 percent of military communications, 100 percent of navigation and positioning.¹⁸ In response to the evolving form of modern warfare and national security requirements, China decided to modify its military guidelines to "winning informationized local wars." The concept of "informatization" figures in PLA is roughly analogous to the U.S. military's concept of "net-centric" or C4ISR.

The C4ISR systems enable information sharing—intelligence, battlefield information, logistical information, and weather reports—on robust and redundant communications networks, which improve commanders' situational awareness and improve the speed and effectiveness of decision-making and make operations more efficient. The US-China Economic and Security Review Commission describes the growing importance of space-based programs in the PLA's strategy as follows:¹⁹

(Washington D.C : National Defense University, 2011), p.468.

¹⁸ Ibid.

¹⁹ Kevin Pollpeter, "China Dream, Space Dream: China's Progress in Space

*A robust, space-based C4ISR system is often described as a critical component of a future networked PLA. The necessity to develop space-based C4ISR systems is based on the requirement to develop power projection and precision-strike capabilities. The development of long-range cruise missiles and anti-ship ballistic missiles for over-the-horizon attacks requires the ability to locate, track, and target enemy ships hundreds of kilometers away from China's shores, as well as the ability to coordinate these operations with units from multiple services. **In doing so, remote sensing satellites can provide intelligence on the disposition of enemy forces and provide strategic intelligence before a conflict begins.** Communication satellites can provide global connectivity and can facilitate communications between far-flung forces. Navigation and positioning satellites can provide critical information on location and can improve the accuracy of strikes.*

Note : Emphasis was put by author.

The PLA seeks to modernize itself both technologically and organizationally to command complex, joint operations in

Technologies and Implications for the United States,” *US-China Economic and Security Review Commission*, March 2, 2015, https://csis-prod.s3.amazonaws.com/s3fs-public/publication/160819_Chinese_Space_Strategy_Developments_0.pdf. (Accessed 2019/10/2)

near and distant battlefields with increasingly sophisticated weapons. There is a complex process to target mobile target: correlating and fusing real-time sensor inputs, and then disseminating accurate situation reports and targeting packages to commanders and shooters. Even when it achieves complete coverage of relevant maritime zones, data transmission (from satellites to ground stations), imagery readouts by analysts (increasing in time consumption with size of area examined) and sending targeting data to the shooter will impose time delays. The PLA is now fielding advanced automated command systems like the Integrated Command Platform to units at lower echelons across the force, consequently, it can shorten the command process to seize tactical opportunity. The adoption of the Integrated Command Platform enables multi-service communications necessary for joint operations while providing secure and reliable communications to fixed and mobile command posts. So the C4ISR hardware capabilities became an essential component of narrowing the gap that separates the PLA from the world's most technologically advanced militaries.

In terms of naval operation, China normally depends on its land based missile to contribute to the defense of its home waters. However, for the operations in the distant sea, the PLAN needs a long range missile system. For example, the PLAN recognizes that long-range anti-ship cruise missiles(ASMs) require a robust, over-the-horizon targeting

capability to realize their full potential, these problems can be mitigated to some degree in a near seas situation with over-the-horizon radar, sea-based radar, and UAV ISR. However, effective space-based C4ISR capable of providing faster processing, more imagery, and data fusion, which is necessary for the anti-ship ballistic missiles (ASBM) or anti-ship cruise missiles (ASCM) to reach its full potential for targeting across the Asia-Pacific.²⁰ For this reason, China is investing in C4ISR systems at the strategic, operational, and tactical levels to provide high-fidelity targeting information to surface and subsurface launch platforms.²¹

China's Space Based Capabilities

In the late 1990s, because the telecommunications infrastructure was “inadequate” and “outdated,” this weakness “severely limited the PLA's operation effectiveness,”²² therefore, China's military leaders asked to achieve “major

²⁰ Anthony H. Cordesman, Joseph Kendall, “How China Plans to Utilize Space for A2/AD in the Pacific,” *The National Interest*, August 17, 2016, <http://nationalinterest.org/blog/the-buzz/how-china-plans-utilize-space-a2-ad-the-pacific-17383>(Accessed 2019/10/1)

²¹ Office of the Secretary of Defense, op. cit., p.25.

