Chapter 3
China's Growing Space and Counterspace Capabilities

Kevin Pollpeter

China's growing military, economic, and political power have been of increasing concern. The expansion of People's Republic of China (PRC) interests, coupled with its increasingly assertive behavior, has given rise to a period of great power competition between the United States and China. China's rise as a world power has also been accompanied by its rise as a space power. China's ambition to become a space power is driven by a belief in the benefits of space power to contribute significantly to China's national power. China regards its space program as an important expression of its overall national power that is intended to portray China as a modernizing nation committed to the peaceful uses of space while at the same time serving its political, economic, and military interests. It contributes to China's overall influence, provides capabilities that give China more freedom of action, and helps maintain national security. Indeed, China has the ultimate goal of transforming itself from a "major space power to a strong space power" on par with the United States by 2049.

Space plays a central role in China's plans to project power far from its shores and in its abilities to defeat high-tech adversaries. China's military has designated outer space as a warfighting domain—described as a "new commanding height of war"—that China must fight for and seize if it is to win future wars. People's Liberation Army (PLA) officers and analysts assert that space is the ultimate high ground and that whoever controls space controls Earth.[1] These analysts describe space-based C4ISR systems as a critical part of a modern military sensor-to-shooter network.[2] At the same time, PRC military analysts regard space as a critical vulnerability that can debilitate an enemy if denied.[3] To further integrate space into military operations, the PLA created the Aerospace Force in April

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1 See, for example, General Xu Qiliang's remarks on the 50th anniversary of the founding of the PLA Air Force, "Flying with Force and Vigor in the Sky of the New Century—Central Military Commission Member and PLA Air Force Commander Xu Qiliang Answers Reporter's Questions in an Interview," (奋飞在新世纪的天空 ——中央军委委员、空军司令员许其亮答本), *Sina.com*, (新浪网), November 1, 2009, http://mil.news.sina.com.cn/2009-11-02/0625572165.html. and eds. Jiang Lianju and Wang Liwen, *Textbook for the Study of Space Operations* (Beijing: Military Science Press, 2013), 13.

2 Jiang and Wang, *Textbook for the Study of Space Operations*, 14.

3 Jiang and Wang, *Textbook for the Study of Space Operations*, 44.

2024 to carry out the PLA's space mission.

China's space program assists the PLA in its efforts to achieve information superiority, which is defined as the ability to use information freely and to deny the use of information by adversaries. Based on their analyses of US military operations, PRC military researchers view space as a critical component in making the PLA into a force capable of winning "informatized" wars and recognize the role space plays in the collection and transmission of information and the need to deny those capabilities to adversaries. Indeed, nearly every PRC source describes space as the "ultimate high ground," leading many PRC analysts to conclude that space warfare is inevitable.

Because of the preeminence of the space battlefield, PRC analysts argue that space will become the center of gravity in future wars and that the first condition for seizing the initiative is to achieve space supremacy. According to PRC analysts, China's space program plays a central role in its effort to possess anti-access/area denial (A2/AD) capabilities. PRC analysts argue that the development of long-range precision strike weapons cannot be separated from space power. Long-range anti-ship cruise and ballistic missiles require the ability to locate, track, and target enemy ships hundreds or thousands of kilometers from China's shores. Such capabilities could also be used to attack US bases and the bases of its allies in Asia as well as targets within the 50 states. PRC writings also focus on the need to develop counterspace capabilities. PRC military analysts have noted the dependence of the US military on space and have concluded that the degradation of US space capabilities may result in decisive losses for the US military.

According to the 2020 US Defense Space Strategy Summary, ensuring the availability of space-based capabilities is "fundamental to establishing and maintaining military superiority across all domains and to advancing US and global security and economic prosperity."[4] The head of the US Space Command has called the PRC's space program the United States' "pacing challenge" and stated that, although the United States is still the leading space power, the PRC is developing space capabilities that may threaten traditional US areas of superiority.[5] Similarly, the head of the US Strategic Command declared in 2021 that the PRC had conducted a "strategic breakout" that points toward an emboldened PRC and that the PRC has the "capability to unilaterally escalate a

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4 Department of Defense, "2020 Defense Space Strategy Summary," https://csps.aerospace.org/sites/default/files/2021-08/Defense%20Space%20Strategy %20Summary%2017 Jun20_0.pdf, 1.

