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Japan's Space Program
Shifting Away from "Non-Offensive" Purposes?

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- "'Japan Is Back': Autonomy and Balancing amidst an Unstable China-U.S.-Japan Triangle" (*Asia & the Pacific Policy Studies*, 2018).

Executive Summary

Japan's space program has evolved greatly since the end of the Cold War, driven by a rapidly changing geopolitical environment and tailored by the emergence of an "intra-alliance hedging strategy". Concerns about the United States' readiness and ability to fulfill its security commitments have led Tokyo to enact security reforms to enhance its value as an ally while moving toward a more autonomous defense posture to prepare for the worst-case scenario of abandonment. This has transformed the Japanese space program from one based on the principle of peaceful use of space to a program aimed at ensuring national security through non-offensive means.

The security track of Japan's space program currently aims at boosting the combat prowess of the Self-Defense Forces (SDF) in accordance with the non-offensive principle, and at maintaining in all circumstances the ability to use space-based assets for this purpose. Therefore, the country is not militarizing outer space beyond what is necessary to guarantee the proper functioning of the SDF.

Modern warfare puts a premium on intelligence and interoperability between different military elements. Information-gathering and maritime domain awareness devices, positioning services and military communications satellites provide Japan with better understanding of its environment, help anticipate and tackle threats, and allow greater interoperability between the SDF services. And, because national security increasingly depends on space operations, space situational awareness has taken prominence in Japan's space program as a way to protect space assets against orbital debris and anti-satellite weapons.

Partly due to domestic legal, political and budget constraints, cooperation with international partners remains crucial for Japan to ensure national security and develop key space assets. With both the United States and India, Tokyo is collaborating on positioning services, maritime domain awareness and space situational awareness to help coordinate troop movements among allies, boost sea and ocean monitoring across the Asia-Pacific, and protect space-based assets. Japan has also partnered with European countries to jointly develop space technologies, pursue deep-space exploration, cooperate on positioning services, and set international norms for space activities.

Japan has yet to join the big three in the 21st century military space race. Compared to the United States, China and Russia, Japan is still inhibited by domestic constraints when it comes to military-related affairs, and thus the use of space for security purposes. But, although Japan's space program is today almost purely non-offensive in nature, the intra-alliance hedging strategy implies a potential weaponization of space, beyond the non-offensive principle. This offensive use of space could materialize through the acquisition of strike capabilities, and the development of Japan's own anti-satellite weapons or of active defense systems for space assets.

Whether Japan will follow this path depends on a variety of factors. On the domestic side, political stability will be decisive for the swift adaptation of Japan's space program to its environment. Internationally, the evolution of the United States' grand strategy and involvement in the Asia-Pacific will be the most influential factor. The more Tokyo doubts Washington's ability and willingness to fulfill its security commitments, the more intense its intra-alliance hedging strategy becomes, further penetrating and transforming the Japanese space program.

List of Abbreviations

AIS	Automatic Identification System
ALOS	Advanced Land Observing Satellite
ASAT	Anti-satellite weapons
ASDF	Air Self-Defense Force
A2/AD	Anti-access/area denial
BMD	Ballistic missile defense
BSGC	Bisei Space Guard Center
CALLISTO	Cooperative Action Leading to Launcher Innovation for Stage Toss-back Operation
CNES	French National Centre for Space Studies
COPUOS	Committee on the Peaceful Uses of Outer Space
CSD	Collective self-defense
C4ISR	Command, control, communications, computers, intelligence, surveillance and reconnaissance
DLR	German Aerospace Center
EFP	Explosively formed projectile
ESA	European Space Agency
EU	European Union
GPS	Global positioning system
GSOMIA	General Security of Military Information Agreement
HBTSS	Hypersonic and Ballistic Tracking Space Sensor
HGV	Hypersonic glide vehicle
ICBM	Intercontinental ballistic missile
IGS	Information-gathering satellite
INS	Inertial navigation system
IRNSS	Indian Regional Navigation Satellite System
ISR	Intelligence, surveillance and reconnaissance

