NIDS International Symposium on Security Affairs 2024

National Security Space Policies in the Changing Environment

The National Institute for Defense Studies, Japan

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Chairperson's Summary

On December 11, 2024, the National Institute for Defense Studies held the International Symposium on Security Affairs on the theme of "National Security Space Policies in the Changing Environment." This symposium aimed to contribute to security dialogues, enhance the quality of research, revitalize human exchanges, foster mutual understanding internationally, and inform security policies.

The symposium was divided into four parts: the Keynote Speech and sessions 1 to 3. Session 1 discussed Changes in the Strategic Environment in the Space Domain, Session 2 discussed Major Country Policies in the Changing Environment, and Session 3 held a Wrap-up Discussion. IIDA Masafumi, Director of the Security Studies Department at the National Institute for Defense Studies, served as the chairperson. Below is the Chairperson's Summary of the symposium from the Keynote Speech to Session 3, in that order.

The Keynote Speech was titled "Space Security Challenges for the U.S.-Japan Alliance" and given by Dr. Scott Pace (Professor of the Practice of International Affairs, Director of the Space Policy Institute, Director of the Institute for International Science and Technology Policy and Director of the MA International Science and Technology Policy program at the George Washington University's Elliot School of International Affairs). Dr. Pace touched on the fact that Japan had adopted the three approaches of (i) radically expand the use of space systems for national security, (ii) ensuring safe and stable use of outer space, and (iii) realizing a favorable cycle between national security and the space industrial base, in the Space Security Initiative (SSI) it had released in June 2023, and then discussed the multifaceted challenges and responses pertaining to space security in relation to these approaches.

Firstly, regarding diplomatic aspects, Dr. Pace stated that if Russia chose to place a nuclear weapon in orbit, that would be a clear violation of international law, and the United States and Japan must continue to work closely together to compel a change in Russia's behavior while considering possible courses of action with like-minded countries in the United Nations.

Next, regarding military aspects, Dr. Pace stated that in order to deter China, Russia, and North Korea, it is important to operate space capabilities linked to the various capabilities in other domains, and that he hoped that the joint capabilities and cross-domain operations capabilities of the Japan Self-Defense Forces would be enhanced. Furthermore, he noted regarding the counterstrike capabilities that the Japan Self-Defense Forces plan to possess, that Japan will need to embed the TCPED (tasking, collection, processing, exploitation, and dissemination) process in its weapons systems and utilize its space capabilities, while ensuring a shared understanding with its allies and partners.

Moreover, regarding economic aspects, Dr. Pace pointed out that Japan should utilize the space industry as the foundation of its own economic security and self-defense capability in preparation for conflict with China. As an example of a first step toward that, he mentioned collaboration on a future Low Earth Orbit (LEO) Hypersonic Glide Vehicle (HGV) detection and tracking constellation, a result of the U.S.-Japan Summit Meeting in April 2024, and he suggested that Japan consider the approach of "Buy it," "Build it," and "Improve it" toward rapidly acquiring national security space capabilities. Note that he also urged caution to ensure, when utilizing private sector capabilities, that the range of satellite constellations being pursued by the Ministry of Defense does not become isolated from actual war-fighting needs and thus not contribute to the U.S.-Japan security alliance.

Finally, Dr. Pace gave three recommendations to Japan: (i) determine which national security missions require space capabilities, (ii) develop plans and budgets for national security–related space programs, and (iii) prioritize the development of national security space capabilities that are complementary and interoperable with allied space capabilities. In addition, he stated that to strengthen the space capabilities of the Japan Self-Defense Forces, Japan should prioritize improving information security, enhancing joint service integration and interagency cooperation, and conducting more realistic training and exercises that reflect joint and combined arms scenarios likely to be faced by Japan. Finally, he concluded his speech by reiterating that challenges to space security are a crucial component of U.S.-Japan defense cooperation.

In Session 1, Mr. Bryan Clark (Senior Fellow and Director of the Center for Defense Concepts and Technology at Hudson Institute), Dr. John Klein (Senior Fellow and Strategist at Falcon Research, Inc.), and Dr. Kevin Pollpeter (Director of Research at the Department of the Air Force's China Aerospace Studies Institute) gave presentations on Changes in the Strategic Environment in the Space Domain, and Dr. AOKI Setsuko (then Professor of Law at Keio University Law School; currently Professor at Chiba Institute of Technology) discussed with the presenters.

At the outset, Mr. Clark gave a presentation titled "Winning the Fight for Sensing and Sensemaking." To begin his presentation, he pointed out that it has become difficult for the U.S. military to maintain overwhelming dominance against its enemies in all environments, and diverse and capable competitors have emerged in all regions, so there is a pressing need to form appropriate deterrence tailored to the nature of each region and adversary. He then argued that in order to counter China, which is particularly reducing the capability gap with the United States, the operation of non-kinetic offensive capabilities, namely the method of countering sensing and sensemaking, will be important.

Based on the recognition that China has been enhancing its sensing and sensemaking capabilities in recent years and is achieving military success by building and using multiple space-based systems, Mr. Clark stated that to counter the Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) capabilities which China has been enhancing, it is necessary to take countermeasures tailored to the capabilities of the adversary; for example, countering satellite-based signal intelligence collection with the creation of false targets by transmitting radio waves from uncrewed surface decoys, and decoys and jamming against synthetic aperture radars (SARs) installed on satellites to counter image intelligence collection.

Furthermore, he mentioned the importance of having more diverse capabilities and a greater number of options to mislead the adversary and delay their decision-making. He explained that in the case that tools for countering an adversary are limited, it is possible for the adversary to easily predict and respond to any moves made by our side, and that maintaining and enhancing the diversity of tools for countering an adversary in order to introduce an element of surprise is effective.

Mr. Clark concluded his presentation by pointing out that collaboration with industry is important in the development of these non-kinetic offensive capabilities, that technological innovation in private sector companies should be encouraged through government support, and that sustained efforts throughout peacetime competition will be the key to restoring U.S. military superiority.

Following this, Dr. Klein gave a presentation titled "Commercial Space for Competitive Advantage" about how governments are using commercial space activities to gain an advantage over their competitors. At the outset, he proceeded on the premise that in recent years, commercial space activities have expanded significantly in both scale and diversity, including a dramatic increase in the number of satellites launched, and they now play an important role in the constantly changing security situation. He followed this by pointing out that the space strategies of the Western countries have emphasized the importance of the private sector in achieving political and military objectives. He then noted that technological innovation by private sector companies is an important element for generating competitive advantage and argued that governments are utilizing private sector technologies to achieve strategic objectives while cutting costs.

Moreover, Dr. Klein mentioned that the utilization of private sector companies can be a way for governments to expand their influence in competition and conflict while avoiding direct risks. He stated that space-related technologies are dual-use and that by using the technologies and services of private sector companies, governments can reduce research and development costs and rapidly acquire the necessary capabilities. In particular, he presented the idea that building and utilizing hybrid space architectures, comprising various orbits and types of satellites and their related systems, would be more effective than using individual satellites and their functions.

Finally, Dr. Klein pointed out that the use of commercial satellites in wartime entails legal challenges and risks, making prior discussions essential. It is necessary to deepen collaboration with the private sector and maximize the utilization of technological innovation, while taking measures to protect commercial assets. He concluded his presentation by stating that building trust between governments and companies during peacetime is key to the success of space strategies.

Finally, in Session 1, Dr. Pollpeter gave a presentation titled "China's Growing Space and Counterspace Capabilities." He began by pointing out that in recent years, China has dramatically increased the number and types of satellites it launches into orbit, and that China's space activity capabilities, including its activities on the Moon and Mars, have achieved remarkable progress not only in quantity but also in quality. He stated that the backdrop to this is that China stated in its Defense White Paper that space is one of its four critical security domains, in addition to maritime, cyber, and nuclear, that China strongly recognizes the importance of space capabilities for fulfilling a variety of functions, such as projecting power far from its shores, intelligence gathering, and strike assessments, and that China has the objective of achieving space superiority which it defines as the ability to freely use space itself and deny space to adversaries.

Dr. Pollpeter also presented several examples and evaluations, showing that China has made remarkable progress in counterspace capabilities, including direct-ascent anti-satellite (ASAT) weapons, directed-energy weapons, cyberattack capabilities, electronic warfare weapons, and co-orbital weapons. He then expressed concern about the potential impact these capabilities could have on the space programs of Japan and the United States.

Moreover, Dr. Pollpeter mentioned the Fractional Orbital Bombardment System (FOBS), which is launched into orbit around the Earth and then deorbited before completing a full revolution around the Earth to attack ground targets, as the largest concern at present. Considering that the FOBS enables surprise attacks on all ground targets from unanticipated directions and could be equipped with nuclear warheads, it could become an extremely large threat. He pointed out that there is a possibility that China is seeking to move from a traditional nuclear triad to a four-component nuclear structure by incorporating FOBS, potentially having a significant impact on the current nuclear deterrence regime.

Finally, Dr. Pollpeter concluded his presentation by reaffirming that China is advancing its space program in various fields, which demonstrates the rise of China's national power and could pose a significant threat to Japan and the United States.

In the Session 1 discussion, Dr. Aoki made comments and posed questions to the three presenters, and received responses from each of them. Dr. Aoki firstly mentioned that the presentations by the three presenters, under the same theme of "Changes in the Strategic Environment in the Space Domain," each had different focus points, but reached common conclusions about (i) the ever-growing threat from China, (ii) the importance of strengthening the deterrence regime using advanced, non-traditional non-kinetic approaches, (iii) the decisive impact that the space capabilities possessed by commercial entities have on national security, (iv) the importance of cooperation with allies in a U.S.-led non-kinetic approach, and (v) the importance of trust-building and effective task division between military and commercial entities.

Following this, Dr. Aoki pointed out that the Government of Japan envisions the utilization of private sector space capabilities being limited to defensive non-kinetic approaches, but even in this case, the space assets possessed by private sector companies are still exposed to threats from enemy nations. Dr. Aoki then presented the view that when the space assets of the private sector are involved in peacetime military activities, even if they are merely providing passive communications or images, if they are deemed to be integrated into a nation's military space activities, the nation will be subjected to retaliation to the extent that is legal in peacetime, and if the assets are judged to have engaged in illegal interference with the adversary nation, they will be subjected to countermeasures. Dr. Aoki then stated that there are problems of what kinds of arrangements should be made between the national government and private sector companies and how the private sector entities should be protected, and pointed out that it was necessary to stipulate in advance, in a specific and detailed manner, the risk allocation between the national government and the companies.

Next, Dr. Aoki posed two common questions to the three presenters and sought their responses to both of the questions or either one. The first question concerned the latter part of Dr. Aoki's comment: what measures can be taken to protect private sector companies, and what types of agreements are essential for this purpose? The second question asked for the presenters' honest views on the role Japan should play in solidarity among allies to maintain and build information superiority against China, particularly regarding the advantages held by Japan and the fields in which Japan should make urgent preparations going forward.

Firstly, Dr. Pollpeter responded that he believes Japan and the United States can cooperate more closely in space situational awareness (SSA) and that supplementing and ensuring redundancy in U.S. launch methods, navigation systems, and remote sensing systems could be considered.

Next, Dr. Klein responded by touching on the ethical problems associated with attacking the commercial systems of countries that are not parties to a conflict, using Starlink as an example. He noted that meticulous coordination and consensus building among the relevant stakeholders is necessary to determine whether such systems should be regarded as allied military assets and how they might be perceived by an adversary. He cited Japan's geographical characteristics and robust industrial base as strengths, but he concluded that a continuing issue is how Japan can fulfill an appropriate role for self-defense within its constitutional constraints.

Finally, concerning the use of Japan's commercial space capabilities, Mr. Clark began by stating that it was possible to advance commercial use pertaining to areas not included in the kill chain, such as use of communications satellites. He further stated that it may also be possible to go a step further to handle missile information, etc. at the planning stage of a conflict before the outbreak of actual hostilities. He then noted that the work of clearly distinguishing between areas included and not included in the kill chain would continue to be important, and that there is still room for improvement. He responded that it is thought that one area in which Japan can demonstrate its strengths is in the utilization of uncrewed systems that are short-range and slow-speed, yet inexpensive, compact, and simple.

In Session 2, Dr. Bleddyn Bowen (Associate Professor in the School of Government and International Affairs at Durham University), Dr. FUKUSHIMA Yasuhito (then Senior Research Fellow, Global Security Division, Policy Studies Department, National Institute for Defense Studies; currently Associate Professor, Faculty of Policy Management, Keio University), Dr. Xavier Pasco (Director of the Foundation for Strategic Research), and Dr. Rajeswari (Raji) Pillai Rajagopalan (Resident Senior Fellow, Australian Strategic Policy Institute) gave presentations on Major Country Policies in the Changing Environment, and Dr. SUZUKI Kazuto (Professor of Science and Technology Policy at the University of Tokyo's Graduate School of Public Policy and Director of the Institute of Geoeconomics) held a discussion with the presenters.

Firstly, Dr. Bowen gave a presentation entitled "The UK in the Global Space Age." He pointed out that the nature of the use of space by the United Kingdom is a "binary system." This means that the space policies of the United Kingdom depend on the "special relationship" with the United States, while being partially embedded in the systems of Europe, and vacillate between the two poles. Then he stated that the space policies of the United Kingdom are facing difficulties in the context of the reelection of Donald Trump as the next president of the United States and the growing political vulnerabilities of the countries in Europe.

Dr. Bowen stated that, in historical terms, the national security space policies of the United Kingdom have largely depended on the United States, including the launch of satellites, and then he pointed out that the United Kingdom had not presented its own comprehensive space policies for many years. According to Dr. Bowen, in this context, the United Kingdom has in recent years announced a string of comprehensive policy documents concerning space. For example, in its 2021 National Space Strategy, the UK presented a policy of spending ten billion pounds in space-related fields over the next ten years, and in addition, in the 2022 Defense Space Strategy, the UK emphasized that it would have its own space capabilities. Dr. Bowen pointed out that the United Kingdom's major areas of military space capabilities are satellite communications, Space Domain Awareness (SDA), ISR, and space control. He noted that the UK is advancing development and launch activities in these areas and is also investing in related U.S. companies.

According to Dr. Bowen, another characteristic of the space policies of the United

Kingdom in recent years is that it has been exploring collaboration with middle powers such as Japan, South Korea, Italy. Finally, he predicted that resource constraints, including budget cuts, could become an issue.

Next, Dr. Fukushima gave a presentation titled “Japan’s Defense Space Policy: The Past and Next Ten Years.” He acknowledged the persistent misconception that Japan was not using space for defense applications prior to the enactment of the Basic Space Law in 2008, and pointed out that actually Japan has used space for defense purposes for over 50 years. That has covered almost all areas, from telecommunications to environmental monitoring (meteorological observation, etc.), ISR, positioning, navigation, and timing, and early warning of missile launches. He also said that one change due to the establishment of the Basic Space Law was that the Japan Self-Defense Forces began to consider acquiring dedicated space-related capabilities.

Following this, Dr. Fukushima mentioned the progress made over the past ten years, the efforts by the Ministry of Defense and the Japan Self-Defense Forces to acquire X-band defense communications satellites, space surveillance capabilities, and capabilities for gaining superiority in the use of space. He pointed out that the backdrop to starting development of the space surveillance capabilities was the emergence of risks to the use of space, as well as the U.S. Department of Defense starting full-scale efforts to strengthen space collaboration with allies during the Obama administration. Furthermore, according to Dr. Fukushima, the major turning points for Japan’s defense space policies were the National Defense Program Guidelines and Medium Term Defense Program, both in 2018. Gaining superiority in the use of space was added as a new mission in the space domain in these documents, and as a result, Japan began development of the related capabilities.

As another example of the progress made over the past ten years, Dr. Fukushima brought up the establishment of dedicated units. The establishment of a space domain mission unit responsible for space surveillance and gaining superiority in the use of space was specified in the above National Defense Program Guidelines and the Medium Term Defense Program. Accordingly, the Space Operations Squadron was launched in the Air Self-Defense Force in 2020 and the Space Operations Group was launched in 2022 to oversee the squadron.

Finally, Dr. Fukushima stated the outlook for the next ten years. He ended his presentation by pointing out that concrete efforts based on the three new strategic documents approved by the Cabinet in 2022 (the National Security Strategy, the

National Defense Strategy, and the Defense Buildup Program) would be made to build satellite constellations utilizing the technologies of the private sector, reorganize the Air Self-Defense Force into the Air and Space Self-Defense Force, and strengthen collaboration with companies, allies, and partners.

Next, Dr. Pasco gave a presentation titled "Protecting and engaging: The Tight Rope of the French Military Space Policy." He firstly stated that the space policies of France were started by President Charles de Gaulle in the 1950s, and France has operated reconnaissance satellites and other systems in order to strengthen its sovereign nuclear deterrence. He also mentioned that since the 1990s, France has utilized satellites in the Gulf War and in counterterror operations conducted in Africa. He stated in relation to these points that "knowledge and anticipation" was incorporated as the fifth strategic function in the White Paper on Defence and National Security published by the French Ministry of Defence in 2008, which led to increased use of space systems for intelligence and combat operations support.

Moreover, Dr. Pasco pointed out that since the ASAT test by China in 2007, multiple countries had conducted similar tests, and against this backdrop, France began efforts to promote active defense through its 2019 Space Defense Strategy, etc. According to Dr. Pasco, France is advancing the creation of a command, control, communication and computing center for space operations and the development of patrol-guard satellites (YODA), in-orbit lasers (FLAMHE), and ground-based lasers (BLOOMLASE) by 2030.

Dr. Pasco ended his presentation by stating that the "active defense" military initiative should be supplemented by diplomatic activities aimed at ensuring transparency, so that the initiative does not provoke excessive reactions from other countries.

Finally, Dr. Rajagopalan gave a presentation titled "India's National Security Space Policy." She first stated that India's use of space was centered on the civil field over many years, and India took the position of criticizing the space policies of the United States, the former Soviet Union, and other countries, which promoted the military use of space. She pointed out that India was prompted to change this kind of negative stance toward the military use of space by China's implementation of an ASAT test in 2007. According to Dr. Rajagopalan, India has begun to discuss the need to prepare for threats from its neighbors and protect its own space assets.

Dr. Rajagopalan pointed out that India's specific measures regarding its use of space for national security purposes include the enhancement of military equipment, such as the development of communications satellites with military applications, positioning systems, and weapons designed to protect space assets (electromagnetic pulses, lasers, directed-energy weapons, etc.). In relation to this point, she noted that Prime Minister Narendra Modi declared in 2019 that India would advance the development of its own ASAT capabilities. Furthermore, she raised the fact that beginning with the establishment of the Defence Space Agency (DSA) within the Indian military in 2018, India has also been advancing the development of institutional aspects. Furthermore, according to Dr. Rajagopalan, the DSA conducted its first military exercises in the area of space operations in November 2024. In addition, she pointed out that in recent years the Indian military leadership has been making positive statements about the military use of space.

Finally, Dr. Rajagopalan stated that India intends to strengthen cooperation with countries which have a similar perspective concerning China. This includes bilateral collaboration with the United States and Japan, among others, as well as deepening cooperation within minilateral frameworks such as the Quad. She stated that while India's external cooperation in space has traditionally been conducted with developing countries in most cases, the strengthening of relations with developed countries such as the United States, as described above, indicates that there has been a change in India's space policy.

In the Session 2 discussion, Dr. Suzuki commented on the presentations by the four speakers and then raised questions. (The responses to the questions were postponed to Session 3 due to time constraints.)

Dr. Suzuki pointed out that the space policies of the four countries raised in this session each have their own historical backgrounds and unique contexts, which suggests that space policies for national security purposes do not necessarily target a specific "enemy" and that the problem of "who the enemy is" is not necessarily a decisive factor. Furthermore, he stated that we can conclude that institutions are also important, and each country is building institutions based on its respective context. Moreover, he presented the analysis that leadership is also an important factor in space policymaking, citing the examples of President de Gaulle of France and Prime Minister Modi of India, who were mentioned in this session, and in addition Chief Cabinet Secretary KAWAMURA Takeo in Japan and Prime Minister Margaret Thatcher of the United Kingdom, to demonstrate that the presence of leaders who form policies based on the context and institutions of their own countries is important.

Based on the above premises, Dr. Suzuki posed three common questions to the four presenters. The first question was, from a leadership perspective, what impact do you expect President Trump's new space policies to have on your country? The second question was, from an institutional perspective, how will the programs for the use of space for national security in your country change going forward as a consequence of the progress of commercialization? Thirdly, he asked about the impact that Mr. Elon Musk will have on the use and commercialization of space going forward. Each presenter was asked to respond to one or more of these questions.

In Session 3, a Wrap-up Discussion by all of the previous speakers was held, but firstly, the presenters responded to the questions from Dr. Suzuki in Session 2, and after that, the discussion was held in the form of responses to questions from the audience.

With respect to Dr. Suzuki's questions in Session 2, firstly Dr. Rajagopalan expressed the view that with President Trump's return to power, uncertainty and unpredictability in the United States will increase, so other countries will want to have their own options while partnering with the United States, will not rely excessively on the United States, and will begin to shoulder more of the burden by themselves. Next, Dr. Pasco stated that in the relationship with the United States, which will become unpredictable with President Trump's return to power, issues such as what Europe is aiming for concerning the use of space, what contribution Europe can make as a partner of the United States, and how Europe manages its relationship with the United States will be important. Regarding the progress of commercial space activities and their relationship to national security, Dr. Fukushima stated that the U.S. Department of Defense had been developing and operating space systems itself and only using the space capabilities of the private sector as auxiliary capabilities, but recently it has been focusing on how commercial space innovation can be utilized effectively. Dr. Fukushima also pointed out that before the establishment of the Basic Space Law the ownership of satellites by the Japan Self-Defense Forces was not permitted and the Japan Self-Defense Forces had a long history of utilizing the space capabilities of the private sector. Then he stated that recently the question of how to stably use commercial space systems in response to the emergence of deliberate threats has become an issue. Finally, Dr. Bowen predicted that the national security space policies of the second Trump administration would maintain continuity with those of his first administration. He pointed out that it is thought that military space cooperation between the United States and the United Kingdom will likely continue unchanged, but Mr. Musk has been intervening in domestic British political affairs, so there is a risk that this could cause diplomatic friction, and caution is necessary.

Next, the presenters responded to questions from the audience. Firstly, regarding the second Trump administration, Dr. Pace acknowledged that space policy would be an area with a high degree of continuity, while stating that the question of what to actually implement was most important, and from that perspective, the nomination of Mr. Jared Isaacman to be the Administrator of the National Aeronautics and Space Administration (NASA) was a good choice. Furthermore, he expressed the view that the second Trump administration would implement various reforms concerning the utilization of private sector space capabilities in the national security field.

Next, in response to a question asking how the space innovation and services of the private sector should be utilized in national security and how the risks borne by the private sector as a consequence of that can be minimized, Dr. Klein pointed out that indemnification and insurance with respect to private sector companies are necessary to minimize risks. Dr. Aoki stated that it is necessary to make arrangements with private sector companies and clarify their conditions in advance, as well as to consider introducing more resilient private sector satellite constellations and economic indemnification for companies.

Next, concerning the military usefulness of the FOBS for which China conducted a launch test in 2021, Dr. Pollpeter responded that unlike the Soviet Union's FOBS, China's FOBS is useful because it is able to use hypersonic technologies to evade missile defenses and attack at high speed. Furthermore, he expressed the view that the reason why China conducted the FOBS test is perhaps that China is thinking that it wants to overcome a vulnerability in its own nuclear forces in order to establish nuclear deterrence against the United States. In relation to that, he stated that China has been concerned about and considering how to evade the missile defenses of the United States since the second half of the 1990s, so China's possession of various long-range strike capabilities, including FOBS, could pose more dilemmas for the United States.

Moreover, regarding the suspicion that Russia is developing a nuclear-armed ASAT weapon, Dr. Pasco responded that it was shocking news for France as well and was a military message showing that the relationship between space and nuclear had become closer. In relation to this, he pointed out that France's defense authorities are concerned about Russia's satellites getting close to those of other countries, and that it is necessary to take concrete measures, including SSA and active defense, to deter such undesirable behavior by Russia. Furthermore, he added that the countries of the world must unite in the United Nations to raise their voices against Russia's undesirable behavior and engage in signaling. Next, Dr. Bowen stated that Russia was probably talking about a nuclear-armed ASAT weapon in order to incite fear, so we shouldn't pay too much attention to it. Finally, Dr. Rajagopalan commented that there are concerns that current international norms are being diluted by irresponsible behavior by China, Russia, and other countries, as in the case of cyberattacks on space systems or the problem of the deployment of nuclear weapons in space, and that it is necessary to reassert basic principles.

Keynote Speech
Space Security Challenges for the U.S.-Japan Alliance

Scott Pace

1.0 Introduction

Japan is a space power. Japan's influence over and reliance upon the space domain will increase in the years ahead, with fundamental implications for all aspects of Japan's strategic interests, including national security, economic security and its geopolitical position and influence. During the Cold War, access to space capabilities was limited, space activities were led by the United States and the Soviet Union, and space power was defined primarily by capabilities in rockets and satellites. Commercial space developments have pushed the definition of leadership in space beyond just space hardware and into information and data services with potential for technological and economic benefit, but also with a larger and more challenging threat horizon.

Japan's space capabilities are foundational to its security, the Japan-U.S. security alliance, and security in the Indo-Pacific region. Japan relies on space for food security, navigation, ocean monitoring, missile defense, communications, economic security, weather, information collection, natural disaster response and recovery, technological innovation, science, and more. Space activities which threaten or block Japan's use of space, or which damage the long-term sustainability of space activity, will harm Japan's security. Similar to the oceans and air, activities in space connect Japan to the world. The ability to have unfettered access to and use of space is therefore vital to Japan's security, economy, and way of life.

This paper focuses on the space security challenges (and some opportunities) for the broader Japan-U.S. Alliance, not just the military activities by the United States and Japan. Security considerations include supporting civil, commercial, and diplomatic space activities that shape the conditions for Japanese national security (e.g., technologies, industrial capabilities, and international diplomacy). The next sections will address the context for U.S.-Japan space cooperation; the space security environment for Japan; key challenges for space security; strengthening the Japanese Self-Defense Forces (JSDF), and some policy recommendations.

2.0 U.S.-Japan Space Cooperation

Japan initially chose to develop independent space science capabilities with its "pencil rocket" in 1955 and launch of the first Japanese satellite, Ohsumi, in 1970 – the same year China launched its first satellite. International collaboration increased with the formation of the Institute of Space and Aeronautical Science (ISAS) in 1964 and the National Space Development Agency of Japan (NASDA) in 1969. Under license from the United States, Japan developed the N-1 and N-2s rocket, which were based on the U.S. Thor-Delta and Delta rocket designs. The United States placed tight restrictions on the transfer and use of ballistic missile technologies, however. Over time, with the H-series and other programs, Japan developed an autonomous launch capability for a wide range of payload weights, using liquid and solid propulsion motors.

The number and scope of space cooperation agreements between the United States and Japan began slowly, but have been increasing rapidly in recent years. See Table 1 below.

1969	Exchange of Notes concerning Space Exploration
1990	Exchange of Notes concerning the Policy and Procedure of R&D and Procurement of Artificial Satellites (Super 301 Trade)
1998	MoU concerning Cooperation on the Civil International Space Station
1998	U.S.-Japan Joint Statement on GPS Cooperation
2013	Japan-U.S. Agreement on SSA Services and Information
2013-Present	Comprehensive Dialogue on Space
2015	Extension of ISS Participation to 2024
2020	Artemis Accords founding member, Civil Lunar Gateway MOU
2023	US-Japan Space Framework Agreement

Table 1. Major Space Agreements between the United States and Japan

The 1969 exchange of notes dealt largely with how missile technologies from the United States would be protected and controlled. Twenty years later, the United States was concerned that Japanese launchers and communications satellites could use protected domestic markets to dominate global sales. Coming near the peak of trade frictions over automobiles, DRAM chips, and agriculture products, the United States and Japan created the 1990 Agreement on Satellite Procurement. This trade agreement barred Japan from excluding foreign suppliers if satellites were to offer international commercial services. Japan could reserve satellites for domestic suppliers for non-commercial purposes such as scientific research or national security. It is still in effect and applies to Low-Earth Orbit (LEO) as well as Geostationary Earth Orbit (GEO) commercial satellites of all kinds.

During Diet debates on ratifying the 1967 Outer Space Treaty in 1969, Japan chose to interpret the term "exclusively for peaceful purposes" as meaning non-military. Thus Japan would not engage in military space activities. In contrast, the United States and other spacefaring countries interpreted "peaceful purposes" as allowing for non-aggressive military uses of space under the terms of the treaty. Japan's interpretation continued up until it was changed by the 2008 passage of the Basic Space Law, which opened the possibility of Japan using space for military purposes, consistent with Article 9 of the Japanese constitution.

Japan chose not to join the Space Shuttle program in the 1970s, while Europe and Canada did. Later, Japan did join the Space Station program, in part due to the common international views of President Reagan and Prime Minister Nakasone. The global growth of Global Positioning System (GPS) commercial applications, including for car navigation, led the United States and Japan to issue a joint statement on GPS cooperation in 1998, ahead of later satellite navigation agreements with Europe and other countries.

In the past decade, the United States and Japan have deepened their space cooperation across a wide range of civil, military, and commercial activities. Japan was one of the first countries to sign a space situational awareness data sharing agreement with the United States, the first country to have an annual comprehensive dialog on space (which has expanded to France), and was among the first eight countries to join the Artemis Accords. In response to current Russian efforts to station a nuclear weapon in orbit, Japan and the United States are working closely together in the UN Security Council and the UN General Assembly to organize international opposition to this potential violation of the 1967 Outer Space Treaty. Over time, Japan has become a crucial, if not leading, international space partner for the United States. In light of growing security challenges for both countries, this relationship is only likely to become more important for space security missions.

Under international law, space is the "province of all mankind" and is not subject to claims of sovereignty. This poses a dilemma for Japan and other spacefaring states in providing for their own security – they rely on the use of a domain that cannot be directly controlled. Thus, Japan must engage with other likeminded countries, especially the United States, to secure support and understanding for Japan's interests. In particular, Japan needs to actively engage with other countries in shaping the conditions for space activities to ensure those conditions are conducive to Japan's interests.

Space activities today occur in a very different international environment than the Cold War or post-Cold War eras. The rapid globalization and democratization of space resulted in many more countries and private entities conducting space activities. Some companies are self-sustaining while others require government support. There has been a dramatic growth in the number of national agencies and there are now a hundred members of the United Nations Committee on the Peaceful Purposes of Outer Space (UNCOPUOS).[1] This trend reflects a broad alignment of interests between spacefaring countries and space-reliant developing countries; both are interested in the sustainable, peaceful uses of space to ensure the benefits from space-based infrastructures (e.g., satellite navigation, satellite communications, weather satellites, and remote sensing).

Japan released its current Space Security Initiative (SSI) in June 2023 which outlines the nation's plans for its space security architectures.[2] It aims to ensure the safe and stable use of space systems with three interrelated approaches representing the military, diplomatic, and economic aspects of space power:

- Radically Expand the Use of Space Systems for National Security (security from space)
- Ensuring Safe and Stable Use of Outer Space (Security in Space)
- Realizing a Favorable Cycle of Security and Fostering Space Industrial Base[3]

Key components of the SSI include: space domain awareness (SDA) satellites; intelligence, surveillance, and reconnaissance (ISR) satellites; space-based communications satellites; positioning navigation satellites; and space surveillance sensors. The SSI also emphasizes the importance of a strong domestic space industrial base and vibrant innovation to support Japan's space security efforts. By leveraging private-sector technologies, Japan can build a space architecture for national security that is both innovative and cost-effective. This is similar to U.S. efforts to make greater

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1 United Nations. 2022. COPUOS Membership Evolution. https://www.unoosa.org/oosa/en/ourwork/copuos/members/evolution.html

2 Japan. 2023. *The Space Security Initiative*. Tokyo, Japan: The Space Development Strategy Headquarters, June 2023. English Translation.

3 Space Security Initiative, *Op. Cit.*

use of commercial technologies and systems to achieve agile capabilities at lower costs.[4] The U.S. situation is markedly different due to the size and scope of U.S. government demand. Nonetheless, U.S.-Japan security cooperation is likely to encourage approaches that leverage and promote commercial space capabilities by both countries.

3.0 The Space Security Environment

The space domain has unique physical properties, and like other shared domains, such as the high seas, the polar regions, and arguably cyberspace, space is a domain in which state and non-state actors interact beyond national borders. Given global dependence on space-derived information and an increase in potential adversary threats to space assets, states have taken a number of steps in recent years to protect their national interests in space.

China has been rapidly increasing the professionalism and capability of its armed forces, including the ability to exploit space for military and economic security purposes and strengthen the power of the Chinese Communist Party. During the George W. Bush and Obama Administrations, the pace of Russian and Chinese anti-satellite (ASAT) testing picked up, most notably with the Chinese ASAT test in 2007. Russia and China reorganized their own armed forces to focus more directly on space, with the Russian Aerospace Defense Forces being established in 2015 and the creation of the People's Liberation Army Strategic Support Forces (PLASSF) in 2016. In April 2024, China subsequently reorganized yet again with the Strategic Support Forces being split into three separate arms: the PLA Aerospace Force, the PLA Cyberspace Force and the PLA Information Support Force.

The Obama Administration opposed officially calling space a "warfighting domain" but proposed funding to improve the resilience of space systems to a range of attacks, including cyber. The first Trump Administration recognized space as a warfighting domain and quickly issued a space strategy that called for a "whole-of-government" approach to United States leadership in space, in close partnership with the private sector and allies. The strategy emphasized four pillars: "transform to more resilient space architectures"; "strengthen deterrence and warfighting options"; "improve foundational capabilities, structures, and processes"; and "foster conducive domestic and international

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4 Defense Science Board. 2024. "Commercial Space System Access and Integrity – Final Report." Washington, DC: U.S. Department of Defense, May 2024.

environments."[5]

The combination of Chinese and Russian actions to hold U.S. space assets at risk, the recognition of space as a warfighting domain, and dim prospects for arms control, all combined to increase U.S. administration and congressional interest in space security. There has been a return of "Great Power Rivalry" with Russian annexation of Crimea in 2014, the invasion of Ukraine in 2022, continuing Chinese challenges in the South China Sea, and cyberattacks from both, have all added to a sense of urgency for long-standing national security reforms. A United States Space Command (USSPACECOM) had been created in 1985, but was disestablished in 2002 after the events of September 11, 2001. Space responsibilities were transferred to the U.S. Strategic Command, which also had responsibilities for nuclear and cyber missions. In response to a new threat environment, the USSPACECOM was reestablished in August 2019, with a mission to "conduct operations in, from, and to space to deter conflict, and if necessary, defeat aggression, deliver space combat power for the Joint/Combined force, and defend U.S. vital interests with allies and partners."[6]

At a meeting of the National Space Council on June 18, 2018, President Trump directed the Department of Defense and the Joint Staff to create a United States Space Force (USSF) as a separate military service dedicated to space.[7] This would be an armed service within the existing Department of the Air Force, just as the Marine Corps is within the Department of the Navy. On December 19, 2019, President Trump signed the 2020 National Defense Authorization Act, which had passed Congress with bipartisan support, creating the Space Force. This was the first creation of a new U.S. armed service since the National Security Act of 1947 created the Department of the Air Force. The Biden Administration continued to support the USSF and the USSPACECOM. Major U.S. allies, such as France, the United Kingdom, and Japan have also created their own dedicated military space organizations.

On October 12, 2022, the Biden Administration released its National Security Strategy.[8] The Strategy states that America has a vital interest in an "open, interconnected,

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5 The White House, "President Donald J. Trump is Unveiling an America First National Space Strategy," Fact Sheet, Washington, DC, March 23, 2018.

6 Department of Defense, *U.S. Space Command*, https://www.spacecom.mil/Mission/

7 Loverro, Douglas. 2018. "Why the United States needs a Space Force," *Space News*, June 25, 2018.

8 The White House. 2022. "National Security Strategy." Washington, DC, October 12, 2022. https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf

prosperous, secure, and resilient" Indo-Pacific, and will support that end through investments in democratic institutions, free press, and civil society. The Strategy also calls for open access to the South China Sea, stating "No region will be of more significance to the world and to everyday Americans than the Indo-Pacific." With regard to shared domains, the Strategy highlights the world's dependence on sea, air, and space for security and prosperity.

The Biden Administration National Security Strategy largely continued the policies and priorities of the Trump Administration, albeit with greater emphasis on climate and environmental issues. The major strategic challenge facing the United States and its democratic allies comes from "powers that layer authoritarian governance with a revisionist foreign policy," creating threats to international peace. Russia and the People's Republic of China (PRC) pose distinct challenges. Russia is an immediate regional threat to a peaceful international system, while the PRC has both the intent to reshape the international order as well as the power to do so. The Strategy outlines how the United States and its allies can shape both Russia and the PRC's external environment to influence their behavior while competing with them to maintain international stability and security.

In recent years, there has been a marked decline in Russian civil space capabilities due to Western sanctions for past actions, such as the 2020 poisoning of Alexei Navalny, combined with those for the 2022 invasion of Ukraine. In addition, domestic opposition to Russian mobilization has led to the loss of younger technical personnel as they sought to flee Russia. Russia remains a space power, but a declining one. It faces increasing difficulty in maintaining its existing space capabilities and lacks the ability to innovate at scale. Conversely, Western commercial space capabilities such as imagery from Maxar, mobile communications from Starlink, and GPS receivers, are being exploited effectively by Ukrainian armed forces in a wide variety of creative ways.

The reelection of Xi Jinping as Chinese Communist Party (CCP) General Secretary for a third term at the 2022 Party Congress was a significant development for the international space security environment. China's space activities have the specific support of Xi Jinping, as the preamble to the 2022 Chinese space white paper states:

> "To explore the vast cosmos, develop the space industry and build China into a space power is our eternal dream," stated President Xi Jinping. The space industry is a critical element of the overall national strategy, and China upholds the principle of

exploration and utilization of outer space for peaceful purposes.[9]

China's space industry is considerably more robust and well-funded than Russia's, and catching up in operational experience. China's space capabilities have continued to grow; China has completed an independent space station and has successfully landed rovers on the Moon and Mars. Due to Western sanctions and export controls, China is not a major competitor in the international launch market today, but they are heavily engaged in marketing launch services, satellites, and other space capabilities to developing countries. In return, China gets access to raw materials, markets for its goods, and access to ports and bases for military use. Every indication exists that they intend to be competitive in all commercial space sectors.

China is rapidly increasing the professionalism and capability of its armed forces, including their ability to exploit space to meet their national security objectives. As part of this effort, China's military possesses increasingly capable space counterforce weapons, as detailed in a 2022 U.S. Defense Intelligence Agency report.[10] These weapons include ground-based kinetic energy and directed energy systems as well as a wide variety of radio frequency jammers. Finally, China is also active diplomatically in a variety of fora. In its most recent space white paper, issued every five years, China addresses global space governance:

- Under the framework of the United Nations, China will actively participate in formulating international rules regarding outer space, and will work together with other countries to address the challenges in ensuring long-term sustainability of outer space activities.
- China will actively participate in discussions on international issues and the development of relevant mechanisms, such as those in the fields of space environment governance, near-earth objects monitoring and response, planet protection, space traffic management, and the development and utilization of space resources.
- China will cooperate in space environment governance, improve the efficiency of

[9] The State Council, People's Republic of China. 2022. *China's Space Program: a 2021 Perspective*. January 28, 2022 (in English). http://english.www.gov.cn/archive/whitepaper/202201/28/content_WS61f35b3dc6d09c94e48a467a.html

[10] United States. 2019. *Challenges to Security in Space*. Washington D.C: Defense Intelligence Agency. https://purl.fdlp.gov/GPO/gpo116298

space crisis management and comprehensive governance, conduct dialogue with Russia, the United States, and other countries as well as relevant international organizations on outer space governance, and actively support the construction of APSCO's (Asia-Pacific Space Cooperation Organization) space science observatory.[11]

In isolation, it should not be surprising that China, as a rising power, would seek to increase all aspects of its space power, whether military, economic, or diplomatic. What is of deeper concern is the Marxist-Leninist ideological conformity imposed by Xi Jinping in all areas. The strengths and weaknesses of a Marxist-Leninist approach to the Chinese economy, combined with a nationalist and confrontational approach to international relations are topics of ongoing debate by government and academic experts that need not be treated here. However, it is safe to say that China's approach to space-related security and economic activities are not, and will not be, separate from the rest of China's political priorities. Economic and military security in space are two sides of the same coin, both designed to strengthen the hegemony of the Chinese Communist Party.

The possible impacts of space activities on Japan's economic and military security over the next ten years depend on Japan's strategic vision for itself and the region. All vital national interests are still on Earth such that space activities are a means to strengthen and protect those interests, and that space activities are not ends in themselves. Space activities are more than just placing machines or even people in space, but also include the human values and goals guiding those space activities. First proposed by Prime Minister Abe in 2016, the goals of a free and open Indo-Pacific can be applied to space as well. As stated by the Japanese Ministry of Foreign Affairs (MOFA):

"The Indo-Pacific region is facing various challenges such as piracy, terrorism, proliferation of WMD, natural disasters and attempts to change the status quo. Under such circumstances, Japan aims to promote peace, stability and prosperity across the region to make the Indo-Pacific free and open as "international public goods", through ensuring rules-based international order including the rule of law, freedom of navigation and overflight, peaceful settlement of disputes, and promotion of free trade."[12]

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11 The State Council. *Op. cit.*

12 Government of Japan. 2019. "Free and Open Indo-Pacific" Ministry of Foreign Affairs. https://www.mofa.go.jp/files/000430632.pdf

The United States endorses the concept of a free and open Indo-Pacific. In its 2017 National Security Strategy, the United States adopted the term "Indo-Pacific" in place of the term "Asia-Pacific" when describing U.S. interests in the region, to include the enhanced defense partnership with India. In 2021, Secretary of State Blinken emphasized that the concept applied to persons and not just governments, militaries, and businesses:

> "When we say that we want a free and open Indo-Pacific, we mean that on an individual level, that people will be free in their daily lives and live in open societies. We mean that on a state level, individual countries will be able to choose their own path and their own partners. And we mean that on a regional level, in this part of the world problems will be dealt with openly, rules will be reached transparently and applied fairly, goods and ideas and people will flow freely across land, cyberspace, and the open seas."[13]

Japan has close relations with many countries in the Indo-Pacific region. Those relations could be strengthened through the use of space capabilities for local development and the appropriate sharing of information for SDA and maritime domain awareness purposes. Building stronger, routine security ties among countries can enable them to better cooperate on common concerns (e.g., illegal fishing, piracy), or in the event of conflict, come to each other's aid more effectively. Expanding the use of space capabilities such as communications, navigation, and remote sensing give developing countries a stake in a peaceful, rules-based order in space. As with the free-and-open Indo-Pacific strategy generally, such cooperation need not be aimed at China, but it can make it easier for smaller countries to resist economic or military pressure from China.