5 Sarah Al-Arshani, "China Is Rapidly Becoming a 'Tremendous Threat' in the Solar System, Says US Space Force Leader," Yahoo.com, Dec. 5, 2021, https://sports.yahoo.com/china-rapidly-becoming-tremendous-threat-005416067.html?guccounter=1.

conflict to any level of violence, in any domain, worldwide, with any instrument of national power, and at any time."[6]

Japan has similarly recognized the importance of space to military operations and the growing threat to space systems. According to Japan's 2023 Space Security Initiative, "space has become a major arena for geopolitical competition for national power" and, in an apparent reference to China, the Space Security Initiative states that "threats in space are growing rapidly. Some countries are developing and deploying a variety of ground-based and space-based counter-space capabilities."[7] Based on this assessment, space superiority is now "an essential matter of national security," and Japan seeks to use space to defend both its national interests and its space systems.[8]

China's efforts to use its space program to transform itself into a military, economic, and technological power challenge the United States and Japan in both absolute and relative terms. Uncertainty over China's pathway to potential major power status, the possibility of a conflict over its territorial claims, and the inherent dual-use nature of space technologies means that China's improving space capabilities could be used against the US and Japanese militaries. As a result, the PLA has embarked on a comprehensive modernization effort involving a new concept of operations, technological modernization, and organizational reform that will allow it to better use space for military operations and to deny the use of space to adversaries.

China's Progress in Space Technologies

Since 2000, China has made significant progress across a broad range of space technologies, including launchers, satellites, lunar exploration, human spaceflight, and counterspace technologies. PRC space professionals have outlined a plan for China to become the world's leading space power by 2045. According to these analysts, by 2030,

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6 Statement of Charles A. Richard, Commander, United States Strategic Command, Before the Senate Armed Services Committee, Mar. 8, 2022, 2, https://www.armed-services.senate.gov/imo/media/doc/2022%20USSTRATCOM%20Posture%20Statement%20-%20SASC%20Hrg%20FINAL.pdf.

7 The Space Development Strategy Headquarters, Japan, "Space Security Initiative," 2-3, https://www8.cao.go.jp/space/english/anpo/kaitei_fy05/enganpo_fy05.pdf.

8 The Space Development Strategy Headquarters, Japan, "Space Security Initiative," 4 and National Space Policy Secretariat, Cabinet Office, Government of Japan, "Outline of the Basic Plan on Space Policy (Provisional Translation)," https://www8.cao.go.jp/space/english/basicplan/2020/abstract_0825.pdf.

China's space program will be able to support China's military modernization.[9] At this time, 60 percent of China's space technology will be at the world-class level.[10] By 2045, China will become the world's leading space power, with a space program that supports the country's full range of scientific, technological, economic, and military needs while leading the United States in some technologies.[11]

Space Capabilities

Since 2000, China has laid a foundation for it to achieve its goal of becoming a strong space power. Gone are the days when PRC launchers were unreliable and China had just a few satellites in orbit. China launched just one satellite in 2001, but, in 2010 and 2011, China equaled and then surpassed the number of US launches for the first time (see Figure 1). Since then, China and the United States exchanged leads. However, since 2022, the United States has maintained a substantial lead over the PRC, largely based on the success of SpaceX. In addition to launching more rockets, PRC launch vehicles have also become more reliable. During the 14-year period from 2010 to 2024, PRC launch vehicles successfully completed 470 out of 488 launches for a 96 percent success rate, a figure comparable with international competitors.

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9 Yan Yujie and Wang Hui, "CASC Clarifies Building a Strong Space Power with a Roadmap," (航天科技集团明确建设航天强国路线图), *China Daily*, (中国日报网), August 30, 2018, http://www.chinadaily.com.cn/interface/toutiaonew/53002523/2018-08-30/cd_36846561.html.

10 "China to Become a Strong Space Power By 2020 With More than 200 Satellites in Orbit and 30 Launches Per Year," (中国2020年成航天强国 在轨航天器逾200颗年发射30次), Xinhua, October 19, 2017, http://www.xinhuanet.com//politics/2017-10/19/c_1121823300.htm.