ISS	International Space Station
JASSM-ER	Joint Air-to-Surface Standoff Missile-Extended Range
JAXA	Japan Aerospace Exploration Agency
JSM	Joint strike missile
JSpOC	Joint Space Operations Center
KITE	Kounotori Integrated Tether Experiment
KSGC	Kamisaibara Space Guard Center
MASCOT	Mobile Asteroid Surface Scout
MDA	Maritime domain awareness
MDDF	Multi-Domain Defense Force
MEF	Marine Expeditionary Force
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MIMO	Multiple-input multiple-output
MMX	Martian Moons eXploration
MoD	Ministry of Defense
MOTR	Multi-object tracking radar
MSDF	Maritime Self-Defense Force
NDPG	National Defense Program Guidelines
NICT	National Institute of Information and Communications Technology
NSC	National Security Council
NSS	National Security Strategy
ONSP	Office of National Space Policy
PAC	Patriot Advanced Capability
PALSAR	Panchromatic L-band Synthetic Aperture Radar
PLARF	People's Liberation Army Rocket Force
PPWT	Draft Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects
QZSS	Quasi-Zenith Satellite System

SDF	Self-Defense Forces
SDMU	Space Domain Mission Unit
SLATS	Super Low Altitude Test Satellite
SLOCs	Sea lines of communication
SOS	Space Operations Squadron
SPAISE	Space-based AIS Experiment
SSA	Space situational awareness
STOVL	Short take-off and vertical landing
STRATCOM	Strategic Command

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Introduction

The bipolar setting of the Cold War provided Japan with ample security. The country was at the forefront of the struggle against the Soviet Union and the communist ideology in Asia, and its geostrategic value was such that Tokyo could count on the United States as a reliable and powerful partner for protection. After the collapse of the Soviet Union, North Korea and China took over as Tokyo's main security challenges, while Japanese confidence in the willingness and ability of the United States to protect its East Asian ally declined. This is particularly the case vis-à-vis China. The USA's biggest trading partner is also a nuclear power that built up an anti-access/area denial (A2/AD) strategy, making a potential American military intervention to defend Japan increasingly costly, and perhaps prohibitively so.[1]

The Japan-US alliance remains paramount to deter Beijing and Pyongyang from resorting to force. Japan's fear of being abandoned by the United States consequently led the country to adopt an "intra-alliance hedging strategy."[2] Tokyo has implemented security reforms to enhance its value as an ally, hoping that Washington would see more benefits in defending Japan, while moving toward a more autonomous defense posture to prepare for the worst-case scenario of abandonment.

To prove its worth to the United States, the Japanese government reinterpreted the country's constitution in July 2014 to allow the exercise of the right of collective self-defense (CSD).[3] Article 9 had hitherto restricted the use of armed forces for Japan's defense. CSD enables, under certain conditions, the Self-Defense Forces (SDF) to fight alongside US forces in

1. A. F. Krepinevich Jr., "The Pentagon's Wasting Assets: The Eroding Foundations of American Power," *Foreign Affairs*, 2009, Vol. 88, No. 4, p. 18; A. L. Oros, *Japan's Security Renaissance: New Policies and Politics for the Twenty-First Century*, New York: Columbia University Press, 2017, p. 174. The probability that Washington would fail to fulfill its security commitments is greater if one assumes that a conflict between Japan and China would likely break out over the Senkaku/Diaoyu dispute. The US has no strategic interest in or emotional tie with the uninhabited islands. E. Resnick, "Dubious Deterrence in the East China Sea," *RSIS Commentaries*, S. Rajaratnam School of International Studies, June 2014, No. 107, p. 2.

2. L. P. Fatton and O. Foppiani, *Japan's Awakening: Moving toward an Autonomous Security Policy*, Bern: Peter Lang, p. 319.