Maritime law enforcement operations by the Japan Coast Guard (JCG) are a particularly promising area for greater diplomatic engagement between Japan and others in the Indo-Pacific region. This is already well-known in Japan, but it is also true that space-enabled maritime domain awareness can enable more effective and efficient use of limited numbers of ships and personnel while encouraging interoperability with likeminded countries. However, major barriers to closer maritime cooperation are a

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13 Blinken, Antony J. 2021. "A Free and Open Indo-Pacific." Speech to the Universitas Indonesia, Jakarta, Indonesia. December 14, 2021. https://www.state.gov/a-free-and-open-indo-pacific/

lack of interoperable communications equipment and procedures among the JCG and local maritime law enforcement authorities. Equipment and legal interoperability are also challenges for closer cooperation between the JCG and the Maritime Self-Defense Force (MSDF). In the past, the JCG has resorted to communicating with the U.S. Coast Guard, who then communicates with the U.S. Navy, who then communicates with the MSDF.

4.0 Space Security and Key Military Challenges

The most significant threats to Japan, involving space systems, arise from China, particularly in the context of a conflict with the United States. North Korea poses a secondary, albeit serious, threat with its potential use of weapons of mass destruction and ballistic missiles against Japan. Japan's ability to deter these threats can be clarified by using the principles of deterrence laid out in the 2020 U.S. National Space Policy. As described in the U.S. Policy, the ability to deter an attack is based on five elements:

- Attribution – being able to identify who is to be deterred;
- Signaling – to communicate whether an action is unacceptable. This can include, but is not synonymous with norms of behavior;
- Credibility – having capabilities that are known, exercised, or demonstrated to support signaling to an adversary;
- Resilience ("denial of benefit") – a characteristic of a nation's capabilities in which they can function effectively across the spectrum of conflict and despite attacks from an adversary; and
- Cost Imposition – which may range from diplomatic protests and economic sanctions, to armed conflict.[14]

For the United States, space systems are needed to support or implement each of these deterrence elements. SDA is needed to attribute actions to adversaries in space. Diplomatic or political complaints about violating norms of behavior in space are one form of signaling, but other actions such as moving deployed forces can also send signals to an adversary. In order to be credible, the United States needs actual space

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[14] The White House. 2020. "The National Space Policy." Washington, DC, December 9, 2020. Page 27. https://history.nasa.gov/NationalSpacePolicy12-9-20.pdf

capabilities, military or civil or commercial, that are proven to operate effectively. Those same capabilities are needed to support resilient functions. Communications and missile warning functions that cannot be easily denied or destroyed enable escalation control and greater crisis stability. The question for Japan is whether it requires space systems for all these elements of deterrence and why.

Attribution: Improving Japan's SDA would give it better knowledge of events in the space environment and allow for independent verification. This would improve and expand international confidence in correctly attributing hostile actions in space. By contributing to improved SDA, Japan can also promote international standards for information about space safety risks and better communicate that information to appropriate satellite owners and operators.

Signaling: Japan can support international discussions on transparent and responsible standards for active debris removal. Such standards can help reduce the risk of space debris and also help distinguish between friendly and hostile close approaches of satellites. Both would contribute to more confident signaling between actors and space and lower the risk of misunderstandings and potential miscommunication.

Credibility: Demonstrating the operational credibility and resilience of Japan's space capabilities is an important part of deterrence, just as it is in other operational domains such as the oceans and the air. This is particularly necessary where there may be intentional interference with those systems, such as jamming or ballistic missile attacks. Space-based communications, navigation, and ISR are especially important to the MSDF and Air Self-Defense Forces in maintaining operational access to the sea and air lines of communication connecting Japan to the rest of the world, and the United States in particular.

Resilience ("Denial of Benefit"): The JSDF should ensure that exercises include using space capabilities under both normal and challenging conditions when access to space-based information is degraded or denied. For example, JSDF ships and aircraft should be able to operate under conditions of GPS jamming. The JSDF and senior civilian Japanese leadership should have secure communications with each other and with U.S. armed forces, even when satellites are subject to interference. The JSDF should be able to maintain SDA and MDA of the areas surrounding Japan at high levels of conflict, when Japan is under attack. Doing so will require not only close cooperation with the United States, but with other Association of Southeast Asian Nations (ASEAN) countries.

Cost Imposition: Japan should consider what diplomatic, military, and/or economic "weapons" it will deploy if/when Japan's space systems are attacked. Japan should develop response plans and determine approval authorities for responses at all levels of the conflict "escalation ladder." Some cost imposition options may be communicated publicly to partners and adversaries while others may be kept only for discussion within the Japan-U.S. alliance, or communicated directly to an adversary.

Space capabilities are part of overall national power. As a consequence, "space" should not be treated in isolation from other domains, such as land, sea, air, and cyber. In the case of a conflict over Taiwan, the U.S. strategy should be one which prevents China from immediately taking critical territory, even if not fully defeated, rather than ceding territory and having to wage a longer, costly counteroffensive after losing ground. The RAND Corporation has written on the specific military capabilities in which there is a

> "…need for a deterrent and defense posture that is based on rapidly blunting invading forces and holding decisive points—that is, *preventing an adversary from seizing the primary objectives of the invasion*, to wit, Taiwan or significant terrain within one or more NATO nations."[15]

Deterrence based on the denial of attack objectives tends to be more credible than threats of future cost imposition or escalation (whether vertical, such as nuclear weapons, or horizontal, such as out-of-area attacks). To blunt an invasion force, the United States, Japan, and their allies will need a strong forward defense to include rapid, precise, over-the-horizon strikes. Such a defense will require space-based communications, positioning, and ISR, as well as resilience to cyber and electronic warfare attacks. The decisive phase of a war could be in days, not weeks or months. Hence the importance of in-place, operational capabilities. RAND describes the information demands that will exist from the beginning of a conflict as follows:

> "Throughout the duration of the blunt phase, establish and sustain a sensing and targeting grid over the battlespace. The grid must be able to find, identify, and track ships, aircraft, and vehicles associated with enemy invasion in the face of *intensive air defenses, counter-space weapons, cyberattacks, and sensor and communications jamming*. The grid should be connected to air, land, and maritime operations centers via

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15 Ochmanek, David A., *Determining the Military Capabilities Most Needed to Counter China and Russia: A Strategy-Driven Approach*. Santa Monica, CA: RAND Corporation, 2022. Page 4. https://www.rand.org/pubs/perspectives/PEA1984-1.html.

> robust data links. The grid should also be capable of autonomously nominating and guiding weapons to targets in cases where those links are temporarily severed."[16]

Meeting these information demands is more than a space problem, but a complex management and technology problem that poses challenges to both military services and the supporting industrial base. That said, there are two space lines of effort that are mutually reinforcing and, when implemented together, will have greater effect. The first consists of space policies that improve the ability of Japan to defend itself, followed by policies which strengthen the Japan-U.S. alliance and foster a more favorable environment for Japan's space activities. The second line of effort are measures to strengthen Japan's space industrial base, raising Japan's ability to utilize space for economic growth, and fostering new innovations and scientific understanding. Clear policies on how and where Japan will utilize space to protect itself provide signals to Japan's industrial base on where to invest, innovate, and build space capabilities. These signals need to be clear and credible if they are to be trusted and acted upon by Japanese industry.

The most recent U.S.-Japan Summit Meeting in April 2024 between President Biden and Prime Minister Kishida resulted in a number of new initiatives in defense and security cooperation, including overlapping efforts in commercial and military space. For example:

> "The United States and Japan announced their intention to collaborate on a future Low-Earth Orbit (LEO) Hypersonic Glide Vehicle (HGV) detection and tracking constellation. This includes cooperation on demonstration, bilateral analysis, information sharing, and potential collaboration with the U.S. industrial base. The integration between U.S. and Japanese constellations of LEO satellites provides an opportunity to improve communications and increase the resilience of both nations' space capabilities."[17]

The focus on LEO satellite architectures addresses several interrelated interests. First, the need for detecting and tracking HGVs which are more difficult to defeat than ballistic missiles. Second, the exploitation of information from LEO constellations can also enable space-based tactical ISR which is a critical need in the Indo-Pacific. In

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16 *Ibid*

17 United States. 2024. "FACT SHEET: Japan Official Visit with State Dinner to the United States." Washington, DC: The White House. April 10, 2024. p. 7

particular, space-based solutions are important as traditional airborne ISR assets are not survivable in the expected threat environment. Finally, large scale production of LEO platforms offers potential economies of scale that would benefit commercial as well as military applications. There is a keen interest within Japanese industry to participate in mega-constellation programs but the current Japanese domestic market is small, making international cooperation a necessity. It is less clear, however, as to what such cooperation would look like, e.g., sales and subcontracting in the U.S. market, licensed production in Japan, or integration of separate, but compatible systems.

The United States increasingly looks to hybrid architecture solutions in which government and commercial assets are used together, rather than relying on purely private or fully government systems for mission needs. This is particularly true in building interoperable and integrated ground systems for space services and Japan should follow this trend closely. Such an approach could provide faster, lower cost acquisitions as well as a means of ensuring interoperability. For example, Ukrainian armed forces have quickly adapted to using U.S. commercial space communications, commercial GPS, and commercial remote sensing data sources to wage highly sophisticated operations. Under the pressure of an existential threat, they are demonstrating the value of hybrid systems.

The most serious interoperability barrier is not likely to be technical or political, but data and information security. Sharing of space data for military or intelligence purposes remains exceedingly sensitive, despite ongoing efforts to lower classification restrictions for allies. For Japan to achieve its own security and enable full integration/interoperability with the United States, three foundational activities must be achieved: secure digital infrastructure, cybersecurity, and a government/industrial security apparatus. Each of these initiatives are foundational, interdependent, and a prerequisite to economic and security development.

Space activities are closely related to economic security as well as direct military security. This is particularly clear when looking at the space industrial base which provides the foundational capabilities for any space activity. As the experience in Ukraine has shown, logistics and the ability to sustain a protracted conflict are crucial to countering aggression. China may seek to prosecute a high-speed conflict, or escalate to multiple domains, such as space and cyber. The United States places its top priority on ensuring nuclear deterrence, to include extended deterrence of nuclear attacks on allies, to prevent nuclear escalation. Ensuring adequate munitions stockpiles and secure industrial supply chains are essential to deterring conflict from beginning by denying the attacker any realistic hope of victory. Resilient architectures that can withstand adversary attacks, whether kinetic, electromagnetic, or cyber, are stabilizing as they enhance Japan's deterrence posture. Resilience can be demonstrated through use of hybrid architectures that draw on diverse commercial as well as government space systems. Like military weakness, perceived industrial weakness can be provocative to conflict rather than stabilizing.

U.S.-Japan commercial partnerships can encompass a wide range of activities such as sales of systems, subsystems, and components, licensed production, and co-development. The different sizes of the U.S. and Japanese space markets can make it difficult to find mutually advantageous projects. However, the United States is finding the Japanese manufacturing capabilities can fill in gaps on the U.S. side; for example in co-production deals for Advanced Medium-Range Air-to-Air Missiles (AMRAAMs) and Patriot missile defense batteries. There are situations in the U.S. space industrial base where there may be only one qualified supplier. Co-production partnerships with Japan could strengthen supply chain resilience and enable more economical, continuous manufacturing.

5.0 Space Security and Diplomatic Challenges

Global and regional geopolitical alignments will continue to be the underlying force behind high visibility human spaceflight cooperation. With an increasingly isolated Russia, international human spaceflight cooperation will likely separate into a new bipolar bloc centered on the United States and China respectively. The China bloc is likely to have limited appeal to developed countries but will be nominally international with Russia in the International Lunar Research Station (ILRS) project. Concern with China, and Russia's ties with China, will likely result in India increasing space cooperation with Quad nations, although remaining formally non-aligned. Japan thus has a potentially important role in encouraging space cooperation with India. Through the Asia-Pacific Regional Space Agency Forum (APRSAF) and other engagements with the ASEAN members, Japan is in a position to promote increased space cooperation across the region and provide an alternative to China.

After the International Space Station (ISS) program ends, either by 2030 or earlier, the ISS partners will shift to new programs. While Japan's space budget continues to emphasize civil space activities, increasing threats from Russia and China in space as well as cyberattacks, have made space cooperation an important part of Japan's security alliance with the United States. As more countries operate in space, for commercial and military purposes as well as traditional scientific purposes, Japan's involvement in human space exploration is an opportunity to shape the governance of the space environment on which it relies. In doing so, a strategic partnership with the United States is one of its strongest assets.

Japan has ambitions to have one of its astronauts be the first non-American on the Moon. On December 28, 2021, Japanese Prime Minister Kishida released a statement on the latest version of Japan's Basic Space Plan which included this statement: "…in the latter half of the 2020s, we will aim to realize the landing of Japanese astronauts on the Moon…"[18] While very much a civilian program, the Artemis effort to return humans to the Moon is also a national security program. The necessary capabilities to operate in deep space and on the lunar surface – transportation, communications, guidance and navigation, power, etc. are all dual-use capabilities. Their development by civil, commercial, and international partners is less provocative than if led by national military forces, such as the U.S. Space Force. In addition, current U.S. military and civilian defense leaders do not see lunar activities as a security priority compared to supporting U.S. and allied forces on Earth.[19]

All countries, including the United States and China, operating in cislunar space need basic space situational awareness and other information for safety reasons. A civil multilateral forum could be created for the exchange of information on lunar operations. The UN Office of Outer Space Affairs (UNOOSA), with the endorsement of member states, supports the International Committee on Global Navigation Satellite Systems (ICG). The ICG provides an open, multilateral forum for technical information exchange among Global Navigation Satellite System (GNSS) providers such as the United States, Russia, China, Japan, Europe, and India. It can address technical matters and improve transparency but does not get into operational decisions, which are the preserve of member states. A Lunar Activities Committee (LAC) could play a similar role for states operating spacecraft, as well as infrastructure services in cislunar space.[20] Looking ahead to the return of humans to the Moon, such a forum could also discuss

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18 Park Si-soo, 2021. "Japan wants a JAXA astronaut to be first 'non-American' to join a NASA lunar landing." *Space News*, December 29, 2021. https://spacenews.com/japan-wants-jaxa-astronaut-to-be-first-non-american-to-join-a-nasa-lunar-landing/

19 Hitchens, Theresa. 2022. "Kendall's 'message' to Space Force: support missions are central role." *Breaking Defense.* April 6, 2022. https://breakingdefense.com/2022/04/kendalls-message-to-space-force-support-missions-are-central-role/

20 United Nations Committee on the Peaceful Uses of Outer Space. 2024. "Draft mandate, terms of reference and methods of work for an Action Team on Lunar Activities Consultation (ATLAC) - Paper submitted by Republic of Korea, and Romania," United Nations, Vienna: June 25, 2024

potential means for the rescue and return of astronauts, or other forms of mutual aid, per international law.[21] While motivated by safety concerns, such a forum could also encourage the development of norms of behavior that would foster more transparent and sustainable lunar operations.

Multiple U.S. administrations have emphasized norms of behavior in space, in particular the voluntary halting of destructive direct-ascent kinetic energy anti-satellite tests. The natural question is what should come next? In deterrence terms, norms are part of signaling, and their significance lies in the extent to which they are broadly followed. In commercial, scientific, and exploration terms, norms of behavior can be important elements for creating or enhancing safe and responsible space operations. For example, in cooperation with likeminded countries, Japan can play a role in setting dual-use norms for rendezvous and proximity operations, satellite refueling, servicing, and active debris removal. Such capabilities are dual use and may be used to harm satellites as well as service them.

Other dual-use space areas where Japan could lead would be in SDA beyond geosynchronous orbit and in cislunar space, defining lunar safety zones for human landings and resource utilization, and procedures for the rescue and return of astronauts. China is expected to eventually send humans to the Moon, including to the South Pole region where Japanese, European, and American astronauts will be. While such activity is not a military threat, discussion and coordination will need to take place with China to ensure safe and responsible operation on the Moon. Japan can play an important international role in establishing norms of behavior in and around the Moon.

The most serious challenge to the international legal regime for space is the potential placement of a Russian nuclear weapon in orbit.[22] In addition to the military and global economic threat posed by such an action, stationing a nuclear weapon in space would be a clear and direct violation of Article 4 of the 1967 Outer Space Treaty.[23] It is unclear how the United States and Japan, along with the rest of the international community, should react if the treaty is violated. Should signatories decide to withdraw from a

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21 *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*. Entered into force December 1968. United Nations, New York. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html

22 Duchaine, Daniel. 2024. "Russia's nuclear threat to space is worse than a 'Cuban Missile Crisis' in space." Commentary in *Space News*, July 9, 2024.

23 Article 4 of the 1967 Outer Space Treaty states in part: "States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction…"

clearly ineffective agreement? Should the Russian violation be tolerated in the hopes of them coming back into compliance and preserving other parts of the treaty? Should international sanctions be imposed – in addition to those already imposed in response to Russia's invasion of Ukraine. As a last resort, should other spacefaring nations be prepared to remove the weapon by force?

If international law and space governance are to be effective, what, if anything, is the international community willing to do to uphold the Outer Space Treaty? Russia could cause global economic disaster by the collapse of space infrastructure. So, should a space-based nuclear weapon be considered an imminent threat? Would destruction of an orbiting nuclear weapon, to enforce the Article 4 prohibition, be legal under the UN Charter? More generally, does this situation suggest that the United States has an undefined military requirement to be able to destroy orbiting nuclear weapons, as well as ballistic transiting through space, and defend high value assets in space (such as missile warning and nuclear command and control systems)?

6.0 Strengthening the Japan Self-Defense Forces

Given historical circumstances and past Japanese government policies, the JSDF today has only limited abilities to utilize space for military benefit. Senior military and civilian leaders in the Ministry of Defense and the Self-Defense Forces (MOD/SDF) are aware of the importance of space to modern military operations, but this has not yet been translated into reality among deployed forces. The MSDF work closely with the U.S. Navy and can use satellite communications and satellite navigation systems. The ASDF are similar in their working relationship with the U.S. Air Force. The Ground Self-Defense Forces (GSDF) lag behind the most in that their vehicles are not routinely equipped with military-grade GPS, they lack robust satellite communications, and cannot easily use space and radar information for over the horizon strikes. JSDF commanders, even very senior ones, do not have access to satellite images, even commercial images, which are a routine part of U.S. military operations. Finally, the JCG is not able to operate as seamlessly with the MSDF as the U.S. Navy and the U.S. Coast Guard are able to do, for both legal and technical reasons. This is particularly worrisome as the JCG faces "gray zone" challenges from the PLA Navy, Chinese Coast Guard, or irregular forces.

The security environment around Japan has changed dramatically in the past decade and this has led to revisions to Japan's National Security Strategy and National

Defense Strategy.[24, 25] These revisions require a strengthening of the JSDF, to include the acquisition of its own counterstrike capabilities in addition to ballistic missile defenses and reliance on U.S. long-range strike capabilities. To defend Japan, the JSDF needs to be able to find, attribute, defend against, and kill targets "over the horizon" and not just on Japanese territory. These capabilities in turn require sophisticated information systems that utilize space-based services. In short, the JSDF cannot succeed without greater abilities to use space in their assigned missions.

Strengthening the JSDF requires more than just new equipment, important as that is. It requires transforming the JSDF into a more joint, flexible force that can adapt to the unexpected. From a U.S. perspective, the JSDF appears similar to U.S. military services prior to passage of the 1986 Goldwater-Nichols Act.[26] JSDF services operate within their own "silos" while competing for budget and attention with each other. They do not operate jointly nor is jointness stressed as a necessary value for military victory. While relations with individual U.S. Services are quite good, the JSDF prefers to work bilaterally with the United States and has difficulty in combined arms operations, such as working with Australia, the United Kingdom, and others in the kinds of coalitions that would arise in a realistic conflict.

The 2022 National Defense Strategy makes clear Japan's intention to "never accept unilateral changes to the status quo by force and such attempts at any time. These efforts cannot be achieved by Japan alone, and it will be necessary to cooperate and collaborate closely with our ally, like-minded countries and others."[27] In 2024, the Diet created a new joint JSDF headquarters and joint commander position to improve command and control coordination among the GSDF, MSDF, ASDF, and the U.S. forces.[28]

In some specialized areas, such as ballistic missile defense, joint operational coordination exists between the ASDF and MSDF, but this tends to be an exception. Some U.S.-JASDF bilateral exercises, such as Exercise Red Flag-Alaska, incorporate space

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24 Government of Japan. 2022. *National Security Strategy.* Tokyo: National Security Secretariat. December 16, 2022. https://www.cas.go.jp/jp/siryou/221216anzenhoshou/nss-e.pdf

25 Government of Japan. 2022. *National Defense Strategy*. Tokyo: Ministry of Defense. December 16, 2022. https://www.mod.go.jp/j/approach/agenda/guideline/strategy/pdf/strategy_en.pdf

26 The Goldwater-Nichols Department of Defense Reorganization Act of October 4, 1986 (Public Law 99-433, signed by President Ronald Reagan) streamlined the military chain of command, increased the authorities of the Chairman, Joint Chiefs of Staff, and the commanders of the unified and specified combatant commands, and enhanced the effectiveness of joint military operations.

27 National Defense Strategy. *Op. cit.*

28 The Japan News. 2024. "Bills to Create Joint SDF Headquarters Pass Diet; New Joint Commander to Ease Burden on SDF Chief." *The Japan News*, May 11, 2024.

assets, but this is not common. The Amphibious Rapid Deployment Brigade (ARDB) conducts exercises (e.g., Iron Fist) with the U.S. Army and the U.S. Marines but space is not a significant aspect. Exercises with the GSDF such as Yama Sakura and Orient Shield typically have very limited cross-domain aspects and are not multi-domain. The GSDF has already established new electronic warfare units, but it is unclear how such units would support non-GSDF units or operate under joint command. In contrast, the U.S. Army, through the U.S. combatant commands, trains in multi-domain scenarios (air, land, sea, cyber, EW, space) as well as cross-domain operations.

In addition to joint and combined arms operations, the JSDF needs to become better at cross-domain and multi-domain operations. Cross-domain operations are those in which information is passed between different secure systems, e.g., from a national intelligence source to a GSDF user. Multi-domain operations are those in which operations are planned and executed across traditional environmental domains, such as the land, sea, and air, and non-traditional domains, such as the electromagnetic spectrum, cyber and space. Promoting JSDF uses of space could be a useful catalyst to improving a "whole of force" approach for the JSDF as space capabilities inherently have joint, cross-domain, and multi-domain applications. What should be avoided, however, is the assignment of "space" or "electronic warfare" tasks to one service without attention to how those tasks contribute to overall joint operations.

The National Defense Strategy does address both cross-domain and space domain activities: "In the space domain, by proactively introducing new form of space use including satellite constellation and by receiving functions such as information gathering, communication, and positioning from space, Japan will reinforce its operational capabilities in the land, sea, and air domains. At the same time, in order to respond to threats to the stable use of outer space, Japan will develop ground-based and satellite-based surveillance capabilities, establish an SDA system, and reinforce the resiliency of space assets to enable the continuation of missions in response to various situations."[29] The Defense Build-up Plan goes on to be more specific when stating that "Japan will strengthen cooperation with the United States and build a satellite constellation to acquire target detection and tracking capabilities, supplemented by various initiatives, including utilizing commercial satellites. In addition, necessary technological demonstrations will be conducted to improve satellite-based countermeasures capabilities, such as detection and tracking of hypersonic glide weapons (HGVs), while taking into account the

29 National Defense Strategy. *Op. cit.*

possibility of cooperation with the United States."[30]

The National Defense Strategy is clear and constructive in its recognition of cybersecurity, electronic warfare, cross-domain operations, and space. In the cyber domain, the MOD/SDF are directed to: "promote its efforts that contribute to reinforcing cooperation with the relevant ministries and agencies, critical infrastructure operators, and the defense industry, while improving its cybersecurity capabilities."[31] This does not directly mention, however, the need for cybersecurity in order to improve cooperation with the United States and other foreign militaries.

Lastly, the National Defense Strategy directs the ASDF to "develop a system which can reinforce quality and quantity of air defense capability, maintain effective stand-off defense capabilities, ensure effective missile and air-defense posture, and introduce various unmanned assets. Also, the ASDF will be renamed the Air and Space Self-Defense Force by reinforcing space operation capability and developing systems to ensure superiority in use of space."[32] Having units focused on space, along with cyber and electronic warfare tasks is a step forward, but the effectiveness of these units will be undercut without JSDF-wide attention to jointness across the services and interagency cooperation (e.g., working with JAXA and civilian ministries such as the Ministry of Land, Infrastructure, Transport and Tourism). The successful integration of space capabilities into the JSDF will require improvements at all levels, from policy and planning, to command post and field exercises, and the training of professional non-commissioned officers.

7.0 Integrating Diplomatic, Economic, and Military Power

Japan takes a "whole of government" approach to the space domain and seeks to integrate its economic, security, scientific and diplomatic efforts. In the 2022 edition of the *Defense of Japan*, this approach is described as: "The National Space Policy Secretariat … engages in the planning, drafting, coordinating, and other policy matters relating to the Government's development and use of space."[33] A comprehensive approach to space security requires integrating diplomatic, economic, and military power. This approach can be seen as a "grand strategy" toward outer space, even if not officially identified as

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30 Defense Build-up Plan. *Op. cit.*
31 *Ibid.*
32 National Defense Strategy. *Op. cit.*
33 Government of Japan. 2022. *Defense of Japan 2022*. Tokyo: Ministry of Defense. https://www.mod.go.jp/en/publ/w_paper/wp2022/DOJ2022_Digest_EN.pdf

such.[34]

Japan has a strong strategic alliance with the United States, but the combined security threats facing Japan are arguably greater than the military and industrial capabilities of the United States and Japan alone. In particular, an extended conflict with China would strain the industrial bases of both countries. During the Cold War, U.S. defense planners would speak of sizing forces to conduct "2 ½ wars" – one in Europe, one in Asia, and one smaller contingency elsewhere. Today, between ongoing conflicts in Europe, the Middle East, and potentially in Asia, the United States is hard pressed to supply, not just fight, multiple conflicts. The United States has lost manufacturing capacities since the end of the Cold War, and while still a global technology leader, has difficulty surging production for war time needs.[35]

An attempt by China to take Taiwan by force would be among the most serious threats, short of a direct attack on Japan itself. As former Prime Minister Abe said in 2021, "A Taiwan emergency is a Japanese emergency, and therefore an emergency for the Japan-U.S. alliance."[36] Helping Taiwan defend itself and be more resilient to Chinese coercion improves deterrence efforts. Stronger deterrence lowers the risk of being forced to defend Taiwan and deterrence is vastly less costly than war.

A quick strength-weakness-opportunity-threat (SWOT) assessment of the U.S.-Japan space security environment shows a mixed picture of the risks facing both countries.

[34] Pekkanen, Saadia. 2024. "Japan's Grand Strategy in Outer Space" chapter in the *Oxford Handbook of Space Security*, Pekkanen, Saadia M., and P. J. Blount, eds. 2024. pp. 334-362. New York, NY: Oxford University Press.

[35] Jones, Seth G., and Alexander Palmer. 2024. *Rebuilding the Arsenal of Democracy : The U.S. And Chinese Defense Industrial Bases in an Era of Great Power Competition*. Washington, DC: Center for Strategic & International Studies.

[36] Blanchard, Ben. 2021. "Former PM Abe says Japan, U.S. could not stand by if China attacked Taiwan." *Reuters*. November 30, 2021

Strengths	Weaknesses
• Strong alliance for many decades • Economic power • World-leading technologies • Aligned international values • Stable democratic governments	• Limited industrial surge capacity, e.g., anti-ship munitions • Slow and costly military acquisition systems; uncertain space requirements for Japan • Risk-averse defense industries • Lack of JSDF space experience
Opportunities	**Threats**
• Indo-Pacific alliances, Quad partners • Leveraging commercial technology for military space • Shaping international law and rules for the space domain • Resilient industrial base supporting multiple allies	• Growing Chinese military power, especially in naval, space, and cyber domains • Unpredictable DPRK with missiles and nuclear weapons • Opportunistic Russian alignments with China and the DPRK

Table 2. Space Security SWOT Analysis for the United States and Japan

There are numerous books and reports on the challenge of deterring a Chinese attack on Taiwan which are beyond the scope of this paper.[37] Suffice to say that space capabilities are routinely recognized as necessary, but not sufficient, to win a conflict, and Chinese counterspace capabilities will attempt to degrade or eliminate U.S. and allied space systems used for Taiwan's defense. It is also recognized that munitions, such as anti-ship and anti-air missiles will be expended at extremely high rates. Assuming a quick loss is avoided, sustaining an extended conflict with China will require large stockpiles and industrial surge capabilities.

The allied forces operating in coalition need not be an Asian form of NATO, but their weapons systems do need to be compatible and interoperable. Coalition forces operating in Asia can be expected to have individual material and non-material (e.g. political) constraints. In his book on *Space Warfare: Strategy, Principles, and Policy*, strategist John Klein observes that "Allies and coalitions do not need a common understanding, but instead should strive for a shared understanding of different viewpoints and concerns."[38] Achieving a shared understanding before and during conflict is perhaps one of the most useful tasks that space systems can provide to an allied coalition for military, economic,

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37 Pottinger, Matt, ed. 2024. *The Boiling Moat : Urgent Steps to Defend Taiwan*. Stanford, California: Hoover Institution Press, Stanford University.

38 Klein, John J. 2024. *Space Warfare : Strategy, Principles and Policy*. Second edition. Abingdon, Oxon: Routledge. p. 103

and diplomatic integration.

Space systems are increasingly important to tactical ISR functions. They have long been important to the United States at the strategic ISR level, with airborne systems providing the bulk of tactical support. However, this is changing in response to the changing threat environment for long-duration air assets. Tactical ISR is part of TCPED, an acronym for tasking, collection, processing, exploitation, and dissemination.

- Tasking: Identify threats and determine where to collect intelligence from
- Collection: Gather intelligence from sources like open-source, human, and technical intelligence
- Processing: Filter out irrelevant information, organize data, and create a report
- Exploitation: Use the intelligence to identify risks and vulnerabilities, and develop strategies to mitigate them
- Dissemination: Make the intelligence available in a format that decision-makers can quickly understand and act on

To employ counterstrike weapons and other military capabilities, Japan will need a TCPED process for its own systems. Developing and exercising its own TCPED process can help improve the ability of JSDF to conduct joint and combined arms operations. Engaging in more realistic exercises that utilize space systems will also help create shared understandings with allies and partners, and develop internal capacity for defining requirements for space systems and services that meet Japanese security needs.

An innovative and competitive domestic space industry is integral to success in achieving Japan's national security goals. Historically, the Japanese government gave direction to industry to develop specific space capabilities, such as launch vehicles and satellites. The situation today is different and the Japanese government is encouraging industry to innovate and create new space products and services, but without being clear on what it will buy and why. Thus, companies have trouble "hearing" and responding to demand signals. Lack of clarity on space security needs, based on realistic needs and priorities, is a "missing link" between good policy documents and actual operational capabilities for Japan.

8.0 Recommendations

Japan developed a strong National Security Strategy, National Defense Strategy, and a Defense Buildup program in 2022. These documents have been complemented by a forward-looking Space Security Initiative in June 2023. While these documents are excellent at the policy level, they do not by themselves provide the operational concepts and technical requirements for implementation by the Ministry of Defense and the Japan Self-Defense Forces. Japanese and U.S. industry can understand the policy and strategic direction but fail to know how they should respond. The government has proposed specific projects, but the requirements that led to those projects are often unclear so that it is difficult to assess alternative ideas. Ideally, the development of requirements, or the proposal of new capabilities that lack formal requirements, should be part of a transparent process from concept to implementation.

To achieve national goals through the use of space, Japan should 1) determine which national security missions require support from space capabilities; 2) develop national security space program plans and budgets that incorporate total mission operations (to include ground systems, data storage/handling, information dissemination, data exploitation, and user hardware/software); and 3) prioritize the development of national security space capabilities that are complementary and interoperable, but not duplicative, with allied space capabilities for the purposes of increasing resilience in space architectures. These capabilities need not be fully government-owned, but could consist of hybrid capabilities with commercial and international partners.

Top space-related priorities for strengthening the JSDF should be 1) the improvement of information security; 2) increasing joint service and interagency cooperation; and 3) more realistic training and exercises that reflect joint and combined arms scenarios that the JSDF (and the JCG) are likely to face. Attention to space applications for the JSDF can be a vital catalyst for advancing each of these priorities. Lack of attention or progress will make it difficult for Japan to secure necessary cooperation on emerging, multi-domain threats. Meeting such threats cannot be accomplished by an individual service alone but requires a joint response in concert with allies.

Just as Japan participates in the Schriever Wargames with the U.S. Space Force, so it should work to participate in the multinational Operation Olympic Defender effort with U.S. Space Command. NATO has declared space to be a distinct operational domain and Japan is an increasingly important partner with NATO. The NATO Cooperative Cyber Defense Centre of Excellence, in Tallinn, Estonia hosts Locked Shields and Crossed Swords exercises, for defense and offensive cyber operations. While not dedicated to space operations, cyber is an integral part of the multi-domain operations that Japan needs to master. Interestingly, these exercises include companies as well as governments.[39] Most immediately, the JSDF should study and observe as closely as possible the practices of the Ukrainian Armed Forces in their use of commercial space communication, navigation, and remote sensing under actual combat conditions.

Japan should encourage the growth of commercial space industries as a foundation for Japan's economic security and self-defense capabilities. This should be done both independently and in cooperation with U.S. space industries. Japan should give precedence to the purchase of commercially available space capabilities that meet its security needs, where available.

One approach to stimulating private industry for military space needs would be to pick a small number of ISR constellation satellites that could be built in the United States with the participation of Japanese experts. Domestic Japanese small satellite production capacity could be expanded using private investment from larger firms or private equity. Some or all of a production could then be shifted back to Japan under a co-production licensing agreement.[40] If co-production is part of a U.S.-Japan security agreement, the United States could waive or subsidize the license fee to make the business case work. Under this arrangement, Japan would get domestic capability faster and the United States would be assured of interoperability. While the Japanese government would be the customer for some (or even most) of the satellite production capacity, if led by Japanese industry, there would be incentives to find other customers beyond the government. This gradual but deliberate arrangement would also allow more time for export control reforms and other policy changes (e.g., as achieved under the AUKUS arrangement for nuclear submarines). The challenge for the Japanese government will be in defining military performance requirements to be met and not just focusing on the production of satellites themselves.

Space security, and challenges to that security, are an increasingly important part of the Japan-U.S. Security Cooperation and Defense. As part of that alliance, Japan should develop space capabilities that meet national goals, increase the security of Japan, and contribute to a free and open Indo-Pacific region. In doing so, Japan should prioritize

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39 NTT Group. 2024. "NTT Group participated in Locked Shields 2024, an international cyber defense exercise organized by NATO CCDCOE" NTT Group press release. July 23, 2024.

40 Rubinstein, Gregg A. "Cooperative Defense Acquisitions Strengthen U.S.-Japan Alliance." Commentary in *Center for Strategic & International Studies*, January 30, 2025, https://www.csis.org/analysis/cooperative-defense-acquisitions-strengthen-us-japan-alliance.

the development and fielding of space security programs that are interoperable at the warfighter level and enable fully integrated and joint national security operations with the United States and likeminded partners. This will entail not only strong collaborative and cooperative programs, but also an independent and vibrant domestic space industrial base.

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Part I
Changes in the Strategic Environment in the Space Domain

Chapter 1
Winning the Fight for Sensing and Sensemaking

Bryan Clark

1. Introduction: Exploiting allied advantages in a post-dominance era

The US military has enjoyed broad superiority over potential and actual adversaries during the last half-century. Backed by a strong alliance network and the most robust defense research and development (R&D) base in the world, US forces routed opponents in Operations Desert Storm and Allied Force through the application of the then-new approach of networked precision strike warfare. And despite being frustrated by insurgencies in Iraq and Afghanistan, those largely strategic failures are not viewed as reflective of shortcomings in US military capabilities.

The era of US military dominance is now coming to a predictable end. The sensor, precision weapon, networking, and processing capabilities the Department of Defense (DoD) pioneered in the late Cold War are widely proliferated and being employed in combat by state and non-state groups across Ukraine, the Red Sea, and the Caucuses.[1] Moreover, as the underlying technologies associated with precision strike warfare—the global positioning system, satellite communications, and autonomous drones—were commercialized, adversaries such as Houthi rebels in Yemen can threaten US and allied forces at a fraction of the cost DoD spends in defense.

The erosion of US military dominance is most apparent with regard to the People's Republic of China (PRC). Through three decades of modernization, the PRC's People's Liberation Army (PLA) took the DoD's concept of precision strike warfare to new levels, fielding an extensive network comprising sensors across every domain and thousands of guided weapon launchers at sea, ashore, and in the air, as shown in Figure 1.

The asymmetry between the PLA and US military capacity in the Western Pacific derives in large part from the PRC's geostrategic advantages. Without significant mutual defense responsibilities, the PLA can concentrate its modernization and force posture on

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1 Defense Intelligence Agency (DIA), *Iran: Enabling Houthi Attacks Across the Middle East*, (Washington, DC: DIA, 2024), https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/Iran_Houthi_Final2.pdf; David Barno and Nora Bensahel, "Learning From Real Wars: Gaza And Ukraine," War on the Rocks, December 6, 2023, https://warontherocks.com/2023/12/learning-from-real-wars-gaza-and-ukraine/.

pursuing a narrow set of core interests such as control over Taiwan or the South China Sea and preventing US or allied intervention.[2] In contrast, the US military is expected to address direct nation-state challengers like the PRC or Russia as well as opponents that are mainly threats to US allies, such as Iran or North Korea and their non-state proxies.

The PLA's structure and organization emphasizes defense of China's "near seas." Rather than build a globally deployed multi-mission military, the PLA Air Force (PLAAF) and Navy (PLAN) have not fielded substantial refueling and logistics capacity as part of their modernization and are still comprised predominantly of platforms that lack the capacity to both protect themselves and conduct attacks away from the PLA's mainland-based defenses.[3] But the most important enablers of China's counter-intervention strategy are the world's largest rocket force and the new Aerospace Force, which will pursue space-based sensing and counter-space capabilities and replaces part of the now-defunct Strategic Support Force.[4]

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2 Timothy Heath and Andrew S. Erickson, "Is China Pursuing Counter-Intervention?," The Washington Quarterly, Volume 38, Issue 3, Pages 143-156, DOI: 10.1080/0163660X.2015.1099029.

3 For example, the PLAAF operates only about 2 dozen aerial refueling aircraft, compared to more than 500 US refueling aircraft; see Caleb Egli, "Fueling a Superpower: Reprioritizing the US Air Refueling Fleet for Great-Power Conflict," Air University, May 8, 2024, https://www.airuniversity.af.edu/JIPA/Display/Article/3768313/fueling-a-superpower-reprioritizing-the-us-air-refueling-fleet-for-great-power/; Mike Yeo, "Satellite Images Suggest China's New Tanker Aircraft Is under Production," Defense News, February 18, 2021, https://www.defensenews.com/global/asia-pacific/2021/02/18/satellite-images-suggest-chinas-new-tanker-aircraft-is-under-production/.

The PLAN has the following major combatants that can conduct offense and defense:
- 3 small carriers (on par with European CVs) vs. 11 larger US nuclear carriers
- 3 amphibious assault ships vs. 10 US amphibious assault ships
- 8 amphibious transport docks vs. 23 US amphibious transport docks
- 8 cruisers vs. 10 US cruisers
- 6 nuclear attack submarines vs. 50 US nuclear attack submarines
- 25 destroyers vs. 70 US Burke-class destroyers that carry 50% more weapons capacity

For smaller combatants, the PLAN has:
- 30 PLAN frigates vs. 32 comparable US littoral combat ships
- 24 quiet Yuan conventional subs that cannot operate quietly outside 2nd island chain
- About two dozen older conventional subs
- About two dozen older frigates and destroyers that only have enough weapon capacity to protect themselves in moderately contested environments: The US has retired equivalent ships

See Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China*, (Washington DC: US DoD, 2023), https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

4 Namrata Goswami, "The Reorganization of China's Space Force: Strategic and Organizational Implications," *The Diplomat*, May 3, 2024, https://thediplomat.com/2024/05/the-reorganization-of-chinas-space-force-strategic-and-organizational-implications/; Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China*, (Washington DC: US DoD, 2023), https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

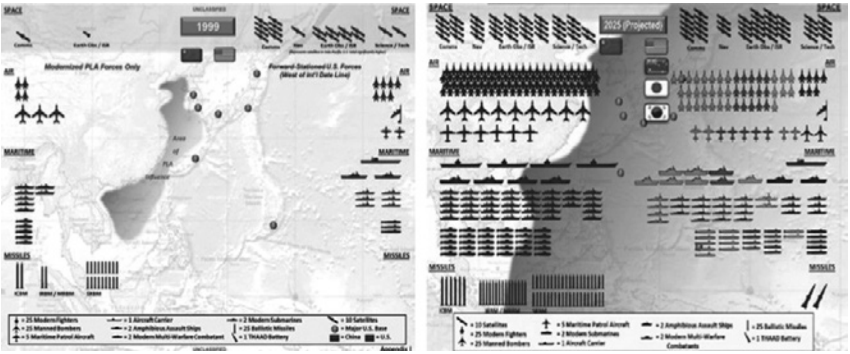

Figure 1: PLA posture in the Western Pacific compared to regionally-based US and allied forces[5]

Being the likely "home team" in future confrontations also affords PLA leaders the luxury to focus their concepts and capability development on countering the US military. As shown in Figure 1, the PLA could confront forces from Japan, Taiwan, Australia, or South Korea, but these US allies draw heavily upon US systems and emulate US tactics to enhance interoperability. And in conflict, the PLA could further undermine allies' contributions by attacking their home territory, compelling allied leaders to withdraw their relatively small forces to focus on homeland defense.