11 "China to Become a Strong Space Power By 2020 With More than 200 Satellites in Orbit and 30 Launches Per Year;" "Strong Space Power: 'Our Journey is the Sea of Stars'," (航天强国: "我们的征途是星辰大海") China Academy of Space Technology, (中国航天技术研究院), March 7, 2018, http://www.cast.cn/3g/ show.asp?m=1&d=6281; Hu Wei, "CASC: To Strive to Push China to Forward Ranks of Strong Space Powers by 2030," (中国航天科技集团：将力争到2030年推动我国跻身世界航天强国行列), Xinhua, June 27, 2019, http://www.xinhuanet.com/science/2019-06/27/c_138177326.htm.

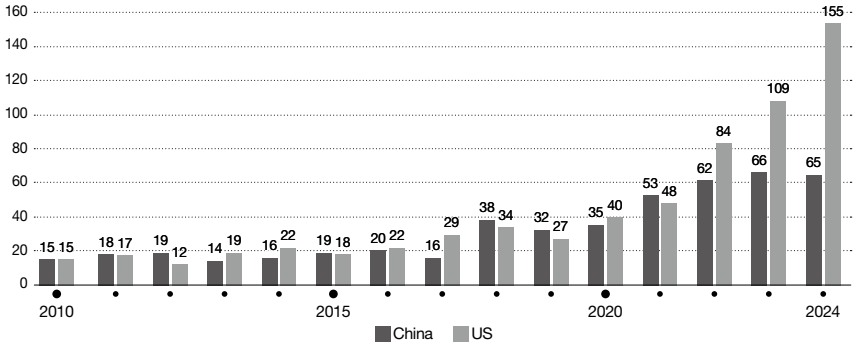

Figure 1: Successful US and PRC Space Launches[12]

China's more active launch schedule has resulted in a concomitant increase in the number of PRC satellites. According to the US Space Force, between the end of 2015 and October 2024, China increased its on-orbit presence by 620 percent. By October 2024, China had over 1,015 satellites in orbit[13] (see Figure 2). China now has the second largest number of satellites in orbit behind the United States. Nearly half of these are intelligence, surveillance, and reconnaissance (ISR) satellites. These satellites carry a variety of optical, multispectral, radar, and radio frequency sensors that "could support monitoring, tracking, and targeting of US and allied forces worldwide, especially throughout the Indo-Pacific region."[14] PLA space-based capabilities can identify land- and sea-based targets globally and can provide intelligence for PLA naval, aviation, and missile forces to adjust fire, restrike targets, or verify a target's destruction. Using space-based ISR capabilities to support 1,500-kilometer range DF-21D ballistic missiles, CJ-10 ground-launched cruise missiles, and 4,000-kilometer range DF-26 ballistic missiles, China can attack both land and naval targets in the western Pacific and Indian Oceans as well as the South China Sea.[15]

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[12] Jonathan's Space Report, "Orbital Launch Attempts by Country," https://www.planet4589.org/space/stats/out/tab1a.txt.

[13] US Space Force, "Space Threat Fact Sheet," December 5, 2024.

[14] Defense Intelligence Agency, "Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion," March 2022, 11, https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/Challenges_Security_Space_2022.pdf and US Space Force, "Space Threat Fact Sheet."

[15] Office of the Secretary of Defense, Military and Security Developments Involving the People's Republic of China 2019, 2019, 44.

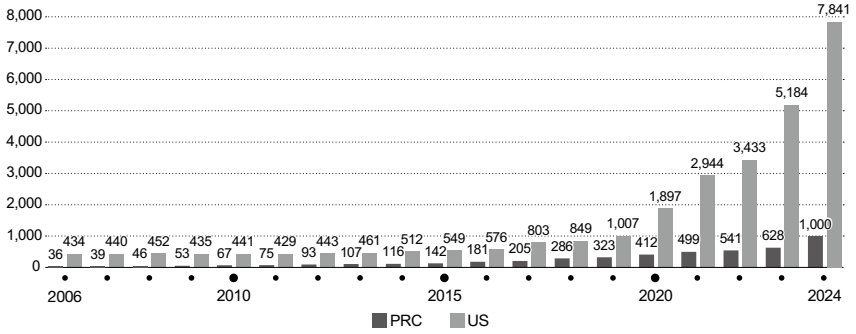

Figure 2: Number of US and PRC Satellites in Orbit

China also has a number of other types of satellites that will likely be used for military missions. According to the US Department of Defense, the PRC had at least three early warning satellites as of 2022 and was operating more than 60 communications satellites by 2023, including four dedicated to military communications use.[16] In June 2020, the PRC completed its BeiDou global satellite navigation system, a GPS-independent system that will support navigation and precision strikes.[17] BeiDou provides positional accuracy of 10 meters worldwide and 5 meters in Asia. In addition, BeiDou provides the PLA with command and control capabilities through a short messaging service that can facilitate messages up to 1,000 characters long within China and surrounding areas.[18]

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[16] Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2023*, 2023, 44. https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF, 100 and 112 and Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2024*, 2024, 85, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF.