3. Japan's Ministry of Foreign Affairs, *Cabinet Decision on Development of Seamless Security Legislation to Ensure Japan's Survival and Protect its People*, July 2014, www.mofa.go.jp.

wartime even in the absence of an attack on Japan.[4] The government also introduced new security bills, adopted by the Diet in September 2015 and enforced in March 2016, that permit the SDF to support and protect US forces engaged in peacetime activities beneficial for the defense of Japan.[5]

Regarding Japan's increasingly autonomous defense posture, the National Defense Program Guidelines (NDPG) released in late 2013 called for reforming the SDF into a flexible and mobile Dynamic Joint Defense Force and for deepening interoperability between the three SDF services.[6] Until recently, the services had almost no direct relations on operational matters and were more integrated with their respective American counterparts than with each other. Greater jointness between the SDF services means more autonomy from US forces.[7] The move toward autonomous defense has also generated a duplication of US forces based in Japan. An obvious example was the creation, in April 2018, of Japan's first amphibious brigade, which partly replicates the capabilities of the III Marine Expeditionary Force (MEF) headquartered in Okinawa.[8]

The National Security Strategy (NSS) released in December 2013 reflected the intra-alliance hedging strategy. While characterizing the alliance with the United States as "the cornerstone of Japan's security," the strategy noted that, "to ensure national security, Japan needs to first and foremost strengthen its own capabilities and the foundation for exercising those capabilities."[9] Similarly for the National Security Council (NSC), created the same month. The body acts as a platform that facilitates security cooperation with the United States, coordinating with its American counterpart. It also provides the Japanese government with a well-regulated mechanism to formulate security policies independent from Washington and to build a more autonomous defense posture.[10]

4. Japan can exercise the right of CSD if three broad conditions are fulfilled: if an attack against a country "in a close relationship with Japan" endangers the latter's survival and Japanese people's rights; if there is no other means to respond, and if the use of force is kept to the strict minimum.
5. Japan's Ministry of Foreign Affairs, *Japan's Legislation for Peace and Security: Seamless Responses for Peace and Security of Japan and the International Community*, March 2016, www.mofa.go.jp.
6. Japan's Ministry of Defense, *National Defense Program Guidelines for FY2014 and Beyond*, December 2013, pp. 7-8 and 17, www.mod.go.jp.
7. L. P. Fatton, "'Japan is Back': Autonomy and Balancing amidst an Unstable China-US-Japan Triangle," *Asia & the Pacific Policy Studies*, 2018, Vol. 5, No. 2, p. 273.
8. Kyodo News, "Japanese Self-Defense Forces Launch 1st Amphibious Fighting Unit," April 2018, https://english.kyodonews.net.
9. Japan's Cabinet Office, *National Security Strategy*, December 2013, pp. 14 and 20, http://japan.kantei.go.jp.
10. Japan's Ministry of Defense, *Defense of Japan 2014*, p. 125, https://www.mod.go.jp.

Japan's intra-alliance hedging strategy extends to outer space.[11] This is because, first, the use of space has become vital to ensure national security. Space-based assets allow Japan to monitor its environment, anticipate threats and boost interoperability between the SDF services while bolstering cooperation with Washington. The ability of the Japanese ballistic missile defense (BMD) system, jointly developed with the United States, to detect and intercept North Korean and Chinese missiles also partly depends on space-based assets. Second, Tokyo is besieged by the same doubts about Washington's capacity and resolve to defend Japan in and through the space domain, and the Japanese dependence on the United States in this domain has been at least as important as in the conventional domains of warfare.

The intra-alliance hedging strategy has gradually transformed Japan's space program from one based on the principle of peaceful use of space, involving exclusively civilian entities and technologies, to a program aimed at ensuring national security through non-offensive means. This early post-Cold War evolution is discussed in the first section. The second section turns to ongoing space-related projects dedicated to boost the combat prowess of the SDF in accordance with the non-offensive principle. It shows that the current objective of Japan's space program is to maintain in all circumstances the ability to use space-based assets for combined SDF operations. Japan's space cooperation with the United States, India and European countries is reviewed in the third section. The final section discusses the potential for further evolution of the Japanese program toward a "weaponization" of space, beyond the non-offensive principle.