²² James Mulvenon and Thomas J. Bickford, “The PLA and the Telecommunications Industry in China,” in James C. Mulvenon and Richard H. Yang, eds., *The People's Liberation Army in the Information Age* (Santa Monica, CA : Rand, 1999), pp.245-257.

progress” toward informatization. One of the lessons that PLA learned from Revolution in Military Affairs is that space system plays a crucial role in conducting a successful sea battle, the core advantage of outer space in current military affairs is providing information integration support. The Space technology has a dual-use characteristic, it implies that most of the technology used in space has both civilian and military applications. Especially, in China, PLA is the one behind China’s space program, it is responsible for operating all of China’s space infrastructure, from launch sites to mission control facilities to tracking stations and ships, therefore, the advancement of China’s space capabilities will inevitably strengthen its military capabilities and comprehensive national power as well.

Unlike the land, space-based sensors permit wide-area search for surface vessels because there is nowhere to hide on the ocean’s surface. The PLA endeavors to improve its ability to monitor the situation in the Asia-Pacific region through an advanced system of space-based remote sensing, communications, and navigation satellite. Meanwhile, China is seeking to utilize space systems to establish a robust C4ISR to provide a real-time and accurate surveillance, reconnaissance and warning function, and to enhance joint operations capabilities. These advancements include the BeiDou navigation satellite system and space surveillance capabilities that can monitor objects across the globe. The purpose China

pursuits of space power consists of politic, economy and military aspects. From the political view, China eagers to procure symbolic benefits that both aid regime legitimacy at home and enhance Chinese prestige abroad; from the economic view, it can make enormous economic benefits; and for military, taking the advantage of dual use characteristic of space technology, it can enhance PLA's military capability to conduct information warfare.

1.China's space force

The PLA established a Strategic Support Force (SSF) on the last day of 2015, which is responsible for these missions may centralize previously disparate components of the PLA. Prior to 2015's structural reforms, for example, the responsibility for space, cyber, and EW rested with offices across the former General Armament Department(GAD) and General Staff Department (GSD), such as the GSD Technical Department and GSD Electronic Countermeasures and Radar Department. The structural reform is actually a revolutionized move to integrate its own space, cyber, and electronic warfare capabilities. During the SSF's establishment ceremony, President Xi described it as a "new-type combat force to maintain national security and an important growth point for the PLA's combat capabilities."²³ As a separate military

²³ "Reform of China's army enters a new phase," *The Economist*, Aug 3rd, 2017,

Service, SSF primarily designed around two operational imperatives. One, is peacetime-wartime integration. The SSF simplifies the commanding process by organizing the related units into operational groups under new domain-centric verticals as standard practice, optimized, like the new Military Theater Commands, as a wartime structure. Two, the SSF is intended to shift the PLA's most strategic, informatized missions from a discipline-centric to domain-centric force structure.²⁴

2.China's Satellite systems

(1)Navigation System--BeiDou System

BeiDou Navigation Satellite System is called BeiDou System for short, with the abbreviation as BDS. When fully deployed, the space constellation of BDS consists of five Geostationary Earth Orbit (GEO) satellites, twenty-seven Medium Earth Orbit (MEO) satellites and three Inclined Geosynchronous Satellite Orbit (IGSO) satellites. The GEO satellites are operating in orbit at an altitude of 35,786

<https://www.economist.com/news/china/21725812-overhaul-says-lot-about-xi-jinpings-governing-style-reform-chinas-army-enters-new-phase>.

(Accessed 2019/10/1)

²⁴John Costello, "The Strategic Support Force: Update and Overview," *The Jamestown Foundation*, December 21, 2016,

<https://jamestown.org/program/strategic-support-force-update-overview/>

(Accessed 2019/10/1)

kilometers and positioned at 58.75°E, 80°E, 110.5°E, 140°E and 160°E respectively. The MEO satellites are operating in orbit at an altitude of 21,528 kilometers and an inclination of 55° to the equatorial plane. The IGSO satellites are operating in orbit at an altitude of 35,786 kilometers and an inclination of 55° to the equatorial plane.²⁵(see Table 1)

Table 1 BeiDou Orbital Constellation

5 satellites on 58.75° E, 80° E, 110.5° E, 140° E, 160° E		
GEO	altitude	35,786 km
27 satellites on MEO	altitude	21 528 km
	inclination	55°
	number of planes	3
	period	12 h 53 min 24 s
3 satellites on IGSO	118° E	
	inclination	55°
	altitude	35,786 km