[17] Office of the Secretary of Defense, "Military and Security Developments Involving the People's Republic of China 2021," 94.

[18] Kevin Pollpeter with Tsun-Kai Tsai, "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-Based PNT," CNA/China Aerospace Studies Institute, May 2024, https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20-%20Beidou.pdf.

Counterspace Capabilities

The PRC is developing and deploying a wide range of counterspace capabilities intended to challenge US space superiority and threaten the United States in all orbital regimes (see Table 1).[19] These capabilities include direct ascent missiles, directed energy weapons, electronic warfare systems, and co-orbital systems. The PRC's rapidly developing counterspace capabilities raise concerns about their wartime use and how they may be employed in peacetime to deter and compel potential adversaries. Indeed, actions by the PRC since 2007, when China destroyed a retired satellite with a direct-ascent kinetic kill vehicle, have highlighted the role that space may play in PRC coercive efforts directed toward the United States. In 2021, the Space Force's Vice Chief of Space Operations reportedly stated that "both China and Russia are regularly attacking US satellites with non-kinetic means."[20]

Direct Ascent Missiles

The PLA has deployed ground-based direct-ascent missiles that have the ability to attack satellites in low-Earth orbit and "likely intends to field ASAT weapons capable of destroying satellites up to GEO at 36,000 km."[21]

Directed Energy Weapons

The PLA also "has multiple ground-based laser weapons able to disrupt, degrade, or damage satellite sensors." The Space Force has concluded that "by the mid-to-late 2020s, [China] could have higher-power systems able to damage satellite structures."[22]

Electronic Warfare Systems

According to the Space Force, "PLA military exercises regularly incorporate jammers against space-based communications, radars, and navigation systems like GPS."[23] The Space Force has also concluded that "the PLA may be developing jammers to target SATCOM over a range of frequencies, including US military protected

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19 General James H. Dickinson, Commander, United States Space Command, Presentation to the Senate Armed Services Committee, March. 1, 2022, 6, https://www.armed-services.senate.gov/imo/media/doc/USSPACECOM%20FY23%20Posture%20Statement%20SASC%20FINAL.pdf.

20 Josh Rogin, "A Shadow War in Space Is Heating Up Fast," *Washington Post*, November. 30, 2021, https://www.washingtonpost.com/opinions/2021/11/30/space-race-china-david-thompson/.

21 US Space Force, "Space Threat Fact Sheet."

22 US Space Force, "Space Threat Fact Sheet."

23 US Space Force, "Space Threat Fact Sheet."

extremely-high-frequency (EHF) systems."[24]

Co-orbital Systems

The PRC has launched multiple satellites to test on-orbit servicing and maintenance capabilities that can also have counterspace applications.[25] In January 2022, the PRC's *Shijian*-21 satellite towed a defunct BeiDou navigation satellite to a graveyard orbit. Although ostensibly a test of space debris mitigation technologies, the capability also has counterspace applications.[26]

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[24] US Space Force, "Space Threat Fact Sheet."

[25] Kristin Burke, "China's SJ-21 Framed as Demonstrating Growing On-Orbit Servicing, Assembly, and Manufacturing (OSAM) Capabilities," China Aerospace Studies Institute, December 2021, https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2021-12-09%20SJ-21%20and%20China's%20OSAM%20Capabilities.pdf?ver=Fs8yAAIxIcQttob5nNFLow%3d%3d.

[26] Andrew Jones, "China's Shijian-21 Towed Dead Satellite to a High Graveyard Orbit," *Space News*, January 27, 2022, https://spacenews.com/chinas-shijian-21-spacecraft-docked-with-and-towed-a-dead-satellite/.