11. For a similar argument, see: C. Hughes, "Japanese Security Turns to the Stars," *East Asia Forum*, May 2019, www.eastasiaforum.org

From "Peaceful" to "Non-Offensive" Use of Space

The disarmament terms enshrined in the 1951 Japan-US security treaty forbade Tokyo to develop aviation and aerospace technologies. Japan subsequently obtained more flexibility regarding space activities, although a resolution adopted by the Japanese Diet in May 1969 stated that outer space should be used exclusively for "peaceful purposes."[12] This was interpreted as preventing the use of space for military purposes, and implied that space activities could be conducted only by the civilian sector and for the development of civilian technologies. The 1978 Fundamental Policy of Japan's Space Activities, the first-ever government document regulating this domain, enshrined the principle of peaceful use of space.[13]

Consequently, the Japanese space program was for decades oriented toward the development of civilian technologies, resulting in rockets such as the *L-4S* and later *H-II* and the orbiting in 1970 of Japan's first satellite, *Ōsumi*. The latter being largely made of American technologies, the country's first indigenously produced satellite, the meteorological and communications satellite *KIKU-3*, was launched in 1981.[14] In 1990, under pressure from Washington, Japan opened its non-R&D satellite market to American competition, forcing a reorientation of space projects toward technologically oriented assets.[15] This eventually led to important achievements such as the robotic astronaut *Kirobo*, assigned in 2013 to International Space Station (ISS) missions, and *Hayabusa*, launched in 2003 and which became the first spacecraft to successfully land on an asteroid and return to earth.[16]

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12. Japan's House of Representatives, W*agakuni ni okeru uchū no kaihatsu oyobi riyō no kihon ni kansuru ketsugi*, [Resolution related to the basics of our country's development and use of space], May 1969, www.jaxa.jp.

13. A. L. Oros, *Normalizing Japan: Politics, Identity, and the Evolution of Security Practice*, Stanford: Stanford University Press, 2008, p. 133.

14. Japan Aerospace Exploration Agency, "Engineering Test Satellite IV 'KIKU-3' (ETS-IV)," http://global.jaxa.jp.

15. K. Suzuki, "An Asian Space Partnership with Japan?" in R. P. Rajagopalan and N. Prasad (eds.), *Space India 2.0: Commerce, Policy, Security and Governance Perspectives*, New Delhi: Observer Research Foundation, 2017, pp. 277-278.

16. A. Vijayakumar, "To Infinity and Beyond: Japan's Rise as a Space Power," *The Diplomat*, January 2020, https://thediplomat.com.

Deploying a ballistic missile defense system with the US: the legal and institutional reforms

Japan's space program entered new realms after the Cold War, mostly due to the growing North Korean threat. In May 1993 Pyongyang tested a *Nodong-1*, its first missile able to reach parts of Japanese territory, and in August 1998 a *Taepodong-1* rocket flew over Japan.

To protect against North Korea, Japan and the United States have developed a BMD system, which Tokyo decided to deploy in 2003.[17] The decision was controversial because it arguably violated the 1969 Diet resolution on the peaceful use of space. BMD assets had a space dimension, were of a military nature and were operated by the SDF. The Japanese government emphasized the defensive nature of BMD, and the interpretation of the term "peaceful purposes" enshrined in the resolution gradually changed from its traditional meaning as "non-military" to "non-offensive."[18]

Another legal issue was related to the ban on CSD. Until 2014, the official interpretation given to Article 9 of the Japanese constitution prevented the SDF from operating alongside US forces if Japan itself was not under direct attack. As Japan possessed limited information-gathering instruments of its own, whether satellites or ground-based radar, the country depended on the United States to detect and track missiles, a prerequisite for its BMD system to intercept them.[19] Intelligence-sharing between the two countries could violate the ban on CSD. The Cabinet Legislation Bureau dismissed this argument in January 2004, arguing that the transfer of information between the SDF and US forces did not contravene the ban because the objective was the defense of Japan itself.[20]