Source : “BeiDou Navigation Satellite System Signal in Space Interface Control Document Open Service Signal (Version 2.1),” *China Satellite Navigation Office*, November 2016, <http://en.beidou.gov.cn/SYSTEMS/ICD/201806/P0201806085>

²⁵ “BeiDou Navigation Satellite System Signal in Space Interface Control Document Open Service Signal (Version 2.1),” *China Satellite Navigation Office*, November 2016, <http://en.beidou.gov.cn/SYSTEMS/ICD/201806/P020180608523308843290.pdf>. (Accessed 2019/9/15)

23308843290.pdf. (Accessed 2019/9/15)

China's decision not to rely on the U.S. GPS satellites apparently stems back to the 1996 Taiwan Crisis, when China claimed that the GPS interfered with missile launching, which a retired Chinese colonel stated was "a great shame for the PLA."²⁶ On the other hand, Beijing has had only limited access to receiver technology and was denied access to the military mode of Europe's nascent Galileo system, apparently intensifying existing Chinese efforts to develop BeiDou further.²⁷ BDS is considered as a Chinese version of Global Positioning System (GPS), one of the major characteristics is the BDS integrates navigation and communication capabilities for the first time, and has five major functions - real-time navigation, rapid positioning, precise timing, location reporting and short message communication services.²⁸

Satellite navigation facilitates the monitoring of friendly

²⁶ Anthony H. Cordesman, Joseph Kendall, op. cit.

²⁷ Andrew S. Erickson, "Satellites Support Growing PLA Maritime Monitoring and Targeting Capabilities," *The Jamestown Foundation*, February 10, 2011, <https://jamestown.org/program/satellites-support-growing-pla-maritime-monitoring-and-targeting-capabilities/>(Accessed 2019/10/1)

²⁸ "China's BeiDou Navigation Satellite System," *Xinhua news*, http://english.chinamil.com.cn/news-channels/today-headlines/2016-06/16/content_7104576_2.htm(Accessed 2019/10/2)

forces and the targeting of enemy forces by offering reliable positioning signals. It supports command and control by providing basic communications functions. China appears on track to achieve its goal of a 35-satellite constellation—called BeiDou-3/Compass—with global coverage by 2020.²⁹

(2) Reconnaissance satellite

Yaogan, Gaofen and Jilin, Operating from near-polar, Sun-Synchronous Orbits (SSO), are the major space satellite series particularly relevant to maritime monitoring and targeting. The Yaogan satellite series is assessed to include high-resolution optical imaging sensors, SAR, and electronic intelligence (ELINT) sensors. Owing to the officials keeping confidential most of the Yaogan's information, it was speculated that the Yaogan was mainly used for the military. The Yaogan is designed for location and tracking of foreign warships, the satellites will collect optical and radio electronic signatures of the maritime vessels that will be used in conjunction with other information valuable for the Chinese maritime forces,³⁰ and provide accurate positioning data to

²⁹ "Beidou/Compass Series, " *Jane's Space Systems and Industry*, 5 July, 2016, www.janes.com.

³⁰ Rui C. Barbosa, "Long March 4C launches Yaogan Weixing-16 spy satellite for China," *Spaceflight.com*, November 25, 2012, <https://www.nasaspaceflight.com/2012/11/long-march-4c-yaogan-weixin-g-16-spy-satellite-china/>. (Accessed 2019/10/2)

missile like ASBMs for targeting. For example, six of the satellites—the Yaogan 9 made up of three co-launched satellites (9 A, 9 B, 9 C), the Yaogan 16(16 A, 16 B 16 C), the Yaogan 17 (17 A, 17 B and 17 C), the Yaogan 20 (20A, 20B and 20 C), the Yaogan 25 (25A, 25B and 25C) and the most recently launched Yaogan 31 (31A, 31B and 31C)—form an Electronic Intelligence (ELINT) Satellite cluster. These are the satellites that enable identification and coarse tracking of objects of interest such as an aircraft carrier strike force.³¹ Furthermore, the two Yaogan 32 satellites, designated Yaogan 32-01 and 32-02, riding a Long March 2C booster into orbit on October 2018 from the Jiuquan space center,³² they are the latest satellites to join the Yaogan series and believed also to be the ELINT Satellite.(See Table 2)

³¹ See S. Chandrashekar and N. Ramani, “China’s Space Power & Military Strategy—The role of the Yaogan Satellites,” National Institute of Advanced Studies, 9, http://issp.in/wp-content/uploads/2018/07/Chinas-Space-Policy_July2018.pdf (Accessed 2019/9/23).