Type	Year	Description	Comments
Direct ascent	2007	KKV test	
	2010	Mid-course ballistic missile defense test	
	2013	Mid-course ballistic missile defense test	
	2013	KKV test	Test to GEO. China called it a "high altitude science mission."
	2014	KKV test	China called it a ballistic missile defense test. The US called it an ASAT test.
	2015	Unknown test	
	2017	Unknown test	
	2018	Mid-course ballistic missile defense test	
	2021	Unknown test	
	2022	Unknown test	
	2022	Unknown test	
Co-orbital	2010	Two Shijian satellites involved in close proximity operation, causing a slight change in one satellite's orbit	
	2013	Three satellites involved in close proximity operation to test space debris removal and robotic arm technologies	
	2016	Aolong-1 tested a robotic arm to remove space debris	
	2016	Shijian-17 rendezvous with ChinaSat-5A	
	2018-2019	TJS-3 satellite conducted operations in proximity to PRC, US, and Russian satellites	
	2019	TJS-3 satellite released a probable subsatellite	
	2022	SJ-21 captured a retired BeiDou satellite and towed it into orbit	
	2021	NEO-1 conducted a test using a net to capture simulated orbital debris	
Cyber	2012	Computer network attack against Jet Propulsion Laboratory	Allowed "full functional control" over JPL networks.
	2014	Computer network attack against NOAA	
	2017	Computer network attack against Indian satellite communications	
	2018	Computer network attack against satellite operators, defense contractors, and telecommunication companies	
Directed energy	2006	Lased US remote sensing satellite	Intent unknown.

Table 1: PRC Counterspace-Related Activities[27]

[27] Brian Weeden and Victoria Sampson, eds., *Global Counterspace Capabilities: An Open Source Assessment*, April 2024 and Clayton Swope, Kari A. Bingen, Makena Young, Madeleine Chang, Stephanie Songer, Jeremy Tammelleo, *Space Threat Assessment 2024*, April 2024.

Orbital Bombardment System

The PRC is also testing technologies to strike ground targets from space. In 2021, the PRC conducted an orbital launch of a hypersonic glide vehicle that may provide the PLA with the ability to project conventional power globally and degrade the US nuclear deterrent.[28] According to the Space Force, this test involved "the greatest distance flown (~40,000 km) and longest flight time (100+ minutes) of any PLA-developed land attack weapon system to date."[29]

The potential development of an orbital bombardment system by the PRC may signal the intent to develop its nuclear triad into a nuclear "quad" based on land-launched nuclear missiles, submarine-launched nuclear missiles, aircraft with nuclear bombs and missiles, and space-launched hypersonic glide vehicles. The addition of a space-launched leg to the PRC nuclear deterrent appears to give the PRC a potential global first-strike capability that could evade US missile defenses and add a destabilizing element into US-PRC crisis management. The development of a space-based nuclear bombardment system could also possibly violate the Outer Space Treaty's prohibition against stationing nuclear weapons in space, which the PRC has signed.

PLA Command and Control of Space Operations

The expansion of the PLA's space capabilities and the importance of the space domain have created a need for organizational reform to effectively command and control the PLA's space forces. On December 31, 2015, the PLA established the Strategic Support Force (SSF), which reported directly to the Central Military Commission and was responsible for strategic level space, cyber, electronic warfare, and psychological warfare operations. Space operations fell under the SSF's Space Systems Department, which commanded the PLA's satellite control centers, launch sites, and likely some portion of the PLA's counterspace capabilities.[30]

In April 2024, possibly due to the realization that the SSF was not achieving the desired organizational effects, it was disbanded and broken into three lower-level units that report directly to the Central Military Commission: the Aerospace Force, the

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[28] Defense Intelligence Agency, "Challenges to Security in Space," 18.

[29] US Space Force, "Space Threat Fact Sheet."

[30] Kevin Pollpeter, Michael S. Chase, and Eric Heginbotham, "The Creation of the Strategic Support Force and Its Implications for Chinese Military Space Operations," RAND, November 10, 2017, https://www.rand.org/pubs/research_reports/RR2058.html.