As the North Korean threat grew, the Japanese government realized that its dependence on the United States in security-related space activities was problematic. Some worried about Japan's reliance on the Americans for information on North Korea's missile and nuclear operations, as Washington might not provide Tokyo with all the data available if doing so ran against its interests.[21] The intelligence gap provided Washington with substantial control over Tokyo's security policy and response to

17. K. E. Calder, *Pacific Alliance: Reviving US-Japan Relations*, New Haven: Yale University Press, 2009, p. 146.
18. Oros, *Normalizing Japan*, p. 164.
19. Calder, *Pacific Alliance*, p. 146.
20. Oros, *Normalizing Japan*, pp. 166-167.
21. *Ibid.*, p. 142.

contingencies. This is the reason why the US was initially reluctant to see Japan develop an indigenous satellite network, saying publicly and on several occasions during the late 1990s and 2000s that this would unnecessarily duplicate American capabilities.[22]

Yet the first Japanese space project endowed with an obvious military dimension resulted in the deployment of information-gathering satellites (IGSs). The government took the decision after North Korea's *Taepodong-1* rocket flew over Japan in 1998 without Tokyo receiving any information from its American ally.[23] The first two satellites were put into orbit in March 2003. Similar to BMD, the government denied violating the 1969 Diet resolution, saying IGSs were purely non-offensive assets dedicated to supporting the defensive duties of the SDF.[24] Moreover, IGSs were multi-purpose satellites, used not only by the Japan Defense Agency but also by other government entities.[25] Data gathered by the satellites were first transmitted to the Cabinet Satellite Intelligence Center before being dispatched to government entities upon request.[26]

The expansion of Japan's space program to new realms required institutional and legal reforms. These reforms reflected Tokyo's ambition to handle space-related activities more autonomously. The Defense Intelligence Headquarters was established in 1997 within the SDF Joint Staff Council to strengthen intelligence gathering and analysis and reduce reliance on the United States.[27] To boost research and technological productivity, the government decided in 2002 to merge three institutions active in space activities – the Institute of Space and Astronautical Science, the National Aerospace Laboratory and the National Space Development Agency – into a new institution called the Japan Aerospace Exploration Agency (JAXA).[28] The law establishing JAXA emphasized that satellite-related activities had to be conducted "only for peaceful purposes," and that

22. P. Midford, *Rethinking Japanese Public Opinion and Security: From Pacifism to Realism?* Stanford: Stanford University Press, 2011, p. 233, endnote 56. The United States nonetheless extended technical and human assistance to Japan after the conclusion of a memorandum of understanding in August 1999. F. Ota, *The US-Japan Alliance in the 21st Century: A View of the History and a Rationale for its Survival*, Folkestone: Global Oriental, 2006, pp. 122-123.

23. K. Suzuki, "Space Policies of Japan, China and India: Comparative Policy Logic Analysis, *Ritsumeikan kokusai kenkyū*, The International Studies Association of Ritsumeikan University, 2019, Vol. 31, No. 5, p. 54.

24. Oros, *Normalizing Japan*, p. 139.

25. A similar interpretation, that civilian space technologies could be used for defense purposes, had already been made by the government in the mid-1980s to justify the acquisition by the Japan Defense Agency of imagery bought from American and French satellites.

26. A. L. Oros and Y. Tatsumi, *Global Security Watch: Japan*, Santa Barbara: Praeger, 2010, p. 42.

27. R. J. Samuels, *Securing Japan: Tokyo's Grand Strategy and the Future of East Asia*, Ithaca and London: Cornell University Press, 2007, p. 104.

28. Japan Aerospace Exploration Agency, "Introduction to JAXA," https://global.jaxa.jp.

the agency fell under the responsibility of the Ministry of Education, Culture, Sports, Science and Technology (MEXT).[29]

The 2008 Basic Space Law: national security and space autonomy

A critical juncture in Japan's space program came in 2008, amid renewed tensions on the Korean Peninsula. Even though the third and fourth IGSs were orbited in 2006 and 2007, Japan still relied on American satellites for military-grade imagery, first- and second-generations IGSs having a relatively low resolution of 60 to 100 centimeters.[30] Japanese satellites also lacked early-warning capabilities. And, although Tokyo obtained greater access to US intelligence through the 2007 General Security of Military Information Agreement (GSOMIA), this did not solve the problem of possible biases in the delivery of information by Washington.