³² Stephen Clark, “Two satellites with secretive missions launched by China,” *Spaceflight Now*, October 12, 2018, <https://spaceflightnow.com/2018/10/12/two-satellites-with-secretive-missions-launched-by-china/>

Table 2 The Yoagan Series

Military Designation	Launch Date of the First Sat.	Designation	Type
JB-5	2006/4/27	Yaogan-1,3,10	SAR
JB-6	2007/5/25	Yaogan-2,4,7,11,24	Optical
JB-7	2009/4/22	Yaogan-6, 13,18,23	SAR
JB-8	2010/3/5	Yaogan-9,16,17,20,25	ELINT
JB-9	2009/12/15	Yaogan-8,15,19,22,27	Optical
JB-10	2008/12/15	Yaogan-5,12,21	Optical
JB-11	2012/5/10	Yaogan-14,26,28	Optical
Note	No military designation: Yaogan 30 : optical ;Yaogan 31 , Yaogan 32: ELINT		

Source : Summarized from *Gunter's Space Page*,
<https://space.skyrocket.de/index.html>

Gaofen is a series of civilian Earth observation satellites developed and launched for the China High-definition Earth Observation System (CHEOS), a state-sponsored program aimed to develop a near-real time, all-weather, global surveillance network consisting of satellite, near-space (stratosphere) airships, and aerial observation platforms. The Gaofen project aims to launch seven high-definition observation satellites before 2020. Presently, Gaofen-1 and Gaofen-2 satellites, part of Gaofen project series, are orbiting around the earth at low orbits around 600-700km. The Gaofen-4, considered to be the world's most powerful GEO spy

satellite, is China's first geosynchronous orbit HD optical imaging satellite and the world's most sophisticated HD geosynchronous orbit remote sensing satellite.³³ Likely to be stationed at 110 to 112°E, areas covered by the satellite include the entire Chinese Territory, the Asia-Pacific Region including Australia, and entire Indian Subcontinent and surrounding regions as well as Kazakhstan and portions of Russia.³⁴ It can track aircraft carriers by their wake at sea because of excellent color image resolution of slightly less than 50 meters, and it can also monitor strategic foreign sites such as WMD facilities and naval bases inside its observation box instantly because of its round-the-clock coverage.³⁵

Otherwise, China launched the first Jilin mission in October 2015. The mission included a high-definition

³³ "China launches HD earth observation satellite," *Xinhua News*, 2015-12-29, <http://www.globaltimes.cn/content/961029.shtml> (Accessed 2019/10/10)

³⁴ "China closes 2015 Space Launch Year – Long March 3B lofts Gaofen-4 Earth Observation Satellite," *Spaceflight101.com*, December 28, 2015, <http://spaceflight101.com/china-gaofen-4-launch/> (Accessed 2019/10/7)

³⁵ Jeffrey Lin and P.W. Singer, "Gaofen 4, The World's Most Powerful GEO Spy Satellite, Continues China's Great Leap Forward Into Space," *Popular Science*, January 8, 2016, <https://www.popsci.com/gaofen-4-worlds-most-powerful-geo-spy-satellite-continues-chinas-great-leap-forward-into-space> (Accessed 2019/9/7)

multi-spectral imaging satellite, two video imaging satellites, and a satellite for “imaging technique testing.” By 2020, China plans to have sixty Jilin satellites orbiting in a global network “capable of a 30 minutes’ update. Finally, by 2030, the goal is to have “138 satellites in orbit, forming an all-day, all-weather, full spectrum acquisition segment data and a capability of observing any global arbitrary point with a 10 minutes revisit capability, providing the world’s highest spatial resolution and time resolution space information products,”³⁶ so it is believed that Jilin satellite will have the capability potentially more than adequate for ASBM targeting.