Cyberspace Force, and the Information Support Force. Although the PLA has provided little information on the new organizations, it is assumed that the Aerospace Force has retained many, if not all, of the same responsibilities as the former Space Systems Department.[31]

While the Aerospace Force commands organizations responsible for launch and satellite control, the control of the PLA's counterspace operations appears to be more disaggregated. According to a report by the China Aerospace Studies Institute written before the breakup of the SSF, only space-based capabilities were solely employed by the SSF, while other capabilities could be employed by the services. The PLA's direct ascent capabilities, for example, are likely employed by the Rocket Force and Air Force, while terrestrial electronic warfare capabilities can be employed by the services. High-power directed energy weapons, on the other hand, were likely employed by the SSF, while low-power directed energy weapons could also be employed by the services. Similarly, offensive cyber counterspace weapons could also be employed by the then Strategic Support Force as well as the services.[32]

PLA Concept of Operations

PLA space operations are inherently tied to its overall concept of operations. The PLA characterizes modern war as "informatized local wars" that take information superiority—the ability to use information and deny its use to adversaries—as the key determiner of battlefield success.[33] A major component of the PLA's modernization focus has been the development of networked C4ISR systems.[34] The PLA has been guided by the US concept of network-centric warfare, a concept first popularized in the late 1990s. Network-centric warfare involved translating an information advantage characterized by

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[31] "Defense Ministry Spokesperson's Remarks on Recent Media Queries Concerning the PLA Information Support Force," *China Military*, April 22, 2024, http://eng.chinamil.com.cn/VOICES/MinistryofNationalDefense_209794/16302634.html.

[32] Kristen Burke, "PLA Counterspace Command and Control," China Aerospace Studies Institute, December 2023, https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-12-11%20Counterspace-%20web%20version.pdf.

[33] PRC Information Office of the State Council, *The Diversified Employment of China's Armed Forces*, April 2013, https://english.www.gov.cn/archive/white_paper/2014/08/23/content_281474982986506.htm and Wu Changde, "Actively Adapt to the New System and Effectively Perform New Duties," (积极适应新体制 有效属性新职能), *China Military Science* (中国军事科学), no. 1 (2016), 37.

[34] Xu Xiaoyan, ed., *An Introduction to Military Informationization*, (军队信息化概论) (Beijing: Liberation Army Press, 2005), 61.

a shift in focus from platforms to networks, information sharing, and shared situational awareness into a warfighting advantage characterized by knowledge of the commander's intent, self-synchronization, and increased combat power.[35] Network-centric warfare is intended to "enable a shift from attrition-style warfare to a much faster and more effective warfighting style" characterized by speed of command. The resulting increase in the speed of command is intended to foreclose enemy courses of action and disrupt the enemy's strategy.[36]

The PLA's adoption of network-centric principles is reflected in the concept of system-vs-system (SvS) operations.[37] Similar to network-centric warfare, SvS operations are intended to "accelerate operational response times to enhance firepower and maneuver, particularly by shortening and streamlining decision-making and sensor-to-shooter times to get inside an opponent's decision cycle." Units participating in SvS operations "operate with greater independence in dispersed deployment in a nonlinear battlespace, yet synchronize operations within a centralized command structure with some allowance for initiative."[38]

PRC analysts portray space as a critical component of SvS operations due to the ability of space technologies to better enable ground, air, and naval operations and the necessity to deny other countries the use of space. A robust, space-based C4ISR system is often described as a critical component of a future networked PLA.[39] For example, a PLA Navy senior captain writes that "modern joint campaigns are inseparable from space information systems support; whoever controls space has space information supremacy, and thus has the initiative in war."[40]

The need to develop space-based C4ISR systems is based on the requirement

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35 "The Implementation of Network-Centric Warfare," Washington, DC: Office of Force Transformation, Jan. 5, 2005, 3-4.

36 U.S. Navy Vice Admiral Arthur K. Cebrowski and John J. Garstka, "Network-Centric Warfare: Its Origin and Future," *U.S. Naval Institute Proceedings* 124, no. 1139 (1998).

37 PRC Information Office of the State Council, *China's Military Strategy*, May 27, 2015, https://english.www.gov.cn/archive/white_paper/2015/05/27/content_281475115610833.htm.

38 Kevin McCauley, "System of System Operational Capability: Key Supporting Concepts for Future Joint Operations," *China Brief* 12, no. 19 (2012), http://www.jamestown.org/single/?no_cache=1&tx_ttnews%5Btt_news%5D=39932#.VenjnWeFOh1.