The Basic Space Law, adopted in May 2008, innovated in three aspects. First, Article 14 explicitly allowed the use of space "to contribute to the national security of Japan."[31] While sticking to the non-offensive principle, the law opened the door to military-grade intelligence and early-warning satellites.

Second, the law accelerated institutional reforms. It created within the Cabinet Office the Strategic Headquarters for Space Development, later renamed Strategic Headquarters for Space Policy. The prime minister would serve as its director-general and the newly established position of minister for space as one of its two vice directors-general, the other being the chief cabinet secretary. The authority in space policymaking switched away from MEXT and was concentrated in the cabinet, reflecting a desire for centralized political control and well-regulated decision-making.

The third innovative aspect of the law was to foster Japan's move toward space autonomy. Article 15 highlighted the importance "for the State to have the capability to independently develop, launch, track and operate artificial satellites, etc." Subsequent strategy documents continued this effort. Based on the principle "that a country's security depends first and foremost on its own efforts," the 2010 NDPG called for "strengthening

29. Japan Aerospace Exploration Agency, *Law Concerning Japan Aerospace Exploration Agency*, December 2002, https://global.jaxa.jp.

30. T. Shinoda, "Costs and Benefits of the US-Japan Alliance from the Japanese Perspective," in T. Inoguchi, G. J. Ikenberry and Y. Sato (eds.), *The US-Japan Security Alliance: Regional Multilateralism*, New York: Palgrave Macmillan, 2011, p. 24.

31. Japan Aerospace Exploration Agency, *Basic Space Law (Law No. 43 of 2008)*, May 2008, http://stage.tksc.jaxa.jp.

information gathering and communications functions" in outer space.[32] The 2013 NSS promoted the use of space "in a manner that contributes to national security," including through "information-gathering and analysis, maritime domain awareness, telecommunication, positioning, navigation and timing" as well as "space situational awareness."[33]

32. Japan's Ministry of Defense, *National Defense Program Guidelines for FY2011 and Beyond*, December 2010, p. 5, www.mod.go.jp.
33. Japan's Cabinet Office, *National Security Strategy*, pp. 19-20.

Backing the Self-Defense Forces with Space-Based Assets

The threat posed by China rose to prominence in the early 2010s. Although the country's growing military might had worried Tokyo for decades, Japanese concerns about Chinese intentions had been based hitherto on fairly abstract behavioral and statistical elements. A collision between a Chinese trawler and two Japanese coastguard vessels in the East China Sea during the autumn of 2010 and Japan's subsequent nationalization of three disputed islands in September 2012 triggered the most severe deterioration of bilateral relations since the end of the Second World War. The primarily geopolitical and long-term Chinese menace became a concrete threat to Japan's territorial integrity. The Japanese space program had to be adapted once again in order to face an opponent more powerful and multifaceted than North Korea.

Based on the 2008 Basic Space Law, JAXA's mandate expanded in 2012 to the development of dual-use technologies and the provision of expertise to the Ministry of Defense (MoD), while the Basic Plans on Space Policy issued by the Office of National Space Policy (ONSP), also created in 2012 within the Cabinet Office, have focused on developing and protecting space-based assets valuable for national security.[34] The second Basic Plan released in 2013 prioritized intelligence, surveillance and reconnaissance (ISR), maritime domain awareness (MDA), space situational awareness (SSA) and the Quasi-Zenith Satellite System (QZSS), the Japanese version of the American Global Positioning System (GPS).[35] The 2015 Basic Plan followed the same approach, but put even greater emphasis on SSA in view of the risks posed to space-based assets by orbital debris and anti-satellite (ASAT) weapons, and prioritized the military rather than civilian aspects of Japan's space program.[36] The latest Basic Plan, approved by the government in June

34. R. S. Wilson, "Japan's Gradual Shift toward Space Security", Center for Space and Policy Strategy, The Aerospace Corporation, May 2020, p. 5, https://aerospace.org. The first Basic Plan was released by the Strategic Headquarters for Space Development in June 2009.
35. Office of National Space Policy, Japan's Cabinet Office, *Uchū kihon keikaku* – Basic Plan on Space Policy), January 2013, pp. 8-9, www8.cao.go.jp.
36. Office of National Space Policy, Japan's Cabinet Office, *Uchū kihon keikaku* – Basic Plan on Space Policy), January 2015, pp. 4-6, www8.cao.go.jp.