Degrading sensing and sensemaking to deter conflict

The US military will need to adopt a sustainable and survivable force posture in the Western Pacific to deter PRC aggression. In a rapid, large-scale conflict such as an invasion, the PLA's strike capacity would be diluted as it sought to engage many US and allied targets simultaneously. During a protracted, lower-intensity scenario like a blockade the PLA could devote more of its weapons to individual targets. And unlike the Taiwan scenario, US forces may not be able to counter-attack China's mainland unless an exchange escalates to theater-wide levels.

The DoD is unlikely to gain the upper hand in a symmetric missile vs. air defense competition with the PLA in the Western Pacific. Instead, it should take an asymmetric approach and degrade the PLA's ability to understand and anticipate allied operations or

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5 Brian Everstine's post on X, September 14, 2020, https://x.com/beverstine/status/1305512270571745282.

accurately target US forces. Attacking adversary command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR) capabilities is already a stated objective of US Indo-Pacific Command leaders.[6] However, counter-C3ISR operations are historically focused on defeating enemy attacks during combat, when the PLA's capacity advantages may obviate US and allied electromagnetic warfare (EW) or cyber operations. Instead, US and allied counter-C3ISR operations will need to center on preventing conflict. PLA commanders may still see US and allied units operating in the region, but may be dissuaded from attacking if they cannot obtain precise location data, predict which US or allied forces are most important to planned operations, or expect their weapons to accurately hit intended targets.

This approach to attacking PLA sensing and sensemaking exploits US strengths in its own C3ISR capabilities and cyber or EW effects while exploiting inherent vulnerabilities in the PLA's operational concept of Systems Warfare. Depicted by Figure 2 in simplified form, Systems Warfare combines operations by reconnaissance-intelligence systems, firepower-strike systems, command systems, support systems, and information-confrontation systems to attack what PLA planners assess as key vulnerabilities in the US military's system of systems.[7]

The PLA's adoption of Systems Warfare is in part an effort to duplicate the successful US approach of precision strike warfare but with Chinese characteristics. Whereas US operations are fundamentally expeditionary, PLA operations are predominantly local. Given the difficulty of maintaining communications during combat, senior US officers and political leaders often rely on field commanders to manage operations, including sequencing fires, orchestrating maneuvers, and taking advantage of emergent openings. In contrast, top PLA commanders and the Central Military Commission (CMC) can easily communicate with PLA units, nearly all of which—such as those of the PLA Rocket Force (PLARF) and PLAAF—are based on Chinese soil. This allows senior leaders to directly control operations and not depend on field commanders, which senior

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6 Jon Harper, "Counter-C5ISRT is Top Priority for Nominee to Lead Indo-Pacific Command," DefenseScoop, February 1, 2024, https://defensescoop.com/2024/02/01/counter-c5isrt-samuel-paparo-indo-pacific-command-nomination/.

7 Jeffrey Engstrom, *Systems Confrontation and System Destruction Warfare* (Santa Monica, CA: RAND, 2018), https://www.rand.org/pubs/research_reports/RR1708.html.

PRC officials may not trust to be effective or loyal.[8]

The hierarchical nature of PLA command and control (C2) makes the reconnaissance-intelligence system and firepower strike system the most important elements of PLA Systems Warfare.[9] Senior PLA leaders depend on the reconnaissance-intelligence system to synthesize sensor data from widely-dispersed space, land, air, and sea-based systems, which is then provided to missile launchers on or near PRC territory for long-range precision strikes.

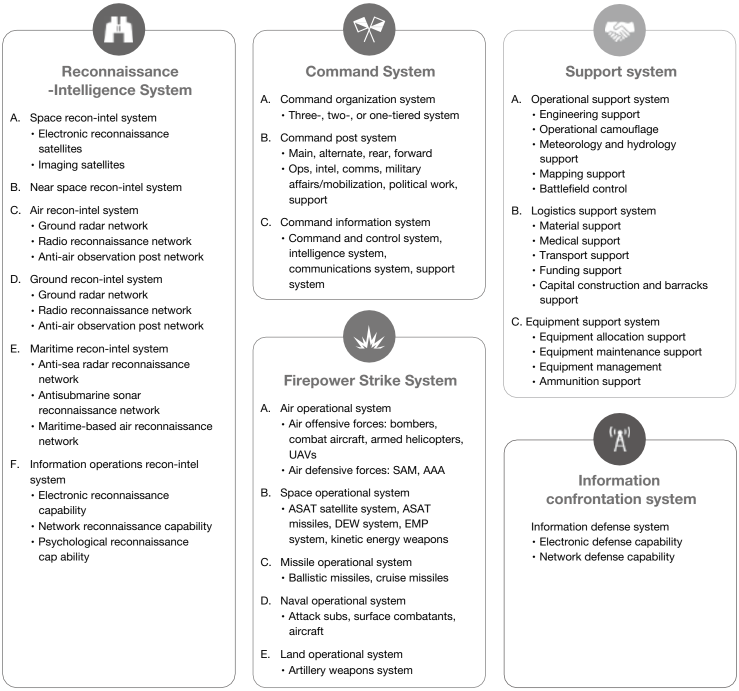

Figure 2: Simplified depiction of PLA Systems Warfare concept

8 Jackson, Kimberly, Andrew Scobell, Stephen Webber, and Logan Ma, *Command and Control in U.S. Naval Competition with China*, (Santa Monica, CA: RAND Corporation, 2020), Pages 23-49. https://www.rand.org/pubs/research_reports/RRA127-1.html; Larry Wortzel, "The PLA and Mission Command: Is the Party Control System Too Rigid for Its Adaptation by China?," Association of the US Army, March 2024, https://www.ausa.org/sites/default/files/publications/LWP-159-The-PLA-and-Mission-Command-Is-the-Party-Conrol-System-Too-Rigid-for-Its-Adaptation-by-China.pdf.

9 Joel Wuthnow, "System Destruction Warfare and the PLA," Institute for National Strategic Studies, June 2024, https://keystone.ndu.edu/Portals/86/PLA%20Systems%20Attack%20-%20JW%20update%20June%2024.pdf.

This centralized structure creates opportunities for US and allied forces to gain an advantage by undermining PLA sensing and sensemaking. Information from PLA aircraft and ships would be transmitted via a multiplicity of datalinks, which will increase their latency and reduce their reliability. Ground- and space-based sensor data would largely be conveyed via hard-wired connections from the sensor or ground station to a command center, offering greater timeliness and resilience compared to underway ships and aircraft. However, both categories of sensors are vulnerable to jamming, deception, and communications interdiction that could confuse the PLA's operational picture and decision-making.

Confusing and degrading sensing

US and allied forces could exploit their decades of experience in EW and cyber operations against PLA sensors on or above the earth's surface. These sensors all depend on radiofrequency (RF), visual, or infrared (IR) emissions, making them vulnerable to the injection of false or obscuring signals and malicious computer code. Undersea sensors like sonar depend on acoustic emissions which could be similarly manipulated to disrupt the PLA's undersea operational picture, as described in a previous Hudson Institute report.[10]

Well-orchestrated allied efforts to deceive or jam PLA sensors could confuse PLA operational pictures and planning. However, these efforts will only succeed for a limited time. Effective counter-sensing operations would need to address the likelihood that the Reconnaissance-Intelligence System could combine in real time the outputs of multiple sensors examining the same geographic position or target. Using sensor fusion, human operators, aided by artificial intelligence-enabled algorithms, would eventually determine the true position and activities of allied forces.

Attacking adversary sensemaking

Allied forces will therefore need to complement their efforts to degrade PLA sensor fusion by attacking PLA sensemaking. One approach would be to disrupt the communication networks needed to simultaneously bring together the outputs of multiple sensors across domains. Jamming or interrupting these signals, such as the datalink from a synthetic aperture radar (SAR) aircraft, would clearly degrade the Reconnaissance-Intelligence

[10] Bryan Clark and Timothy A. Walton, *Fighting into the Bastions: Getting Noisier to Sustain the US Undersea Advantage*, (Washington, DC: Hudson Institute, 2023), https://www.hudson.org/fighting-bastions-getting-noisier-sustain-us-undersea-advantage-submarine-bryan-clark-timothy-walton.

System's sensor fusion capability. And more subtle techniques—such as injecting code into the datalink that changes its message format—could defeat sensor fusion by slowing the integration of sensor data or by making the data appear to be associated with a different location or target.

US and allied forces can also undermine PLA sensemaking by combining their counter-sensing operations with less predictable tactics and force compositions. AI-enabled algorithms in the Reconnaissance-Intelligence System will attempt to compare sensor data with historical US operations and doctrine to inform PLA course of action (COA) development. US and allied forces can exploit the PLA's reliance on AI and predictive planning processes by establishing the possibility that US and allied forces could pursue a wide range of force compositions and operational concepts, rather than just those the PLA has seen or studied.

The DoD's ongoing efforts in Combined Joint All-Domain Command and Control (CJADC2) can help enable a more recomposable force that would give commanders more options for organizing and orchestrating their operations. Experiments such as those being pursued under the Army's Project Convergence and Navy's Project Overmatch are increasing the diversity of kill chains available to US forces through communications interoperability improvements. At the combatant commander level, the CJADC2 initiative produced an initial instantiation of the Joint Fires Network (JFN), which will connect commanders, shooters, and sensors across an entire theater to provide an adaptable set of attack options.[11]

However, force design can be more impactful than communications interoperability in creating a wider range of COAs for commanders and, as a result, greater uncertainty for enemy sensemaking. As depicted in Figure 3 and described in the authors' research on Mosaic Warfare and Decision-Centric Warfare, the DoD will need a more disaggregated force with a larger number of less multifunctional—and probably uncrewed—forces to substantially degrade PLA sensemaking. A small force, represented by the top half of Figure 3, can only configure itself in a few different ways, which limits it to a narrow range of operational concepts and tactics. Even a small force of multimission ships or aircraft does not present substantial complexity to an opponent like the PLA because each platform often behaves as a self-contained kill chain that can be neutralized by attacking only one target.

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[11] Mark Pomerleau, "Indo-Pacific Command to Test Prototype of Joint Fires Network This Year," DefenseScoop, March 21, 2024, https://defensescoop.com/2024/03/21/joint-fires-network-indo-pacific-command-test-prototype/.

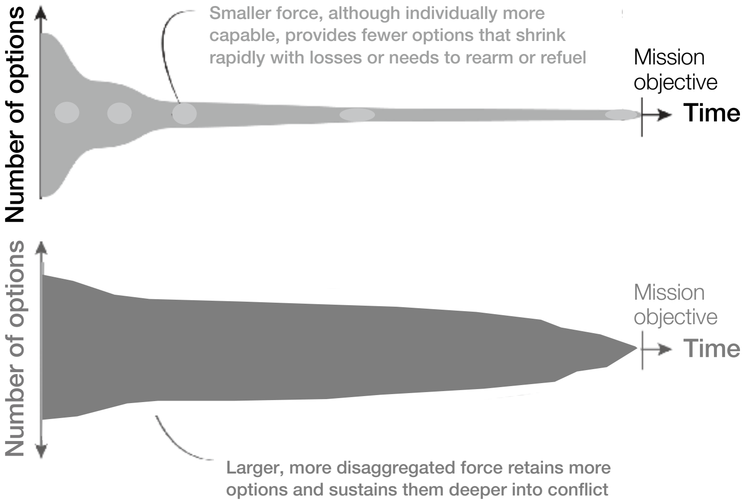

Figure 3: Options available to allied commanders

A larger force with more individual units, even if they are less sophisticated than those in a smaller force, would afford commanders more options for composing kill chains and therefore create more challenges for PLA sensemaking. And this disaggregation does not need to be of real weapons systems to be useful. Decoy or simulated platforms and vehicles can create the same complexity for enemy sensemaking as actual ones, compelling the adversary to either prepare for a wider range of US options or spend time and sensing resources to resolve ambiguity regarding the sensor information.

Prioritizing cross-domain non-kinetic effects

Compared to 20th century wars and 21st century counterterrorism, US and allied forces will need a more sophisticated EW and cyber approach to undermine a major power's comprehensive sensing and sensemaking architecture. In previous confrontations, non-kinetic capabilities were often employed within their respective domains and in different phases of conflict. Cyber exploits and malware were generated and delivered via wired networks, often as part of peacetime intelligence or counterterrorism operations. EW jamming and false targets were transmitted to enemy radars and radios through the RF spectrum during combat. For example, the PLA's reconnaissance-intelligence system is largely built on stand-alone networks inaccessible from outside China and incorporates large numbers of redundant RF sensors.

Adversaries' incorporation of digital technology into communications and sensing creates opportunities for allied forces to circumvent adversary efforts to create resilient sensing and sensemaking networks. Computerized military sensors can be better at detecting and countering EW attacks through signal processing but also include security weaknesses common to digital systems. And although potential opponents have shifted more of their military communications to stand-alone networks to protect against hacking, they still rely on RF apertures for sensing and to communicate with space, airborne, and sea-based platforms to enable sensor correlation and fusion.[12]

This suggests non-kinetic effects should increasingly be combined to overcome adversary sensor processing and fusion, as shown in Figure 4 and described in the 2020 Department of Defense Electromagnetic Spectrum Superiority Strategy.[13] For example, in addition to traditional "on-network" cyber effects being delivered via a wired connection, cyber effects will need to be delivered through RF apertures into stand-alone networks.[14] In addition to traditional EW effects that manipulate or obscure the RF signal reaching a sensor or radio, EW effects will depend on cyber exploits degrading the receiver's processing or verifying the EW effect succeeded.[15]

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12 Mark Pomerleau, "Services Working to Convergence EW, Cyber Warfare Capabilities," DefenseScoop, September 30, 2022, https://defensescoop.com/2022/09/30/services-working-to-convergence-ew-cyber-warfare-capabilities/.

13 US DoD, 2020 *Department of Defense Electromagnetic Spectrum Superiority Strategy* (Washington, DC: US DoD, 2020), https://dodcio.defense.gov/Portals/0/Documents/Spectrum/2020DoD-EMS-SuperiorityStrategy.pdf.

14 Director, Operational Test and Evaluation (DOT&E), *Cyber Assessment Program (CAP)* (Washington, DC: US DoD, 2023), https://www.dote.osd.mil/Portals/97/pub/reports/FY2023/dotemanaged/2023cap.pdf?ver=DrwfdCEmkKW0KX4UEQLFXg%3D%3D#:~:text=DoD's%20cyber%20posture%20remains%20at,systems%20that%20are%20essential%20to.

15 Mark Pomerleau, "US Cyber Command Looking at How to Utilize Tactical On-the-ground Systems," DefenseScoop, January 16, 2024, https://defensescoop.com/2024/01/16/us-cyber-command-looking-at-how-to-utilize-tactical-on-the-ground-systems/.

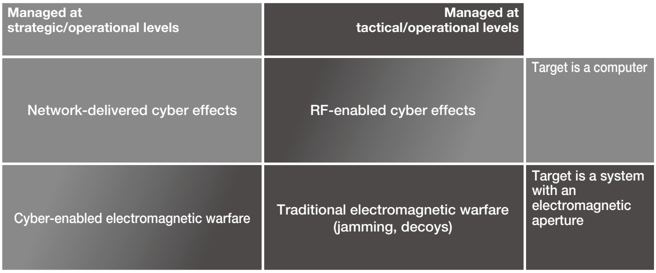

Figure 4: Emerging relationships between non-kinetic effects

Offensive cross-domain non-kinetic effects like cyber-enabled EW and RF-enabled cyber operations create new considerations for DoD C2. On-network US offensive cyber operations are generally authorized at the operational to strategic level by combatant commanders like US Cyber Command or the National Command Authority, which is either the president or secretary of defense. This reflects the permanent impact of releasing a cyber tool with the potential for immediate and recurring collateral damage. Offensive EW operations are usually controlled by field commanders or individual operators at the tactical to operational level because the effect is temporary and isolated to the aperture being targeted. Defensive effects in both cyber and EW operations are almost always controlled at a much lower level of authority and in many cases are automated.

Reforming for cross-domain non-kinetic operations

Offensive cross-domain non-kinetic effects will demand new C2 approaches. Like other military operations, operators delivering non-kinetic effects need access to the target, which is often fleeting. For an on-network cyber effect, senior leaders can usually monitor the target in real time over transcontinental distances and authorize delivery when appropriate. In contrast, forces delivering cyber-enabled EW and RF-enabled cyber effects will often be in areas where communications are degraded far from a command center. Field commanders may be challenged to obtain senior leader authorization during a window when the target aperture is accessible.

Cross-domain non-kinetic effects also occur over a different time scale compared to traditional cyber or EW effects, complicating planning and execution. Once authorized, operators can deliver on-network cyber tools at the speed of light and the impacts occur over minutes or hours. EW operations such as jamming or decoying transpire over minutes or hours because the effect is transitory and generally dissipates once the EW system is turned off. Like EW operations, cross-domain non-kinetic effects may take minutes or hours to deliver due to challenges gaining access to the appropriate apertures, but the impacts may be long-lived like cyber effects because they incorporate digital code.

Cyber-enabled EW and RF-enabled cyber effects will likely require a hybrid C2 approach similar to how other military capabilities are employed. Senior military and civilian leaders generally prefer to have control over on-network cyber effects because their presence on the internet can cause collateral damage or allow them to be released "into the wild." However, cross-domain non-kinetic effects are by definition being delivered into an isolated adversary and have less likelihood of impacting other military or civilian networks. To avoid missing opportunities to exploit US advantages in cyber and EW, senior leaders could approve types or categories of cross-domain effects and delegate to local commanders the authority to use them in accordance with prescribed rules of engagement.

Most relevant to this report, cross-domain non-kinetic effects also demand a new capability development approach. The US military services and US CYBERCOM develop new offensive cyber tools on government-owned ranges at a relatively slow tempo, given their infrequent employment in military operations. In contrast, the services each have a robust infrastructure for EW requirements development and reprogramming that, while slow, implements a substantial number of changes each year. The DoD will need an approach that can model both wired network and RF delivery mechanisms and allow for integration of activities across electromagnetic and cyber environments.

The DoD's non-kinetic capability development process will also need to deliver at greater scale than today. As described in Section 2, the US military will need to employ non-kinetic effects more frequently as part of peacetime competition and crisis. Historically, these operations were reserved for combat, where they protected allied forces and degraded the effectiveness of enemy attacks. However, given their geostrategic disadvantages US and allied militaries will need to disrupt enemy sensing and sensemaking as an element of dissuasion and deterrence. Section 3 of this report will detail an approach to counter-sensing and sensemaking campaigns against capabilities like those deployed by the PLA.

The DoD will need a deep magazine of non-kinetic effects to implement a counter-sensing and sensemaking campaign. This report concludes with recommendations for the DoD to adopt this new process and enable the US military to regain the advantage in a post-dominance era.

2. Using counter-sensing and sensemaking for deterrence and dissuasion

Allied forces should use their advantages in C3ISR and counter-C3ISR to support deterrence and dissuasion, rather than only relying on these capabilities in combat after deterrence has failed. Traditionally, the US military has pursued deterrence by threatening to deny success to an adversary's aggression and impose economic or military punishments that would outweigh the benefits of an attack. This approach is losing efficacy in the post-dominance era. Russian president Vladimir Putin chose to attack Ukraine in 2022 despite facing the most comprehensive economic and diplomatic punishments mounted since World War II and continued the invasion after Ukraine's initial denial of the assault.[16] Iranian-backed Houthi rebels regularly attack US ground and naval forces across the Middle East despite sanctions on Iran and counter-attacks by US and allied forces.[17] And the PRC's coast guard and maritime militia routinely harass and periodically collide with naval and constabulary forces from the Philippines, Taiwan, and Japan.[18]

The US and its allies will need to do more than threaten punishment or denial to dissuade PRC aggression. Incremental attacks like Russia's "gray-zone" operations in eastern Ukraine and annexation of Crimea can be difficult to counter with traditional military forces. More overt actions such as Russia's 2022 invasion of Ukraine are easier to recognize but difficult to interdict from long range and on short notice. A PRC blockade of Taiwan could look more like the former while an invasion would more closely resemble the latter.

US and allied militaries could exploit the PLA's dependence on its reconnaissance-intelligence system to address both types of challenges. For example, Chinese forces implementing a blockade will require an accurate and timely operational picture to understand where shipping is attempting to enter or leave the blockaded country and the position of potential escorts. During an invasion of Taiwan, attacking PRC forces will need an accurate target picture to avoid wasting weapons that may be needed later if a conflict becomes protracted, as happened in Ukraine.

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16 Nadia Schadlow, "Why Deterrence Failed Against Russia," The Wall Street Journal, March 20, 2022, https://www.wsj.com/articles/why-u-s-deterrence-failed-ukraine-putin-military-defense-11647794454.

17 Oren Liebermann and Nikki Carvajal, "Biden Concedes Houthis Haven't Been Deterred from Carrying Out Attacks as US Launches Further Strikes," CNN, January 18, 2024, https://edition.cnn.com/2024/01/18/politics/biden-houthi-strikes/index.html.

18 Derek Grossman, "How to Respond to China's Tactics in the South China Sea," *Foreign Policy*, May 29, 2024, https://foreignpolicy.com/2024/05/29/philippines-us-south-china-sea-gray-zone-tactics-alliance-military-treaty/.

The 2022 US National Defense Strategy (NDS) offers a way to exploit the PLA's sensing and sensemaking vulnerabilities through its line of effort for "campaigning." The strategy directs the DoD to "operate forces, synchronize broader Department efforts, and align Department activities with other instruments of national power, to undermine acute forms of competitor coercion, complicate competitors' military preparations, and develop our own warfighting capabilities together with Allies and partners."[19]

In US Marine Corps doctrine, campaigning is a series of operations designed to achieve a particular objective in a specific time and space.[20] Campaigning recognizes that winning battles is no guarantee of achieving long-term objectives, as numerous historical cases can attest.[21] Often associated with large-scale combat operations like the Allied retaking of Europe during World War II, campaigns can also comprise a long series of less-intense actions during peacetime, such as the British counterinsurgency operation in Malaysia.[22] Although nonmilitary instruments have a substantial role in enabling these and other successful campaigns, this report will focus on the application of military activities.

The DoD could use a counter-sensing and sensemaking campaign to dissuade aggression by the PRC. Although less studied and discussed compared to deterrence, dissuasion offers a way to influence competitions or confrontations when conflict is not imminent. If combatants are hurtling toward war and key decisions have already been made, it is likely that only the certainty of failure or intolerable punishment will stop them; for every other situation, efforts to dissuade could steer the belligerents away from destructive action.[23]

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19 Lloyd Austin, *2022 National Defense Strategy of the United States of America*, (Washington, DC: US DoD, 2022), 1, https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF.

20 US Marine Corps, "Campaigning," in *Marine Corps Doctrinal Publication 1-2*, August 1, 1997, https://www.marines.mil/Portals/1/Publications/MCDP%201-2%20Campaigning.pdf.

21 Perhaps the best recent example of this is William Westmoreland, who proudly claimed that the US won every battle it fought though many people regard the Vietnam War as unsuccessful in achieving US aims. See Neil Sheehan, *A Bright Shining Lie: John Paul Vann and America in Vietnam* (New York: Random House, 1988).

22 Robert W. Komer, *The Malayan Emergency in Retrospect: Organization of a Successful Counterinsurgency Effort* (Santa Monica, CA: RAND, 1972), https://www.rand.org/pubs/reports/R957.html.

23 For more details on this approach, see Bryan Clark and Dan Patt, *Campaigning to Dissuade: Applying Emerging Technologies to Engage and Succeed in the Information Age Security Competition*, (Washington, DC: Hudson Institute, 2023), https://www.hudson.org/defense-strategy/campaigning-dissuade-applying-emerging-technologies-engage-succeed-information-age-bryan-clark-dan-patt.

Restoring escalation advantage

PRC military and paramilitary forces would need to mount an intense, large-scale fires campaign to support an invasion of Taiwan. History shows amphibious assaults are high-risk operations that leave large numbers of troops exposed and vulnerable for extended periods.[24] To prevent Taiwan and its allies from interdicting its invasion force, the PLA will need to neutralize ships, air bases, and aircraft carriers across the East and South China Seas and Philippine Sea. US and allied forces could use counter-sensing and sensemaking operations to increase the likelihood an invasion could fail by degrading PLA fires.

The PLA would normally have a substantial escalation advantage over Taiwan and its allies. As shown in Figure 5, the reconnaissance-intelligence system and firepower strike system enable the PLA to mass fires at various scales in its near-abroad, including in defense of its gray-zone operations. Allied forces lack the defensive capacity to protect themselves from PLA attacks unless they aggregate in large formations that may only be practical in the context of major conflict. Moreover, US allies in the region could consider large formations to be overly provocative or escalatory if mobilized in response to a gray-zone confrontation.

The asymmetry depicted in Figure 5 leaves US and allied forces at an escalation disadvantage to China. For example, People's Maritime Militia and China Coast Guard ships can harass and ram Philippine fishing and coast guard vessels under the protection of mainland-based ships, aircraft, air defenses, and surface-to-surface missiles. Allies confronting the aggression will either need to do so at elevated risk or bring substantial offensive and defensive firepower to survive and threaten counterattacks in a highly contested environment close to China. However, such a robust force posture could prove counterproductive by portraying US and allied militaries as aggressors rather than the PRC.[25]

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24 Carter Malkasian, *Charting the Pathway to OMFTS: A Historical Assessment of Amphibious Operations from 1941 to the Present*, (Alexandria, VA: CNA, 2002), https://www.cna.org/reports/2002/D0006297.A2.pdf.

25 These dynamic and potential solutions are addressed in Bryan Clark, Mark Gunzinger, and Jesse Sloman, *Winning in the Gray Zone: Using Electromagnetic Warfare to Regain Escalation Dominance*, (Washington, DC: CSBA, 2017), https://csbaonline.org/research/publications/winning-in-the-gray-zone-using-electromagnetic-warfare-to-regain-escalation.

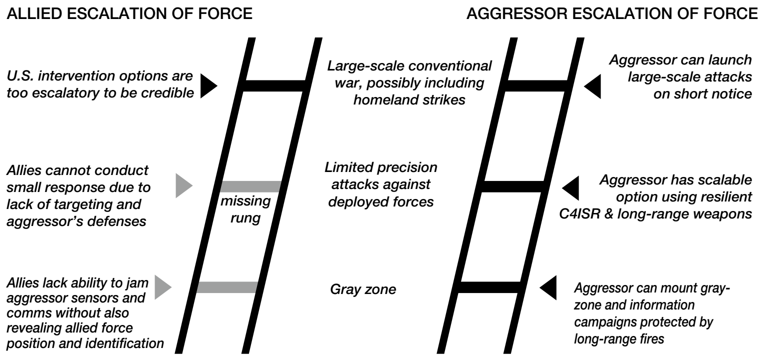

Figure 5: Escalation ladder comparing allied forces and PLA forces

If equipped with appropriate delivery systems and effects, US and allied forces could use non-kinetic operations to restore lower-level rungs on the escalation ladder and switch this asymmetry as shown in Figure 6. For example, US and allied forces could degrade adversary sensors through electronic jamming and deploy persistent decoys across multiple regions of the EMS. They could enhance the impact of counter-sensing operations through actions to complicate sensemaking, such as deploying in distributed and recomposable formations that deny adversary operators an opportunity to determine which targets are real or most valuable based on historical patterns. In addition to creating uncertainty for opposing commanders' plans, these activities could elicit responses that reveal adversary concerns regarding reconnaissance-intelligence system effectiveness.

Non-kinetic effects would also drive the potential aggressor to higher levels of escalation. To ensure they engage intended targets in the face of US and allied counter-sensing and sensemaking operations, aggressors may need to expend more weapons to attack all the potential targets simultaneously. Alternatively, enemy commanders could attempt to clarify the target picture and enable more efficient strikes, but these actions can also be escalatory. PLA sensor platforms may need to closely approach US and allied forces to obtain accurate classification and identification information or illuminate them with fire control radars, which could be perceived as provocative. In either case, counter-sensing and sensemaking removes lower rungs from China's escalation ladder.[26]

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[26] Bryan Clark and Dan Patt, *Campaigning to Dissuade: Applying Emerging Technologies to Engage and Succeed in the Information Age Security Competition*, (Washington, DC: Hudson Institute, 2023), https://www.hudson.org/defense-strategy/campaigning-dissuade-applying-emerging-technologies-engage-succeed-information-age-bryan-clark-dan-patt.

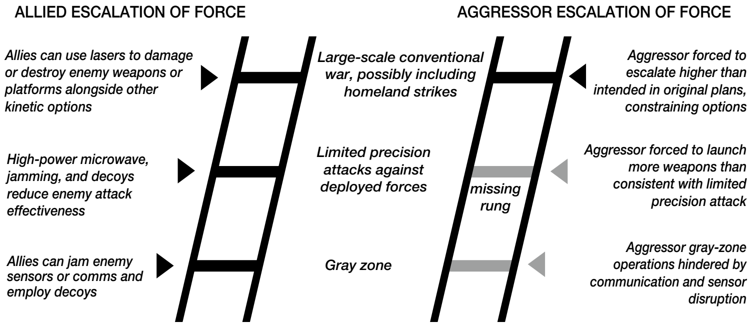

Figure 6: Revised escalation ladder with effective counter-sensing and sensemaking of allied forces

In addition to being escalation options in their own right, counter-sensing and sensemaking would also restore the ability to conduct small-scale allied physical attacks. Under the current escalation paradigm of Figure 6, small attacks such as disabling a maritime militia ship or forcing down an intruding bomber can only be undertaken at great risk in the region around China. However, if complemented by counter-sensing and sensemaking operations, these small-scale engagements could be obscured for long enough to complete the operation or seem to require so large an intervention that PRC leaders choose not to escalate.

Designing a counter-sensing and sensemaking campaign

During a peacetime competition, such as exists today between China and United States, the goal of a US-led counter-sensing and sense-making campaign would be to steer PRC leaders away from the most destructive paths to their objectives. As shown in Figure 7, the PRC has several different scenarios it could pursue to forcibly unify with Taiwan. The most undesirable path from the US and allied perspective is likely an invasion, followed by bombardment or a blockade.

By targeting the reconnaissance-intelligence system, a counter-sensing and sensemaking campaign would likely have the most impact on an invasion scenario. Aerial bombardment of Taiwan or its neighbors could rely on pre-determined aimpoints and implementing a blockade does not depend on timely, centrally-organized targeting information. An invasion, in contrast, will require PLA forces to quickly engage US and other allied ships, submarines, and aircraft that may seek to stop the invasion. These moving forces cannot be targeted in advance but the PLA would need to neutralize them for an invasion to succeed.

A counter-sensing and sensemaking campaign would not render an invasion infeasible. The PLA has a sufficient capacity advantage to possibly succeed even with poor C3ISR performance. However, the higher dependence of an invasion on the reconnaissance-intelligence system suggests counter-sensing and sensemaking operations could drive down the preference of PRC leaders for that scenario and make other scenarios more attractive. These other scenarios may still be undesirable for US and allied leaders, but they may be less-destructive, slower-paced, and offer more off-ramps to de-escalation compared to an invasion.

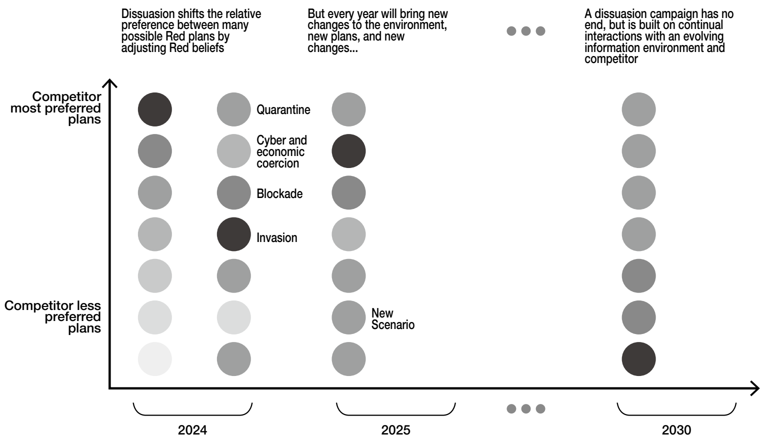

Figure 7: Implementation of a dissuasion strategy

Tell, don't show

US and allied forces have increased their use of lower rungs on the escalation ladders during the last several years. In response to rising PRC intrusions into its airspace and maritime zones, Japan's military stepped up interdictions and patrols. The US Navy is now routinely joined by Australian, Japanese, and European naval vessels in conducting freedom of navigation operations in waters illegally claimed by China.[27] And most prominently, Philippine ships regularly confront Chinese fishing and coast guard vessels attempting to block access to features in the Philippine's Exclusive Economic Zone, such

[27] Reuters, "Allies, Partners Conduct Joint Naval Exercises in South China Sea for Free and Open Indo-Pacific," Indo-Pacific Forum, October 4, 2024, https://ipdefenseforum.com/2024/10/allies-partners-conduct-joint-naval-exercises-in-south-china-sea-for-free-and-open-indo-pacific/.

as Second Thomas Shoal and Mischief Reef.[28]

These overt measures are effective at demonstrating allies' resistance to Chinese gray-zone operations for the international audience. However, they may be counter-productive in dissuading future Chinese gray-zone or more escalatory acts of aggression. By openly opposing Chinese intrusions, allied efforts create reputational risk for PRC leaders, who likely believe that gray-zone operations show their strength and resolve in establishing and enforcing regional hegemony. For example, the Philippines' open defiance of China's attempts to close the entrance of Second Thomas Shoal—where Philippine sailors operate a grounded tank landing ship—demands that Chinese leaders ramp up their efforts to hinder, harass, and contain Philippine efforts to resupply the ship. If China did not respond forcefully, Chinese leaders risk other countries in the region taking a similar stance regarding disputed territorial claims.[29]

Covert actions may offer more leverage in influencing Chinese leaders compared to overt actions. As shown in Figure 8, allied forces (in green) can send signals to PRC leaders (in red) through two main channels. One path, for overt actions, travels through the global information environment to be received by the opponent. The other, for covert actions, travels directly from one competitor to the other in what is essentially a closed feedback loop.

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28 John Pollock and Damien Symon, "China Blocks Philippines Access to South China Sea Reef," Chatham House, March 21, 2024, https://www.chathamhouse.org/publications/the-world-today/2024-02/china-blocks-philippines-access-south-china-sea-reef.

29 Andrew Taffer, "The Puzzle of Chinese Escalation vs Restraint in the South China Sea," War on the Rocks, July 26, 2024, https://warontherocks.com/2024/07/the-puzzle-of-chinese-escalation-vs-restraint-in-the-south-china-sea/.

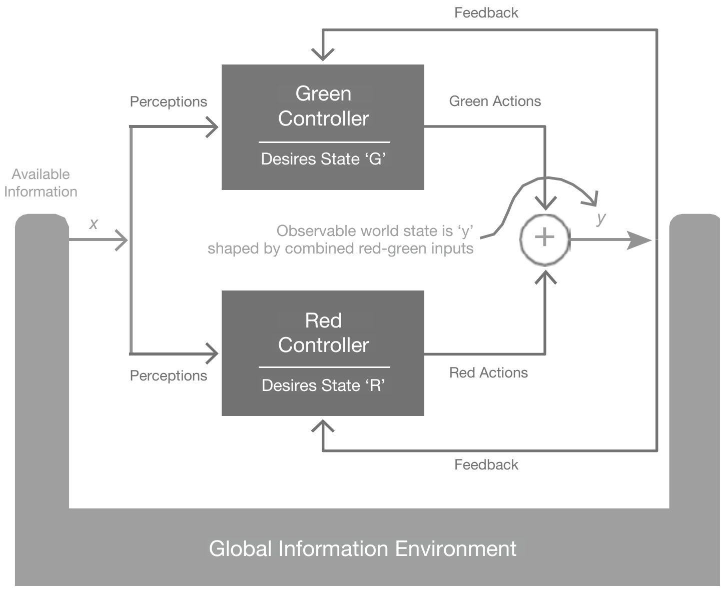

Figure 8: Information exchange between US and allies (Green) and PRC (Red)

Counter-sensing and sense-making operations exemplify operation of the feedback loop in Figure 8. Because they are designed to impact the adversary's sensors and associated C3 capabilities, actions like jamming, decoy deployment, or cyber attacks would normally only be perceived by the adversary. In some cases, counter-sensing and sensemaking actions could be observable to others, such as commercial satellite-sensing providers. However, these companies and the analysts who rely on them would not know whether the PLA was impacted by the operation. PRC officials may be reticent to complain about the counter-sensing and sensemaking operation to avoid revealing a potential vulnerability in the reconnaissance-intelligence system.[30]

Chinese leaders may not acknowledge an allied counter-sensing and sensemaking action, but effective jamming or deception should generate a reaction as PLA operators attempt to clarify their contact picture and remediate vulnerabilities in their sensors and C2 capabilities. US and allied observers could use the PRC response to assess

30 Richard Manley, "Cyber in the Shadows: Why the Future of Cyber Operations Will Be Covert," (Washington, DC: US National Defense University, 2022), https://ndupress.ndu.edu/Media/News/News-Article-View/article/3105355/cyber-in-the-shadows-why-the-future-of-cyber-operations-will-be-covert/.

the relative importance of the affected system, process, or organization in the overall reconnaissance-intelligence system and whether the system's shortfalls were known to PLA and PRC leaders. For example, if after a decoy and jamming operation against Chinese ELINT satellites the PLA were to modify their orbits or begin flying more ISR aircraft in the area allied leaders could assess that either ELINT satellite performance was already suspect or that they form a critical node in the reconnaissance-intelligence system. Future counter-sensing and sensemaking operations could target the updated ELINT constellations or shift to other sensors or processes and evaluate their role in the reconnaissance-intelligence system.

A magazine of surprise

Counter-sensing and sensemaking actions can support US and allied combat operations by degrading adversary targeting and undermining its plans. But as the discussion above suggests, non-kinetic effects are also central to a peacetime dissuasion campaign. The two applications demand somewhat different types and orchestrations of cyber and EW effects. During combat operations, US and allied forces would likely rely on standardized and overt non-kinetic effects that are easy for operators to execute in battle and that can be observed by other friendly forces. However, a successful dissuasion campaign will require counter-sensing and sensemaking operations that produce unexpected effects. Predictable allied actions will generate proforma responses, such as China's now-standard demarches against US and allied freedom of navigation operations. Allied non-kinetic operations will need to be surprising if they are to undermine PLA plans and confidence and reveal insights regarding Chinese perceptions of its own systems, processes, and organizations.

The need for surprise in peacetime counter-sensing and sensemaking operations reinforces the importance these actions being covert. A surprising overt action in peacetime, like shutting down a Chinese state-owned commercial satellite surveillance constellation with a cyber attack, could be viewed by Chinese leaders as highly escalatory and necessitate a robust response that proves counter-productive to the goal of dissuading aggression. In contrast, Chinese leaders would be less likely to react substantially to a covert allied non-kinetic action because a strong response could confirm the existence of an underlying vulnerability to the attacker or wider public.

Non-kinetic effects could offer a new path to dissuading aggression, but allied forces will be challenged to generate covert and surprising non-kinetic effects at the scale needed to shape Chinese leaders' scenario preferences. Cyber and EW effects are generally perishable because an adversary will likely quickly attempt to mitigate a C3ISR vulnerability once revealed. A sustained peacetime competition could require thousands of non-kinetic effects over time, but unlike conventional munitions, each non-kinetic effect will need to be different. This suggests the DoD will need to invest in the infrastructure to produce adaptable effects at scale.

As shown in Figure 9, allies will rapidly deplete their stockpile of non-kinetic effects as they take EW or cyber actions and the adversary fields countermeasures or the associated vulnerability is discovered and corrected by an opponent. At the same time, China will likely also take non-kinetic actions against allied interests to deter them from further cyber and EW operations. Allied forces will need a deeper magazine of non-kinetic effects compared to China for US and other leaders to be confident in carrying on the competition and to demonstrate to Chinese leaders that the PLA cannot sustain sensing and sensemaking superiority.

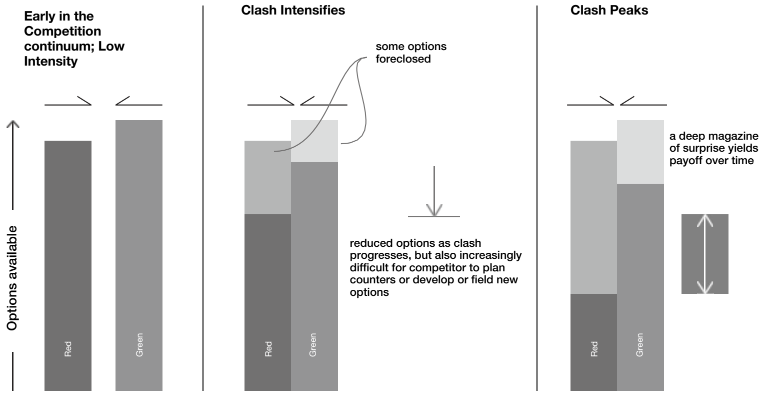

Figure 9: Representation of Allied (Green) and Chinese (Red) non-kinetic capability magazines

US forces arguably field the world's most capable portfolio of non-kinetic effects. And the US military is deploying new families of EW systems in each service that are beginning to move beyond self-protection to execute offensive effects such as decoying, deception, and stand-in jamming. For example, the Army is fielding its Terrestrial Layer

System at the soldier, brigade, and division level.[31] The Navy is installing upgraded versions of its SLQ-32 Surface EW Improvement Program system on DDGs.[32] And the Air Force is expanding its spectrum warfare wing with new squadrons and missions.[33]

The US government may have the world's most capable cyber and EW systems and operators, but it is generally focused on protecting troops, ships, and aircraft in wartime and specific, highly specialized offensive actions in peacetime. The DoD's supply chain for cyber tools and EW techniques and systems lacks the diversity and capacity needed to engage in a protracted sensing and sensemaking competition. US forces will need a wide variety of effects for a peacetime dissuasion campaign ranging from the most-capable "silver bullets" needed to gain the upper hand in a war to the "lead" or "brass" bullets needed to undermine adversary sensing and sensemaking over a sustained, multi-year competition.