39 Zhao Junfeng, Wang Haibo, and Chen Jinjun, "Assurance Requirements and Development Trends of Informationized Space Battlefields" (信息化太空战场的保障要求及发展趋势), *Wireless Internet Technology* (无线互联科技), No. 4, 2013, p. 184; Deng Jiekun, Shi Tongye, and Xie Jing, "ECM Capabilities of Space Information System" (空间信息对抗能力分析), *Aerospace Electronic Warfare* (航天电子对抗), No. 28, Issue 4, 2012, 4-6, 28.

40 Deng, Shi, and Xie, "ECM Capabilities of Space Information System." 4-6, 28.

to develop power-projection and precision-strike capabilities. The development of long-range cruise missiles and ballistic missiles for over-the-horizon attacks against land and naval targets requires the ability to locate, track, and target enemy installations and 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, provide strategic intelligence before a conflict begins, and help provide post-strike battle damage assessments. Communication satellites can provide global connectivity and facilitate communications between far-flung forces. Navigation and positioning satellites can provide critical information on location and improve the accuracy of strikes. These capabilities will also better integrate disparate services into a joint force by allowing one service to better support other services through better communications and by helping to integrate intelligence functions through a shared battlefield picture.

Information is not just to be collected and utilized, however, but also to be denied to adversaries. PLA writings on information warfare put an emphasis on striking first. According to PLA sources, the decisive nature of information and the faster operational tempo brought about by its use will lead to "the first battle being the decisive battle" and "a single battle determining the outcome" of a war.[41] As a result, PLA writings state that the PLA should attempt to achieve information superiority at the outbreak of a conflict and before operations in other physical domains.[42] Gaining information superiority at a conflict's outset should enable successful joint operations during the rest of the conflict, while the lack of information superiority could jeopardize victory.[43]

The Importance of Space to Military Operations

Space operations play a critical role in the PLA's ability to conduct anti-access/area denial (A2/AD) operations by enabling long-range precision strikes against land, air, and naval

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41 Wen Bing, "Correctly Locate the Basic Point for Preparation for Military Struggle," *Study Times* (学习时报), July 2015.

42 Wang Zhengde (Editor-in-Chief), "Chapter 8: Confrontation in the Network Domain," (第七章：网络领域对抗), *Information Confrontation Theory* (信息对抗论) (Beijing: Military Science Press, 2007); Ye Zheng, ed., *Lectures on the Science of Information Operations*, (信息作战学教程) (Beijing: Military Science Press, 2013), 174; Xiao Tianliang, *The Science of Military Strategy* (战略学), (Beijing: National Defense University Press, 2015), 147-148.

43 Defense Intelligence Agency, "China Military Power: Modernizing a Force to Fight and Win," 2019, 45, https://www.dia.mil/Portals/110/Images/News/Military_Powers_Publications/China_Military_Power_FINAL_5MB_20190103.pdf "Information Dominance."

targets and in denying adversaries the use of their own space assets. In its 2015 defense white paper, *China's Military Strategy*, China for the first time officially designated outer space as a security domain. According to the white paper, the PLA must be able to deal with "a wide variety of emergencies and military threats" and "prepare for military struggle in all directions and domains."[44] As a result, the PLA is required to "safeguard China's security and interests in new domains" and "threats from such new security domains as outer space and cyber space will be dealt with to maintain the common security of the world community."[45] Therefore, "China will keep abreast of the dynamics of outer space, deal with security threats and challenges in that domain, secure its space assets to serve its national economic and social development, and maintain outer space security."[46]

Since the early 2000s, Chinese military writings have characterized space as the new high ground and concluded that, without space superiority, China would be at a disadvantage in all other domains.[47] The authors of the 2013 *Study of Space Operations*, for example, predict that future wars will likely begin in outer space and that "achieving space superiority and cyber superiority are critical for achieving overall superiority and being victorious over an enemy."[48] They argue that China must prepare for an enemy to attack from all domains, including space, and identified outer space as one of five major military threats facing the PLA along with nuclear, conventional, cyber, and nuclear-conventional threats. They also included space operations as one of nine "main operational activities" along with information operations, joint strike operations, air and missile defense, air and sea blockades, island seizure operations, area denial operations, border defense operations, and cyber operations.[49]