The Support of China's Space Based Capabilities to naval Operation

In order to protect the core interests of China, whether security or sovereignty, keeping the capabilities to successfully execute A2/AD strategy is the important goal for China to achieve. It is widely posited that China's A2/AD strategy is to seek to delay or even deter US intervention in support of key friends and allies in the Asia Pacific region, including Taiwan. By holding at risk key American platforms and systems (e.g., aircraft carriers), A2/AD allows Beijing to compete with the

³⁶ Rui C. Barbosa, “China Launches Jilin-1 Mission via Long March 2D,” *Spaceflight.com*, October 7, 2015, <https://www.nasaspaceflight.com/2015/10/china-launches-jilin-1-mission-long-march-2d/>.(Accessed 2019/9/7)

United States asymmetrically. A2/AD is a joint campaign that involves the PLA Navy, Air Force and Rocket Force that has the operational objective of keeping an approaching hostile forces at bay by attacking them far from China (A2) or if that fails, or if hostile forces are already within striking range of China, attempt to deny them freedom of operational and tactical action (AD). In the U.S. Department of Defense report 2016, Chinese military capabilities for A2/AD warfare consists of eight different aspects: information operations, cyber operations, long-range precision strike, ballistic missile defense (BMD), surface and undersea operations, space and counterspace, Integrated Air Defense System (IADS), and air operations.³⁷ Long-range precision strikes, theater ballistic missile defense, information dominance, and conventional counterforce tracking are the key components of A2/AD, which requires significant tracking and C4ISR ability, much of which can only be provided by space-based assets.

China's A2/AD programs rely on a mix of space-based systems including remote sensing satellite and BeiDou navigation satellite, Yaogan, Gaofen, and Jilin, as remote sensing satellites, are particularly relevant to maritime monitoring and targeting. In terms of naval operation, the PLAN should pursuit the ability to conduct operations

³⁷ Department of Defense, *Military and Security Developments Involving the People's Republic of China for 2016*, April 2016, pp.59-62.

including offense and defense in near seas. The improvements in these space based platforms will inevitably enable an increase in Chinese naval capabilities from A2/AD in the near seas to regional blue-water operations, and coordinating joint operations.

In order to deny access, China must be able to execute a kill-chain starting with “target detection and including munition delivery, weapon guidance, damage assessment, and potential restrike” of its opponent’s battleships, aircraft carriers, fighter jets, submarines, information hubs, and missile positions at long distances.³⁸ At its simplest, A2/AD is centered on conventional counterforce targeting, however, the successful targeting is not an easy thing in practice, detecting and identifying a target may be relatively simple, target tracking and information passing in real time is much more complicated. In addition, China must build the integrated system necessary for the substantial tracking , this requires high-quality real-time satellite imagery and target locating data and fusion, as well as of reliable indigenous satellite positioning, navigation, and timing (PNT)³⁹

The 2001 QDR identified missiles (both ballistic and cruise) and chemical, biological, radiological, nuclear and explosive (CBRNE) weapons as the greatest anti-access

³⁸ Anthony H. Cordesman, Joseph Kendall, op. cit.

³⁹ Anthony H. Cordesman, Joseph Kendall, op. cit.

threats, particularly for their ability to deny or delay U.S. military access to overseas bases, airfields, and ports. Especially, ASCM is one of the weapon systems that can threaten the ability of U.S. naval and amphibious forces to operate in littoral waters.⁴⁰ For example, the most advanced ASCMs that are now appearing, such as the YJ-18 supersonic long-range ASCMs will be deployed on the PLAN's new generation of naval surface ships and submarines. The YJ-18's greater range and speed than previous Chinese ASCMs, along with its wide deployment across PLA platforms, would significantly increase China's A2/AD capabilities against U.S. Navy surface ships operating in the Western Pacific during a potential conflict.⁴¹ The YJ-18 equally depend on effective and timely intelligence gathered by sensors in space such as China's BeiDou Navigation Satellite System. On the other hand, the deployments of ASCM-equipped submarines in support of counterpiracy patrols, underscoring China's interest

⁴⁰ U.S. Department of Defense, *Quadrennial Defense Review Report 2001* (Washington D.C. : U.S. Department of Defense, 2001), pp.26–43.