3. Mounting a counter-sensing and sensemaking campaign

US and allied forces can most effectively employ EW and cyber effects as part of a campaign. As described in the DoD's cyber strategy, readying a few highly-classified non-kinetic "silver bullets" does not contribute to deterrence or dissuasion.[34] And from the perspective of sensing and sensemaking, DoD leaders who plan to use only a small set of highly-sophisticated non-kinetic tools in wartime accept the risk that an aggressor could overcome targeting shortfalls with greater mass. US and allied forces are likely to confront the PLA in China's near-abroad where the PRC will have an advantage in munitions capacity and resupply, making this "silver bullet" approach unlikely to succeed.

The DoD cyber strategy emphasizes use of non-kinetic capabilities as part of campaigns, but concerns itself primarily with thwarting and deterring espionage and non-kinetic attacks on US military forces and civil infrastructure. US and allied forces attempting to deter or dissuade multi-domain aggression will need to degrade an

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31 Mark Pomerleau, "Army Pursuing New Electronic Warfare Architecture," DefenseScoop, August 21, 2024, https://defensescoop.com/2024/08/21/army-pursuing-new-electronic-warfare-architecture/.

32 Sam LaGrone, "Navy Refining Plan for its $17B Destroyer Electronic Warfare Backfit with 4 Test Ships," USNI News, January 19, 2024, https://news.usni.org/2024/01/19/navy-refining-plan-for-its-17b-destroyer-electronic-warfare-backfit-with-4-test-ships.

33 Greg Hadley, "Spectrum Warfare Wing Adds Two New Squadrons to Handle Growing Mission," *Air and Space Forces Magazine*, May 1, 2024, https://www.airandspaceforces.com/spectrum-warfare-wing-two-new-squadrons/.

34 US DoD, *Summary of the 2023 Cyber Strategy of the U.S. Department of Defense* (Washington, DC: US DoD, 2023), https://media.defense.gov/2023/Sep/12/2003299076/-1/-1/1/2023_DOD_Cyber_Strategy_Summary.PDF.

adversary's operational capabilities overall —not just those in cyberspace or the EMS. As described previously, PLA strategy and concepts hinge on the reconnaissance-intelligence system's ability to understand opposing forces' positions and actions and target long-range fires. Therefore, US non-kinetic campaigns should focus on winning the sensing and sensemaking competition.

Allied forces can take multiple paths to degrading PLA sensing and sensemaking, but one approach is described below. This example is intended to illustrate at an unclassified level the kinds of capabilities and operations that could be used as part of a campaign. An actual campaign would be more complex and incorporate a range of classified and specialized EW and cyber effects.

Avoid an "own goal" in sensing and sensemaking

The first principle of counter-sensing and sensemaking is to "do no harm." US and allied forces will need to avoid providing enemy reconnaissance systems easily-detected and classified signals that could obviate allied deception operations. For example, the monostatic radars and datalinks that became essential to air surveillance, early warning, and missile defense during the last half-century can also reveal a platform's location as well as its type and classification.

Due in large part to the vulnerability of monostatic radars and datalinks, the US military prioritized emission control (EMCON) operations during the Cold War. Understandably, EMCON became a lower priority in the decades since the Soviet Union fell.[35] However, in recent years US forces reestablished these practices as part of their operational routines.[36] EMCON primarily involves minimizing the use of radios and radars when enemy forces could detect them. However, given the ubiquity of passive RF and signals intelligence (SIGINT) sensors, allied forces will need to increasingly turn to passive and multistatic sensing combined with low-probability of intercept/low-probability of detection (LPI/LPD) communications.

As shown in Figure 10, allied forces could pursue several types of new sensing modalities that move away from monostatic radar. Using multiple RF receivers on nearby uncrewed vehicles, allied forces could geolocate enemy forces by detecting their radio

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35 Robert G. Angevine, "Hiding in Plain Sight—The U.S. Navy and Dispersed Operations under EMCON, 1956–1972," Naval War College Review, Volume 64, Issue 2, 2011, https://digital-commons.usnwc.edu/nwc-review/vol64/iss2/6.

36 Bryan Leese, "Living in TACSIT 1," *USNI Proceedings*, February, 2017, https://www.usni.org/magazines/proceedings/2017/february/living-tacsit-1.

or radar emissions. Uncrewed aircraft or missiles could illuminate with RF energy an enemy ship or aircraft to allow bistatic targeting by an allied platform that can remain in EMCON. Allied forces could use the background emissions from local television or mobile communication towers to illuminate enemy targets using passive radar. And allied forces could use IR sensors such as IR search and track (IRST) to find and classify enemy forces using their heat signatures.[37]

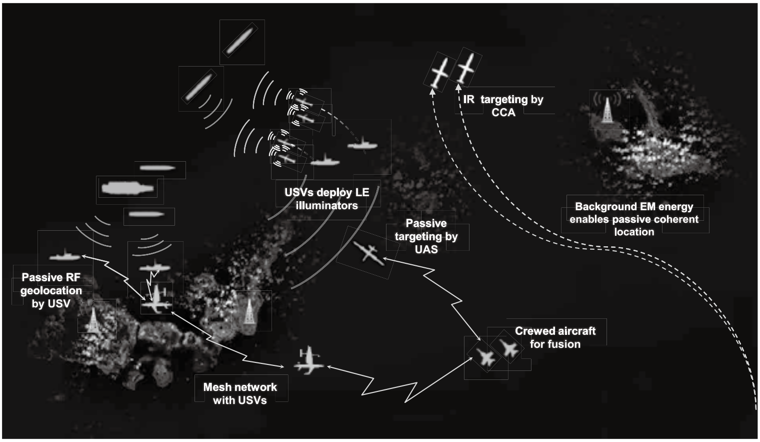

Figure 10: Concepts for passive and multistatic sensing

Passive and multistatic sensing is generally shorter-range and less precise than active monostatic radar. However, emerging technologies and techniques can help allied forces mitigate these shortfalls.[38] For example, expendable uncrewed systems could be used to closely approach enemy forces or illuminate a target to enable detection with lower consequences compared to a crewed ship or aircraft. Higher-density RF or electro-optical sensors can obtain more precise bearings to a radar, radio, or infrared emission. And artificial intelligence (AI) can be applied to improve predictions of adversary target

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37 US DoD, "Selected Acquisition Report (SAR): F/A-18 E/F IRST," (Washington, DC: US DoD, 2023), https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Selected_Acquisition_Reports/FY_2022_SARS/IRST_SAR_DEC_2022_final.pdf.

38 Jheng-Sian Li, Yung-Cheng Yao, Chun-Hung Chen, and Jyh-Horng Wen, "A Method to Improve the Accuracy of the TOA Position Location Solution in Multistatic Radar Systems," Proceedings - 6th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, IMIS 2012, Pages 500-505, 10.1109/IMIS.2012.36.

locations and classifications through training on actual targets with human supervision.[39]

US and allied forces will also need to reduce their IR signatures. This largely is done through platform design, but could be augmented by camouflage or additional heat sources that could obscure the ship, aircraft, or vehicle signature and reduce the opponent's ability to discern the target's classification or identification.[40] These approaches are being employed by Russian and Ukrainian troops to counter opponents' sensing and sensemaking during their ongoing conflict.[41]

Deceiving SIGINT sensors

A counter-sensing and sensemaking campaign would start with decoy operations. By creating numerous false targets for enemy sensors and obscuring returns from real targets, US and allied forces can degrade the reliability of PLA sensors and, by extension, the confidence of PLA leaders in plans that depend on this targeting and assessment information. Decoys would predominantly be uncrewed vehicles, which could allow them to perform double-duty as elements of a passive or multistatic sensing network as described above.

The campaign prioritizes operations against SIGINT satellites, as shown in Figure 12, because they are likely the primary sensors in the PLA reconnaissance-intelligence system. Able to stare across wide areas, commercial and military SIGINT satellites can identify the rough location of hundreds of emitters at a time and determine their classification using characteristics such as frequency, pulse width (PW), pulse repetition frequency (PRF), or scan pattern. SIGINT satellites in a geostationary orbit (GEO), like those in Figure 11, can view almost an entire hemisphere at once. However, GEO satellites cannot locate emitters precisely because they only receive one line of bearing and the beamwidth of the emitter is widened due to the satellite being at a high altitude. Low earth orbit SIGINT satellites can receive multiple lines of bearing because they are

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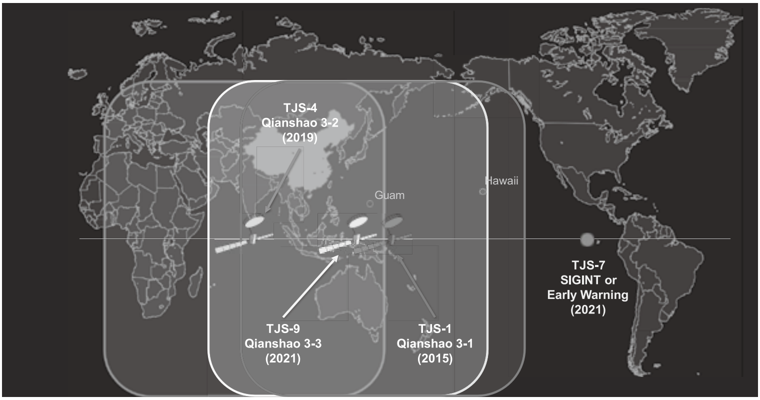
39 Denghui He, Yuanhui Cui, Fangchao Ming, and Weiping Wu, "Advancements in Passive Wireless Sensors, Materials, Devices, and Applications," *Sensors*, Volume 23, Issue 19, 2023, Page 8200, https://doi.org/10.3390/s23198200.

40 "Better camouflage is needed to hide from new electronic sensors," *The Economist*, March 29, 2023, https://www.economist.com/science-and-technology/2023/03/29/better-camouflage-is-needed-to-hide-from-new-electronic-sensors.

41 Dylan Malyasov, "Russia Uses Advanced Camouflage to Hide Their Iskanders from Ukrainian Drones," Defense-Blog, April 19, 2022, https://defence-blog.com/russia-uses-advanced-camouflage-to-hide-their-iskanders-from-ukrainian-drones/; Sam Cranny-Evans, "The Role of Artillery in a War Between Russia and Ukraine," *RUSI Commentary*, February 14, 2022, https://rusi.org/explore-our-research/publications/commentary/role-artillery-war-between-russia-and-ukraine.

in motion relative to the emitter and are more numerous than GEO satellites, which affords them more precise location information.



Notes: All shown constellations are in geosynchronous (GEO) orbit.

Figure 11: PLA SIGINT satellite coverage[42]

Although US and allied forces can greatly reduce their detectability to SIGINT sensors using EMCON practices, sometimes radio communications and radar operations will be necessary. Ships, aircraft, and troop formations can use decoys operating away from actual forces to prevent these limited, but necessary, emissions from providing enemy forces actionable targeting information. Decoys can create confusion for enemy sensing and sensemaking by providing more numerous targets for assessment and tracking in lieu of, or in addition to, the real targets provided by necessary allied emissions. Knowing that false targets are present in the SIGINT constellation's view will lead operators to investigate each detection, slowing the sensemaking process and perhaps ceding the initiative to allied forces.

Realistic decoys will need to incorporate RF transmitters that can emulate at least some signals the actual platform is likely emit. A low-cost decoy is unlikely to have sufficient power to fully represent a large radar like the Navy SPY-1 or Army Patriot, but RF decoys can exploit creative tactics and new technologies to provide a realistic simulation. For example, radar operators seeking to avoid detection may operate their

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[42] J. Michael Dahm, "Testimony before the U.S.-China Economic and Security Review Commission," March 21, 2024, https://www.uscc.gov/sites/default/files/2024-03/J.Michael_Dahm_Testimony.pdf.

systems at low power or use spot beams to avoid detection. A decoy operating in a contested environment could simulate a SPY-1 or Patriot operating in one of these less-demanding modes.

Waveform generation is the other significant challenge with RF decoys. To be versatile, a decoy may need to use a software-defined radio (SDR) to generate its signal. SDRs can be programmed to produce a wide variety of signal characteristics such as pulse repetition rate, pulse width, or frequency within the limitations of the antenna hardware. But SDRs also demand substantial power for processing, which increases depending on how versatile the SDR is intended to be.[43] US and allied forces should develop modular low-cost, low-power decoy transmitters that each specialize in a small range of signals that can be incorporated onto a variety of uncrewed systems.

While the power and waveforms of radars can be challenging to emulate, decoys can more easily create realistic radio communication signals. Radios—especially those carried by ground troops and vehicles—are small, low-power, and relatively inexpensive. Rather than building decoy emulators, US and allied forces should simply incorporate real radios into decoys to provide a high-fidelity deception for enemy SIGINT sensors.[44] Several companies are pursuing this approach in uncrewed vehicles that simulate armored vehicles or missile launchers.[45]

Navies are also experimenting with active RF decoys and defense companies are beginning to develop and field RF decoy systems designed for deception, rather than simply self-protection.[46] For example, Thales demonstrated a surface decoy that combined the company's Halcyon unmanned surface vehicle (USV) with the EW payload of the French Accolade airborne self-protection decoy, shown in Figure 12.[47]

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43 Tore Ulversoy, "Software Defined Radio: Challenges and Opportunities," *IEEE Communications Surveys and Tutorials*, Volume 12, Issue 4, 2010, Pages 531-550. 10.1109/SURV.2010.032910.00019.

44 Walker Mills, "A Tool for Deception: The Urgent Need for EM Decoys," US Military Academy, February 27, 2020, https://warroom.armywarcollege.edu/articles/tactical-decoys/.

45 Remy Hermez, "To Survive, Deceive: Decoys in Land Warfare," War on the Rocks, April 22, 2021, https://warontherocks.com/2021/04/to-survive-deceive-decoys-in-land-warfare/.

46 David Tremper, "Unmanned Sea Surface Vehicle Electronic Warfare," *Naval Research Laboratory*, 2007, https://apps.dtic.mil/sti/tr/pdf/ADA518455.pdf.

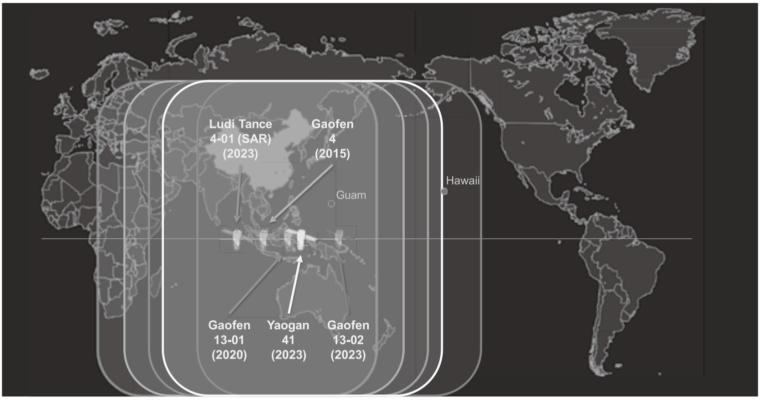
47 Thomas Withington, "Winning Accolades," Armada International, February 5, 2020, https://www.armadainternational.com/2020/02/winning-accolades/.

Figure 12: Thales Halcyon USV used in decoy experiments

While the majority of counter-SIGINT operations would rely on decoys, cyber operations could also be used to create false targets in the processing systems of the SIGINT constellation. For commercial SIGINT providers, these cyber effects could be introduced via a wired network, but military SIGINT constellations are likely firewalled from global communications networks like the Internet. As a result, allied forces may need to inject these cyber tools via an RF aperture, such as the SIGINT satellite's own antenna.

Countering imaging sensors

Faced with potentially large numbers of RF decoys, PLA operators would turn to imagery satellites, which provide the ability to scan large areas and obtain high-fidelity synthetic aperture radar (SAR) returns or visual and IR signatures. The PLA reconnaissance-intelligence system uses both electro-optical/infrared (EO/IR) and SAR imaging satellite constellations, as shown in Figure 13.



Notes: Gaofen and Yaogan satellites constellations use EO/IR sensors and Ludi Tance uses a SAR sensor. All shown constellations are in GEO orbit.

Figure 13: PLA SAR and EO/IR satellite coverage[48]

EO/IR and SAR sensors each have advantages and disadvantages. Because they are active sensors, SAR sensors can penetrate clouds and do not require sunlight or heat sources on the target to generate detections. SAR sensors also can provide greater precision for weapons targeting compared to EO/IR satellites that is require large and expensive sensors to achieve high resolution.[49] However, EO/IR satellites may enable classification and identification against a wider variety of targets because SAR sensors view the earth's surface from an angle, which can distort the radar image.[50]

Deceiving SAR

The most important difference between EO/IR and SAR imaging satellites for a counter-sensing and sensemaking campaign is their susceptibility to decoys and jamming. Lasers can disrupt visual and IR sensors. However, because these sensors are passive, the laser

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48 J. Michael Dahm, "Testimony before the U.S.-China Economic and Security Review Commission," March 21, 2024, https://www.uscc.gov/sites/default/files/2024-03/J.Michael_Dahm_Testimony.pdf.

49 G. M. Koretsky, J. F. Nicoll, and M. S. Taylor, *A Tutorial on Electro-Optical/Infrared (EO/IR) Theory and Systems* (Alexandria, VA: Institute for Defense Analysis, 2013), https://www.ida.org/-/media/feature/publications/a/at/a-tutorial-on-e-lectro--opticalinfrared-eoir-theory-and-systems/ida-document-d-4642.ashx.

50 Mark Ashby and Edmund Zelnio, "Multi-platform EO and SAR Fusion for Target ID," *Proceedings of SPIE 12095: Algorithms for Synthetic Aperture Radar Imagery XXIX*, paper 1209505, May 31, 2022, https://doi.org/10.1117/12.2624109.

operator would need to know from other sources the sensor's presence and exact location. SAR satellites can be detected and located by their emissions. And like other radars, SAR satellites could be disrupted by noise jamming or deceived by decoys that provide a false return emulating a different platform at a different location.[51]

Because it can use digital signal processing to manipulate the radar return, a SAR jammer could be smaller than the system or vehicle being emulated.[52] The Leonardo AN/ALQ-260(V1) BriteCloud countermeasure, shown in Figure 14, is an expendable decoy incorporating that provides a return to radar-guided missiles that looks like the defended aircraft.[53] Sweden's Saab recently began testing a similar decoy for its Gripen fighter aircraft that incorporates a propulsion system so it can draw a threat away from the defended aircraft.[54] And the Thales decoy USV shown in Figure 12 carries a jammer that could provide a radar return like that of the simulated ship.

Source: Leonardo

Figure 14: BriteCloud decoy simulating a defended aircraft

51 Hua Li, Zhenning Li, Kaiyu Liu, Kaijiang Xu, Chao Luo, You Lv, and Yunkai Deng, "A Broadband Information Metasurface-Assisted Target Jamming System for Synthetic Aperture Radar" *Remote Sensing, Volume 16,* Issue 9, 2024, Page 1499, https://doi.org/10.3390/rs16091499.

52 Dahai Dai, X. F. Wu, X. Wang, and Shunping Xiao, "SAR Active-Decoys Jamming Based on DRFM," in *Proceedings of the IET International Conference on Radar Systems* (Edinburgh: IET, 2007), pp. 1-4.

53 Steven D'Urso, "A Deep Dive Into BriteCloud Advanced Expendable Active Decoy," The Aviationist, July 6, 2021, https://theaviationist.com/2021/07/06/a-deep-dive-into-britecloud/.

54 Thomas Withington, "Decoy and Destroy," Armada International, October 7, 2020, https://www.armadainternational.com/2020/10/decoy-and-destroy/.

Although most of the radar decoys described above are intended to draw incoming weapons away from the defended platform, they could be repurposed to be decoys against satellite or airborne radars. In these counter-sensing and sensemaking use cases, the decoys would need to operate far enough from the defended platform for it to not attract attention toward actual US and allied forces.

Deceiving EO/IR

EO/IR satellites are more difficult to deceive compared to SAR sensors. As noted above, the defending force would need to know EO/IR sensors are in the area and their approximate location to either disrupt or decoy them. If available, lasers could disrupt EO/IR sensors regardless of the size of the system being protected. To deceive an EO/IR sensor, the decoy would need to have a similar size and shape as the system being emulated and have a comparable heat signature. Although the US and its Asian allies largely stopped widespread fielding of decoys after the Cold War, Eastern European US allies worried about potential Russian aggression continued R&D on decoys and fielding demonstration systems. Most of these decoys are inflatable, which makes them light and easy to deploy. Many incorporate radar-reflecting material to make them show up in radar searches as well.

Inflatable decoys like that shown in Figure 15 are built by the Czech company Inflatech and are likely being supplied to the Ukrainian military. In addition to providing a visual and radar signature to overhead sensors, newer inflatable systems like that in Figure 15 incorporate heaters to simulate the heat from engines or generators to deceive IR sensors. These signatures can appear realistic at ranges of more than several hundred yards away, making the decoys effective against overhead sensors on ISR aircraft or satellites.

Source: Inflatech

Figure 15: Inflatable decoy High-Mobility Artillery Rocket System (HiMARS)[55]

However, enemy UAVs may be able to approach inflatable decoys closely enough to distinguish them from real systems. For example, even if they incorporate radar-reflecting material, inflatable decoys lack the hard edges radars use to identify and classify a contact and the internal structure to allow accurately positioning heaters for realistic IR signatures.

Decoy developers are improving the fidelity of decoys while keeping their cost and complexity low enough that they can be deployed at scale and potentially lost without regret. Constructed, rather than inflated, decoys can provide the structure and power generation for more realistic decoys, like the wooden radar being built in Figure 16.[56] The US Army recently teamed with students from Georgia Institute of Technology to build working deception systems during a three-day "hack-a-thon."[57]

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55 Associated Press, "Inflatable Tanks, Missiles: Czech Firm Makes Decoy Armaments," March 6, 2023, https://apnews.com/article/czech-decoys-war-ukraine-russia-inflatable-a9c478adb9d7ecaa615cb19b25f4833f.

56 Isabel Coles, "How Ukraine Tricks Russia Into Wasting Ammunition," The Wall Street Journal, October 2, 2023, https://www.wsj.com/world/how-ukraine-tricks-russia-into-wasting-ammunition-799ed95f.

57 "GTRI, Army Team Up for Decoy Hackathon," Georgia Tech Research Institute (GTRI), January 18, 2023, https://www.gtri.gatech.edu/newsroom/gtri-army-team-decoy-hackathon.

Figure 16: Decoy radar under construction at Metinvest in Ukraine

To effectively emulate an actual platform, a decoy will need to also behave and be protected like a real system. Therefore, mobility and camouflage—techniques used to protect real vehicles, ships, and aircraft from detection—would also need to be employed with decoy systems. Many of the ground decoys being deployed by Ukrainian or Russian forces can be moved to simulate a real mobile system, but this creates risk for troops conducting the movement. To achieve greater realism and reduce risk to forces, several companies are fielding uncrewed vehicles that can either tow or carry visual and IR decoys or are themselves able to emulate a real system to enemy EO/IR sensors, as shown in Figure 17.[58]

[58] Raider Targetry, "ATTLAS," https://raidertargetry.com/attlas-3/; Nick Reynolds, 'Heavy Armoured Forces in Future Combined Arms Warfare', *RUSI Occasional Papers*, 12 December 2023, https://www.rusi.org/explore-our-research/publications/occasional-papers/heavy-armoured-forces-future-combined-arms-warfare.

Source: Raider Targetry

Figure 17: The Raider Targetry Mobile Moving Target System, which combines an uncrewed ground vehicle with a rigid target

Camouflage provides additional benefits beyond simply improving the quality of a decoy's simulation. If used on both real and decoy systems, camouflage can make differentiating between them more difficult and allow lower-fidelity decoys to be effective. Many companies are fielding camouflage that works across multiple regions of the electromagnetic spectrum, such as the Saab Barracuda family of camouflage systems.[59]

Denying sensor fusion

US and allied decoy and deception operations will not be perfect. Decoys will not perfectly represent the emissions or behavior of real platforms and militaries will have difficulty fielding and operating visual or IR decoys for larger platforms like ships and aircraft. As a result, US and allied forces will face the risk of PLA operators, aided by AI algorithms, using inputs from multiple sensor types to determine real from false targets. This process is called sensor correlation when multiple detections are associated with the same target. With the advent of modern data processing, operators often now pursue sensor fusion, which combines data from multiple sensors to create a single target. Sensor correlation can help reveal which sensor contacts could be real or fake. Sensor fusion could allow attackers to create high-quality tracks that can be used for engagement

59 Saab, Barracuda MCS, Saab, https://www.saab.com/products/mcs-mobile-camouflage-system.

despite the defender's attempts at jamming and obscuring.[60]

The PLA reconnaissance-intelligence system would likely attempt to correlate or fuse target tracks from space-based sensors with those from ground-based radars and passive RF receivers on the PRC mainland, complemented by airborne and shipboard sensors deployed in China's near abroad. The decoys, jammers, and camouflage US and allied forces use against SIGINT, SAR, and EO/IR satellites would be effective against similar sensors deployed ashore or on aircraft. However, ground, ship, and aircraft sensors would likely have different characteristics and view US and allied forces from different and more unpredictable angles compared to space-based sensors. This would make effective decoy and jamming operations more challenging.

While seemingly simply in theory, sensor fusion is difficult in practice. Data formats, refresh rates, and the characteristics associated with detections differ widely between sensor types. Differing levels of latency can make reports of the same contact from multiple sensors appear to be of different targets. And data from deployed sensors depend on RF communications that are subject to environmental conditions and jamming or electronic deception.[61]

Allied forces can exploit the difficulty of sensor fusion by hindering the PLA reconnaissance-intelligence system's ability to fuse data from multiple sensors in real time. As shown in Figure 18, decoys would create false SIGINT, SAR, and EO/IR targets. When airborne early warning (AEW) aircraft are sent to investigate, their sensors are obscured by jammers and their communications blocked by small UAVs with EW systems. SAR jammers would hide the real ships behind a wall of noise in the SAR satellite's frequency range.

The decoy and jamming operations shown in Figure 18 could predominantly be done using uncrewed systems. When emulating a ship applying EMCON practices, a USV would only need emit low radio or radar power levels to fool a SIGINT satellite or shore-based listening station. SAR satellites operate at long range and the power reaching the earth's surface is within the level possible from an USV. And USV-borne radio or

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60 Joseph Peri, "Approaches to Multisensor Data Fusion," Johns Hopkins University Technical Digest, 2001, https://secwww.jhuapl.edu/techdigest/Content/techdigest/pdf/V22-N04/22-04-Peri.pdf/; Ashraf M. Aziz, "Fuzzy Track-to-track Association and Track Fusion Approach in Distributed Multisensor–multitarget Multiple-attribute Environment," *Signal Processing*, Volume 87, Issue 6, 2007, Pages 1474-1492, ISSN 0165-1684, https://doi.org/10.1016/j.sigpro.2007.01.001.

61 S. Hamed Javadi and Alfonso Farina, "Radar Networks: A Review of Features and Challenges," *Information Fusion*, Volume 61, 2020, Pages 48-55, ISSN 1566-2535, https://doi.org/10.1016/j.inffus.2020.03.005.

radar jammers working against a terrestrial system like an AEW aircraft or ground-based HF radar can compensate for their lower power levels by more closely approaching the targeted system.

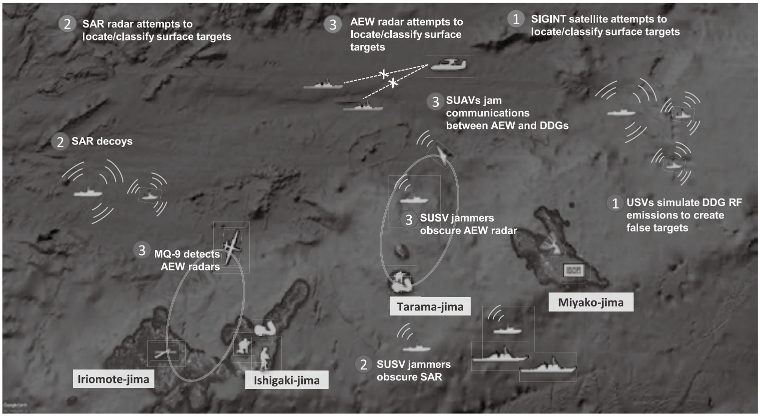

Figure 18: Lines of effort in notional counter-sensing and sensemaking campaign

Jammers like those shown in Figure 18 would also be useful for injecting cyber tools into enemy networks and systems. Deployed aircraft and ships may not be connected to the wide internet and the PLA has likely hard-wired its ground-based radars and SIGINT sensors to reduce their susceptibility to jamming and interdiction. However, this still leaves them vulnerable to a "front-door" attack that injects a cyber tool into the system's antenna.

Against a major power like the PRC, US and allied forces are unlikely to prevail in a salvo competition. These militaries and their leaders will need to focus on deterring conflict, not just hoping to win the war when it comes. The DoD will need a robust non-kinetic capability development process and industrial base to sustain a peacetime counter-sensing and sensemaking campaign that could dissuade PRC aggression.

4. Conclusion

The US military is no longer broadly dominant against all adversaries across all scenarios. To regain an edge against peer competitors like China, US forces will increasingly need to rely on counter-sensing and sensemaking operations. In addition to reducing the effectiveness of enemy fires in wartime, these operations can undermine the confidence of adversary commanders and leaders in their ability to accurately target allied forces and predict future allied operations.

To stay ahead in the sensing and sensemaking competition, US and allied militaries will need to improve their own C3ISR capabilities through improved interoperability, new proliferated LEO satellite constellations, and continued advancements in uncrewed systems on, under, and over the water. More important, allied forces will also need to field a large and diverse array of non-kinetic cyber and EW effects that can degrade adversary efforts to see and understand their operational picture.

The DoD's non-kinetic capabilities are arguably second to none. However, the relatively small number of exquisite "silver bullet" effects US forces develop to meet ambitious requirements may only be useful in wartime, when their expenditure can have maximum impact. To deter conflict, US and allied forces will need non-kinetic effects they can employ during peacetime competition to show opponents that their C3ISR capabilities may be unreliable in combat.

A sustained peacetime effort to dissuade aggression through non-kinetic means will depend on a deep magazine of cyber and EW effects that are unlikely to cause widespread or permanent damage. These "brass" or "bronze" bullets would incur a lower risk of escalation compared to their more damaging counterparts and likely could be fielded in greater numbers because they may need less-challenging access to adversary systems or networks and could employ common attack methodologies.

Competition-phase non-kinetic effects will also need to be unexpected, even if they are usually less dramatic than attacks like the Stuxnet virus or the supply chain attack on Solar Winds software.[62] Predicable non-kinetic effects are desirable in uses like self-protection jammers, but in counter-sensing and sensemaking could ironically act to encourage an opponent by implying its C3ISR systems can address allied cyber and EW attacks. US and allied forces could achieve surprise in their non-kinetic capabilities through novel coding or waveforms in the effect itself as well as through the entire effects chain's delivery mechanism, target, or tactics.

Achieving a deep magazine of surprising non-kinetic effects will require different

62 National Public Radio, "A 'Worst Nightmare' Cyberattack: The Untold Story of the SolarWinds Hack," NPR.org, April 16, 2021, https://www.npr.org/2021/04/16/985439655/a-worst-nightmare-cyberattack-the-untold-story-of-the-solarwinds-hack; David Kushner, "The Real Story of Stuxnet," *IEEE Spectrum*, February 26, 2013, https://spectrum.ieee.org/the-real-story-of-stuxnet.

approaches to the EW and cyber supply chains and a defense industrial base that is incentivized to build capabilities at scale and pursue independent innovation. Using existing acquisition and contracting authorities, the proposed consortium and process of this report would provide a "sandbox" for industry to develop and assess new approaches and effects using government-approved intel and models. By buying the most promising non-kinetic capabilities at competitive prices, the government would produce a "pull" for new effects that would incentive further industry-led innovation. An example of such a process is shown in Figure 19.

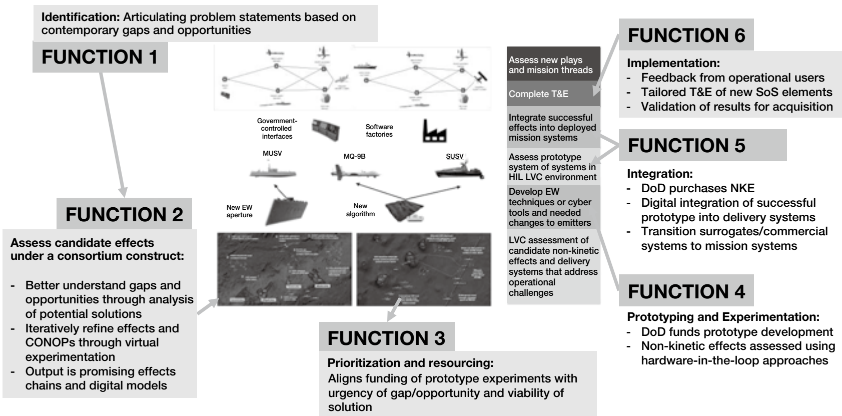

Figure 19: Potential future non-kinetic capability development process

US and allied militaries can no longer depend on their general superiority to deter and defeat aggression. Recent events in multiple theaters highlight how regional powers, transnational organizations, and peer competitors all are gaining the ability to stress or overmatch US and allied forces in their regions. Non-kinetic effects offer a way for the DoD to take advantage of an area of US and allied strength and regain the ability to dissuade opponents through sustained efforts to undermine their sensing and sensemaking. Exploiting these strengths, however, will require buying and delivering non-kinetic capabilities in ways more akin to their kinetic counterparts.

Chapter 2
Commercial Space for Competitive Advantage

John J. Klein

Introduction

The emerging commercial space ecosystem is opening new or expanding existing markets, along with playing a key role in the ever-changing global security landscape. Within the last decade, commercial space activities have expanded significantly in both scale and diversity, resulting in new capabilities and services that take advantage of off-the-shelf technologies and lower barriers for market entry. These recent developments are contributing to a burgeoning space industry driven by entrepreneurial innovation and investment, advanced technology, and decreased costs.

Space technologies—particularly commercial ones—play a substantial role in the conduct of everyday commerce and international trade, and because of growing demand, the number of satellites launched per year is growing exponentially (see Figure 1). Satellite deployment rates have increased nearly tenfold since 2014, driven by launches of commercial satellite constellations.[1] Those countries with space launch capabilities—including members of the European Union, Japan, China, India, Russia, and the United States—have greater control over scheduling whose satellite is launched and when (see Figure 2).

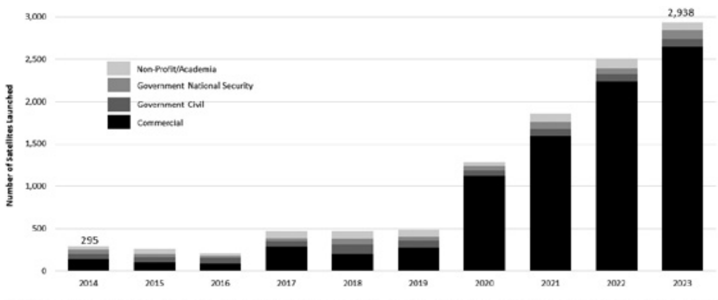

Figure 1. Number of Satellites Launched per Year by Operator Type (*BryceTech*)

1 Nickolas Boensch, email message to author, February 6, 2024.

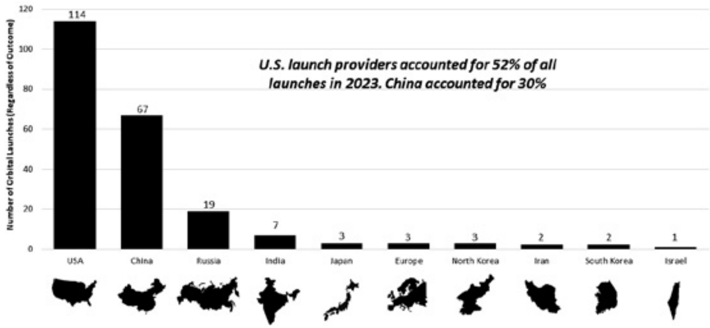

Figure 2. Number of Launches in 2023 by Country (*BryceTech*)

Many Western space strategies acknowledge the importance of the private sector in achieving political and military objectives. For example, the French *Space Defence Strategy* explains: "Alongside central governments, private-sector actors play a key role in the economic development of a space industry which is now more flexible, more innovative, more connected to other segments of the economy. The United States and China have long grasped the importance of this crucial turning-point for the development of our societies. Europe and France cannot turn a blind eye to an emerging area of potential conflict."[2] The emergence of disruptive innovation by space companies necessitates changes in the way France approaches the development of its space capabilities.[3]

According to François Raffenne, professor of European space studies at the Paris-based "SciencesPo" School of Public Affairs, "France's 2019 *Space Defence Strategy* underscores the need to more purposefully leverage commercial space to bolster national capabilities, provide additional resilience, and harness increasingly innovative services and systems coming from commercial providers."[4] The concept of "trusted operators" proposed in the strategy looks to define the conditions for greater industry engagement, but the lack of a clear legal definition has hindered the ability of the French Space Command to move beyond existing contractual relationships towards greater commercial integration.[5] Raffenne explains that "the lack of a clearly defined commercial integration strategy and

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2 French Armed Forces Ministry, *Space Defence Strategy* (2019), 4, https://cd-geneve.delegfrance.org/IMG/pdf/space_defence_strategy_2019_france.pdf.

3 Armed Forces Ministry, 4.

4 François Raffenne, email message to author, February 16, 2024.

5 Armed Forces Ministry, *Space Defence Strategy*, 9; Raffenne, email message.

limited funding for the acquisition of services within the French Programming Law [Military Planning Law] has, so far, limited progress."[6]

Moreover, Japan's 2023 *Space Security Initiative* emphasizes the importance of both allies and the commercial sector.[7] The document outlines the country's initiatives necessary for space security over the next decade and reflects those related efforts as part of Japan's Space Basic Plan, which is a cross-governmental initiative. In highlighting the need to work with other Western liberal democracies, the document notes that the purpose of Japanese space security is "to promote the peace and prosperity of Japan and the safety and security of our citizens through outer space, together with our ally, like-minded countries, and others to maintain the stable use of and free access to outer space."[8] Japan looks to cooperate with allies, along with strengthening domestic and international public-private partnerships to incorporate the commercial space sector's technological innovations and achievements.[9]

Commercial: Not Easy to Define

Even though the main theme of this paper is commercial space, reaching a consensus on how best to define what is and is not a commercial space entity proves elusive. Given that industry has played a pivotal role in delivering space capabilities and services for decades, the fact that *commercial space* is difficult to define may surprise some security experts and analysts. But it is exactly because categorizing commercial space proves elusive that it is especially relevant as part of irregular space warfare.

U.S. and Western Perspective

There are disparate definitions of what should be considered *commercial space*. Some consider a commercial activity to be one in which a private sector entity puts its own financial capital at risk and provides goods or services primarily to other private sector entities or consumers instead of the government.[10] Examples of these entities would be

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6 Raffenne, email message.

7 The Space Development Strategy Headquarters, Japan, *Space Security Initiative* (June 2023), https://www8.cao.go.jp/space/english/anpo/kaitei_fy05/enganpo_fy05.pdf.

8 Strategy Headquarters, 4.

9 Strategy Headquarters, 4.

10 Space Policy Online, "Commercial Space Activities," *SpacePolicyOnline.com*, updated February 6, 2025, https://spacepolicyonline.com/topics/commercial-space-activities/.

providers of direct-to-home satellite television (e.g., DirecTV and DishTV), satellite radio (Sirius XM), and commercial satellites delivering Internet services (e.g., SpaceX's Starlink and OneWeb).[11]

From a U.S. policy perspective, determining what is and is not commercial typically has two dimensions. The first dimension is risk-taking—especially financial risk—by entities other than the government. Generally, for a company's activities to be considered commercial, at least some private capital must be at risk or the company must sell to the private sector. The second dimension is the breadth of the customer base and the relationship between governmental and non-governmental customers.[12] These two dimensions are highlighted by the 2020 U.S. National Space Policy when defining *commercial*, which also notes the vital importance of the commercial space sector.[13] The policy document states, "The term 'commercial,' for the purposes of this policy, refers to goods, services, or activities provided by private sector enterprises that bear a reasonable portion of the investment risk and responsibility for the activity, operate in accordance with typical market-based incentives for controlling cost and optimizing return on investment, and have the legal capacity to offer those goods or services to existing or potential non-governmental customers."[14] This U.S. policy definition does include some ambiguous language, including: what is considered a "reasonable portion" of investment risk, and what constitutes "typical" market-based incentives? This lack of clarity is likely because U.S. government-wide consensus was unable to be reached in respect of providing more explicit language. Also, the definition of *commercial space* is not linked to the goods, services, and activities directly tied to space-based systems. The 2020 policy explains, however, that *commercial* is best understood within the context of providing goods and services to non-governmental customers.

Other definitions for *commercial space* are broader and include entities that sell consumer equipment, even when the satellite constellation enabling the capability is government owned. An example of this arrangement is the Global Positioning System (GPS) positioning, navigation, and timing satellite constellation, which is owned and

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11 "Commercial Space Activities," *SpacePolicyOnline.com*.

12 Irina Liu, Evan Linck, Bhavya Lal, Keith W. Crane, Xueying Han, Thomas J. Colvin, "Evaluation of China's Commercial Space Sector" (September 2019), 3, https://www.ida.org/-/media/feature/publications/e/ev/evaluation-of-chinas-commercial-space-sector/d-10873.ashx.

13 Executive Office of the President, *National Space Policy of the United States of America* (December 9, 2020), 20, https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/12/National-Space-Policy.pdf.

14 Executive Office of the President, 20.

operated by the U.S. Air Force and used by a vast array of consumers for automobile navigation, cell phone use, and precision farming.[15] While consumer devices using GPS are sold by commercial companies, the satellite timing signal that makes them work is provided for free by the U.S. government.[16]

Another potential definition includes commercial entities providing capabilities and services to primarily government customers, such as through the United Launch Alliance between Boeing and Lockheed Martin.[17] Critics of this definition, however, do not consider these entities commercial because they are reliant on the government for most of their revenue and the government assumes the majority of the risk as the "anchor customer." Instead of being considered commercial, critics would call such entities *government contractors*.[18] Space Foundation makes a similar distinction in defining *commercial*: "All space-related endeavors—including goods, services and activities—provided by private sector enterprises with the legal capacity to offer their products to *nongovernmental customers*" (emphasis added).[19] Using Space Foundation's definition, a label of *commercial* necessitates that revenue or sales not be the sole or primary result of governmental customers, such as the U.S. Department of Defense or National Aeronautics and Space Administration.