The authors conclude that "whoever is the strongman of military space will be the ruler of the battlefield; whoever has the advantage of space has the power of the initiative; having 'space' support enables victory, lacking 'space' ensures defeat."[50] Consequently, the authors of *Study of Space Operations* assert that space warfare is inherently offensive in nature and that "active offense is the only method for achieving victory in war."[51]

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44 PRC Information Office of the State Council, *China's Military Strategy*.
45 PRC Information Office of the State Council, *China's Military Strategy*.
46 PRC Information Office of the State Council, *China's Military Strategy*.
47 China Academy of Military Science, *Science of Military Strategy* (战略学), (Beijing: Military Science Press, 2013), 96; and Jiang and Wang, *Textbook for the Study of Space Operations*, 13.
48 Jiang and Wang, *Textbook for the Study of Space Operations*, 96.
49 China Academy of Military Science Military Strategy Studies Department, *Science of Strategy*, 100.
50 Jiang and Wang, *Textbook for the Study of Space Operations*, 1.
51 Jiang and Wang, *Textbook for the Study of Space Operations*, 73.

The basis for these assessments is PLA analysts' assessments of US military operations. PRC writers continue to view space as essential to modern war and see the United States as heavily dependent upon space-based systems.[52] According to PRC sources, US military operations rely on space for more than 70 percent of the US military's communications needs, 80 to 95 percent of its intelligence collection needs, 100 percent of meteorological forecasting, and 90 percent of precision guidance for munitions.[53]

The reliance of the US military on space is also viewed by PLA analysts as a critical vulnerability. Counterspace operations can deny, degrade, disable, or destroy an opposing side's space capabilities. These can include attacks against both ground-based and space-based space assets through the use of kinetic and non-kinetic means.[54] Articles in China's military media on US satellite capabilities highlight the US military's reliance on satellites for its military operations. One article from the *Winged Missiles Journal*, a monthly periodical from the China Aerospace Science and Industry Corporation (CASIC), described US satellites as an "indispensable means for direct support of battlefield operations" and stated that the United States would "lose its military advantage" if its satellites were destroyed.[55]

Conclusions

The PLA's development of space capabilities strikes at the heart of US and allied military superiority. The acquisition of space-based intelligence and navigation information to enable long-range strikes and the use of offensive space control measures against US satellites demonstrates the prominent role of space in China's efforts to establish effective A2/AD capabilities. The denial of critical space-based C4ISR capabilities integrated with cyber and kinetic attacks against ground-based C4ISR nodes could complicate the ability of the US and allied militaries to flow forces to the region and conduct operations effectively. This strategy could be even more effective when coupled with the PLA's

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52 Wang Liping and Zhang Ya, "Development of Space War Based on Space Operation Exercises" (从太空作战演习看天战的最新发展), *Aerospace Electronic Warfare* (航天电子对抗), Issue 27, No. 3, 2011, 4-6.

53 Jiang and Wang, *Textbook for the Study of Space Operations*, 65.

54 Wang and Zhang, "Development of Space War Based on Space Operation Exercises," 4-6 and Chen Baoquan, Yang Guang, and Li Xuefeng, "Research on System Combat Effects and Develop Policy of Space Electronic Attack" (空间电子攻击的体系作战效用及发展对策), *Aerospace Electronic Warfare* (航天电子对抗), No. 28, Issue 1, 2012, 11-13, 22-23.

55 Song Yanxue, Zhang Zhifeng, and Qi Lihui,"Latest Developments in U.S. Anti-Satellite Weapons," *Winged Missiles Journal*, (飞航导弹), January 31, 2008.

predisposition to gaining the initiative at the beginning of a conflict.

The development of a space warfare doctrine would appear to have to be based on the requirement to fight and win informatized wars. Under this concept, warfare is no longer one platform against another or even one system against another. It is instead a conflict between opposing systems of systems in which space is a key enabler of long-range precision strikes and joint operations. Space, through counterspace capabilities, also acts as a key method for degrading an opponent's systems. PRC writings stress achieving space superiority with strong strikes at the beginning of a conflict. PRC technology developments indicate that the PLA is developing a wide-range of counterspace capabilities designed to attack every type of satellite in all orbits using kinetic and non-kinetic means. Space now plays a prominent role in China's efforts to establish a military capable of winning informatized wars through an asymmetric strategy directed at critical military platforms. As a result, the PLA now sees space systems in the same way that the US military regards its space systems: as an integral part of its military.