⁴¹ Michael Pilger, "China's New YJ-18 Anti-ship Cruise Missile: Capabilities and Implications for U.S. Forces in the Western Pacific," *the U.S.-China Economic and Security Review Commission*, October 28, 2015, <https://www.uscc.gov/sites/default/files/Research/China%E2%80%99s%20New%20YJ-18%20Antiship%20Cruise%20Missile.pdf>. (Accessed 2019/9/12)

in protecting SLOCs beyond the South China Sea. Furthermore, among these various A2/AD systems, the one that is causing the greatest concern to the U.S. Navy is the DF-21D development. DF-21D is an ASBM capable of hitting U.S. aircraft carrier a couple thousand kilometers out into the western Pacific from China's east coast. It is claimed that this missile has inertial guidance, possibly combined with indigenous BeiDou satellite navigation. It is also claims that during the terminal phase it uses active radar guidance, as a result, it is likely that it has a CEP of less than 30 meters.⁴²

Conclusion--The review of China's Space Power to Its Naval Operations

Considering the economic growth and sovereignty are the factors that matter CCP political legitimacy, China is not satisfied to be a historic land power any more, it apparently trying to transition from a continental to a concurrent maritime power. Therefore, China is willing to become a maritime power who can immunize itself against the potential rival to jeopardize its sovereignty and interests by either peacetime sanction or wartime blockades at sea. The most effective way to defuse the problem is to build and deploy a robust global navy that can outreach their power to the place they desire,

⁴² "DF-21D," *Military-Today.com*,

http://www.military-today.com/missiles/df_21d.htm. (Accessed 2019/10/9)

with the support of space capabilities.

The PLAN's command and control information management seemed to remain problematic, there is lots of comments and questions to China's space capabilities for naval operation, the most common criticism of Chinese capabilities is the lack of a sophisticated sensor-to-shooter data fusion capability for utilizing long range, precision-strike weapons.⁴³ Andrew S. Erickson noted that“ it's still a long way to determining such critical issues as whether its C4ISR efforts in actual, real-time conditions yield productive data fusion, or merely confusion.”⁴⁴ He also questioned that “C4ISR technologies probably still lag behind the requirement to identify and track a U.S. aircraft carrier in real time under wartime conditions.”⁴⁵

While the PLA recognize that aircraft carrier plays the role of commanding center in joint naval operations, it still

⁴³ Andrew S. Ericson and Michael S. Chase, “Information and the Chinese People's Liberation Army Navy,” in Phillip C. Saunders, eds., *The Chinese Navy : Expanding Capabilities, Evolving Roles* (Washington D.C. : National Defense University, 2011), p.275.

⁴⁴ Greg Chaffin, “China's Navy and Air Force Advancing Capabilities and Missions,” *The National Bureau of Asian Research*, September 27, 2012, http://nbr.org/downloads/pdfs/PSA/SA_Interview_Erickson_09272012.pdf. (Accessed 2019/8/15)

⁴⁵ Anthony H. Cordesman, Joseph Kendall, op. cit.

remains to be seen whether the C4ISR system functions well in China's first aircraft carrier. Moreover, the PLA is fielding advanced automated command systems-- the Integrated Command Platform as a part of C4ISR system, how's its performance compared with the US JMCIS (Joint Maritime Combat Information System) maybe an issue can be explored. Therefore, at this moment, on the basis of rapid modernization of space and naval assets, Chinese military will be demanded to invest substantial effort focus on integrating space-naval capabilities, in order to put C4ISR into practice. How can PLAN make good use of their space assets and technology to create a robust C4ISR system, is remained to be the primary challenge to PLAN and China authority.

We can easily see the china's remarkable progress in its weapon systems like DF-21D even aircraft carrier, but the PLA's efforts to achieve and maintain overall information dominance are mostly kept in the dark. Even it's always hard to figure out the true situations in China's military affairs, one thing is for sure, the rapid progress of navigation and SR satellite system will shorten the time for PLA to build up a robust aircraft carrier battle group to execute the mission of far seas protection in the near future. The rise of China will inevitably alter the balance of power on the global stage, and China would have unilaterally and fundamentally altered the Western Pacific security dynamic. It's fair to say that space capability is one of the key factors that help China to till the

balance. As an arch rival of China, US needs to maintain its leading role in space, the competition between two powers in space is still ongoing.