As the previous discussion illustrates, what is considered a commercial actor may be unclear because of the active role of governmental customers. In these situations where doubt remains as to whether an entity is truly commercial—especially in a U.S. and Western context—the modifier *quasi* is helpful to highlight this ambiguity. According to the Nasdaq Stock Market, a quasi-public corporation is an entity that is operated privately but is supported by the government in its operations, even though it is often traded publicly.[20] Some public-private partnerships may have similar considerations because of a government and private nexus. The World Bank considers public-private partnerships (PPPs) a tool for governments to use to help deliver needed services, using private sector innovation and expertise. These PPPs often leverage private finance, and

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15 U.S. Space Force, "Basics of GPS," *Schriever.spaceforce.mil*, https://www.schriever.spaceforce.mil/GPS/.

16 "Commercial Space Activities," *SpacePolicyOnline.com*.

17 Boeing Corporation, "United Launch Alliance," *Boeing.com*, accessed June 15, 2025, https://www.boeing.com/space/united-launch-alliance/.

18 "Commercial Space Activities," *SpacePolicyOnline.com*.

19 Space Foundation Editorial Team, "Space Briefing Book," *SpaceFoundation.org*, accessed June 15, 2025, https://www.spacefoundation.org/space_brief/space-sectors/.

20 Nasdaq, Inc., "Quasi-public corporation," *Nasdaq.com*, accessed June 15, 2025, https://www.nasdaq.com/glossary/q/quasi-public-corporation.

in certain contexts, PPPs can be seen as a way to improve the provision of needed public services and facilitate economic growth.[21] Throughout the remainder of this paper, therefore, *quasi-commercial* will be used to refer to entities and activities that blur the line between purely governmental or non-governmental actions, including companies that operate in the private sector but also receive significant government backing.

Chinese Perspective

Consistent with the thought that there is no consensus regarding what constitutes *commercial space*, a 2019 study by the Institute for Defense Analyses, *Evaluation of China's Commercial Space Sector*, explains that, given the central role of China's state-owned enterprises (SOE), a proper understanding of China's commercial space sector requires a different, non-U.S.-centrist definition. The authors of the study explain that, to date, nearly all of China's accomplishments in space have been achieved by China's government, its state-owned enterprises (SOE), or its subsidiaries and suppliers. Historically, China's space industry has consisted predominantly of SOEs controlled by China's central or provincial governments. Since 1999, two SOEs—the China Aerospace Science and Technology Corporation (CASC) and the China Aerospace Science and Industry Corporation (CASIC)—have had a near duopoly on launch and space technology in China, with CASC serving as the primary SOE overseeing launch and space technologies.[22]

For the reasons above, the study's authors explain that what differentiates a commercial company in China varies depending on who is asked.[23] For example, many SOEs conduct commercial activities with the private sector, buying and selling goods and services from and to households and businesses. Many of these SOEs, however, prioritize state goals over making profit and do not face traditional market pressures because they receive government funding to offset any net losses.[24]

Ultimately, the study's authors define a Chinese commercial company as "an enterprise that is primarily operated in pursuit of profit, as opposed to an organization that prioritizes public policy goals over profits, even though it conducts commercial

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21 World Bank Group, "Public-Private Partnerships (PPP): How can PPPs help deliver better services?" *Worldbank.org*, accessed June 15, 2025, https://ppp.worldbank.org/public-private-partnership/library/ppp-massive-open-online-course-how-can-ppps-deliver-better-services.

22 Liu et al., "China's Commercial Space Sector," 1.

23 Liu et al., 2-3.

24 Liu et al., 3.

activities. Notably, this definition can include companies that are fully state-owned."[25] Based on this definition, China's space industry includes a variety of participants, from large SOE subsidiaries to small, privately-owned start-ups, with all being primarily motivated by the pursuit of profit. Some of these organizations—in particular, CASC, CASIC, and their subsidiaries—engage in commercial activities, which include buying and selling goods and services with the private sector.[26] As a result, there are now seventy-eight commercial space companies operating in China.[27] More than half of these companies have been founded since 2014, with the vast majority focusing on satellite manufacturing and launch services. To a large extent, China is viewed as having followed the same blueprint drawn up by the United States of using government contracts and subsidies to give companies a competitive advantage in the market.[28] A common theme between China and the United States is that both, at times, have strong linkages between the government and the commercial space sector.

While Chinese space companies may look private on paper, they must still acquiesce to government guidance and control, along with accepting some level of interference. It may be difficult for China's commercial entities to make the case to potential overseas and Western customers that they operate independently of governmental control and influence. The distinction between space companies that are truly private and those that are more or less state actors is still quite fuzzy, especially when the government is a frequent customer. "That could still lead to a lack of trust from other partners," explains China space scholar Namrata Goswami, and it does not help that the Chinese government is less than transparent about the ownership and leadership of its national space programs.[29]

Throughout the remainder of this paper, *commercial* and *quasi-commercial* space entities may both be mentioned to indicate the range of commercial entities' behavior and motivations while acknowledging that different interpretations of what constitutes *commercial* exist. Therefore, inclusion of the term *quasi-commercial* is meant to address those actors behaving in some respect like commercial companies, such as seeking profit and increased market share, even though they may not operate in a purely commercial

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25 Liu et al., 4, 27.

26 Liu et al., 2-3, 27.

27 Liu et al., 6.

28 Neel V. Patel, "China's Surging Private Space Industry is out to Challenge the US," *TechnologyReview.com* (January 21, 2021), https://www.technologyreview.com/2021/01/21/1016513/china-private-commercial-space-industry-dominance/.

29 Patel, "China's Surging Private Space Industry."

sense and may have additional non-commercial interests and relationships. Including both commercial and quasi-commercial space actors is reflective of the breadth of relevant capabilities and services available during irregular warfare and competition in space.

Commercial Innovation for Competitive Advantage

For many security experts, technological innovation in the commercial sector is seen as an opportunity to achieve a competitive advantage over rivals. Governmental leaders often expect that entrepreneurial interest and investment in space companies will lead to significant changes in civil, commercial, and national security use of and access to space. Commercial space innovation is considered critical for developing novel ways of operating and protecting national security interests extending into space. Governments often see commercial space companies as a source for achieving strategic and political objectives while spending less than they would have otherwise. Because the commercial space sector is considered a means for achieving a competitive advantage among rival states, the sector will be instrumental in executing a holistic and practical space strategy.

Furthermore, governmental procurement professionals frequently seek to capitalize on commercial innovation to gain new capabilities using a faster, more responsive acquisition process. As a result of pacing innovation in the commercial marketplace, some national security space experts view commercial advancement as needing to inform not only which services can be commercialized, but also which mission areas should be the focus of space forces.[30] As a result, policymakers need to understand which space functions should be solely government-owned and operated and which functions are able to be integrated with or completely outsourced to commercial providers.

Many national security analysts expect that commercial activities will play a significant role during future competition and potential conflict in space. Strategies function in balancing desired ends with available means (see Figure 3), and commercial actors provide available means to support the desired ends of policy. This relationship results in commercial activities potentially playing a considerable role during competition, crisis, and conflict.

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30 Doug Loverro, "If Commercial Space Is Ready to Set Sail, Why Are We Still Missing the Boat?" *Breakingdefense.com* (August 25, 2021), https://breakingdefense.com/2021/08/if-commercial-space-is-ready-to-set-sail-why-are-we-still-missing-the-boat/.

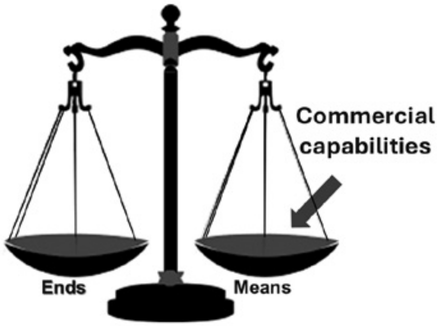

Figure 3. Strategy: Balancing Ends and Means (*author*)

Using Novel Commercial Technologies for Asymmetric Advantage

The use of novel commercial technologies will play a key role in space warfare's strategy. This is because the employment of commercial advanced technologies holds the promise of creating an asymmetric advantage between belligerents. In general, the employment of innovative technologies is an enduring part of both regular and irregular styles of warfare, but this is especially true during irregular forms of warfare where one competitor is less capable than the other. A less capable space power will seek any possible advantage and will try anything that might work to gain an edge during conflict, and the purpose of exploiting innovative technologies is to nullify one or more of the enemy's advantages. Therefore, the task of the disadvantaged space strategist is to alter the military balance to its benefit, which includes using novel technologies and weapons of war. The disadvantaged belligerent will likely eschew regular, conventional styles of warfare in favor of irregular modes where a technological edge can yield maximum benefit. For many space powers, the allure of finding a single, dominant technological solution to achieve any warfighting advantage will be just too great not to try.

Maritime history is illustrative of the relationship among innovative technologies, military advantage, and seeking asymmetric advantage. For example, the early adoption of torpedoes initially met with failure, but after evolutionary improvements to associated technologies and operational concepts, torpedoes eventually became operationally effective.[31] The employment of weapons technology does not necessarily signify that its use is well understood from the beginning, which can result in a failure to produce meaningful results. The lesson here is that the use of new technology does not necessarily mean success, either tactically or operationally.[32] Also, during other maritime experiences, new ways of warfare, particularly irregular styles, were the impetus to test novel technologies in the hopes of achieving asymmetric advantage and shaping new operational concepts. Maritime historian Benjamin Armstrong explains, "Early innovations with steam power and undersea warfare demonstrated how irregular operations offered an opportunity for early adoption of new and disruptive naval technology."[33] While innovation and disruptive technologies offer important contributions during irregular warfare, sometimes change comes as evolution rather than transformation, and one should not expect too much too soon.[34]

For the space strategist, it is helpful to think of the technology's utility—including the application of commercial innovation—in terms of achieving strategic effect. Technology and its application are meaningless, in a strategic sense, in all aspects aside from the effects achieved and the realization of outcomes that positively affect a conflict's resolution at the strategic level of war. Particularly within the U.S. defense establishment, there is often a widespread belief that superior technology is always the answer without knowing what the question is—how will the war's outcome be affected? Bigger, faster, and higher are seen as the ultimate criteria for technological success, but such data exists in its own world of unreality.[35] Strategic effect is determined by the target and not by the means of attack. Therefore, advanced technologies in themselves will not determine whether strategic effect is achieved or not; rather, the manner in which technologies are used and whether the adversary's decision calculus is affected are what counts. A good space strategy is one that yields sufficient strategic effect to achieve political ends and make positive military gains. Strategic effect—the common currency earned through military behavior and action—is generated by the fortitude, blood, and treasure expended during conflict.[36]

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31 Benjamin Armstrong, *Small Boats and Daring Men: Maritime Raiding, Irregular warfare, and the Early American Navy* (Norman, OK: University of Oklahoma Press, 2019), 193.

32 Armstrong, 193.

33 Armstrong, 193.

34 Michael Howard, *The Lessons of History* (New Haven, CT: Yale University Press, 1991), 4.

35 Jeremy Black, *Rethinking Military History* (Abingdon: Routledge, 2004), 110.

36 Colin S. Gray, *Fighting Talk: Forty Maxims on War, Peace, and Strategy* (Westport, CT: Greenwood Publishing, 2007), 55.

Another important point is that advanced technology and its successful use can dramatically improve the morale of fighting forces. Historian Jeremy Black explains, "Providing troops with better arms than their opponents not only enhances their effectiveness but also their morale, a point that is frequently ignored."[37] The strategy of space warfare must embrace the central role that is human activity. While technology is an important dimension in warfare, warfare is primarily a human activity with a technological context, and not vice versa.[38] Advanced technologies can create a sense that the adversary can be beaten, thereby enabling a polity and its armed forces to envision victory and carry out space operations that were previously considered unrealistic. Technological success during combat can beget further success and improve a belligerent's morale during a protracted conflict in the space domain. On many occasions, wars are won or lost in the minds of the polities involved, and this applies to space warfare as well.[39] Because victory or defeat during space warfare will hinge on the beliefs, attitudes, and behavior of the public, any morale boost through the successful application of novel technology should be pursued.

Technology's Proper Place within Space Strategy

The influence of technology on the conduct of warfare and the development of strategy is still not fully understood within many military communities. This misunderstanding may indeed hold true in respect of technology's role in the development and execution of space strategy. Based upon historical experience, it can be expected that advances in space-related technology will be used initially in ways commensurate with the current military and operational paradigms. Therefore, in the near-term, space operations will likely continue to play mostly supporting roles—albeit important ones—to operations on land, at sea, in the air, and in cyberspace. It may be some time until the strategic advantages of space-based or space-enabled operations are fully understood and effectively employed. While advances in space-related technology or space-based weaponry will not change the fundamental nature of warfare, these advances will change warfare's conduct and character.

There is a proper balance and perspective that must be sought when considering the

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37 Black, *Rethinking Military History*, 111.

38 Colin S. Gray, *The Strategy Bridge: Theory for Practice* (Oxford: Oxford University Press, 2010), 72.

39 Colin S. Gray, *Irregular Enemies and the Essence of Strategy: Can the American Way of War Adapt?* (Carlisle, PA: Strategic Studies Institute, March 2006), 25.

application of technological innovation, and Thomas Mahnken advises on the need to strike the right balance: "If the enthusiasts are guilty of hyping technology, the skeptics have all too often discounted the role of technology in war. Although technology is not the only—or necessarily the most important—determinant of success, its effects should not be ignored."[40] Mahnken notes that evolutionary advancements in precision guidance and stealth technologies are two examples where applying advanced technology had far-reaching strategic consequences.[41] A balanced understanding of technology's influence on the conduct of military operations can lead to the development of a more complete general theory of space strategy and suggest future operational style.

It is expected that space operations two hundred years from now will look significantly different from the space operations of today. To get a hint of how space operations of the future will be different from today, one can compare maritime operations during the Age of Sail to modern maritime operations. Just over two centuries ago, transoceanic shipping traveled using primarily the seasonal prevailing winds, and shipping that tried to deviate from the prescribed seasonal trade routes was at risk of taking an excessive amount of time to reach an intended destination, or not reaching the destination at all. It was not until the use of coal-fueled steam engines that transoceanic shipping was at last permitted to travel without being restricted by seasonal wind patterns.

Just as oceanic travel of the past was dictated by seasonal wind patterns, many space operations today are determined primarily by orbital mechanics or the gravitational pull of celestial bodies. In the future, when propulsion technology advances to the point where extended space travel is possible using more efficient sources of abundant energy, such as fusion reactors or advanced electric propulsion drives, it is expected that space travel will increase exponentially. Furthermore, improved propulsion technology will allow a state's interests in space to move beyond just near-Earth concerns and extend to cislunar regions and beyond.

Commercial Proxies and the Indirect Approach

There is growing interest in space actors using external third parties, whether state or non-state actors, during future crises and conflicts. Indeed, the histories of land and naval warfare repeatedly illustrate the use of third party organizations, groups, and participants

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[40] Thomas G. Mahnken, *Technology and the American Way of War Since 1945* (New York: Columbia University Press, 2008), 220.

[41] Mahnken, 227.

when employing force to achieve political aims and strategic ends. During the conduct of land warfare, soldiers of fortune and mercenaries—those paid to fight, deciding to do so willingly on their own behalf, or third party auxiliaries hired out to another party by their own government —frequently have played a vital role during military operations.[42] In naval warfare, privateers have also played an important part, including during the early days of the United States. Soldiers of fortune, mercenaries, and privateers all relate to the concept of using proxies during war and warfare. These external third parties may be either national or extranational actors.[43]

Proxies are those organizations, groups, and participants acting on behalf of another. These third parties may intervene on behalf of a sponsor or benefactor to help influence events and achieve political aims. Within the context of irregular forms of crisis and conflict in space, commercial and quasi-commercial entities may act as surrogates for governments or other sponsoring organizations and groups. These sponsoring governments, organizations, and groups may look to commercial entities to provide emerging technology and novel capabilities for achieving political objectives and strategic effect.

Also, the use of commercial and quasi-commercial space actors can absolve the sponsoring party or benefactor from having to undertake its own direct action by outsourcing either benign or questionable activities to commercial third parties. Commercial space proxies would allow a sponsor to affect outcomes during competition and conflict while being at arm's length and avoiding direct exposure to potential military escalation and adversary threats. The use of commercial proxies during space warfare can make attributing either provocative or harmful actions more difficult, thereby preventing a sponsoring actor from being held responsible for a commercial proxy's action and avoiding an adversary's follow-on retribution.

Commercial as the Indirect Approach

The idea of commercial and quasi-commercial actors serving as an alternate method for achieving desired political aims and military effects corresponds to the indirect approach, as addressed by British strategist B. H. Liddell Hart in his writing, particularly his

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42 Rodney Atwood, *The Hessians: Mercenaries from Hessen-Kassel in the American Revolution* (Cambridge: Cambridge University Press, 1980).

43 Stephen Biddle, *Nonstate Warfare: The Military Methods of Guerillas, Warlords, and Militias* (Princeton: Princeton University Press, 2021), xvi.

book *Strategy: The Indirect Approach*. In the book, Liddell Hart writes that the indirect approach incorporates the idea that strategy should adjust as the situation develops in war, along with achieving positive results separate from direct, large force-on-force engagements.[44] By incorporating the indirect approach into competitive and wartime strategies, policymakers and military leaders can achieve greater operational success with fewer casualties.[45]

Although Liddell Hart never addresses the concept of commercial proxies, the use of commercial surrogates by a sponsoring government, organization, or group is certainly in line with his thinking. The use of commercial and quasi-commercial entities can help achieve political aims and military objectives while obviating the need for a government to risk the destruction of its own fighting forces. The utilization of a commercial space sector's capabilities and services can help a sponsor achieve advantageous situations and decisive results, including throwing an adversary off-balance and leading to one's operational advantage, as Liddell Hart recommends.[46] Examples of commercial space proxies being part of the indirect approach are using commercial and non-governmental space services to conduct information operations to shape public opinion about a competitor's actions, using commercial surrogates to conduct cyberattacks against a rival's space-enabled communications networks, and using quasi-commercial entities to conduct rendezvous and proximity operations (along with non-cooperative docking) to coerce an adversary.

Buying Power and Creating Asymmetric Advantage

The commercial sector can also support a space strategy by enabling sponsors to purchase novel capabilities and services in order to create an asymmetric advantage. Fundamentally, sponsors of commercial proxies are able to convert fiscal capital and economic power into other forms of power to achieve strategic effects. This is simply buying power.[47] Even if a government, organization, or group does not have its own internal capabilities, it can simply procure the needed novel capabilities to deter or compel a competitor if it has the requisite fiscal means. Even if a government or organization has relatively minimal

44 B. H. Liddell Hart, *Strategy: The Indirect Approach*, 2nd ed. (London: Faber and Faber, 1967, reprint BN Publishing, January 15, 2020), loc. 152 of 3881, Kindle.
45 Liddell Hart, loc. 2442.
46 Liddell Hart, loc. 2417.
47 John J. Klein, *Understanding Space Strategy: The Art of War in Space* (Abingdon: Routledge, 2019), 131-32.

domestic technological capacity, it can still achieve substantial political aims and strategic effect through the procurement of commercial capabilities and services.

Sponsoring states, organizations, and groups may enter into contracts or service agreements with commercial space companies to augment the sponsor's access to and use of space. Through the procurement of commercial companies' novel capabilities and services, the sponsor does not need to spend money upfront for the research and development costs of high-end space systems—as is common with many government-led space programs—but only pays for those commercial services for a specified purpose and duration. By not needing to spend money upfront on technological research and development, a sponsor can save costs, and such a contractual arrangement can give middle and emerging space powers greater access to capabilities and services that they would not have had otherwise. Importantly, many commercial space capabilities and associated technologies may be considered dual-use in nature, thereby causing ambiguity as to whether the space systems are solely benign or have military implications. By procuring commercial technologies and services, a state can lower its risk in a competitive environment by gaining additional dual-use capabilities to achieve an operational advantage over a rival.[48]

Sponsors who purchase a commercial proxy's capabilities and services can also create an asymmetric advantage with the potential of positively affecting the strategic level of war, or achieving strategic effect. Financial strength can be turned into other forms of commercial-enabled strength, and a small amount of money can be used to achieve big results. The commercial-enabled asymmetric advantage seeks to use fiscal means to create strength in order to exploit a rival's weakness and realize an advantage. A sponsor's expenditure of relatively modest financial means may result in deterring or compelling competitors. Ultimately, the commercial-enabled asymmetric advantage will be used to achieve strategic effect by exploiting any imbalances in the competitive environment between rivals. As part of a competitive strategy, sponsors of commercial proxies must fully understand their own strengths and weaknesses relative to an opponent when seeking to create an asymmetric advantage. That is what competitive strategies do: they exploit asymmetric advantage and the adversary's soft spots.

Commensurate with the fundamental concepts of asymmetric warfare and the indirect approach is using commercial capabilities during competition and conflict,

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48 Dani Haloutz, "Air and Space Strategy for Small Powers: Needs and Opportunities," in *Toward Fusion of Air and Space: Surveying Developments and Assessing Choices for Small and Middle Powers*, eds. Dana J. Johnson and Ariel E. Levite (Santa Monica, CA: RAND Corporation, 2003), 148.

which is part of the precept of "trying anything that might work." There are several examples that illustrate a government, organization, or group buying power to create a potential asymmetric advantage: entering into a service agreement for commercial satellite communications with guaranteed availability throughout the peace-conflict continuum; purchasing commercial space launch services, whether as the primary payload or as a rideshare; procuring commercial on-orbit servicing and inspection capabilities; contracting for terrestrially-based space situational awareness services for detecting and tracking a competitor's satellites; contracting for active debris removal capabilities for use against a rival's defunct satellite in a non-cooperative manner; and acquiring commercial on-orbit, dual-use space capabilities to coerce a competitor.

Private Military Companies and Space Mercenaries

Commercial entities can directly support space warfare, especially during coercion and the use of force during irregular forms of warfare. This underlying concept is exemplified by today's routine use of private military companies, which are independent corporations offering training, logistical, security, and military services to national governments, international organizations, and other actors.[49] Peter Singer calls these commercial entities *corporate warriors* when highlighting the past role of private corporations during U.S. military conflicts in Iraq and Afghanistan.[50] Terrestrially, the work of private military companies ranges from running small-scale training missions to providing combat units composed of up to several hundred highly trained soldiers equipped with weapons platforms, such as artillery and main battle tanks.[51]

The use of private military forces is not a new idea: the idea is as old as warfare itself. Indeed, most of military history illustrates examples of privatized forces being used. Rulers of ancient Egypt and Rome used "armies for hire," or private forces, to supplement

[49] Rodrick H. McHaty and Joe Moye, "The US Military Must Plan for Encounters with Private Military Companies," *Brookings.edu* (March 30, 2021), https://www.brookings.edu/blog/order-from-chaos/2021/03/30/the-us-military-must-plan-for-encounters-with-private-military-companies/.

[50] P. W. Singer, *Corporate Warriors: The Rise of the Privatized Military Industry* (Ithaca, NY: Cornell University Press, 2003), 2–3.

[51] Sean McFate, *Mercenaries and War: Understanding Private Armies Today* (Washington, DC: National Defense University Press, December 2019), 1, https://ndupress.ndu.edu/Portals/68/Documents/strat-monograph/mercenaries-and-war.pdf.

their imperial armies.[52] While maintaining a permanent, standing military may seem normal today, it was not the norm throughout history. Paying for one's own armed forces can be ruinously expensive, and renting fighting forces is much cheaper than owning them.[53]

International security scholar Sean McFate comments on the various terminology in today's lexicon seeking to differentiate *private military companies* from the pejorative term *mercenaries*:

> There is no expert consensus on who exactly is a "mercenary." Those in the industry, their clients, and some outside experts spurn the "M" word owing to the associated stigma, and give these private-sector fighters new labels: private military contractors, private security companies, private military companies, private security/military companies, private military firms, military service providers, operational contractors, and contingency contractors. Since the emergence of this new warrior class in the 1990s, volumes of academic ink have been spilt on differentiating them from mercenaries.[54]

McFate notes, however, that such labels fail to endure, explaining, "There is no shining line between these categories, and it all depends on the individual warrior's will and market circumstances." Frequently, academia overcomplicates an already complex phenomenon by seeking neat typologies, but these efforts really help no one.[55] It is exactly because private military companies are difficult to define—along with the uncomfortable recognition that private corporations routinely provide combat power—that the topic is relevant to the strategy of warfare in space.

Corporate space warriors should be expected to play a notable role during future competition and conflict. Although this may be a contentious realization for some policymakers and security experts, historical experience underscores the enduring use of private forces. Moreover, other governments and non-state actors are imitating the private military company model, with the commoditization of private force turning into a global

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52 Alexander Casendino, "Soldiers of Fortune: the Rise of Private Military Companies and their Consequences on America's Wars," *Berkeley Political Review* (October 25, 2017), https://bpr.berkeley.edu/2017/10/25/soldiers-of-fortune-the-rise-of-private-military-companies-and-their-consequences-on-americas-wars/.

53 McFate, *Mercenaries and War*, 10.

54 McFate, 6.

55 McFate, 6.

free market sector.[56] On the current and future use of private military companies, Sean McFate elucidates, "Those who think the private military industry can be safely ignored, regulated, or categorically banned are too late."[57] Through the use of corporate space warriors, states, organizations, and groups can outsource paramilitary services without needing to maintain a standing or permanent space capability. Also, private military companies that provide space capabilities and services can help hide a state's involvement, thereby escaping retaliation and international sanctions through plausible deniability.[58] Corporate space warriors give sponsors the flexibility to adjust to the complexities of a changing competitive environment, especially during the conduct of irregular forms of warfare.

In general, private military corporations can help support space warfare strategy in primarily two ways. First, corporate space warriors may provide a coercive presence. Private space entities may serve the ends of policy through presence, proximity, and the perceived threat of force, especially because of the dual-use applications of many associated space technologies. Private military companies' actions may fall short of any actual use of force or violence, but these actions can still play a significant part in a space warfare strategy. Corporate warriors may provide logistical services using dual-use, space-based capabilities, and these logistical services may include active debris removal, refueling, and inspection services. Second, even though private military companies cause consternation and make some policymakers uncomfortable, they may provide security and military services in, from, and through space. These security and military services may include the use of force, and private military companies can be used to compel an adversary to acquiesce on some contentious demand or change a previous decision. Furthermore, sponsoring states, organizations, and groups may use private military companies as part of a complex strategy to exploit the gray-zone gap between peace and war by using measures short of armed conflict, including the introduction of non-state military forces, contractors, and corporate warriors into the battlespace.

Hybrid Space Architectures and Their Potential Downsides

Some governments and defense agencies, like those within the United States, are seeking to take advantage of commercial advancements by blending governmental and

56 McFate, 26.
57 McFate, 43.
58 McHaty and Moye, "US Military Must Plan for Encounters."

commercial architectures. For many government leaders, the commercial sector is seen as a way of achieving cost savings and incorporating innovative capabilities at the same time. Certainly, the commercial space sector is moving rapidly to provide robust and proliferated capabilities on-orbit, and so some consider it foolish not to take advantage of existing and planned commercial space capabilities.

The U.S. Space Force's space capstone doctrine describes *space system architecture* as the space, terrestrial, and link segments, all of which comprise a multi-domain approach that enables space capabilities and services.[59] First, the space segment consists of a spacecraft in orbit beyond Earth's atmosphere, and *spacecraft* refers to remotely piloted, crewed, or autonomous systems. Second, the terrestrial segment encompasses all terrestrial equipment required to operate spacecraft and satellites, and this includes control stations, antennas, tracking stations, launch sites, launch platforms, and user equipment. Third, the link segment comprises the electromagnetic spectrum and associated communication signals that connect the terrestrial segment and the space segment. Uplink signals transmit data from Earth to spacecraft, downlink signals transmit data from a spacecraft to Earth, and crosslink signals transmit data from one spacecraft to another.[60]

When considering existing space architectures, some space professionals view the interweaving of governmental and commercial architectures as a method to dramatically improve deterrence and space resiliency.[61] Deterrence efforts would be improved by distributing risk throughout proliferated, disaggregated, and diversified capabilities that operate across various orbital regimes.[62] Through the integration of governmental and commercial space architectures, it is possible to achieve greater diversity of capabilities and services while reducing any inherent vulnerability associated with using small numbers of high-value, exquisite governmental satellites.[63] Countries that integrate commercial systems and capabilities into their governmental space architectures can potentially achieve an asymmetric advantage over rivals by taking advantage of the speed of the commercial innovation cycle, novel technical capabilities, proliferated satellites,

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59 U.S. Space Force, "Space Capstone Publication: Spacepower Doctrine for Space Forces" (June 2020), 5, 37, https://apps.dtic.mil/sti/pdfs/AD1129735.pdf.

60 U.S. Space Force, 5, 37.

61 "Hybrid Space Architecture: Statement of Principles," SmallSat Alliance, accessed June 15, 2025, https://smallsatalliance.org/wp-content/uploads/2020/09/Hybrid-Architecture-Statement-of-Principles-v21.pdf.

62 Office of the Assistant Secretary of Defense for Homeland Defense and Global Security, *Space Domain Mission Assurance: A Resilience Taxonomy* (September 2015), 6-7, https://www.hsdl.org/?view&did=789773.

63 "Hybrid Space Architecture," SmallSat Alliance.

and diverse orbital regimes—all at significant cost savings when compared to using solely government funded efforts.[64]

Hybrid Space Architectures

As used in this paper, *hybrid space architecture* is the intermingling of governmental and commercial capabilities and services across the space, terrestrial, and link segments. The term *hybrid space architecture* is frequently used in the context of mixing small constellations of large, exquisite, and expensive governmental satellites with large constellations of smaller, less costly commercial satellites—with the combined architectures spanning various orbital regimes.[65] Certainly, there are other definitions of what entails a hybrid space architecture. SmallSat Alliance, for example, explains the concept thusly. "The Hybrid Space Architecture is the integration of emergent 'new space' smallsat capabilities with traditional US Government space systems."[66] Commercial space advocate Charles Beames views a hybrid space architecture as the preferred way for both the old and new space industries to operate as an integrated whole to support military, civil, and intelligence needs.[67] Beames explains, "With near parity in space competence and capability arising quickly worldwide, our government must no longer compete against, but instead harvest the innovations from the new commercial space sector. By integrating small, commercial space technologies, we can accomplish this and provide strength in numbers by mitigating vulnerabilities inherent in relying on a very small number of very expensive systems."[68] In general, a hybrid space architecture is understood as governmental and commercial constellations working in an integrated fashion, more effectively and efficiently than their individual parts.

For many within the U.S. defense community, moving towards a hybrid space architecture is considered vital. Gen. John Raymond, former chief of space operations, comments, "What we're looking at is to develop not a one size fits all, but a hybrid

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64 Charles Beames, "Why Hybrid Systems will enable the United States' Space Future," *Forbes.com* (November 29, 2019), https://www.forbes.com/sites/charlesbeames/2019/11/29/why-hybrid-systems-will-enable-the-united-states-space-future/.

65 Theresa Hitchens, "For Space Force, it's Acquisition, Acquisition, Acquisition: 2022 Preview," *BreakingDefense.com* (December 29, 2021), https://breakingdefense.com/2021/12/for-space-force-its-acquisition-acquisition-acquisition-2022-preview/.

66 "Hybrid Space Architecture," SmallSat Alliance.

67 Beames, "Hybrid Systems."

68 Beames, "Hybrid Systems."

architecture, with large and small [spacecraft] so you don't have a vulnerability."[69] Raymond elaborates on the advantages of a hybrid space architecture. "If you go to a more proliferated architecture, rather than the handful of exquisite capabilities, you then open the opportunities for more commercial collaboration and you open opportunities for more collaboration with our allies and partners."[70] For example, a future architecture for space-based communications may include a mix of both exquisite and mass-produced satellites, which is a mixture of both high-end and low-end capabilities.[71] Hybrid architectures also hold promise for remote sensing missions. Rather than relying exclusively on high-demand, low-density government owned satellites, commercial sensing satellites offer orders of magnitude more coverage and revisit rates that can augment and cue the sensing capabilities provided by more exquisite government owned and operated systems.

Potential Legal Implications of Hybrid Space Architectures

The intermingling of governmental and commercial space architectures raises legal questions, which must be fully considered and mitigated when using hybrid space architectures during irregular forms of competition and conflict. Specifically, questions pertaining to the principles of targeting and distinction are currently being raised on this exact matter. The intermingling of military and civilian space activities can blur the line between civilian and military property, and in theory, could lead some to construe commercial, or civilian, systems as being legitimate military targets under the Law of Armed Conflict.[72]

One of the underpinnings of the Law of Armed Conflict is the principle of lawful targeting, which is inclusive of the principle of distinction. Lawful targeting requires that all feasible precautions must be taken to ensure that only military objectives are targeted so that noncombatants, civilians, and civilian objects are spared as much as possible from

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[69] John Raymond, as quoted in Sandra Erwin, "Raymond: U.S. Space Command Needs Satellites to be Built Fast, to be Survivable," *SpaceNews.com* (September 17, 2019), https://spacenews.com/raymond-u-s-space-command-needs-satellites-to-be-built-fast-to-be-survivable/.

[70] John Raymond, as quoted in Sandra Erwin, "Military Space Chiefs from 15 Countries Gather amid Growing Security Concerns," *SpaceNews.com* (April 4, 2022), https://spacenews.com/military-space-chiefs-from-15-countries-gather-amid-growing-security-concerns/.

[71] Erwin, "Military Space Chiefs Gather."

[72] David A. Koplow, "Reverse Distinction: A U.S. Violation of the Law of Armed Conflict in Space," *Harvard National Security Journal* Vol. 13, iss. 1 (2022): 25-26, https://harvardnsj.org/wp-content/uploads/2022/01/HNSJ-Vol-13-Koplow-ReverseDistinction.pdf.

the ravages of war.[73] Undergirding this principle of targeting is that distinctions between combatants and non-combatants must be made to spare injury to non-combatants as much as possible. Consequently, under lawful targeting, all "reasonable precautions" must be taken to ensure only military objectives are targeted, so that damage to civilian objects (collateral damage) or death and injury to civilians (incidental injury) are avoided as much as possible.[74] Military objectives are combatants and those objects that, by their nature, location, purpose, or use, effectively contribute to the enemy's warfighting or war-sustaining capability. Additionally, civilians and civilian objects may not be made the object of attack. Civilian objects consist of all civilian property and activities other than those supporting or sustaining the enemy's war-fighting capability. The principles of targeting and distinction have implications when considering commercial satellites and their use during armed conflict.

David Koplow, legal scholar and Georgetown University law professor, highlights the potential downsides of today's general practice of intermingling commercial and military space infrastructure and architectures. Koplow comments that blurring the distinctions between civilian and military space systems and architectures poses serious implications for commercial customers and foreign nations.[75]

Explaining his concern over hybrid space architectures within the context of the Law of Armed Conflict, Koplow explains, "This intermingling runs afoul of one of the most central requirements of the traditional law of armed conflict: the principle of distinction (or discrimination), which mandates that in combat, states may lawfully direct their attacks only against military objectives, not against civilians or their property."[76] Moreover, he explains that an important corollary of this principle is that of *reverse distinction*, which requires a state to separate its military assets from civilian objects to the extent feasible. This precaution is necessary in order to spare civilians and their property from the ravages of warfare while enabling an adversary to make the distinction when directing armed attacks against only military targets.[77] Koplow makes the point, however, that reverse distinction is a somewhat "soft" obligation and this duty is not absolute. Consequently, parties are committed only to use their best efforts to separate military and

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73 U.S. Navy, U.S. Marine Corps, and U.S. Coast Guard, *The Commander's Handbook on the Law of Naval Operations*, NWP 1-14M/MCTP 11-10B/COMDTPUB P5800.7A (Aug 2017), 8-1, https://www.gc.noaa.gov/pdfs/CDRs_HB_on_Law_of_Naval_Operations_AUG17.pdf.

74 U.S. Navy et al., *Commander's Handbook*, 8-3.

75 Koplow, "Reverse Distinction," 25-26.

76 Koplow, 25-26.

77 Koplow, 25-26.

civilian assets to the "maximum extent" feasible.[78]

Providing an alternate viewpoint on the same concern is legal scholar Charles Dunlap.[79] Dunlap explains that determining if something is "feasible" can properly include the cost and practicality of creating a parallel system. In highlighting the potential impracticability of a reverse distinction corollary, Dunlap explains, "In theory, a government might be able to create a separate road system, electrical grid, petroleum refineries, internet, and so forth for its armed forces. However, doing so for such major systems that serve both civilian and military needs would be so enormously costly as to be impractical."[80]

The blending of commercial and governmental space capabilities is here to stay, and questions about how to reconcile the conduct of space warfare with the Law of Armed Conflict and the principles of targeting and distinction are important to discuss and debate with respect to hybrid architectures. Policymakers and space strategists will need to consider how best to target military objects and discriminate between commercial and military space systems and infrastructure. In cases where hybrid space architectures are used, this consideration will need to include how to specifically target an adversary's military satellites without negatively affecting commercial capabilities. In cases where hybrid architectures include governmental hosted payloads—referring to the utilization of available capacity on commercial satellites to accommodate additional transponders, instruments, or other space-bound items—military planners and targeteers may need to target a particular military subsystem or capability on a satellite that also includes non-military components and functions.[81] This same idea holds for making distinctions between military and non-military services that utilize the electromagnetic spectrum, such as when jamming and interfering with a rival's satellite communication frequency spectrum used for both military and non-military purposes.

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78 Koplow, 34.

79 Charles Dunlap, as quoted in Amanda Miller, "Resilient Architecture vs. Civilian Risk," *AirandSpaceForces.com* (February 16, 2022), https://www.airandspaceforces.com/article/resilient-architecture-vs-civilian-risk/.

80 Miller, "Resilient Architecture vs. Civilian Risk."

81 Office of Space Commerce, "Category: Hosted Payloads," *Space.Commerce.gov*, accessed June 15, 2025, https://www.space.commerce.gov/category/government-business/hosted-payloads/.

Will Commercial Be There When Needed?

The commercial space sector will play a substantial role in the conduct of military operations and strategy development. This will be because either the commerce enabled by space-relevant technologies is considered a vital national interest that needs to be protected, or because the commercial space sector will provide the means to help achieve a strategy's goals. Presently, the latter seems to be more the case. For many countries, space-based technology, capabilities, and services are interwoven into how their militaries train and fight. Satellite communication, remote sensing, and global positioning services are extensively used during the conduct of normal military operations. While it may be an exaggeration to say some militaries are "dependent" on space-derived services—because militaries often train to the loss of space-enabled capabilities—it is safe to say they have grown more reliant on them.

Because of the dual-use nature of many of the products and services provided by commercial space activities, it will be difficult at times to discriminate between purely military and commercial endeavors and associated systems. There may be shared architectures where military-related communications are enabled by commercial satellites. While there are implications that the strategist must consider, the mixing of military and commercial activities in space is nothing new. Land, sea, and air operations have all had to consider the blending of military and commercial sectors. Space, as well as cyber, will need to consider the means and methods to target and negatively impact commercial activities that may be commingled with military operations to achieve strategic effect.

Will commercial companies be there to support governments in times of war? This is a frequent question among national security analysts. When looking to fully integrate the commercial space sector into an overarching space strategy, this is a question on the minds of many military service members. The short answer to the previous question is "Yes." This question and answer are not unique to the space domain. The aerospace, automotive, and shipbuilding industries have a history of providing military products and services during times of conflict. Unless there are conditions beyond their control, commercial companies will seek to honor the terms of service level or licensing agreements because reneging on contracts would cause the company to lose market share and future revenue. In short, it is bad business not to keep your word. Yet, it must be underscored that commercial companies will support states in times of conflict *if the applicable agreements are in place before the onset of war*.

To ensure that the commercial sector can provide the most benefit in times of conflict, it is necessary that militaries and commercial partners establish trust during peacetime. Only by establishing trusted relationships and sharing information on commercial products, services, and capabilities can a polity implement a space strategy effectively and in a practical manner.

Occasionally, government or military personnel may presume that commercial partners and their services will not be available during conflict, believing that the commercial space sector's capabilities cannot operate in or withstand a non-permissive or hostile space domain. Such thinking is unfounded. Many commercial space service providers operate in a non-permissive environment every day. Commercial space companies are routinely under cyber-attack, whether by individuals, foreign militaries, or their surrogates. Many commercial space capabilities are more robust and resilient than generally understood by policymakers and warfighters. Commercial satellite operators have become more resilient because of the various threats—jamming of satellite communications or cyber-attacks on networks—they deal with every day. Also, many of the medium-to-large commercial space companies conduct their own research and development to improve how they operate under jamming or cyber-attack conditions, and governments can benefit by applying the lessons learned from commercial partners.

To best incorporate innovative commercial space capabilities, companies and governmental organizations should thoroughly understand certain subjects before conflict occurs. These areas of shared understanding include:

- commercial companies and governmental licensing authorities;
- implications of employing commercial assets to support military activities;
- governments considering the ways and means needed to protect commercial space assets when such assets are employed to support military operations;
- companies and their shareholders considering the implications of providing services to governments during hostilities, such as commercial space assets becoming targets for kinetic or non-kinetic attacks;
- for commercial remote sensing companies, such as those subject to U.S. policies and licensing regulations, understanding the potential level of control that licensing nations may exert during hostilities, including *shutter control*;
- establishing the most effective and efficient communication structure or architecture between governments and commercial partners to enable the unimpeded flow of data information during peace and conflict; and
- ensuring commercial partners have access to all necessary data and information—whether classified or not—to ensure they are able to provide the agreed-upon

products and services during times of war.

Looking Up and Forward

Commercial and quasi-commercial space activities can support the accomplishment of political aims and achieve strategic effect. Certainly, the commercial space sector often will have typical industry-centric concerns, like expanding market share, customer base, and profit margins. Also, governments may look to industry in a traditional manner: enabling a technically educated workforce; increasing gross domestic product; advancing technological innovation; and enhancing national prestige. Even with all these commonly understood roles, commercial entities can also play a key role during competition, crisis, and conflict in the space domain.

Commercial space activities can be beneficial during space warfare for two main reasons: supporting an indirect approach and creating an asymmetric advantage. First, the commercial space sector is an alternate means for coercing others separate from major military forces and actions, which is a fundamental element of the indirect approach. Sponsors and benefactors who are economically well-off can purchase a commercial proxy's capabilities and services to serve policy aims and achieve military objectives. By acting as a proxy or third party, commercial entities can perform a sponsor's bidding to coerce a competitor, which may include deterring a rival from pursuing a certain course of action or compelling a rival to cease a currently ongoing activity. Second, commercial innovation and novel capabilities can create an asymmetric advantage that can be exploited during irregular space warfare. The commercial sector is routinely able to innovate quicker than most governments, thereby rapidly bringing new capabilities and services to market. Because of these benefits, policymakers and military leaders will want to integrate and synchronize commercial space activities with their strategies and operational art of war.

Lastly, commercial entities can operate in a non-traditional or irregular manner, which can make some policymakers uncomfortable because commercial actions may appear to be quasi-governmental or quasi-military in nature. This would be the case of private military companies providing security and military services on behalf of a government sponsor. The blending of governmental and commercial roles and capabilities may raise legal questions regarding how to best discriminate between military and non-military objects during conflict, and these questions must be discussed and debated well before the onset of hostilities.

A key takeaway going forward is that Western leaders and policymakers must consider and have a meaningful dialogue today regarding their respective comfort level and the policy implications of targeting a rival's or third party's commercial capabilities. If Western countries target those commercial capabilities and services providing meaningful military capability to an adversary, the actions may lead to unintended conflict escalation or establishing a normative behavior that runs counter to U.S. and Allied long-term interests.

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.

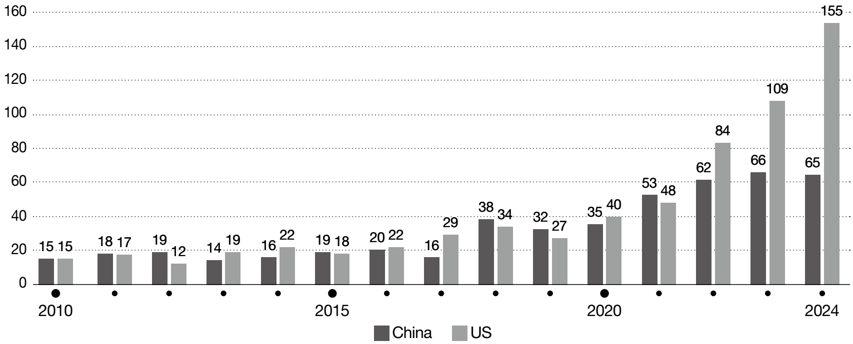

Figure 1: Successful US and PRC Space Launches[12]

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.

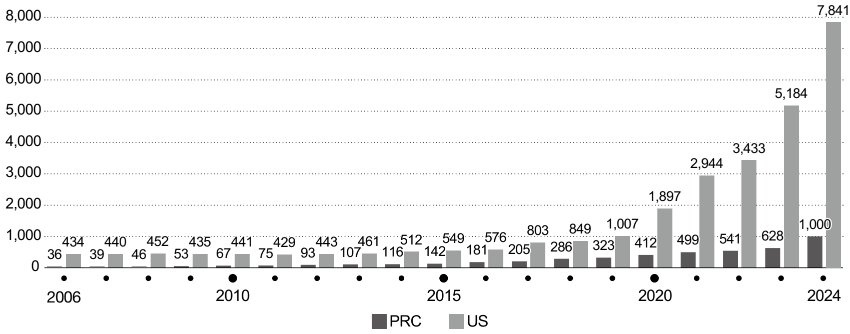

Figure 2: Number of US and PRC Satellites in Orbit

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]

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

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.

Part II
Major Country Policies in the Changing Environment

Chapter 4
The UK in the Global Space Age

Bleddyn Bowen

This paper sets out a brief history of the UK in military space and contemporary UK policy while placing the UK in its immediate transatlantic geopolitical context, where it is entrenched in a "Global Space Age". The "bottom line up front" of this presentation is that the UK finds itself in a binary system, caught between the bigger blocs of the United States on the one hand and the European Union (EU) on the other. London has long had to manage its military and intelligence dependencies on the United States alongside its economic and scientific integration with Europe in space.[1]

Brexit did not cause such tensions or problems, but it has arguably made such tensions in Britain's position relative to the USA and Europe more acute. Brexit has deprived the UK of an important position within the European Union, which is crucial in shaping the wider European system, including the European Space Agency (ESA). A new, unpredictable Trump administration adds a new force of uncertainty to an already volatile geopolitical situation in Europe, which has to contend with a revanchist Russia, expeditionary North Korean forces, and authoritarian and populist political movements within the EU. As the EU may turn inwards and may have to contend with a trade war with both China and the USA, the US-UK "Special Relationship", particularly in nuclear, space, missile, and intelligence matters, will be strained further.

Therefore, the two biggest challenges facing the UK in space security are: how to make its relatively meagre resources matter and, more importantly, in which direction? There are no clear or easy answers to such difficult questions, but this paper may further a wider understanding of the challenges and trade-offs facing the UK Government in military space matters at the moment. Whilst the UK Government has published the Strategic Defence Review (SDR) and recognised the fundamental importance of space systems to modern defence planning and military capabilities, it did not provide a clear

1 See: Bleddyn E. Bowen, "British strategy and outer space: A missing link?", *British Journal of Politics and International Relations*, 2018, 20:2.

list of priorities for capability investment at scale in space.[2]

Losing an Empire, Finding a Role?

How has the UK become more integrated with and dependent on others in space than many of its peers, such as France and Japan? Much of the answer lies in the UK's "Special Relationship" with the US, particularly in the nuclear, missile, and space dimensions, which still bears a dominating influence on UK space security and military power today. Therefore, exploring how this came about is important to understand the structural conditions British spacepower faces as we enter the middle years of the 21st century.

The UK has an interesting history in outer space and, like Japan, is still shaped by the legacies of big decisions made on space and rocket technologies back in the 1960s. Today, Britain has no sovereign launch capability and very few assets in orbit. 2025 or 2026 may see the first suborbital small satellite test launches from UK soil by companies such as Germany-based Rocket Factory Augsburg and UK-based Skyrora. Despite the absence of launch capability, Britain fields one of the most modernised military forces on Earth, which draws upon cutting-edge space support and intelligence from the United States and numerous allied states and companies. Compared to France, which is the fulcrum of the 'European' launcher industry and has a military with access to a range of sovereign or bilaterally operated satellites with Germany and Italy, Britain is far less of a direct or sovereign spacepower.

Yet Britain began the Space Age as a contender for the rank of third-place space power, after the Soviet Union and the USA. It would soon be overtaken, however, due to the collapse of the British Empire and a string of economic crises, ultimately settling into a new reality where the two superpowers dominated.[3] In the early years of nuclear and space technologies, the UK was investing in these new technological areas as they were seen as crucial to keeping up with the two new superpowers. Similarly to France, Britain was pushing ahead with its nuclear bomb and ballistic missile programmes. Britain was adamant to not repeat the experience of the US McMahon Act of 1946, which cut

2 UK Government, "The Strategic Defence Review 2025 - Making Britain Safer: secure at home, strong abroad", 2 June 2025, https://www.gov.uk/government/publications/the-strategic-defence-review-2025-making-britain-safer-secure-at-home-strong-abroad

3 On British decline, nuclear weapons, and the early Cold War, see: Richard Moore, *Nuclear Illusion, Nuclear Reality: Britain, the United States and Nuclear Weapons, 1958–64* (Palgrave, 2010); Kristan Stoddart, *Losing an Empire and Finding a Role: Britain, the USA, NATO, and Nuclear Weapons* (Palgrave, 2012)

all allies, including the UK, out of all nuclear cooperation. This upended years of UK support and cooperation in the Manhattan Project. Britain doubled down on its nuclear weapons programme, Tube Alloys, and reckoned with the reality that the US was not as reliable a post-war partner as some had hoped.[4]

Ernest Bevin, the UK Foreign Secretary in the Attlee government, commented that:

> "We've got to have this… I don't mind for myself, but I don't want any other Foreign Secretary of this country to be talked at, or to, by the Secretary of State in the United States as I just have with Mr Byrnes. We've got to have [the nuclear fission bomb] over here, whatever it costs. We've got to have the bloody Union Jack [sic] on top of it."[5]

Of course, nuclear weapons are pointless without a delivery mechanism, unless one is building nuclear-tipped mines. Britain's delivery system was a Medium-Range Ballistic Missile (MRBM) called Blue Streak. It would be housed in silos on UK soil designed to reach the western/northern Soviet Union and other Warsaw Pact countries. Developed and tested through the 1950s, including at the Woomera test range in Australia, the rocket functioned well and, by some accounts, came in under budget. According to one historian, it was one of the last achievements of Britain's wartime state engineering prowess.[6] A Blue Streak missile remains on display at the National Space Centre in Leicester today.

Having lost interest in Blue Streak as an MRBM, London supplied it as the first stage of the Europa satellite launcher, the European Launcher Development Organisation's (ELDO) first and only attempt at a pan-European launch system. Blue Streak was the first stage, with a French second stage, a West German third stage, and an Italian test satellite. It failed but sowed the seeds for the formation of the European Space Agency (ESA) in 1973, which eventually went on to develop the successful Ariane rocket family. Britain also developed the Black Knight and Black Arrow Space Launch Vehicles (SLVs). The Black Arrow, known as the "lip stick" due to its bold red satellite fairing, successfully launched the British satellite Prospero from Australia in 1971.

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4 Bleddyn E. Bowen, *Original Sin*: *Power, Technology and War in Outer Space* (Oxford University Press, 2023), pp. 68-70

5 Peter Hennessey, *The Secret State: Preparing for the Worst, 1945-2010* (Penguin, 2010), pp. 50-51

6 Richard Moore, "Bad Strategy and Bomber Dreams: A New View of the Blue Streak Cancellation", *Contemporary British History*, 2013, 27:2, pp. 147, 149, 158

Yet Britain cancelled both its Blue Streak and Black Arrow projects and withdrew entirely from the European rocket business by the time ESA came about. Much of the reason for abandoning the SLV effort lies in the UK's military, economic, and political relationship with the US. Unlike the rest of Europe, the UK benefitted from a genuine "Special Relationship" in nuclear, missile, and space technologies as well as in intelligence sharing and cooperation to a level no other European had. The UK was given launcher access for all its satellite needs, whereas the US in the 1960s was reluctant to offer military and commercial launch services to Western Europe, instead offering launches for only 'scientific' satellites. Though the US would open up its launcher access to other NATO allies, it vindicated the Gaullist approach to nuclear, missile, and, by extension, SLV technology development.[7]

A crucial military factor in the cancellation of Blue Streak was that it was seen by some in Whitehall as inherently vulnerable to a Soviet first strike, being a land-based deterrent. Such concerns were first raised in 1957 in the Ministry of Defence.[8] Following the Skybolt and Polaris nuclear missile decisions of the 1960s, Britain no longer had the need for an MRBM or any heavy ballistic missile capability as it could rely on the United States to provide cutting-edge delivery systems at a fraction of the cost of sovereign British equivalents. The Polaris and subsequent Trident deals would ensure that the UK could build nuclear-powered ballistic missile submarines (SSBNs) under licence. With the nuclear deterrent issue resolved, an all-British ballistic missile programme lost its *raison d'etre*. Access to US imagery and signals intelligence from satellites also took away a driver for sustaining a British ballistic missile and SLV programme. Alongside this, Britain became a crucial node in the US Ballistic Missile Early Warning System (BMEWS) with the RAF Fylingdales radar site and invested in the Skynet SATCOM system. These were exceptions to the general rule of dependency on the United States on the military front and integration with Europe on industrial and scientific endeavours.

Space and Nuclear Empires

The origins of humanity's space age cannot be divorced from historically expansive centralised industrial states; nuclear weapons and missile technology; and the damage of nuclear testing and rocket developments on local, marginalised communities and

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7 Bowen, *Original Sin*, pp. 72-74

8 John Boyes, *Blue Streak: Britain's Medium Range Ballistic Missile* (Fonthill, 2019), pp. 104-105

peoples of the global periphery. Like most contemporary space powers, Britain had an imperial and colonial legacy that shaped its early space development. Britain is not in an optimal zone for equatorial launches – but Australia provided what was deemed to be ample ground for missile/SLV test sites and more equatorial launch points. Woomera was a major test site, but it negatively impacted the aboriginal communities that lived there. Little consideration was given to the impact of the test site itself or to the socio-economic and environmental impact of settling a town of 4,500 Europeans and White Australians in such a location. The use of imperially gained settler-colonial territories in space industry is not unique to Britain. France in Algeria and Guiana, the US across the Pacific and Diego Garcia, the Soviet Union in Kazakhstan, China in Xinjiang, and the USA and Italy in Kenya all show a common thread of imperial practices and space technology. In this context the reversal in technological capabilities between Britain and India is remarkable – today, British companies are paying the Indian Government to launch British satellites into space.

As the work of Alice Gorman and Peter Redfield show,[9] the metropole "suddenly" found geographical sites of supreme interest in the periphery, sites that had long either been of little value or home to penal systems. Now the Space Age demanded these locations, and the imperial centres pushed forward Space Age development at the further expense of people and communities that had already been marginalised or decimated by centuries of empires that were now reaching beyond the atmosphere. Our intention is not to explore such things in depth, but this highlights the impacts of the Global Space Age on the ground in very real and tangible ways on communities that are often invisible when we think, speak, and act in 'space'. Such marginalised perspectives and experiences need to be remembered and integrated into the histories that we are more familiar with: the histories of the centres 'reaching out'. It is no less true when considering politics and strategy in space. Looking ahead to the maturing years of the 21st century, this should serve as a reminder that many Global North states are not ideally located for heavy-lift equatorial launches or reaching deep space. Such states will continue to rely on access to distant locations and may rely on vulnerable logistics chains (e.g. Korou and Wenchang spaceports).

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9 Alice Gorman, "La terre et l'espace: rockets, prisons, protests and heritage in Australia and French Guiana", *Archaeologies*, 2007, 3:2; Peter Redfield, *Space and the Tropics* (University of California Press, 2000)

Major UK Space Policy Documents

Throughout the remainder of the Cold War, the UK deepened its military dependencies on the United States in space whilst participating in the economic and scientific integration of the Western European space sector, notably through the ESA and later the EU. There was no major national civil UK 'space programme' as it was instead a range of projects carried out by British universities and small high technology industries as part of European and American collaborative projects. On the military side, Skynet SATCOMs remained the UK's general exception to wholesale dependence on the U.S. regarding space-based military and intelligence platforms. Commercially, UK industry remained significant globally for telecommunications (e.g. Inmarsat) and maintained niche component manufacturing, downstream application, and service strengths in the space industry.

It was not until the 2010s that the UK Space Agency was formed to oversee most UK science and research space activities. The following years saw a range of UK Government space policy documents released for the first time, including the 2014 National Space Security Policy, the 2015 National Space Policy, the 2021 National Space Strategy (NSS), and the 2022 Defence Space Strategy (DSS) and Joint Doctrine Publication 0-40 UK Space Power. Collectively these documents, overseen during almost a decade and a half of mostly Conservative Party governments, have institutionalised space policy in all its forms in the British state's bureaucratic machinery. 2021 saw the formal inauguration of UK Space Command, incorporating the many duties of the former Joint Forces Command. It is now the primary point of training, public communications, operations, and capability acquisition for space in the Ministry of Defence. Indeed, contrary to my own argument penned in 2018, it is fair to say that, as of 2025, spacepower is no longer as much of a "missing link", or a neglected domain, in official British strategic thinking, professional vernacular, and official policy processes related to wider security and defence decision-making.[10]

The 2021 National Space Strategy (NSS) set out a general plan for £10bn of spending over 10 years. Half of this – around £5bn – is being spent on Skynet 6. Approximately £1.4bn was allocated to other Ministry of Defence space projects, including the ISTARI space-based Intelligence,Surveillance and Reconnaissance (ISR) research, development, and testing programme in particular. The 2022 DSS, the first of its kind in the UK, emphasised the "own, access, collaborate" approach to space capabilities. This recognises

[10] Bowen, 'British strategy and outer space'.

the rather limited unilateral capability the UK has in space and its long-established dependencies on the US and integration with Europe. The Integrated Review of Defence and Security in 2021 was notable in the prominence it afforded to spacepower in the all-of-defence document and dedicated several pages to space-specific defence issues.[11] This kind of attention and profile for space in the Ministry of Defence (MoD) was unthinkable 15 years ago but falls in line with the general European trend of converging with U.S. policy and discourse on military space and potential threats from China and Russia due to their military modernisation and anti-satellite weapons development.[12] Prior to the 2010s the UK did not conceive of space policy as a particular area that needed explicit and public Government statements, language, or central direction. This institutionalisation of space policy has also reached the Devolved Administrations, with the Scottish and Welsh Governments releasing their own space strategies in 2022 and 2021, respectively.

The NSS, Space Industrial Plan, and devolved space strategies emphasise that the UK Government, prior to the Labour government entering in summer 2024, was primarily interested in using space for economic growth, services and manufacturing exports, and foreign direct investment. Given the growth-focused rhetoric of the new Labour government, it would not be surprising to see a continuation of the major strands of current UK space policy. The 2025 SDR does not indicate a significant shift in priorities, though it mentions a possible interest in space and Earth-based weapons for the first time. However, the SDR is not a firm programmatic commitment but more a summary of general views and recommended courses of action. Government policy and decisions will need to be more specific and engage with trade-offs in a way that the SDR cannot. The Labour Government has already reconfirmed its commitment to the building of the military Deep-Space Advanced Radar Capability (DARC) radar in Wales and has continued to invest further public funds into UK small launch capabilities in Scotland and Shetland.[13]

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11 UK Government, "Global Britain in a Competitive Age: the Integrated Review of Security, Defence, Development and Foreign Policy", 16 March 2021, https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy (accessed 28/01/2025)

12 Bleddyn E. Bowen, "How to Approach Nato Deterrence and Defence Aspects", in Nicolò Fasola et al, *Space: Exploring NATO's Final Frontier* (IAI, 2024)

13 UK Government, "Deep Space Advanced Radar Capability (DARC)", 8 August 2024, https://www.gov.uk/guidance/deep-space-advanced-radar-capability-darc (accessed 28/01/2025); UK Government, "Scottish rocket launch boost to get Britain back into space race", 29/01/2025 (accessed 29/01/2025)

2023 National Space Strategy in Action

In 2023, the UK Government released an update to its 2021 NSS – the NSS in Action.[14] It contains a 10-point plan, which is a useful overview of the then-Government's priorities and helps give a taste of UK space policy. The 10-point plan is:

1. Capture the European market in commercial small satellite launch
2. Fight climate change with space technology
3. Unleash innovation across the space sector
4. Expand our horizons with space science and exploration
5. Develop our world-class space clusters
6. Lead the global effort to make space more sustainable
7. Improve public services with space technology
8. Deliver the UK Defence Space Portfolio
9. Upskill and inspire our future space workforce
10. Use space to modernise and transform our transport system

The list is very broad and ambitious, covering almost every sector of space activity, from launches to defence, the workforce, and terrestrial transport. There is nothing particularly objectionable within these priorities in general and on their own terms. Therefore, there is ample material for the Labour ministers and secretaries of state to work with in crafting a new UK space policy. However, questions remain on the coordination of such efforts and activities – for example, interest in UK launches is not matched by an ambitious UK-funded satellite programme to provide the assured demand for such launch services, which would stimulate private investment in the UK launch sector. Whilst the UK MoD is interested in fielding more satellites, they are of a class and orbital regime that cannot be serviced by UK launches. Continued financial difficulties in the British higher education system, [15] which is highly regulated by the state, directly challenge UK Government ambitions regarding the development of a capable workforce and the technologies and innovations needed to keep Britain's space and science industries globally competitive.

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[14] UK Government, "National Space Strategy in Action", 2023, https://www.gov.uk/government/publications/national-space-strategy-in-action/national-space-strategy-in-action (accessed 28/01/2025)

[15] Tom Williams, "Public funding rebuke leaves universities looking for small wins", *Times Higher Education*, 27 January 2025, https://www.timeshighereducation.com/news/public-funding-rebuke-leaves-universities-looking-small-wins (accessed 29/01/2025)

The UK is continuing with the development of spaceports for very small satellites and polar orbits. The UK Government has provided tens of millions of pounds of funding but also is hoping that commercial interest will develop the financial support necessary for companies like Orbex and Skyrora to complete the development of their small SLVs. The ESA has also contributed various funds to UK launch companies. At the time of writing, there is no discernible or announced MoD interest in such launch capabilities. The DSS states, "Though we will not develop our own independent launch systems, we will continue to support the UKSA in the advancement of UK-based space launch activities".[16] This suggests that UK launches are not intended to satisfy any UK military needs, but the UK Government has more recently boasted of UK launch contributions to a new NATO initiative – STARLIFT – to increase launch capacities in the alliance. Therefore, foreign military needs might be targeted for UK launches before UK military needs.[17]

Defence Highly Assured Capability Areas

Of particular note within the NSS in Action document is a section that highlights Defence Highly Assured Capability Areas. These highlight main areas of interest for the UK MoD in "assured" capabilities. Some of these are owned, others are collaborations with trusted partners, and many are foreign-owned but are trusted as offering assured access for UK needs, such as systems fielded by NATO allies:

- SATCOMs
- Space Domain Awareness
- Intelligence, Surveillance and Reconnaissance
- Space Control (resilience, 'defensive space control')

These translate into more detailed Technical Priority Areas, where the UK has varying degrees of existing capabilities. In addition, these areas will likely be open to further development or expansions in the future. SATCOMs are one area where the UK

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16 UK Government, "Defence Space Strategy: Operationalising the Space Domain", 1 February 2022, https://www.gov.uk/government/publications/defence-space-strategy-operationalising-the-space-domain (accessed 28/01/2025), p. 32

17 UK Government, "UK to support NATO space launch capabilities and artillery supplies", 17 October 2024, https://www.gov.uk/government/news/uk-to-support-nato-space-launch-capabilities-and-artillery-supplies (accessed 29/01/2024)

provides major investment, namely the Skynet constellation. Two 4th generation Skynet satellites are being phased out, and it is likely that three 6th generation Skynet satellites will be deployed to join the five 5th generation Skynet satellites currently in orbit. The UK is also home to several SATCOM companies, including Inmarsat. Together with other companies that include Airbus, the UK does have a good position relative to its overall capabilities in space with the telecoms sector, which would provide a solid industrial basis for any expansion of UK SATCOMs for assured capabilities and services.

In 2020, the Johnson Government bailed out the OneWeb megaconstellation company for $500m alongside a similar investment from the Indian company Bharti Telecom. The UK held a majority of shares in the 600-satellite company, which had manufacturing premises in Florida. However, in 2022, OneWeb was merged with EUTELSAT, which reduced the UK's overall share proportion in the new venture.[18] In February 2024, EUTELSAT sold the OneWeb venture to Airbus, which now is the sole owner of the company, with the UK Government retaining 19% of shares as well as the right to veto clients based on security grounds.[19] It was estimated in early 2024 that the value of those shares is half of their value when the Government bailed out OneWeb in 2020.[20] It is unknown what role OneWeb will have in future UK plans – civil or military – if any at all. The French President Emmanuel Macron announced that the French Ministry of Defence is interested in developing OneWeb as a SATCOM provider as part of EUTELSAT, and the next 100 OneWeb satellites will be built in France.[21]

Space Domain Awareness (SDA), previously known as Space Situational Awareness (SSA), is another area where the UK has existing strengths and capability and is investing more. A major part of the US Ballistic Missile Early Warning System (BMEWS) is the RAF Fylingdales Phased Array Radar in the North Yorkshire Moors. Whilst this is first and foremost a ballistic missile radar, its secondary mission is to detect and track objects in space. This information is fed into the US Space Surveillance Network, where combined US and UK information is transmitted to the National Space Operations Centre at RAF

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18 UK Government, "OneWeb merger with Eutelsat", 26 July 2022, https://www.gov.uk/government/news/oneweb-merger-with-eutelsat (accessed 28/01/2025)

19 Alun Williams, "Airbus buys out OneWeb from AOS jv, satellite manufacturing facility", *Electronics Weekly*, 12 February 2024, https://www.electronicsweekly.com/news/business/airbus-buys-out-oneweb-from-aos-jv-satellite-manufacturing-facility-2024-02/ (accessed 28/01/2025)

20 UK House of Commons Treasury Committee, "Oral evidence: Work of UK Government Investments, HC 494", 6 February 2024, https://committees.parliament.uk/oralevidence/14262/pdf/ (accessed 28/01/2025)

21 Rachel Jewett, "France to Increase its Stake in Eutelsat, Military Reaches Agreement for LEO Access", *Via Satellite*, 18 June 2025 (Accessed 18/07/2025)

High Wycombe.[22] This general BMEWS and SSA/SDA arrangement emerged in the early years of the Space Age and is an important manifestation of the US-UK "Special Relationship" and the Mutual Defence Agreement.

As part of AUKUS Pillar II, a UK-based DARC programme was announced during the Sunak government[23] and then re-confirmed with the Starmer government.[24] The proposed site is at Cawdor Barracks, Pembrokeshire, on the south-west Wales coastline. This barracks is home to the British Army's 14th Signals Regiment, a major electronic warfare unit. This would be Britain's first *dedicated* military space tracking facility once local planning is approved. Lockheed Martin has been awarded $200m for the fabrication of the radar hardware, with the entire site to be completed by 2030.[25] The DARC system includes three such sites, with another in Australia and the third in the United States. Together these facilities provide greater global radar coverage of the geostationary belt, including a sensor in the southern hemisphere. They will be staffed and operated by 100 MoD personnel from 14th Signals and presumably civilian contractors.

Regarding ISR, the UK has embarked on the ISTARI programme. It consists of four research and development satellites contracted with Surrey Satellite Technology Ltd (SSTL) to test systems and sensors in low-Earth orbit. Tyche is an electro-optical visible light imagery intelligence (IMINT) satellite and was launched in 2024. Juno is scheduled for launch in 2027 and is also an IMINT satellite. Titania is an experimental laser communications satellite, and Oberon is a Synthetic Aperture Radar (SAR) satellite. Titania and Oberon are expected to be launched in 2025 or 2026. These are research and development satellites and should not be viewed as a full operational constellation due to their small numbers and staggered deployment. It is unclear what the next steps for a space-based ISR system will be for the UK. Given budgetary and workforce constraints, it is unlikely the UK could field a large constellation of a single type of these satellites quickly, let alone multiple types. In addition to the challenges of constructing and operating a large fleet of ISR systems, the analytical burden of a new ISR constellation (as

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22 UK National Space Operations Centre, "About us", https://www.gov.uk/government/organisations/national-space-operations-centre/about (accessed 28/01/2025)

23 UK Government, "New deep space radar will transform UK security", 2 December 2023, https://www.gov.uk/government/news/new-deep-space-radar-will-transform-uk-security (accessed 28/01/2025)

24 UK Government, "Deep Space Advanced Radar Capability (DARC)", 8 August 2024, https://www.gov.uk/guidance/deep-space-advanced-radar-capability-darc (accessed 28/01/2025)

25 Mikayla Easley, "Northrop Grumman awarded $200M deal for deep-space radar that will be hosted in Wales", *Defense Scoop*, 23 August, 2024, https://defensescoop.com/2024/08/23/space-force-darc-radar-site-wales-cawdor-barracks-northrop-grumman/ (accessed 28/01/2025)

well as increased SSA sensors) remains a challenge to address given the highly specialised technical nature of such analysis as well as general staffing and recruitment issues faced by Western militaries.

Space control remains ill-defined at this stage, but the NSS in Action document does refer to hardening and resilience measures for satellites against electronic warfare and laser dazzling, among other forms of satellite interference. It also refers to manoeuvring capabilities, which is a reference to increasingly sophisticated and possibly belligerent Russian and Chinese proximity and orbital operations in recent years. These would correspond to defensive space control operations as well as passive and active variants as described in the UK Ministry of Defence's space doctrine.[26] Though the UK doctrine recognises and defines offensive space control, there is no evidence in writing that the UK is pursuing offensive anti-satellite capabilities of any kind, including "soft-kill" mechanisms (i.e. electronic warfare, cyber operations). The UK has signed the US test ban moratorium on direct-ascent kinetic kill ASAT systems. Therefore, a hard-kill capability of that kind remains off the table for the UK for the foreseeable future.

Position, Navigation, and Timing (PNT) systems are not included in such a capabilities list, but PNT investments do feature prominently in the 2024 Space Industrial Strategy. However, it lacks detail on what kinds of PNT developments the previous UK Government may have been interested in when it penned that strategy. Whilst a GNSS such as GPS or Galileo or even an augmenter such as QZSS or EGNOS are beyond the reasonable means of the UK for the foreseeable future, there are other PNT technologies, particularly non-space-based systems, that could act as resilient home island backups in the event of widespread GNSS failure, such as eLORAN radio beacons and cellular network positioning systems.

The Global Space Age

Now that the UK space security situation has been looked at in some detail, it is important to put Britain into its contemporary geopolitical context. As you can see in Table 1, the UK holds or has registered 653 satellites as of May 2023. Of those, 588 are OneWeb satellites that are manufactured in Florida and owned entirely by Airbus, a transnational European company. The extent to which it is truly a 'British system' is

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26 UK Government, "UK Space Power (JDP 0-40)", 19 October 2022, https://www.gov.uk/government/publications/uk-space-power-jdp-0-40 (accessed 28/01/2025)

up for debate. However, that still leaves 65 satellites held within Britain, the majority of which are commercial SATCOMs.

At the European scale, the above is not insignificant. However, on the global level, the UK is not the most capable state based on numerous indicators. Whilst Japan enjoys a similar level of satellite registrations (OneWeb excepted), it also, like India, possesses a viable heavy lift Space Launch Vehicle (SLV) industry and capacity that guarantee sovereign access to space, which could be ramped up in the future should circumstances require and budgets allow. China and the US are of course in different categories, with the US perhaps in a category of its own. Yet China remains firmly in second place as it can already field all forms of spacepower at a significant scale. Russia remains a significant space power but is in long term decline as it continues to rely on its Soviet heritage and struggles to modernise key infrastructures, such as the GLONASS GNSS.

Collectively, Europe is significant on paper, but its fragmented and complex political structures hold back its collective material potential. That said, where the EU can forge a consensus and assemble budgets, it is difficult to stop once it is in motion. The EU has developed important systems such as the Galileo GNSS and the Copernicus imaging system while also creating institutional demand for the Ariane SLVs. Once an agreement is reached on the fundamental architecture and funding, there is little reason to doubt that the EU will eventually succeed in deploying the new IRIS^2 secure SATCOM constellation. Few other space powers could match the industrial scale of such a project on a unilateral basis. Whether Britain could participate in any way or access such important systems in the future remains subject to wider UK-EU post-Brexit settlements.

Yet much military satellite capability remains focused on Member States and bilateral cooperation. Furthermore, European states compete as often as they collaborate on commercial and industrial matters in space. Nevertheless, in a crisis or war situation, there is a pool of resources that many European allies can draw upon, which NATO is taking a role in facilitating and integrating now that it has recognised outer space as an operational domain and explicitly stated that an attack on a satellite could trigger an Article V response.

Actor	Total Satellites (Owned/Registered Within)
USA	8,241
EU, European Space Agency, plus Member States	1,204 (of which in UK: 58)
China	978
Russia	290
Japan	110
India	71
Canada	52
Republic of Korea	38
Türkiye	28
Republic of China (Taiwan)	18
United Arab Emirates	18
Brazil	16
Others	300

Table 1: Satellites by State as of March 2025[27]

The table above shows the proliferation of space systems not only from China and the U.S. but importantly the rest of the world as well. Whilst calling such a world multipolar may be going too far, the reality is that there are more independent centres of spacepower now than 40 years ago, with significant impacts for future space development. Already, China can provide high quality and a broad spectrum of space services and joint cooperative ventures for states that may wish to avoid U.S. or European entanglements. With Japan, India, South Korea, and the United Arab Emirates increasing their own spectrum of competencies in a range of space technologies and industries, the forthcoming years of the 21st century will provide yet more opportunities for space developments and business beyond the direct control and influence of the US and China.

Whilst such states clearly have an interest in developing greater sovereign space capabilities, they will also seek export opportunities in the global market. Whilst Britain will remain an exporter of commercial SATCOM capabilities as well as some specialised commercial imagery and small satellite buses, it remains to be seen whether it will be

[27] Jonathan C. McDowell, General Catalog of Artificial Space Objects, 18 March 2025

able to compete in the areas the EU, Japan, India, and South Korea will choose to invest the bulk of their resources in. The UK has to recognise its relatively modest sovereign capabilities in a century where an increasingly large proportion of space developments, investments, and innovations will occur in Asia.

The SDR: Caught in a Binary System?

The UK therefore must act at all times with regard for its allies and partners, and it has no independent access to outer space and relies for the most part on satellite and space services provided by allied states and private sector entities. The UK is dependent on the USA for military and intelligence space systems, which is a tangible manifestation of the "Special Relationship" between London and Washington. The UK continues to enjoy privileged access to US nuclear, missile, and intelligence technologies, information, processes, and practices that no other state can boast. RAF Fylingdales and RAF High Wycombe are specific examples of the embedded nature of the UK in this nexus, where information flows rather freely between the two states in the space-nuclear dimension. Government Communications Headquarters (GCHQ) and the US National Security Agency (NSA) also enjoy a close partnership, an intelligence partnership that transmits heavily via secure SATCOMs. The UK MoD is entirely dependent on the USA for most overhead ISR capabilities and of course for military GPS services.

Whilst this has generally served the UK well by avoiding the need to duplicate space systems with its minimal resources, there are always tensions inherent in such a dependent relationship, which can flare up when transatlantic relations are stressed. During the Falklands War, the reluctance of the U.S. to share all space-based intelligence, including Signal Intelligence (SIGINT), as required by the MoD led PM Margaret Thatcher to explore the potential for a UK SIGINT satellite called Zircon – in the face of persistent Cabinet opposition.[28] Should the U.S.-UK relationship be strained in the future, the impacts on the UK's military space access would be difficult to overstate and could ensnare the rest of the Five Eyes states as well.

Whilst the UK relationship with the US in the military and intelligence dimension can be described as one of dependency, the UK's relationship with 'Europe' (broadly defined) can be labelled as 'integrated'. This label accurately describes the situation both before and after the Brexit process began in 2016. The UK has traditionally pooled

[28] Bowen, *Original Sin,* pp. 137-138

resources in space industry and science with Europe – firstly with the ELDO, the European Space Research Organisation (ESRO), and the ESA. As a founding member of these organisations and one of their larger states, the UK has maintained a significant presence in the high technology industries and university research ecosystems that have driven the main missions and achievements of ESA and, until recently, the EU in space. Without European cooperation, British companies and Universities would struggle to find customers or collaborative projects that their specialised capabilities could contribute towards. Traditionally 75% or so of the UK civil space budget goes directly to ESA and returns as part of large collaborative projects that the UK could not do on its own.

At present the UK is the 5th largest contributor to the ESA budget – after the EU, Germany, France, and Italy. Recently the UK has been jostling in position with Italy, but a jump in Italy's contribution seems to have concluded that budgetary struggle within ESA. The contributions for ESA are extremely important due to its principle of "georeturn", where ESA attempts to ensure that contributing states receive a 1:1 return on investments. However, that principle may be revisited in the near future.[29]

The status of EU-ESA relations remains in flux due to the increasing weight of the EU as a major space actor and ESA's status as its primary contractor and biggest contributor. The UK's exit from the EU has changed the dynamics of ESA as now there is a major member of ESA outside the EU bloc. Switzerland and Norway were in this category before as well, but they are smaller and much more integrated in the wider European economic and customs system. With Britain's departure from all EU structures, the UK and ESA are still finding their way in this new political-institutional reality. The EU's expansion of the GNSS Space Agency (GSA) into the Agency for the European Union Space Programme (EUSPA) in 2022 has raised some concern that, in the longer term, this may displace ESA as the major 'European' space institution. In EU-funded space projects, participation and contracts are not guaranteed to be open for competition or negotiation, and there can be no participation in security-related dimensions of such programmes for non-EU members. This reality was evident in 2019 during the Galileo exit row between London and Brussels.[30]

With a revanchist Russia seizing territory by force of arms and right of conquest;

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[29] Jeff Foust, "ESA to use launch competition to test georeturn reforms", *Space News*, https://spacenews.com/esa-to-use-launch-competition-to-test-georeturn-reforms/ (accessed 29/01/2025)

[30] UK House of Commons Exiting the EU Select Committee, "Oral evidence: The progress of the UK's negotiations on EU withdrawal, HC 372", 9 May 2018, https://committees.parliament.uk/oralevidence/7948/pdf/ (accessed 28/01/2025)

11,000 North Korean troops fighting in Europe; and an increasingly isolationist USA, concerns about European contributions to NATO are in the ascendancy once more. NATO is not pursuing sovereign capabilities of its own, but it can still play an important role in pooling the resources of its members and facilitating the processes of interoperability and compatibility between terrestrial military forces and space systems. The 2022 Strategic Concept and 2019 Space Policy have elevated the salience of space security and space warfare for the alliance in light of Russian aggression and anti-satellite weapons development. For now, at least, much of NATO is "singing from the same hymn sheet" regarding the bigger picture of the threat of space warfare, which is a sea change from 20 years ago, when Europe and the United States could not agree on the existence, let alone the nature of, chronic threats in the space domain.[31]

The UK's dependency on the US puts it in an important position in NATO as a very experienced user of US space systems, and the UK will therefore be able to assist with the development and training of NATO militaries that may not be as integrated in US space systems. However, this also places Britain in a more compromised position should wider transatlantic NATO relations break down in the years to come. Even if British investments in its space system continue, it will still have a long way to go to reach the level of sovereign operational space capability that France, Italy, Germany, and Spain have possessed for many years. These European states have long had bilateral or multilateral military space capabilities, usually in SATCOMs or ISR, that the UK has traditionally not participated in. That said, the UK has much to offer with its space industry and military experience should there be an appetite for more international cooperation within or outside Europe after its testing phases of ISTARI are complete in the coming years.

The Russian-Ukrainian War has again shown the value of space systems in major conventional operations or "high intensity wars". In my view, much of the discourse surrounding the "lessons learned" from the use of space systems seems to echo the language of the so-called "First Space War" of the 1991 Gulf War regarding the use of space systems by the U.S. military against Iraq as well as some of the more hyperbolic claims about "transparent battlefields", "net-centric warfare", and "information dominance" from the "Revolution in Military Affairs" (RMA) literature of the 1990s and 2000s. Once again, the value of a space 'backbone' of C4ISR systems has shown how even an ad-hoc assembly of such services can be instrumental in blunting the advances

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31 Bowen, "How To Approach", p. 80

of heavy, massed formations and demonstrated the effective use of limited personnel and ammunition reserves.

Of course, it is important to learn the technical-tactical details of current and new systems and how they enable new techniques and opportunities. However, the larger strategic forces at work with the use of space systems have not diverged dramatically since the 1990s – space systems can still make military forces more efficient, lethal, mobile, and survivable.[32] But this does not diminish the need for competent terrestrial military forces, joint and combined arms warfare, or a political centre that demands only feasible achievements for policy. These things were true at the dawn of the Global Space Age and remain so now. The participation of private actors also does not transform this, as private suppliers and combat units in warfare are also long realities in European political-economic models.

With Asia now home to three major space powers (China, Japan, and India) and five launching states, there may be ample opportunity for the UK, India, Japan, and South Korea to explore security and industrial cooperation and partnership. The UK and Italy have embarked upon a 6th generation fighter project – the Global Air Combat Platform. The UK and Japan signed a Terms of Reference Agreement in 2023, which should enable more focused discussion on military-to-military cooperation in the future.[33] South Korea is embarking on a significant space investment. In 2023, South Korea increased its general space spending by approximately 19.5% as part of the 4th Space Development Promotion Basic Plan.[34] This includes a new SLV and a suite of satellites, including a form of GPS augmentation satellites, called the Korean Positioning System (KPS). Both KPS and Japan's QZSS may provide important "lessons learned" for the UK, which may consider specific PNT investments of its own at some point.

The 2025 SDR is yet to result in major decisions on spending and acquisitions for British spacepower. The SDR is a continuation of rather than a departure from the 2022 Defence Space Strategy. The handful of pages devoted to space in the SDR lists almost

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32 For example: Colin S. Gray, *Strategy for Chaos: Revolutions in Military Affairs and the Evidence of History* (Routledge, 2003); Colin S. Gray, *Another Bloody Century: Future Warfare* (Weidenfeld and Nicholson, 2005)

33 UK Government, "UK and Japan sign arrangement to cooperate in space", 17 March 2023, https://www.gov.uk/government/news/uk-and-japan-sign-arrangement-to-cooperate-in-space (accessed 28/01/2025)

34 Park Si-soo, "South Korea sets record space budget to bolster industry, develop new rocket", *Space News*, 31 March 2023, https://spacenews.com/south-korea-sets-record-space-budget-to-bolster-industry-develop-new-rocket/ (accessed 28/01/2025); Robert S. Wilson and Nicholas J. Wood, "Country Brief: South Korea", August 2023, Aerospace Corporation, https://csps.aerospace.org/sites/default/files/2023-08/Wilson-Wood_SouthKorea_20230802.pdf (accessed 28/01/2025)

every capability area, and introduces a new explicit reference to space-based weapons which was not seen in past official documentation. Britain cannot afford to develop and deploy all the capability areas the SDR has listed, therefore the difficult choices over prioritisation and funding for capabilities that go beyond demonstrators and research and development systems – such as ISTARI – remain. It is impossible therefore to outline at this stage where Government thinking is regarding space and defence, and in particular UK Space Command investments, beyond the previously mentioned Skynet, DARC, and UK launch projects that have been reconfirmed since the new Labour government took office. As other powers, notably India, Japan, France, and South Korea embark on larger communications or ISR constellations, Britain risks falling behind without cooperating more with such partners, or developing its own large-scale, operational constellations.

Despite the opportunities provided by some Asian space powers for British cooperation, the reality is that the UK will be shaped by the space policies of the US and Europe the most. The UK will need to adjust its relationship to them as the situation continues to evolve in both continents. It was ever thus in British astropolitics – Britain has long been shaped by the binary system of the US and Europe and has always had to negotiate a delicate balance of dependency and integration across the military, political, economic, and scientific dimensions.

Successive UK governments depended on the U.S. for military space in the early Cold War yet retained a role as a major player in European space science and industry. Today, an increasingly erratic United States, a more politically fraught Europe, the conventional military threats from Russia and China, and the consequences of Brexit are testing both planks of the UK's traditional role in space caught between these two giant centres of spacepower. It remains to be seen whether a revanchist Russia and over 11,000 North Korean troops fighting in Europe will focus minds soon. If not, the UK will face greater challenges in accessing and developing the space capabilities it believes it needs in an increasingly deteriorating security environment in its immediate neighbourhood.

Chapter 5
Japan's Defense Space Policy: Focusing on Changes Based on the 2018 National Defense Program Guidelines

FUKUSHIMA Yasuhito

Introduction

This paper analyzes Japan's defense space policy, focusing on changes triggered by the National Defense Program Guidelines for FY 2019 and beyond (2018 NDPG), which was approved by the Cabinet in 2018.[1] Much attention on Japan's defense space policy has focused on the changes that followed the enactment of the Basic Space Law in 2008. The Basic Space Law has indeed transformed the legal basis of Japan's use of outer space for defense. The possession of satellites by the Ministry of Defense (MOD) and the Self-Defense Forces (SDF) began after the law was enacted.

In terms of Japan's actual use of outer space for defense, however, more attention should be paid to the fact that Japan's efforts have entered a new phase with the 2018 NDPG. The three new defense documents in 2022 — the National Security Strategy (NSS), National Defense Strategy (NDS), and Defense Buildup Program (DBP) —[2] also expand Japan's efforts in the space domain based on the 2018 NDPG.

1. A misconception about Japan's defense space policy

Before delving into the analysis, it is necessary to clear up a widely held misconception about Japan's defense space policy. Even among Japanese and international experts and practitioners involved in space policy, there is a persistent misconception that Japan only began using outer space for defense purposes after the enactment of the Basic Space Law. It is true that, prior to the enactment of the Law, Japan's use of outer space was limited to non-military purposes based on the 1969 Diet resolution and related answers in the

1 National Defense Program Guidelines for FY 2019 and beyond, approved by the National Security Council and the Cabinet on December 18, 2018.

2 National Security Strategy, approved by the National Security Council and the Cabinet on December 16, 2022; National Defense Strategy, approved by the National Security Council and the Cabinet on December 16, 2022; Defense Buildup Program, approved by the National Security Council and the Cabinet on December 16, 2022.

Diet.[3]

In practice, however, the Defense Agency (the MOD since 2007) and the SDF had begun utilizing outer space long before the enactment of the Basic Space Law.[4] As far as can be confirmed from publicly available information, the Air Self-Defense Force (ASDF) began operating a weather satellite image receiving system in 1974.[5] This means that the history of the use of outer space for defense in Japan can be traced back more than half a century. While the use of outer space was limited to non-military purposes, the Defense Agency and the SDF based their use of space on the Nippon Telegraph and Telephone Public Corporation's principle of non-discrimination and fairness in public telecommunications services, which applied to some communications satellites (such as Sakura-2), and the 1985 government's official position called the "generalization theory," which applied to other satellites.[6] However, as mentioned above, it should be noted that the use of outer space by the Defense Agency and the SDF predates the expression of this government view.

The Defense Agency and the SDF used space systems in a wide range of applications prior to the enactment of the Basic Space Law. As shown in Table 1, the Defense Agency and the SDF utilized space systems for various purposes, including meteorological observation, telecommunications, intelligence, surveillance, and reconnaissance; positioning, navigation, and timing; and early warning of missile launches.

Furthermore, the use of space systems by the Defense Agency and the SDF extended beyond ancillary applications. In particular, the Defense Agency and the SDF recognized the advantages of X-band satellite communications with respect to their reliability and broad coverage and positioned X-band satellite communications using commercial

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3 Japan Aerospace Exploration Agency, "Resolution Concerning the Basic Principles for the Development and Utilization of Space in Our Country (plenary session of the House of Representatives, May 9, 1969)," https://www.jaxa.jp/library/space_law/chapter_1/1-1-1-4_j.html; Aoki Setsuko, *Nihon no uchū senryaku* [Japan's space strategy], Keio University Press, 2006, pp. 175–177.

4 The Defense Agency was elevated to the Ministry of Defense on January 9, 2007. Refer to the following for a history of Japan's use of outer space for defense purposes: Fukushima Yasuhito, "Japan's Use of Space for Defense Purposes: Continuity and Change Before and After the Enactment of the Basic Space Law," *Briefing Memo*, March 2017, pp. 1–6, https://www.nids.mod.go.jp/publication/briefing/pdf/2017/201703.pdf.

5 Air Self-Defense Force Air Weather Group, "Kōkūkishōgun no enkaku" [History of the Air Weather Group], https://www.mod.go.jp/asdf/awsg/aboutawg/history/index.html.

6 The generalization theory was the government's view that satellites whose use had become ubiquitous in the civilian sector, as well as those with equivalent capabilities, were permissible for use by the SDF. Aoki, *Nihon no uchū senryaku*, pp. 180–189.

satellites as "backbone communications for the command and control of SDF units."[7]

However, within the framework of the generalization theory, significant hurdles remained for the Defense Agency and the SDF to own and operate dedicated satellites.[8] Therefore, as also shown in Table 1, the Defense Agency and the SDF were exclusively *users* of domestic and foreign civil satellites (i.e., satellites owned and operated by other ministries and agencies, as well as non-military satellites owned and operated by foreign governments), other countries' military satellites, and domestic and foreign commercial satellites.

Applications	Satellite types and examples	
Meteorological observation	Domestic civil satellites Foreign civil satellites	e.g., Himawari e.g., U.S. NOAA
Telecommunications	Domestic civil satellites Foreign military satellites Domestic commercial satellites	e.g., Sakura-2 e.g., U.S. FLTSATCOM e.g., Superbird
Intelligence, surveillance, and reconnaissance	Domestic multi-purpose satellites Foreign civil satellites Foreign commercial satellites	e.g., IGS e.g., U.S. Landsat e.g., U.S. IKONOS
Positioning, navigation, and timing	Foreign military satellites	e.g., U.S. GPS
Early warning of missile launches	Foreign military satellites	e.g., U.S. DSP

Source: Prepared by the author

Table 1. Use of outer space for defense before the enactment of the Basic Space Law

The significance of the Basic Space Law in Japan's defense space policy lies in its allowance for efforts beyond the generalization theory[9] and the acquisition of dedicated satellites by the MOD and the SDF. In fact, the Japanese government's 2010 Medium Term Defense Program (MTDP) clearly stated that it would build an X-band satellite

7 The House of Representatives, Japan, "Shūgiin giin Yoshii Hidekatsu-kun teishutsu Jieitai ga hoyū suru tsūshin eisei to mujinki no dōnyū ni kansuru shitsumon ni taisuru tōbensho" [Written answer to the question submitted by Mr. Hidekatsu Yoshii, member of the House of Representatives, on the introduction of communications satellites and unmanned aerial vehicles owned by the Self Defense Forces], December 13, 2011, p. 13.

8 It has been noted that since the generalization theory only permits satellite "use," the SDF faced difficulties in launching and possessing its own military satellites. Aoki, *Nihon no uchū senryaku*, p. 190.

9 Committee on Promotion of Space Development and Use, Ministry of Defense, "Basic Guidelines for Space Development and Use of Space," January 15, 2009, p. 9.

communications network for defense purposes.[10] The MOD accordingly launched one X-band communications satellite in 2017 and another in 2018. These were the first satellites owned by the MOD. Also, in its 2013 NSS, the Japanese government stated its intention to establish a space situational awareness (SSA) system. Based on this strategy, the NDPG and MTDP stipulated that the SDF would engage in SSA activities.[11] Then, in FY 2016, the MOD began designing and establishing an SSA system consisting of an operating system and ground-based radar.[12]

2. Changes brought about by the 2018 NDPG

Building upon the efforts following the enactment of the Basic Space Law, Japan's defense space policy entered a new phase with the adoption of the 2018 NDPG. First, the Japanese government described space, cyberspace, and the electromagnetic spectrum as "new domains" and deemed them just as important for defense as the "traditional domains" of land, sea, and air.[13] The 2018 NDPG also stated that Japan would prioritize the allocation of resources to acquiring and strengthening capabilities related to new domains.[14] Considering that Japan's use of space was restricted to non-military purposes until about a decade prior to the formulation of the NDPG, this decision by the Japanese government was a major departure.

The Japanese government's decision to upgrade the status of space in its defense policy was driven by its recognition of Japan's precarious position surrounded by militaries that are superior both qualitatively and quantitatively[15] and by concerns that

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10 Medium Term Defense Program (FY2011-FY2015), approved by the Security Council and the Cabinet on December 17, 2010, p. 9.

11 National Security Strategy, approved by the National Security Council and the Cabinet on December 17, 2013, p. 17; National Defense Program Guidelines for FY 2014 and beyond, approved by the National Security Council and the Cabinet on December 17, 2013, p. 18; Medium Term Defense Program (FY2014-FY2018), approved by the National Security Council and the Cabinet on December 17, 2013, p. 9.

12 Cabinet Office, Ministry of Education, Culture, Sports, Science and Technology, and Ministry of Defense, "Wagakuni no SSA shisutemu no seibi ni kakaru mōshiawase" [Agreement on the establishment of Japan's SSA system], March 24, 2016, https://www.cao.go.jp/others/kichou/pdf/kakusho_015.pdf; Ministry of Defense, "Uchū (anzen hoshō) ni kansuru kongo no torikumi hōkoku" [Report on future initiatives related to space (security)], March 2022, p. 3.

13 National Defense Program Guidelines for FY 2019 and beyond, p. 2.

14 Ibid., p. 17.

15 Ibid., pp. 3, 9.

Japan's capabilities may be inferior in individual domains.[16] Based on this recognition, the Japanese government outlined a policy in the 2018 NDPG to amplify overall capabilities through cross-domain operations that fuse capabilities across all domains, thereby ensuring Japan's defense.[17]

Second, through the 2018 NDPG, the Japanese government effectively tasked the MOD and the SDF with a third pillar for their missions in the space domain. In other words, in addition to (1) space-enabled information-related support for land, sea, and air operations and (2) SSA, a new mission of (3) ensuring "superiority in use of space" was added.[18] The concept of "superiority in use of space" is similar to "space superiority" in the U.S. military and encompasses both defensive and offensive aspects.[19] In fact, the 2018 NDPG specified that, with respect to the defensive aspect, the SDF would strengthen its mission assurance capability; with respect to the offensive aspect, it would improve its capability to disrupt an opponent's command, control, communications, and information.[20] The latter is worth noting because it marked the first time the Japanese government had acknowledged its possession of counterspace capabilities. However, the use of the term "superiority in use of space" instead of "space superiority" suggests that the concept was focused on the capabilities provided by the space system, rather than outer space as a physical space.[21]

The 2018 NDPG's inclusion of ensuring superiority in the use of space was based on the Japanese government's policy of accomplishing national defense through the aforementioned cross-domain operations. As part of this policy, the Japanese government clearly stated in the NDPG its recognition that achieving superiority in all the new domains had become "essential."[22] Japan asserted in the NDPG that it would take measures to disrupt its opponents' use of not only outer space, but also cyberspace and the electromagnetic spectrum, and disable related systems.[23] The Japanese government

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16 Ibid., p. 9.

17 Ibid.

18 Ibid., p. 18. See the following for the English translation: Japan Ministry of Defense, National Defense Program Guidelines for FY 2019 and beyond, December 18, 2018, p. 20, https://www.mod.go.jp/j/policy/agenda/guideline/2019/pdf/20181218_e.pdf.

19 Fukushima Yasuhito, "Uchū riyō no yūi o ikani kakuho suru ka? –Ronten no seiri–" [How can Japan secure superiority in the use of space? Outlining key points], *Air and Space Power Studies*, Vol. 7 (March 2021), p. 41.

20 National Defense Program Guidelines for FY 2019 and beyond, p. 18.

21 Fukushima, "Uchū riyō no yūi o ikani kakuho suru ka? –Ronten no seiri–," p. 41.

22 "National Defense Program Guidelines for FY 2019 and beyond," p. 2.

23 Ibid., pp. 18–19.

was likely seeking to overcome its inferiorities as much as possible in individual domains, such as sea and air, by reducing capabilities in new domains used in operations by its opponents.

In the Medium Term Defense Program (FY 2019 - FY 2023) (2018 MTDP), which was approved by the Cabinet together with the 2018 NDPG, the Japanese government decided to acquire and improve mainly the following capabilities in the five years from FY 2019 to ensure superiority in the use of space. First, it stipulated that it would strive to secure redundancy through the use of multiple positioning satellite signals, as well as through Information Gathering Satellites, commercial satellites, and other means.[24] In addition, it stated that it would acquire training devices to study and train responses to vulnerabilities in Japanese satellites, as well as devices to monitor the status of electromagnetic interference with Japanese satellites. In this manner, the SDF would build the capability to disrupt opponents' command, control, communications, and information in collaboration with the electromagnetic domain.[25] The last point implied the acquisition of either a counterspace capability based on a non-kinetic physical attack capability or an electronic attack capability, or both, rather than a kinetic physical attack capability that destroys satellites directly, such as with warheads.[26]

The Japanese government also indicated in the 2018 NDPG and MTDP that it intended to significantly strengthen SSA, which would serve as the foundation for gaining superiority in the use of space. More specifically, the Japanese government decided to build a structure to conduct persistent monitoring of situations in space from outer space, not only from the ground,[27] and announced that it would introduce space-based optical telescopes (i.e., SSA satellites) for this purpose.[28]

Along with acquiring these space-related capabilities, the 2018 NDPG and MTDP specified the establishment of a space domain mission unit in the Air Self-Defense Force

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24 Medium Term Defense Program (FY 2019 - FY 2023), approved by the National Security Council and the Cabinet on December 18, 2018, p. 6.

25 Ibid., pp. 6–7.

26 Refer to the following for a classification of counterspace capabilities: Kari A. Bingen, Kaitlyn Johnson, and Makena Young, *Space Threat Assessment 2023*, Center for Strategic and International Studies, April 2023, pp. 4–7; Almudena Azcárate Ortega and Victoria Samson, eds., *A Lexicon for Outer Space Security*, United Nations Institute for Disarmament Research, August 2023, p. 28; Fukushima Yasuhito, "Is Space Beginning to be Considered a *Normal* Military Domain? A Study Based on the Announcement Status of Counterspace Activities," *Security & Strategy*, vol. 5, no. 2, March 2025, pp. 97–98.

27 National Defense Program Guidelines for FY 2019 and beyond, p. 18.

28 The 2018 MTDP also included the introduction of ground-based SSA laser ranging devices. Medium Term Defense Program (FY 2019 - FY 2023), p. 6.

(ASDF) for the missions of SSA and ensuring superiority in the use of space.[29] In 2020, the ASDF accordingly established the Space Operations Squadron, led by a lieutenant colonel, as the first unit dedicated to space domain missions. In 2022, the ASDF also established the Space Operations Group, led by a colonel, to oversee the Space Operations Squadron and other units, as well as the Space Operations Control Squadron under the command of the Space Operations Group.

3. Expansion of efforts under the three new defense documents

Although the Japanese government positioned the three defense documents (NSS, NDS, and DBP) approved by the Cabinet at the end of 2022 as a major shift in postwar security and defense policy from a practical perspective,[30] these documents largely maintain the trajectory set by the 2018 NDPG in regard to defense space policy. The significance of the three new defense documents lies in the fact that they indicate Japan's intention to continue and further expand its efforts in the space domain based on the 2018 NDPG.

First, regarding space-based information-related support for the operations, as outlined in the new NSS, the Japanese government has decided to build a satellite constellation using space technologies of the domestic private sector.[31] On this point, the DBP clearly states that the objective of building a satellite constellation is to acquire target detection and tracking capabilities, which are necessary to operate stand-off missiles.[32] The targets in this case include enemy naval vessels and ground units. In the 2022 NSS, the Japanese government identifies counterstrike capabilities that leverage stand-off defense and other capabilities as key to deterring an invasion of Japan.[33] Therefore, by supporting the operation of stand-off missiles, the satellite constellation will also play a vital role in the defense of Japan. The MOD plans to begin building this satellite constellation at the end of FY 2025, with full-scale operations set to launch at the end of FY 2027.[34]

In addition, the DBP includes plans for conducting technological demonstrations of satellites for the detection and tracking of hypersonic glide vehicles (HGVs), with a view

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29 Ibid., p. 3; National Defense Program Guidelines for FY 2019 and beyond, p. 24.

30 National Security Strategy, 2022, p. 5; National Defense Strategy, p. 2.

31 National Security Strategy, 2022, p. 23.

32 Defense Buildup Program, pp. 3, 5.

33 National Security Strategy, 2022, p. 17.

34 Ministry of Defense, "Bōeiryoku bapponteki kyōka no shinchoku to yosan – Reiwa 7-nendo yosan no gaiyō – " [Progress and budget for drastic reinforcement of defense capabilities: Overview of the FY 2025 budget], April 2025, p. 8.

to cooperating with the United States.[35] These efforts aim to study the acquisition of a satellite constellation for the detection and tracking of HGVs in flight.

Next, regarding SSA, the Japanese government clearly states in the 2022 NSS that it will reinforce the structure for Space Domain Awareness (SDA).[36] SDA is a term the U.S. Department of Defense began using in 2019 in response to the transformation of outer space into a warfighting domain. SDA emphasizes not only tracking the orbital location of satellites and space debris, but also understanding how satellites are being used and operated, as well as their intentions and capabilities.[37] The DBP includes consideration of multiple SDA satellites.[38]

The MOD and the SDF are making steady progress on SDA-related efforts. The Space Operations Group launched its SDA mission in 2023.[39] Specifically, it began sharing data in both directions with the Japan Aerospace Exploration Agency (JAXA) and the U.S. Space Command (USSPACECOM), as well as providing SSA information to domestic private sector entities.[40] A ground-based space surveillance radar became operational in 2025.[41] An SDA satellite is also scheduled for launch in FY 2026.

Finally, in terms of ensuring superiority in the use of space, the Japanese government has indicated in the NDS, which replaces the NDPG, that Japan will work to strengthen the resiliency of its space assets.[42] In relation to this, the DBP states that the MOD and the SDF will promote the use of multiple satellite positioning signals, commercial satellites, and other means, as well as start the development and demonstration of satellite technology related to the resilience of satellite communications and promote multilateral shared use of communication waves with high resiliency.[43] Regarding the last point,

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35 Defense Buildup Program, p. 5.

36 National Security Strategy, 2022, p. 23.

37 Ministry of Defense, "Uchū ryōiki haaku (SDA) ni kansuru torikumi" [Efforts related to Space Domain Awareness (SDA)], November 28, 2023, p. 7, https://www8.cao.go.jp/space/comittee/27-anpo/anpo-dai58/siryou2.pdf.

38 Defense Buildup Program, p. 5.

39 Space Operations Group, Japan Air Self-Defense Force, "Uchū sakusen-gun no enkaku" [History of the Space Operations Group], https://www.mod.go.jp/asdf/ssa/second/history.html.

40 Ministry of Defense, "Bōeishō no uchū kōtsū kanri ni kansuru torikumi ni tsuite" [Ministry of Defense initiatives for space traffic management], March 2024, https://www8.cao.go.jp/space/taskforce/debris/stm/dai2/siryou3_2.pdf.

41 NHK, "Bōeishō no uchū kanshi rēdā kokunai-hatsu no unyō hajimaru Sanyō-Onoda" [Ministry of Defense's space surveillance radar begins operation in Japan for the first time in Sanyo-Onoda], March 19, 2025, https://www3.nhk.or.jp/lnews/yamaguchi/20250319/4060022677.html.

42 National Defense Strategy, p. 19.

43 Defense Buildup Program, p. 5.

the MOD is preparing to join a U.S.-led framework called Protected Anti-jam Tactical SATCOM beginning in FY 2026.[44]

Furthermore, the 2022 NSS and the DBP clearly state that Japan will expand and enhance the development of capabilities to disrupt the command, control, communications, information, etc., of its opponents.[45] By contrast, the 2018 NDPG and MTDP described the target of disruption as "command, control, communications, and information." The addition of "etc." in the 2022 NSS and DBP suggests that the scope of disruption has expanded, though no further details are provided. The use of the phrases "expand" and "enhance" implies that the MOD and the SDF have already made steady progress in acquiring counterspace capabilities based on the 2018 NDPG and MTDP.

In conjunction with these expanded efforts, the Japanese government has announced in its NDS that it will reorganize the ASDF as the Air and Space Self-Defense Force.[46] The DBP also stipulates the establishment of a new, space domain mission unit commanded by a general officer.[47] In fact, in FY 2025, a new Space Operations Wing (tentative name) is scheduled to be created, which will be responsible for space surveillance and response missions.[48] The Space Operations Wing will oversee the Space Operations Group and other units, and will be commanded by a Major General.[49] "Response missions" are thought to refer to missions to ensure Japan's superiority in the use of space. The Japanese government has announced its intention to complete the transition to the Air and Space Self-Defense Force by FY 2027.[50]

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44 Ministry of Defense, "Uchū anzen hoshō ni kakaru bōeishō no torikumi ni tsuite" [Ministry of Defense's efforts for space security], April 2024, p. 8; Ministry of Defense, "Bōeiryoku bapponteki kyōka no shinchoku to yosan – Reiwa 7-nendo yosan no gaiyō – ," p. 20.

45 National Security Strategy, 2022, p. 23; Defense Buildup Program, p. 5.

46 National Defense Strategy, p. 24.

47 Defense Buildup Program, p. 15.

48 Ministry of Defense, "Bōeiryoku bapponteki kyōka no shinchoku to yosan – Reiwa 7-nendo yosan no gaiyō – ," p. 54.

49 Ibid.

50 Prime Minister's Office of Japan, "Reiwa 5-nendo Kōkūkanetsushiki Kishida Naikakusōridaijin kunji" [Address by Prime Minister Kishida at the FY2023 Air Review], November 11, 2023, https://www.kantei.go.jp/jp/101_kishida/discourse/20231111kunji.html.

4. Future points for attention

As discussed above, Japan's defense space policy has entered a new phase with the 2018 NDPG, and the three new defense documents from 2022 build further on these efforts. One point to pay attention to in the future regarding Japan's defense space policy is how the MOD and the SDF will collaborate with companies, allies, and other partners. For many years, the MOD and the SDF remained dependent on other entities' satellites; it was only through the existence of collaborative partners with relevant knowledge that the MOD and the SDF were able to acquire their own space-related capabilities steadily. Their X-band defense communications satellites are operated by a special-purpose company under Japan's Private Finance Initiative (PFI). As for SDA, the ASDF has been establishing a structure dependent on cooperation with JAXA, USSPACECOM, and other partners.[51]

In a similar vein, the success or failure of future efforts in the space domain by the MOD and the SDF will be largely dependent on cooperation with others. The MOD has decided to build a satellite constellation to detect and track targets using the PFI approach. Furthermore, unlike its X-band defense communications satellites, the private sector will be responsible for both owning and operating this satellite constellation.[52] Reliance on the private sector for one of the target detection and tracking capabilities to enable stand-off missile operations is a bold decision by the MOD and the SDF. To prepare for interference with the aforementioned satellite constellation, the MOD and the SDF will need to collaborate with relevant companies from the perspectives of SDA and mission assurance.

Additionally, the MOD and the SDF are pursuing cooperation with the United States through demonstrations, bilateral analyses, information sharing, and collaboration with the U.S. industrial base on satellite constellations that detect and track HGVs.[53] Since Japan has no experience in developing and operating traditional early warning satellites, let alone satellites that detect and track HGVs, the knowledge possessed by the United States' public and private sectors is critical. The executive order on the *Golden Dome for America* (formerly *Iron Dome for America*) initiative, issued by the second Donald Trump administration, includes plans to accelerate the deployment of the

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51 Cabinet Office, Ministry of Education, Culture, Sports, Science and Technology, and Ministry of Defense, "Wagakuni no SSA shisutemu no seibi ni kakaru mōshiawase."

52 Ministry of Defense, "Eisei konsuterēshon no seibi unei tō jigyō jisshi hōshin" [Policy for the implementation of a project to establish, operate, etc., a satellite constellation], April 2025, p. 8.

53 Ministry of Foreign Affairs, "FACT SHEET: Japan Official Visit with State Dinner to the United States," April 10, 2024, p. 4.

Hypersonic and Ballistic Tracking Space Sensor layer, a satellite constellation that can detect and track HGVs. The order also calls for expanding cooperation on missile defense with allied countries.[54] Japan's ability to capitalize on these opportunities will be a key factor in the future success of related efforts by the MOD and the SDF.

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[54] The White House, "The Iron Dome for America," January 27, 2025, https://www.whitehouse.gov/presidential-actions/2025/01/the-iron-dome-for-america/.

Chapter 6
Protecting and Engaging: A Balanced French Military Space Policy

Xavier Pasco

An early French "special relationship" with military space

The publication by France five years ago of a new "Space Defense Strategy"[1] may have come as a surprise to many, in its timing and in its substance. When it came out, France was among the very few nations with such a strategy endorsed by the highest political authority, namely the French presidency in this case. Of course, a number of space faring nations had already produced strategic and military doctrines at various levels, but none with such a clear political objective. Prepared over a 10-month period, this document highlighted the special relationship the French political leadership has entertained with space over the past decades. Making this case for space very early on (and in a highly political fashion compared to other countries), as well as mentioning the risks and threats weighing today on satellites, give a measure of the specific resonance space has gained in France, mostly for historical reasons.

With an accent put in the 50s on the quest for strategic autonomy, space has become, along with the mastering of nuclear energy, the spearhead of the post second world war recovery period. In these highly characteristic Gaullist years, the development of nuclear technologies would not only mean the condition of a future national energetic independence but also the acquisition of a sovereign deterrence force. All that is precisely along the same line as the development of rocketry technologies which would mean creating from scratch a product-line both suited to completing the deployment of the deterrent force and to accessing space.

Even if for its symbolic value only, military space was continuously put at the foreground of national public investments and has benefitted all along of the special attention devoted to the nuclear deterrence by the successive presidencies to this day. This close relationship has not been challenged and may even gain strength at moments

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1 Space Defence Strategy, Report of the « Space » working group, 2019, DICOD, French Ministry for the Armed Forces, November 2019, 59 p.

when the credibility of the deterrence needed to be reinforced. As an illustration, the mid-eighties was one of these periods when a new strategic visibility for French political and military authorities was required for consolidating the deterrence policy by measuring its efficiency, at least symbolically, vis-à-vis the level of possible new defensive systems against long-range ballistic missiles. At a time when Ronald Reagan was pronouncing his infamous "*Strategic Defense Initiative*" speech, the launch in 1986 of the HELIOS programme (the first series of Earth observation satellites devoted to military observation and targeting) was speaking volumes in this respect. This new focus on space systems themselves, beyond the sole rocketry activity, would seal the common destiny of space and nuclear in France to this date. If these new developments may have been merely conceived as a nice-to-have capability in a deterrence context (along with the Syracuse series of telecommunication satellites), France quickly became the sole European power eager to launch a large portfolio of more or less military-oriented space programmes, from space launchers to specifically designed space systems. That history largely explains the differences still visible to this day when one compares the space activities between the different European Member-States.

A policy that remains unique in Europe

This uniquely close link between space and nuclear in Europe explains why space systems have quickly gained a highly valued status in the eyes of the successive French policy makers. Space systems and installations, either in orbit or on the ground, have become a highly critical infrastructure that, *per se,* should be supported and protected. This quickly became consensus. Even if security in space was not viewed at the time as a first-rank challenging issue (very few national actors were then able to put satellites in space), keeping French military satellites safe and secure has progressively appeared as a key rationale in the French general strategic and military posture. In a bit of a parallel evolution with the U.S. use of space systems, the fact that France started to use satellites to support its military operations in the 1990s (Gulf War) and in the 2000s with repeated operations in North Africa and in the Sahel in the context of an ambitious counter-terrorist policy, has reinforced this feeling over the years.

In the « *Defense and Security White Book* » published in 2008, a new concept labelled as "*knowledge and anticipation*" emerged as a "fifth strategic function" with the objective to better prepare France to new forms of security and military threats. This was undoubtedly another national "space moment", calling this time for an increased use of space systems for intelligence and combat operations support. This would mean the development of new capabilities capable of meeting part of the new military needs (including for example the beginnings of early warning experiments – dubbed *SPIRALE*- or electronic intelligence orbital systems – called *ESSAIM*-). The Helios family itself, emblematic of this historic strategic-level use of space would have to evolve towards more capable satellites both ensuring the strategic monitoring missions but also feeding the armed forces with imagery and information more actionable on the battlefields.

This large reconsideration also led to the creation a new « *Joint Space Command* » (JSC) with a coordination mission. In 2019, at the occasion of the publication of the new "*Space Defense Strategy*", this JSC would ultimately be transformed into a full-fledged "*Space Command*" placed under the control of the French Air Force renamed for the occasion "*Air and Space Force*". In other words, it was confirmed that space would not be reserved anymore to the secret service of deterrence but that it would take more and more part of conventional operations and would thus become part and parcel of the national defense apparatus at large. And it would consequently become a possible target, as seen with a military eye.

The logic of discouraging hostile space moves

This long historical detour hopefully helps explain to the reader unfamiliar with the French military space policy the relative risks taken by France by being one of the first space faring nations to publish such a politically explicit strategy and to promote rather audacious concepts (if not provocative for some) such as the notion of "*active defense*" as proposed in its text. As already mentioned, firstly the timing of all this should not come as a surprise. The strategy was laid out after a series of anti-satellite tests carried out by several major space powers. The revival of the weaponization of space was (re)started in January 2007 by China.

More than the resumption of ASAT tests by itself, the general feeling that such events[2] might in one way or another become standard activities would need to be thwarted. From France's standpoint, such disruptive events as ASAT tests shall not be viewed as "normal activities" and the strategy outlined in 2019 had also as a prime purpose to express it clearly.

Then comes the substance of the strategy itself with a deliberate insistence on this

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2 Countries like India or Russia would leave similar marks in the next decade.

deterrent-based approach, signaling at the same time, even implicitly, this enduring background of the close link between space and nuclear policies. This context of proximity explains the overall rationale behind the 2019 strategy, which was (and remains) to deter any enemy from attacking French national space systems. Here again, the parallel with the nuclear doctrine can appear quite natural, given the very history of the French program, even if the concept of "deterrence" by itself remains highly codified in the French doctrine, and reserved for nuclear force. As far as space is concerned, military circles are more inclined to talk about "discouraging" adversaries from attacking space systems, with the underlying idea of introducing a strategic-level logic for space, without risking some sort of semantic confusion.

An important part of the new strategy has been focused on the new space environment (including both threats and risks). For first time, future military uses of space have been evoked that go beyond the classical Earth-oriented applications (be it Earth observation, telecommunication or timing and positioning). In a speech accompanying the publishing of the strategy, the then Minister of defense, Florence Parly, even underlined this new concept of "*active defense*" in space, stressing the need for France to get equipped with specific space weapons, even if this latest expression does not appear in the speech nor in the strategy itself.

This was putting France in the spotlight at a time when debates were heating up for more than a decade of unending United Nations-led discussions with blatant differences between the main space powers about the development of safer, more secure, and more sustainable development of space activities. Enduring disagreements over definitions and ways forward (how defining a space weapon has remained one of the most controversial questions), with a split over choosing between a renewed treaty forbidding weapons in space and a more responsibility-based political instrument have fed years of discussions between diplomats. To put it bluntly, this fundamental difference had almost completely frozen high-level progresses in the domain since about 2008.

In such a challenging context, this French announcement about the setting of a new concept of "*active defense*" may have looked like a form of political gamble. As a matter of fact, it was more like a work in progress. The speech first of all notes this trend towards greater militarization and acknowledges that the time has come to try to prevent it. The strategy seems to acknowledge the fact that the time for sanctuary space is over even if regrettable. From then on, French strategy has seemed to be playing on two sides that could hopefully be seen as complementary.

On the one hand, it has been a matter of going away from naivety and getting prepared for protecting oneself, including by evoking concepts that may have been taboo in the past. Suggesting perimeters to be protected against intruding satellites[3] has raised the largest issue of the general principles of freedom of movement in space. Likewise, mentioning the possible use of weapons in orbit clearly seems at odds with the China-Russia proposals to ban weapons in orbit and implicitly focuses on hostile-like behaviors rather than on capabilities. This sort of "stating what we do, doing what we state" assertive posture may be seen as being part and parcel of this "discouragement" –based strategy mentioned earlier.

But more than that, some corresponding programmes have also been announced at the occasion of the latest financing military act. More precisely, a few new measures have been evoked by the Ministry of Armed forces in its presentation of the 2024-2030 French Military Programming Act:

> *"Strengthening France's action in space requires:*
> - *renewed space observation and listening capabilities;*
> - *enhanced Space Domain Awareness (SDA) capabilities to detect suspicious or aggressive acts in space;*
> - *technologies to protect our assets through active defense;*
> - *active defense, particularly in low-Earth orbit.*
>
> *To this end, the LPM 2024 - 2030 provides for:*
> - *the creation of a command, control, communication and computing center for space operations (C4OS), with the means to pilot actions to, in and from space;*
> - *the programming of patrol-guard satellites (YODA, a European first), in-orbit lasers (FLAMHE project) and ground-based actions (BLOOMLASE laser). These capabilities will be operational before the end of the decade.*
>
> *6 billion euros will be devoted to strengthening France's action in space over the period 2024-2030."* [4]

Creating structures suited to these new objectives

The creation of the Space Command in 2019 under the auspices of the French Air Force, renamed Air and Space Force for the occasion, was obviously in line with this

[3] If only through reiterated references to the maneuvers of the Russian *Luch-Olymp* satellite near a French Syracuse military telecommunications satellite at the time.

[4] See https://www.defense.gouv.fr/actualites/lpm-2024-2030-reussir-sauts-technologiques.

new general orientation. This Command was not intended to become a *sui generis* "*Space Force*" and the institutional effects of this reorganization have remained highly symbolic to date. Still, with an expanded scope, including the ultimate function of controlling military satellites, the very creation of this new command signaled the evolution of the functional relationship between the armed forces and satellite capabilities. From then on, providing for the possible protection of military satellites deployed in orbit would become an explicit mission entrusted to the Space Command.

Therefore, with this institutional reorganization alone, the announcement of new defensive space programmes could take shape in the proper sense. Both in the Minister's speech[5] and in the strategy itself[6], new satellite protection missions have been mentioned. They include both the ability to watch possible hostile incoming satellites[7] and response means notably authorizing the possible use of directed energy techniques, and lasers in particular as announced later on in the 2024 Military Programming Act. While the experimental YODA programme has been about testing the deployment of some sort of "sentinel" or "guardian angel" satellites aimed to detect and monitor hostile moves around national military satellites in GE orbit, a more operational programme called EGIDE has also been planned to bring real operational capabilities in future years.

Another official announcement made as recently as in September 2024 introduced the TOUTATIS programme. A as stated by the Ministry of Armed Forces, it will make "*use two nano-satellites in low Earth orbit (LEO) to validate operational defense scenarios. Dubbed "TOUTATIS[8]", this first demonstration will put into action a complete chain of knowledge and reactions in the face of attempted space interference*." In November 2024, another recently created *Defense Innovation Agency* (AID, *Agence d'Innovation de Défense*, hosted by the *Armament Procurement Agency* - DGA) also announced the launch of studies to "*simulate the capture of dangerous space objects in low-Earth orbit*". Notified to DARK, a French start-up founded in 2022 with the goal to develop a reactive sort of "launch and grab" system to quickly deorbit space debris[9], these studies, according to AID, should

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5 See https://www.defense.gouv.fr/content/download/563595/9727199/Discours de Florence Parly%2C présentation de la stratégie spatiale de défense à Lyon%2C le 25 juillet 2019.pdf

6 Space Defence Strategy, Report of the « Space » working group, 2019, DICOD, French Ministry for the Armed Forces, November 2019, 59 p.

7 Idem, p.48.

8 After the name of a Gallic God but also providing the following French meaning of "*Test en Orbite d'Utilisation de Techniques d'Action contre les Tentatives d'Ingérences Spatiales*" (or *In-Orbit Testing of Action Techniques against Attempted Spatial Interference*).

9 In 2023, DARK has already carried out an emergency interception study for the CNES, targeting a piece of space debris. This study was the first test of DARK's simulations.

lead to the definition of "*space defense missions in emergency situations with high operational availability. It features a multi-stage space access system, capable of rapidly reaching a specific point in orbit, while bypassing meteorological constraints and certain types of orbital transfer. Its final stage is equipped with a robotic module dedicated to target capture*."[10] As mentioned in the official announcement, this experimental programme is clearly intended to lead to an operational capability for "*intercepting orbital objects*" at a post-2030 horizon.[11]

Thus, in less than 5 years, the French military space policy, simply by endorsing the possibility to face a crisis in space has been through a major and rather fundamental doctrinal reshuffling. Subsequent counterspace programmes as planned in the ongoing 2024-2030 military programming Act have progressively taken shape, even if they may appear modest in size in comparison of parallel -but most often unacknowledged- efforts by leading spacefaring countries undertaken for several years if not decades. In this respect, the French approach appears to remain largely experimental in scope, highlighting the "*discouragement*" dimension as promoted in the strategy. Here again, the "signaling" aspect may have appeared as one of the most striking features with a direct effect on the whole reorganization undertaken by the French military space since 2019. This open communication-based approach immediately suggests that the military dimension does not suffice to render the political rationale behind the national strategy.

The necessary corollary to the Space Defense Strategy: a pro-active transparency-based diplomacy

Renewed calls for greater transparency and cooperation have also structured the French position for the past years. Of course, this might represent a hollow or at least less apparent part of a highly comprehensive approach but this has been the product of an early involvement, as noted for example in the now-defunct project of an EU-led "*International space Code of Conduct*". A soon as 2008, at the very moment when China and Russia were actively promoting a capability-based "*Prevention of Placement of Weapons in Outer Space*" treaty (PPWT), France was actively pushing for an early effort to stimulate an international consensus about the principle of responsible behaviors in space. The point was essentially to propose some sort of "*rules of the road*" to be adopted

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10 See the official communiqué at https://www.defense.gouv.fr/aid/actualites/interception-dobjets-orbitaux-laid-lance-etude-preliminaire-dark

11 It should be noted that in 2025, DARK is experiencing economic problems that could lead to the selection of another company.

internationally and provide a shared framework for collective coexistence in orbit.

As a European-wide effort, this first attempt failed to be endorsed by the international community. The refusal by key countries to open formal negotiations in 2015 signaled the momentary ending of one of the first attempts by the European Union to show itself as a capable diplomatic player in a sensitive domain. While appearing at times as a relatively inexperienced diplomatic player (with probably some insufficient early engagement towards the international community as often mentioned since then), the EU also suffered from the relatively low level of awareness of mounting risks in space by a majority of nations. To be true, in 2015, very few analysts would have forecasted what has happened since then, i.e., the order of magnitude-change of the number of satellites in space and the emergence of an increasingly "*contested, congested and competitive*" space environment, as often hailed for the last decade. While put on hold at the European level, the responsibility-based effort was not given up. For France and like-minded countries, this has remained the key to unlocking the international discussions especially in the context of PAROS (*Prevention of an Arms race in Outer Space*) as debated in the first committee of the United Nations.

In August 2020, the United Kingdom tabled the project of a U.N. resolution that called for "*reducing space threats through norms, rules and principles of responsible behaviours*". While China and Russia initially opposed a text that they felt should be considered outside of the PAROS discussions, the U.K. proposal was adopted by the First Commission and voted by a large majority of the U.N. general assembly on 7 December 2020[12]. Following the vote and a report from the U.N. General Secretary published in July 2021, a new resolution has been proposed to set up an "*Open-Ended Working Group*" (OEWG) on the security of outer space (Doc A/C.1/76/L.52).

While held in difficult circumstances, mainly due to the war declared by Russia to Ukraine, the OEWG has managed to keep lines of communications opened with allied partners, among them France, constantly standing strong to support and enhance the U.K. initiative to focus first on the need for collectively agreed rules for responsible behaviors in space. The adoption in 2024 of the creation of two parallel OEWGs to study this option and also consider the prospect for a future legally binding instrument, more in line with the treaty project defended both by China and Russia, has made clear that future arrangements in space will rely on enhanced mutual trust and transparency.

[12] Resolution 75/36, "Reducing space threats trough norms, rules and principles of responsible behaviours", adopted by the General Assembly on 7 December 2020 (Yes: 164 | No: 12 | Abstentions: 6 | Non-Voting: 11 | Total voting membership: 193).

What role for France?

The technical and military initiatives as announced by France in the last months may also be understood as feeding what could be called a two-fold policy. And as seen from a French perspective, this is precisely where the main political gamble lies from now on:

First, the signaling effect produced by the recent decisions put France on par somehow with today's most active space powers in space, themselves possessing counterspace programmes. Again, most of these activities, often reported to a wide international audience in the press, first appear as strategic signaling sent to peer competitors before representing real operational military capabilities. In this respect, any attentive observer can only be amazed by the number and the relative high profile of most recent of the counter-space activities carried out world-wide.

But second, these official announcements also foster openness for more public visibility obviously posing the hard question of collective transparency. To some extent, this is all about prioritizing some form of pragmatism, at the risk of being perceived by some as officializing new forms of militarization of space. By difference, such pragmatism may also be seen as a bet on a possible new start for more mature and more responsible discussions on space security.[13] While those discussions have clearly stagnated for more than a decade, it may after all seem healthy to discuss, or even prepare collectively for renewed discussions on these technologies without fearing their possible military outputs. At a time when, for example, servicing and refuelling programmes are gradually being put in place, implying procedures for bringing satellites closer together, some degree of collective responsibility will be unavoidable to face and control their possible consequences. As suggested by my colleague Dr. Rajagopalan a few years ago[14], the rising tension around space security issues makes it all the more urgent to resume effective multilateral talks.

While acknowledging the legitimacy for any space power to protect its orbital assets, the French space defense strategy, precisely for this reason, also suggests an urgent need for developing mutual confidence in space. From this standpoint, a large part of France's strategy can also be read as an attempt to underline the need for promoting efficient transparency mechanisms that do not exist today in space. For sure, such an effort would be difficult to be envisioned in its details today. Counterspace programmes have been

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13 Along this line, the French support of the U.S. moratorium proposed by Vice-President Kamala Harris on the use of Direct-Ascent ASAT missiles appears as rather consistent.

14 Rajagopalan (Rajeswari Pillai), *It Is Time for Space Governments Talks*, The Diplomat, 21 May 2020 (https://thediplomat.com/2020/05/it-is-time-for-space-governance-talks/).

on the rise worldwide and an ever more tensed international strategic environment do not incline to optimism. Identifying transparency measures in detail may appear out of reach when they may be seen by space powers as limiting their military options. At first glance, the prospect of "*transparency and confidence building measures*" (or TCBMs) for space would call at a minimum for serious reassessments of national security doctrines...

What can be a realistic way forward?

Given the stated ambition, and facing the paradoxes of space security, it may be interesting to look at existing models in other sensitive fields. More precisely, focusing on the promotion of TCBMs in space may present several merits as debates about possible scenarios for collective security in space have remained the rule at the U.N. level.

A TCBM-based approach may first be seen as a natural extension of the concept of "responsible behavior in space" already in discussion in the OEWGs. As such, it shall not raise negative political reactions *per se*. As a collective action by essence, it shall not also pretend to substitute to national threat assessments. The goal is simply to take stock of the level of threat as it is collectively perceived (and agreed upon) on a shared basis. Obviously, this shared assessment would have an indicative value, helping engage intergovernmental discussions without superseding independent national assessments. The ultimate objective would be to keep at a minimum early national sensitivities and resistances. Also, such a TCBM certainly cannot take the form of a constraining document that would aim to prevent the fielding of this or this capability (a measure likely to be refused by the State parties or that would at best considerably slow discussions down). For the sake of efficiency, it would primarily promote the notion of voluntarism and the willingness of States to take part in the elaboration of de-confliction mechanisms aiming at preventing any escalation dynamics in space. In such a context, developing the right to protect assets would likely appear as a way to share reflections about best collective practices.

An existing precedent?

The proposal of TCBMs for space immediately comes up against the question of their acceptability by States. Such measures may be perceived as entailing a risk of interference with the freedom of action inherent to defense space policies. Conceived in this way, such a proposal would run counter to the consensual character that should define it, and run counter to the purpose. Therein lies the challenge of proposals whose primary objective remains the creation and maintenance of a platform for exchange between countries first capable of agreeing to agree on the content of their exchanges. From the point of view of national defenses, the sensitivity of space has become such that collective agreement on these contents might well be the essential point of any discussions.

Given this general sensitivity, the very idea of a mechanism capable of organizing these exchanges may seem highly debatable. However, the exploration of such an avenue could be based on the example of existing multilateral mechanisms that have set useful precedents. In addition to the major agreements in the maritime and aviation fields, it is worth mentioning the precedent set by the adoption in 2002 by 92 countries of the *Hague Code of Conduct against Ballistic Missile Proliferation* (HCoC). Proposed to create the basis for an exchange mechanism on a subject of highly strategic sensitivity, the HCoC today appears to be one of the only multilateral instruments that can claim a definite political success, with 145 signatories in 2024.

In formal terms, this mechanism was meant to avoid misunderstandings linked to ballistic missile tests or space launches. In this case, it relies on three types of voluntary measures:

- *Pre-notification of launches or space launches*: the signatory countries pre-notify the launch or launch they are planning by filling in a short form containing the most important information (not very detailed in reality), which is sent to the Austrian authorities who run the code secretariat, and which is accessible to the signatory countries.
- *Production of an annual report on ballistic and space activities*: each signatory country is required to produce an annual report on its ballistic and space activities. Signatory countries with no activities in this field can use a pre-filled form.
- *The option of inviting a delegation from a few signatory countries (or even non-signatory countries, to reinforce the transparent nature of the process) to visit an experimentation or space launch site*: this is an optional voluntary action left to the discretion of the countries involved. France, for example, has invited visitors to tour its Guiana space center on two occasions since joining the Code. Other countries have chosen to exercise this option (Japan, United States, or more recently South Korea for example) or are planning to do so.

In operational terms, the HCoC represents above all an opportunity for ongoing exchanges beyond the sole plenary meetings held annually in Vienna. Constant communications between experts, administrative and governmental decision-makers is now certainly one of the most decisive arguments when it comes to assess the efficiency of a TCBM of this sort. In practice, the interest of exchanges and the promotion of a genuine concept of transparency seems to have largely prevailed and won the support of most of the international community (including countries which have neither ballistic missiles nor space launchers, but which also feel concerned by a question of international security) as testified by the sheer number of signatory countries in 2024.

A narrow path to walk

This example raises the question of the feasibility of a similar instrument for space, in the wake of the OEWG discussions mentioned above. The principle of a space TCBM seems to be in line with the general objective of these discussions which have been calling now for new proposals.

In this general context, and building on its 2019 Space Defence Strategy, France shall find itself well placed to put forward concrete and actionable proposals in the field of responsible behavior. Both in substance and in form, solutions are *a priori* conceivable once the consequences for national security have been measured. The existence of a precedent on the sensitive subject of proliferation and ballistic policies may facilitate the political acceptance of such proposals and encourage innovative ideas for the space sector.

If several different proposals could of course be made based on this model, they would all have to envision wide-ranging consultations of all the players involved at military, diplomatic, economic, and industrial levels, to assess their scope, limits, and practical views. This preliminary communication effort, firstly carried out at national level, has been consistently missing from previous European undertakings. Now equipped with a space strategy that sets out its military objectives and specifies their diplomatic framework, France may be well placed inside Europe to take the lead for a more proactive approach based on these first lessons learned. Promoting reasoned transparency measures, with the aim of effectively limiting the risks of tension in space, both political and military, while recognizing the legitimate need to enhance the security of space systems outlines at least the narrow path that may have been opened up by France's defense space strategy a few years ago.

Chapter 7
India's National Security Space Policy

Rajeswari (Raji) Pillai Rajagopalan

Introduction

India's space programme has gone through an impressive journey in the last nearly six decades. As a developing country, with limited resources, India began its space programme with an initial focus on the social and economic development of the country, but in recent decades, it has had to re-orient and expand its space programme with a focus on security needs more than ever in the past. Also, as India's interests grow more international and become a more influential player in global politics, its approach to security issues has also undergone some changes. Further, there is interest among international players to understand India's evolving approach and how it positions itself on critical international security issues. Space is one such domain where some of the changes are becoming more evident, shifting from a purely civilian space orientation to one with greater attention to military and security facets, given the rapidly changing space security conditions.

Some of the key factors driving the change in the Indian approach to space include changing threat scenario within the space domain and the broader shifting global balance of power, which is evident in the Indo-Pacific regional power balance as well.

Progression of India's Space Programme and Approach

In some ways, the Indian space programme has gone through transformative changes in recent years, if one were to compare the earlier Indian position, which was vehemently critical of the US' Strategic Defense Initiative and the anti-satellite (ASAT) tests conducted by the US and USSR in the 1970s and 1980s. India's position has evolved in a way, transitioning from a morality and principle-based position to one that is conditioned by pragmatism and national security interests. This in effect means India is no longer tied to its decades-old position that opposed any kind of militarisation of space and that space utilization is for peaceful purposes alone. This is not to suggest that India has entirely given up on its official rhetoric as yet, but on the ground, the military utilities of the Indian space programme have grown and will continue to grow in the coming years.

One has to acknowledge that this has not been an easy shift for India, but the change to the Indian approach has been gradual and evolving. India's position today is a lot more calibrated and considered and aligns more with its broader approach to global security norms itself, which has also seen certain loosening up.

The Indian space programme as it began in the 1960s was a fairly modest one with limited goals and even more limited resources, and it was primarily geared towards the social and economic development of the country. But India has had to expand the space agenda with new considerations from a national security angle. China's gaining of greater proficiency in space is something that has put many spacefaring powers including India, Japan and the US on notice. Even as China continued with the rhetoric of peaceful uses of outer space, there has been a flourishing military space programme under the PLA's (People's Liberation Army's) leadership, in reality. Introduction of ASAT weapons in the Indo-Pacific neighbourhood by China in January 2007 and China's repeated tests since then add to the regional anxieties and competition. Irrespective of the logic for China's pursuit of new weapon systems, because they have a larger economy kitty that permits them to do so or due to their own perceived security calculations, countries in the Indo-Pacific neighbourhood perceive these as threatening to their own security and destabilizing in the regional context. The baggage of history and the great power politics in the region are in addition accelerating the security dilemma in the region.

ASAT weapons are inherently destabilizing in nature, and the January 2007 ASAT test in fact pushed a new debate within India on how India must approach outer space including the need to develop new counter-space capabilities to protect its own assets in outer space. India's growing security concerns, especially those related to China, including an array of counter-space capabilities, appear to be driving much of the new focus of India's space programme. But this new orientation has also brought India in closer alignment with a new set of actors who are becoming critical to India as it shapes new space security partnerships.

A second change in India's space programme relates to a more determined space exploration, which includes inter-planetary missions and the goal to establish a small space station in the coming decade. This change appears to be a natural progression as the Indian space programme has reached certain levels of technological maturity and sophistication. But this paper will focus on the first aspect, relating to the national security aspects of India's space programme and policy. However, it should be noted that while India's Moon and Mars missions have been an outgrowth of the growing technological capabilities, the intensifying space security and the broader Asian competition have been factors that pushed India towards such missions. Also, because these missions have boosted the visibility and profile of the Indian space programme, they highlight India's potential role as a space collaborator. Thus, there has been a small commercial angle that has been key in pushing India to undertake such complex missions despite operating with a tiny budget. Of course, these complex missions have also produced spin-off technological benefits for India. India's deep space communication capabilities is a case in point. Finally, India has held the view that demonstration of such missions has also an instrumental value in augmenting India's voice in the global governance debates with a seat at the high table.

Competitive Asian Space Landscape

Indo-Pacific in general, and the three established space powers – India, China and Japan – have actively collaborated with other space powers including the US, France and Russia, but intra-regional collaboration has been minimal or nil. While India and Japan have established space cooperation across different facets, cooperation of the two with China has been practically nil due to the fact that these programmes have been driven with a sense of geopolitical competition and rivalry. Also, one cannot overlook the fact that there are two regional space organisations: APSCO (Asia-Pacific Space Cooperation Organization) under the Chinese leadership and APRSAF (Asia-Pacific Regional Space Agency Forum) under the Japanese leadership, each with their respective member countries, with very little overlap, and there exists no mechanism for cooperation between these two regional initiatives. This demonstrates the competitive tone and tenor of the two groupings and their broader goals within the regional and broader context. India and South Korea are part of the APRSAF and Pakistan is a member of the APSCO.

Many of the Asian space players have developed their space programme with an economic rather than security agenda but are increasingly making crucial departures with the security environment becoming not so benign. There is a sense that inaction could cost them, with implications for their national security. In both of India and that of Japan, the changes are becoming more prominent, with the two developing certain military profiles to their space programmes and developing appropriate technologies and institutions to make efficient use of space in the national security context. The two countries also collaborate both in the bilateral context but also within the regional and minilateral context with a focus on space security. India and Japan for instance are involved in an annual space security dialogue.

India's National Security-Driven Space Progression

While there has been an overall expansion of India's space programme, its national security dimensions have become quite significant given the growing military and security drivers in the Indo-Pacific and beyond. Considering the emerging security trends, India and many of its new security partners in the region will continue on the path to build up their deterrence capabilities in space even as deterrence in space is yet to become a state policy. Lack of substantial multilateral negotiations can accelerate the pace towards deterrence in space, something that can be avoided, but we are losing time.

India has been a bit slow in bringing about the policy changes, but it has been active in terms of the various capability requirements, which have been practically beneficial. For instance, some of India's earliest military satellites such as the RISAT series, have been useful in augmenting Indian military's situational awareness. The RISAT series of satellites, with synthetic aperture radar (SAR) have been particularly beneficial to the Indian military. The RISAT series of satellites gained greater traction in the context of the Mumbai terrorist attacks in November 2008, when India acutely felt the need for all-weather surveillance satellites that could provide India's security agencies with security updates, especially for its eastern and western fronts.

One of the first dedicated military satellites that India developed was the GSAT-7 for the Indian Navy in August 2013. The satellite was meant to boost India's space-based maritime communications and electronic intelligence. This made perfect sense given that the Navy operates in far-flung operational theatres from the Indian mainland and was seen as particularly important in the context of changing security dynamics in the Indian Ocean. Since then, India has developed a number of communication satellites for the other two services of the Indian military including GSAT-6, GSAT-7A in order to have enhanced and secure communications and to facilitate better coordination in the context of military operations. In 2019, the ISRO, (Indian Space Research Organisation) went on to launch EMISAT (Electro-Magnetic Intelligence Satellite), a satellite jointly manufactured by ISRO and the Defence Research and Development Organisation (DRDO). This satellite was developed for the Indian military with the objective of improving the military's ability to track and intercept enemy radars by sensing electromagnetic rays they emit.

India has also developed a smaller version of the GPS for its navigational requirements, which has been reportedly helpful to the Indian military in their operations, without having to depend on foreign navigational programmes. India has considered foreign dependence as a vulnerability given its historical experience of relying on foreign partners for its broader security needs.

In addition to stepping up its technological wherewithal, India has also established the necessary institutions for effective coordination between the civilian and military agencies, thus paving way for seamless utilisation of space capabilities. One of the first institutions was the Integrated Space Cell under the Integrated Defence Services Headquarters of the Ministry of Defence (2010). This was considered the baby step in creating effective coordination between the Department of Space and the Indian armed forces in creating better synergies in a variety of ways. Specifically, the new set up was meant to be helpful in generating a common understanding of the emerging threats that India faces as well as consider possible responses to "offensive counter space systems like anti-satellite weaponry, new classes of heavy-lift and small boosters and an improved array of Military Space Systems ... in our neighbourhood." It was an important first step, but it did not really evolve in terms of effectiveness and delivery.

Next, among the three services, the navy took the lead in establishing the Indian Navy's Assistant Chief of Naval Staff (Communications, Space and Network Centric Operations or ACNSCSNCO) in 2012. In 2015, it seemed like the Indian government was onto more institutional innovations with the Ministry of Defence said to be finalising the final steps towards the establishment of three tri-service commands – cyber command under the Indian Navy, aerospace command under the Indian Air Force and the special operations command under Indian Army. However, in place of full-fledged commands, three interim organisations – Defence Cyber Agency (DCA), the Defence Space Agency (DSA) and the Special Operations Division (SOD) – evolved gradually with the DSA established towards the end of 2018. Many consider this as an institutional innovation that might lead to a full-fledged aerospace command, which has been a demand from the armed forces for more than two decades. Then Indian Air Force Chief, also the chairman of the chiefs of staff committee, Air Chief Marshal Arup Raha noted that these would remain as "interim arrangements" before the establishment of the full-fledged commands. It is seven years since the DSA was set up, and the integration of space in military affairs has become greater but there is no sign of a full-fledged command as yet.

India's Changing Policy Approach to Space

India announced a national space policy for the first time in 2023, although it is fairly limited and has several lacunae especially from a space security perspective. The 2023 policy appears to be more like a guidance document for start-ups and new space industries to engage the Indian space establishment. It outlines roles and responsibilities of the ISRO, NewSpace India Limited (NSIL), and the Indian National Space Promotion and Authorization Center (IN-SPACe), as well as that of the private players in furthering the Indian space agenda. It is indeed important in the sense that it acknowledges the critical role that private entities can play, thus opening up the Indian space sector in a more straightforward fashion. That there is a clear recognition of the private sector in stepping up India's competitiveness is noteworthy. Giving the private sector a bigger role can also mean that the ISRO should be better placed to go back to its original mandate of focusing on research and development of advanced space technologies, space exploration and non-commercial missions. However, looking at the rapidly changing space security scenario, the Indian government lost an opportunity to outline its vision on space security issues and its perspective on how India plans to counter the growing space security threats. Until the Indian government announced this policy in 2023, one had to go with official statements in the Indian Parliament and in multilateral fora such as the United Nations to understand India's space leanings.

Even as India did not spell out anything worth on the space security policy aspects, there have been subtle changes over the years in how India has approached space in the security context. India in the past decades had adopted a doctrinaire approach or a sanctuary school of thought to space security issues, which reaffirmed that space must be used for peaceful purposes alone and strongly opposed militarisation and weaponisation of space. And accordingly, as mentioned earlier, India was a vocal critic of the US and USSR through the Cold War years for their military space programmes and repeated ASAT tests. The Indian position of course made sense given that India had no such capabilities and therefore criticised those who possessed them.

But India's position began to see some important changes in the 2000s. One can attribute many reasons for the subtle changes in India's approach, but an important consideration was India's desire to integrate with the global non-proliferation architecture and be part of the solution than be part of the problem, which was the perception in the preceding decades. A second important factor was the changing security environment in its neighbourhood, wherein Pakistan was the initial focus, but by the late 1990s, the threat focus had shifted to China. The China-Pakistan partnership that spanned a number of areas including Beijing's transfer of small- and medium-range missiles to Pakistan and the broader missile proliferation in the region were particularly concerning. All of these were imperatives for India to adopt a new thinking on space and missile defence issues. These changes also softened India's rhetoric considerably and India's stance on military space and missile defence issues became more considered and nuanced.

While India's policy approach towards space has evolved considerably since the 1970s and 1980s, it is yet to embrace the full change and goes back every now and then to its old comfortable position that space is for peaceful purposes alone. Given the politicised nature of space debates, and despite the Indian ASAT demonstration, India tends to hold a moralistic argument and principled position on space security issues. This is evident in the global governance aspects of space security. India is yet to totally endorse political instruments such as Transparency and Confidence Building Measures (TCBMs). India still continues to hold the view that they are good supplementary measures, but that they cannot replace legally binding instruments.

Dealing with Space Security Threats

India's space security environment has been worsening for about two decades now. China's first successful ASAT test in January 2007 was a wake-up call to India on the kind of threats in its own neighbourhood and that India should be prepared to address. This in fact prompted the Indian establishment across the board, the political, technical and military leadership, to discuss and debate on how India should develop the means to protect its own space assets. In a unique fashion, there was a consensus view that India must develop appropriate measures as a way to deter any attacks on its space assets. The Manmohan Singh Government in fact sanctioned the research and development of India's own ASAT capability even though the government did not decide on when to have a demonstrated capability. The decision to demonstrate India's ASAT capability was taken by Prime Minister Narendra Modi in March 2019. The decision was possibly conditioned by India's experience in the nuclear domain with the Nuclear Non-proliferation Treaty (NPT). India wanted to ensure that it had a demonstrated ASAT capability before any NPT-like global mechanism on space security came about given that the three established space powers – the US, Russia and China – had already demonstrated ASAT capabilities, and it is possibly in their interest to prevent others from conducting ASAT tests. India was also possibly driven to assume that given the state of multilateralism and the worsening great power relations, strengthening or establishing new global governance measures was not going to be a reality and therefore it felt the need to have its own capabilities in place to deter others from blowing up India's space assets. This sentiment was captured in a statement issued by the Ministry of External Affairs, which said that the new capability "provides credible deterrence against threats to our growing space-based assets from long range missiles."

India's ASAT test was again not an easy decision given that it was walking away from a well-established decades-old position against militarisation of space. It would have been a strange decision also because India was a vocal critic against the US and the Soviet Union for their military space programmes, including their ASAT tests. But ultimately, the national security considerations became the essential drivers for India to take the decision on its ASAT demonstration. There are of course questions around the deterrence value of the Indian ASAT in deterring China. But it appears to have sent a political message to China for the time being.

Meanwhile, the Indian defence research and development community appears to be keen on other counter-space weapons too. Then Director General of the DRDO, Dr. Satheesh Reddy in a newspaper interview said that the DRDO is "working on a number of technologies like DEWs (directed-energy weapons), lasers, electromagnetic pulse (EMP) and co-orbital weapons etc." He of course clarified that these are political decisions, but he stated that "space has gained importance in the military domain. The best way to ensure security is to have deterrence." This is in fact the language one hears from the military, especially the Indian Air Force leadership as well. The Air Force is also gearing to rename itself to the Indian Air and Space Force (IASF) in its efforts to make it a "credible aerospace power". One however needs to exercise a bit of caution while reading these statements. From bureaucratic politics to gaining access to funds, there are a number of such factors that can be read into these statements. This is not to suggest that the Indian establishment is not worried about the worsening space security conditions. In fact, it used to be a concern that the Indian establishment may not fully understand or appreciate the space security issues and the urgent measures that are required to counter them. But it no longer appears to be the case; space security especially in India's neighbourhood appears to have gained greater acknowledgement. Like mentioned before, China's ASAT test in 2007 was a game changer moment as far as India's space security thinking is concerned.

In fact, the Indian Defence Space Agency conducted its first military space exercise, "Antariksha Abhyas 2024," in New Delhi in November 2024. The exercise was conducted with the goal of further integrating space in India's military operations. Speaking on the occasion, Chief of Defence Staff General Anil Chauhan underlined that space "is now the critical enabler of India's defence and security apparatus. With its rich legacy of space exploration and growing military capabilities, India is well positioned to navigate the challenges posed to space based capabilities." In recent years, the military leadership has become quite vocal on the use of space in the context of national security and military operations. The kind of hesitancy that prevailed in the past is not there anymore. The exercise involved personnel from the Defence Space Agency, army, navy, and the air force, along with other specialist branches and representatives from the DRDO and ISRO.

Capacity Constraints

While the Indian civil space organisation, the ISRO has done quite well, especially considering the small budget with which it operates, capacity issues are becoming more serious with the expanding space agenda. The military and security requirements on space assets have grown over the past decade and the ISRO is having to do a lot of catch up, but there are capacity constraints, which are beginning to impact on India's space security technology credentials. If India cannot keep pace with the fast-moving military space sector in India's neighbourhood and globally, New Delhi stands to lose in critical national security capabilities. Also, with both civil and military dependence on space go up, there will be a corresponding increase in the vulnerabilities to its space systems. India will need to factor in attempts by adversaries to create temporary disruptions, degrade or destroy Indian space assets through a range of counter-space capabilities including cyber and electronic warfare. This means that the already stretched Indian space programme also has to pay attention to developing counter-measures, including better redundancy measures and better resiliency to its space systems. These will only add to the growing and diverse requirements on the Indian space programme that is already dealing with capacity crunch.

India's capacity crunch is in multiple areas, each of which calls for a different response. The first factor that affects the capacity constraints comes from the small budget of the ISRO. With a budget around US$2 billion, India has done pretty impressive work, but this is far from sufficient for the growing demands on the Indian space programme and if India has to stay competitive and effective, the budgetary allocation has to be addressed. Without a hike in India's space budget, the ability of the ISRO to retain or attract new talent will be futile. There is a thriving private sector across the region and beyond and India will lose some of the best private sector talent to the West or even Asia, where they may be in demand.

A second area that India has to address is with regard to the constraints in the technological domain, especially in its ability to launch heavy satellites. This is an area in which India can work with partner countries to boost the launch vehicle capabilities so that India becomes a competitive player in launching heavier satellites. The next section on space security partnerships delves into some of the details for making this happen.

A third area is to improve India's launchpad infrastructure, which has continued to impact on India's launch goals. Launch numbers have to go up to keep up with India's growing demand in addition to its ability to cash in on the global commercial space market. India enjoys certain advantages in terms of cost and reliability but the ability to keep with the increased number of launches is partly at least determined by the infrastructure in place, something that needs attention from the political and ISRO leadership.

A fourth and final area that India needs to pay attention to is the expansion of the workforce. A few years ago, ISRO admitted that it had only around 16,000 personnel, which was not sufficient to meet the expanding space agenda. Three years earlier in 2014, while responding to a question in the Indian Parliament on manpower shortages, Dr. Jitendra Singh, Minister of State in the Prime Minister's Office claimed that there was no manpower deficit. A quick way to address this is by bringing in the Indian private sector, which is a competent force and might at best need a bit of handholding by the government. In recent years, the Indian political and scientific leadership have acknowledged this critical step, and the private sector has found reasonable openings to work with the ISRO. But the embrace of the private sector needs to done on a faster pace if India does not want to lose to its competitors including China, who has embraced the private sector with both arms. Also, for the private sector to be an invested party, there has to be regulatory certainty and funding, without which attracting the best talent may not come to fruition.

Emerging Space Security Partnerships

With China and its space security prowess gaining greater traction in India's space security policy debates, India is looking to solidify partnerships with those like-minded countries who share similar perspectives on the growing space threats and also in how they might deal with those threats. In this regard, India has gone on to establish as well as strengthen space security partnerships with the Quad as a whole as well as with individual Quad countries and France. It is also interesting to note that India's first space security dialogue was with the US that began in 2015, and thereafter India entered into a similar dialogue format with Japan from 2019 and with France from 2021. In India's earlier approach to space, one would have envisioned India to have a space security conversation with countries like Russia and maybe France but not the US and Japan. Thus, the changed space security conditions have driven a certain amount of pragmatism to acknowledge the like-mindedness in terms of threat perceptions in the space domain and the possible countries that India can work with in addressing the current and future security threats in space. India also has a strong space collaborative agenda with Australia, most of which fall in the civil and commercial space arena, but with growing reliance on space for our respective societies, economies and national security, it is a matter of time before New Delhi and Canberra will expand their conversation to include the space security agenda.

But all the three countries, alongside the US, are part of the Quad space engagements, which include consultations with each other on a range of issues including space norms to ensure that space is safe, secure and sustainable. The Quad as a whole is also engaged in consultations on norms of responsible behaviour and regulations, which has an emphasis on China's counter-space capabilities and behaviour. This is an interesting and important development especially from an Indian perspective because traditionally India partnered with the non-aligned G-21 countries which have insisted on legally-binding verifiable mechanisms as far as space global governance measures are concerned. For India to engage in a smaller grouping such as the Quad and collaborate on possible space norms is an important departure in India's space approach. But China's aggressive behaviour across terrestrial geopolitical issues and its inventory of counter-space capabilities have driven India to shed some of the hesitancies and develop like-minded partnerships that could be also a soft-deterrent measure. These trends are likely to continue into the future given the state of the play in multilateral institutions, and minilateralism may be the possible answer for the time being. If that be the case, Quad and other minilateral partnerships with like-minded countries in the Indo-Pacific and beyond could gain greater traction in the coming years. For India and its new security partners, it is also a way to develop technological responses to the multitude of space security threats by building better resilience and redundancy, thus minimizing disruptions and vulnerabilities. India and its space security partners need to also develop and enhance Space Domain Awareness (SDA) and thereby be better equipped to understand the space environment on all the threats including space weather and other intentional acts.

Having said that, there are areas that India needs to prioritize and be able to call out bad and irresponsible behaviour in space, as and when it happens. That India abstained from voting on the UN resolution to ban destructive direct-ascent ASAT weapon tests in December 2022 was a mistake that could have been avoided. Similarly, the Japan-US resolution that sought to reaffirm and extend critical norms against placing weapons of mass destruction (WMD) in space was a critical one and India could have been an active party co-sponsoring such proposals. This proposal came in the backdrop of the US reports that Russia is possibly developing an electromagnetic pulse (EMP) weapon that involves setting off a nuclear explosion in space. Even if only to generate an EMP, such explosion can lead to indiscriminate destruction of a large number of satellites in addition to creating a huge amount of space debris. It goes without saying that these will impact multiple sectors from civilian and military communications to PNT (position, navigation and timing) services and ISR (intelligence, surveillance and reconnaissance) as well as a host of other functions. Also, it is true that Outer Space Treaty (OST) of 1967 already prohibits placement of WMD in space, but given the trends wherein states are increasingly breaking norms with impunity, it appears that these norms, whether they exist through legal or political measures, need to be reiterated and recommitted by states. Geopolitical competition in space has driven to such an extent that states are willing to forego their own commitments in place of achieving narrow political goals. Therefore, there is an urgent need to reiterate some of the existing norms in new pledges and agreements so as to ensure space remains safe and secure for future generations.

In addition to active collaboration on developing norms and ensuring that outer space activities are regulated even in a limited manner, India needs to further these collaborations also to augment India's launch vehicle capabilities as well as find other ways to cooperate so that India and its partner countries can corner the market with an emphasis on launching heavier payloads. These are not easy and there are legal and regulatory challenges, but it is in the interest of India and its new security partners to make conscious political decisions to effect some changes.

Conclusion

India is yet to have a comprehensive national space policy, but despite that, there has been an appreciation for the increasing stresses that the space domain is confronted with. This is reflected in the Indian capability developments as well as institutional innovations to adapt to the changing space security conditions. This has also brought out the appreciation for developing and nurturing space security partnerships with a number of like-minded partners including the United States, Japan, France and Australia. Some of the shifts that India has shown such as the Quad consultations on space norms will likely pick up momentum in the coming years as space security developments appear to be on a slippery slope. But there are areas in which India needs to give up its ambiguity and adopt pro-active approaches in countering the growing space security threats.

Contributors (as of April 2025)

Dr. Scott Pace is the Director of the Space Policy Institute and a Professor of the Practice of International Affairs at George Washington University's Elliott School of International Affairs. In addition, he formerly served as the Director of the International Institute of Science and Technology Policy as well as the Master of Arts program in International Science and Technology Policy. Dr. Pace is also a member of the faculty of the Trachtenberg School of Public Policy and Public Administration. His research interests include civil, commercial, and national security space policy, and the management of technical innovation. Dr. Pace rejoined the faculty of the Elliott School in January 2021 after serving as Deputy Assistant to the President and Executive Secretary of the National Space Council from 2017-2020. From 2005-2008, he served as the Associate Administrator for Program Analysis and Evaluation at NASA. Prior to NASA, Dr. Pace was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy (OSTP). From 1993-2000, Dr. Pace worked for the RAND Corporation's Science and Technology Policy Institute (STPI). From 1990 to 1993, Dr. Pace served as the Deputy Director and Acting Director of the Office of Space Commerce, in the Office of the Deputy Secretary of the Department of Commerce. He received a Bachelor of Science degree in Physics from Harvey Mudd College in 1980; Master's degrees in Aeronautics & Astronautics and Technology & Policy from the Massachusetts Institute of Technology in 1982; and a Doctorate in Policy Analysis from the RAND Graduate School in 1989. Dr. Pace received the Order of the Rising Sun with Gold and Silver Stars from the Government of Japan in 2021, the Office of the Secretary of Defense Group Achievement Award in 2020, the NASA Outstanding Leadership Medal in 2008, the US Department of State's Group Superior Honor Award (GPS Interagency Team) in 2005, and the NASA Group Achievement Award (Columbia Accident Rapid Reaction Team) in 2004. He has been a member of the US Delegation to the World Radiocommunication Conferences in 1997, 2000, 2003, and 2007. He was also a member of the US Delegation to the Asia-Pacific Economic Cooperation Telecommunications Working Group, 1997-2000. More recently, he has served as a member of the U.S. Delegation to the UN Committee on the Peaceful Uses of Outer Space in 2009, 2011-17, and 2022-2024. Dr. Pace was a member of the NOAA Advisory Committee on Commercial Remote Sensing (ACCRES) from 2012-2017 and was the Vice-Chair. Dr. Pace is a former member of the Board of Trustees, Universities Space Research Association, a Member of the International Academy of Astronautics, an

Associate Fellow of the American Institute of Aeronautics and Astronautics, and a Fellow of the American Astronautical Society.

Mr. Bryan Clark is a senior fellow and Director of the Center for Defense Concepts and Technology at Hudson Institute. He leads studies there in naval operations and fleet architecture, electronic warfare, autonomous systems, military competitions, 5G telecommunications, and command and control. Before joining Hudson Institute, Bryan was a senior fellow at the Center for Strategic and Budgetary Assessments (CSBA), where he led studies for the DoD Office of Net Assessment, Office of the Secretary of Defense, and Defense Advanced Research Projects Agency on new technologies and the future of warfare. Prior to joining CSBA, he was special assistant to the Chief of Naval Operations and director of his Commander's Action Group, where he led development of Navy strategy and implemented new initiatives in electromagnetic spectrum operations, undersea warfare, expeditionary operations, and personnel and readiness management. During his 25-year Navy career, Bryan was an enlisted and officer submariner, serving in afloat and ashore submarine operational and training assignments including tours as chief engineer of two nuclear submarines and operations officer at the Navy's nuclear power training unit. He has a Master of Science degree in national security studies from the U.S. National War College, a Bachelor of Science degree in chemistry and philosophy from the University of Idaho and conducted graduate research in chemistry at the University of Washington.

Dr. John Klein, callsign "Patsy," is a subject matter expert on space strategy and also instructs space policy and strategy courses at the undergraduate, graduate, and doctorate levels at several universities in the Washington, DC area. He routinely writes on space strategy, deterrence, and the Law of Armed Conflict. He is the author of the books *Understanding Space Strategy: The Art of War in Space* (2019), *Fight for the Final Frontier: Irregular Warfare in Space* (2023), and *Space Warfare: Strategy, Principles and Policy* (2006 and 2024), along with a score of other book chapters and articles. Dr. Klein is also a retired Commander, United States Navy, receiving his commission through the Naval Reserve Officers' Training Corps program at Georgia Tech. He served for 22 years as a Naval Flight Officer, primarily flying in the S-3B Viking carrier-based aircraft. Dr. Klein supported combat operations in Iraq and Afghanistan. His tours included the Executive Officer of Sea Control Squadron Twenty Four and the final Commanding Officer of Sea Control Weapons School. Dr. Klein holds a bachelor's in Aerospace Engineering from Georgia Tech, a master's in Aeronautical Engineering from the Naval Postgraduate School, a master's in National Security and Strategic Studies from the Naval War College, and a Ph.D. in Strategic Studies from the University of Reading, England. Patsy is a distinguished graduate of the U.S. Naval Test Pilot School. He has over 2,700 flight hours in 27 different type aircraft and over 600 carrier arrested landings.

Kevin Pollpeter, **Ph.D.,** is the Director of Research for the China Aerospace Studies Institute (CASI). Before joining CASI, he was a Senior Research Scientist at the Center for Naval Analyses. Dr. Pollpeter is widely published on China national security issues, focusing on China's space program and information warfare. His recent publications include *To Be More Precise: BEIDOU, GPS, and the Emerging Competition in Satellite-Based PNT; Coercive Space Activities: The View from PRC Sources; The PLA and Intelligent Warfare: A Preliminary Analysis*; and *China's Space Narrative: Examining the Portrayal of the US-China Space Relationship in Chinese Sources and Its Implications for the United States.* A Chinese linguist, he holds an MA in international policy studies from the Monterey Institute of International Studies and a Ph.D. from King's College London.

Dr. Bleddyn Bowen is Associate Professor of Astropolitics at the School of Government and International Affairs (SGIA) and a Co-Director of the Space Research Centre (SPARC) at Durham University. He is the author of two monographs: *Original Sin: Power, Technology, and War in Outer Space* (Hurst, 2022) and *War in Space: Strategy, Spacepower, Geopolitics* (Edinburgh University Press, 2020); and multiple peer-reviewed articles. His research focuses on spacepower and strategic theory; space policy and politics; military space history; technology and modern warfare; international relations, security, and intelligence in space. Dr Bowen has advised, presented, and briefed for many government agencies and offices, including the UK Prime Minister's Policy Unit, the US National Space Council, the US Space Force, the European Space Agency, UK Ministry of Defence, UK Space Agency, the UK Parliament, and the Japanese Cabinet Office. Prior to joining Durham University, Dr Bowen taught and researched at the University of Leicester, King's College London, and Aberystwyth University.

Dr. FUKUSHIMA Yasuhito is an Associate Professor in the Faculty of Policy Management at Keio University. He holds a Ph.D. in Media and Governance from Keio University. Before assuming his current position in 2025, he served as a Research Fellow at the Center for the Promotion of Disarmament and Non-Proliferation of the

Japan Institute of International Affairs, and as a Senior Research Fellow in the Global Security Division of the National Institute for Defense Studies. His research focuses on space policy and space security. He has held visiting scholar positions at the Space Policy Institute of the Elliott School of International Affairs, George Washington University (August–October 2013), and at the University of California Institute on Global Conflict and Cooperation (September 2022–June 2023). His major publications include *Uchu to Anzen Hosho: Gunji Riyō no Chōryū to Gabanansu no Mosaku* [Order and Disorder in Space Security: Past, Present, and Future] (Chikura Shobo, 2020) and the co-authored chapter "Techno-Security Space Innovation," co-authored with Tai Ming Cheung, in *The Oxford Handbook of Space Security* (Oxford University Press, 2024).

Since October 2016, **Dr. Xavier Pasco** (Doct. In Pol. Sc.- Univ. of Paris-Sorbonne) has been Director of the Fondation pour la Recherche Stratégique (FRS) in Paris. Before that, Dr. Pasco has been in charge of space, high technology and security-related studies since the late eighties at FRS and CREST (*Center for Research and Evaluation of the relationships between Strategies and Technology*) associated to Ecole Polytechnique. Xavier Pasco has conducted several projects related to the use of space for security, notably in support of national and international organizations. For more than two decades, he has also coordinated several projects supported by the European Union (EC and EDA) and the European Space Agency. He has published numerous works (books and more than 100 articles or papers) on these topics. His latest books include « *La ruée vers l'espace : nouveaux enjeux géopolitiques* », Paris, Editions Tallandier, 2024 ; and "*Le nouvel âge spatial : de la Guerre froide au New Space*", Paris, CNRS Editions, 2017. He has also been giving lectures in the French Military School in Paris as well as at the Institute of Political Studies in Paris. He is the European Editor of the international academic review *Space Policy* and has been elected in 2012 as a full member of the *International Academy of Astronautics.* He has also been a member of the U.S. based *Secure World Foundation* (SWF) Advisory Committee.

Dr. Rajeswari (Raji) Pillai Rajagopalan is Resident Senior Fellow at the Australian Strategic Policy Institute (ASPI), Canberra, Australia. Prior to joining ASPI, she was the Director of the Centre for Security, Strategy & Technology (CSST) at the Observer Research Foundation, New Delhi. In 2020, she was Co-chair for a thematic group on "Strategic Technologies" for Science, Technology, and Innovation Policy (STIP 2020) Report, Office of Principal Scientific Advisor, Government of India and Department of Science and Technology, Government of India. In 2018-19, Dr. Rajagopalan was the Technical Advisor to the United Nations Group of Governmental Experts (GGE) on Prevention of Arms Race in Outer Space (PAROS). She was also a Non-Resident Indo-Pacific Fellow at the Perth USAsia Centre from April-December 2020. She was also a Visiting Professor at the Graduate Institute of International Politics, National Chung Hsing University, Taiwan in 2012. From 2018-2024, she was a senior Asia defence writer and a weekly columnist for *The Diplomat*, focusing on Asian strategic issues. Dr. Rajagopalan joined ORF after a five-year stint at the National Security Council Secretariat (2003-2007), Government of India, where she was an Assistant Director. Prior to joining the NSCS, she was Research Officer at the Institute of Defence Studies and Analyses, New Delhi. Dr. Rajagopalan has authored/ co-authored or edited more than a dozen books including *Assessing India's Perceptions of China's Nuclear Expansion* (2025), *In Pursuit of Nuclear Security: Reducing India's Risks to Nuclear Terrorism* (2024), ORF-Global Policy Journal Special Issue, *Future Warfare and Critical Technologies: Evolving Tactics and Strategies* (2024), *Military Ambitions and Competition in Space: the Role of Alliances* (2022), ORF-Global Policy Journal Special Issue, *Future Warfare and Technology: Issues and Strategies* (2022), *Military Ambitions and Competition in Space: The Role of Alliances* (2021), *Global Nuclear Security: Moving Beyond the NSS* (2018), *Space Policy 2.0* (2017), *Nuclear Security in India* (2015), *Clashing Titans: Military Strategy and Insecurity among Asian Great Powers* (2012), *The Dragon's Fire: Chinese Military Strategy and Its Implications for Asia* (2009). She has published research essays in edited volumes, and in peer reviewed journals such as *India Review*, *Strategic Studies Quarterly*, *Air and Space Power Journal*, *International Journal of Nuclear Law* and *Strategic Analysis*. She has also contributed essays to newspapers such as *The Washington Post*, *The Wall Street Journal*, *Times of India*, and *The Economic Times*. She has been invited to speak at international fora including the United Nations Disarmament Forum (New York), the UN Committee on the Peaceful Uses of Outer Space (COPUOS) (Vienna), Conference on Disarmament (Geneva), ASEAN Regional Forum (ARF) and the European Union. Dr. Rajagopalan tweets @raji143 and she can be reached on email: rajiraja@aspi.org.au; rajeswarirajagopalan@gmail.com

NIDS International Symposium on Security Affairs

National Security Space Policies in the Changing Environment

Wednesday, December 11, 2024

9:30-9:35 Opening Remarks: **KOBAYASHI Kazuhiro** (Parliamentary Vice-Minister of Defense)

9:35-10:05 Keynote Speech

Dr. Scott Pace (Professor of the Practice of International Affairs, Director of the Space Policy Institute, Director of the Institute for International Science and Technology Policy and Director of the MA International Science and Technology Policy program at the George Washington University's Elliot School of International Affairs)

10:20-11:50 Session 1 Changes in the Strategic Environment in the Space Domain

Chair: **Dr. FUKUSHIMA Yasuhito** (Senior Research Fellow, Global Security Division, Policy Studies Department, National Institute for Defense Studies)

Speakers:

Bryan Clark (Senior Fellow and Director of the Center for Defense Concepts and Technology at Hudson Institute)

Dr. John Klein (Senior Fellow and Strategist at Falcon Research, Inc.)

Dr. Kevin Pollpeter (Director of Research at the Department of the Air Force's China Aerospace Studies Institute)

Discussant: **Dr. AOKI Setsuko** (Professor of Law at Keio University Law School)

13:30-15:20 Session 2 Major Country Policies in the Changing Environment

Chair: **IIDA Masafumi** (Director of the Security Studies Department at the National Institute for Defense Studies)

Speakers:

Dr. Bleddyn Bowen (Associate Professor in the School of Government and International Affairs at Durham University)

Dr. FUKUSHIMA Yasuhito (Senior Research Fellow, Global Security Division, Policy Studies Department, National Institute for Defense Studies)

Dr. Xavier Pasco (Director of the Foundation for Strategic Research)

Dr. Rajeswari (Raji) Pillai Rajagopalan (Resident Senior Fellow, Australian

Strategic Policy Institute)
Discussant: **Dr. SUZUKI Kazuto** (Professor of Science and Technology Policy at the University of Tokyo's Graduate School of Public Policy and Director of the Institute of Geoeconomics)

15:35-16:35 Session 3 Wrap-up Discussion
Chair: **Dr. FUKUSHIMA Yasuhito** (Senior Research Fellow, Global Security Division, Policy Studies Department, National Institute for Defense Studies)

16:35-16:40 Closing Remarks: **IMAKYUREI Manabu** (President, National Institute for Defense Studies)

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