2020, seeks to achieve superiority in outer space by bolstering Japan's autonomy in this domain and deepening cooperation with international partners, the United States in particular.[37] The Japanese space program has rapidly moved forward in the security domain based on these plans.

Keeping track of missile activities

The threat from both Chinese and North Korean missiles grew tremendously during the 2010s. The pace of Pyongyang's missile and nuclear testing accelerated following the death of Kim Jong-il in December 2011. This led to breakthroughs in terms of missile propulsion, range, stealthiness and accuracy as well as the ability to fire numerous missiles simultaneously. North Korea also perfected its nuclear technology, claiming in September 2017 that it had detonated a hydrogen bomb dedicated "to be placed at the payload" of an intercontinental ballistic missile (ICBM).[38] In the meantime, China had reinforced its A2/AD strategy with a wide array of cruise and ballistic missiles to counter the military might of the United States in Asia.

The SDF today operates six Air Defense Missile Groups endowed with the lower-tier *Patriot Advanced Capability* (PAC) BMD batteries.[39] The planned commission in March 2021 of a second *Maya*-class vessel will push up to eight the number of destroyers equipped with the mid-course *Aegis* BMD system.[40] The proper functioning of Japanese BMD infrastructures depends first and foremost on the ability to detect and track missiles, and thus on effective information-sharing with the United States and, increasingly, on Japan's own intelligence capabilities.

The first third-generation optical IGSs, *Optical-5*, mainly dedicated to better monitor the missile activities of neighboring countries, was launched in March 2015, followed by *Optical-6* in February 2018 and *Optical-7* in February 2020.[41] Japan also plans to orbit the *Advanced Land Observing Satellite-3* (*ALOS-3*), a state-of-the-art optical satellite, in fiscal 2020.[42] Optical satellites have a finer resolution than radar satellites (less than 40

37. Office of National Space Policy, Japan's Cabinet Office, *Uchū kihon keikaku* – Basic Plan on Space Policy), June 2020, p. 4, www8.cao.go.jp Commenting upon the Basic Plan, Prime Minister Shinzō Abe said he wanted to transform Japan into "a future independent space power." M. Yamaguchi, "Japan to boost space cooperation with US in revised policy," *Associated Press*, June 2020, https://apnews.com.

38. T. Karube, "N. Korea Conducts 6th Nuclear Test, Claims H-Bomb to Be Put on ICBM," *Kyodo News*, September 2017, https://english.kyodonews.net.

39. Japan's Ministry of Defense, "Organizational Diagram of the Self-Defense Forces," www.mod.go.jp.

40. Kyodo News, "Japan Deploys New Aegis Destroyer, to Get Improved Interceptor," March 2020, https://english.kyodonews.net.

41. W. Graham, "H-IIA Conducts IGS Optical 7 Launch," *NASASpaceFlight.com*, February 2020, www.nasaspaceflight.com.

42. T. Tadono *et al.*, "Advanced Optical Satellite (ALOS-3), Overviews," *Japan Aerospace Exploration Agency*, January 2018, www.eorc.jaxa.jp.

centimeters for third-generation IGSs) but need a clear sky over the target.[43] Because they capture radio waves reflected from the ground, radar satellites are not affected by weather conditions and can operate at night. IGSs *Radar-5* and *-6* were put into orbit in March 2017 and June 2018, respectively, adding to two other second-generation radar satellites.[44] Japan currently possesses four radar IGSs (plus one spare) and three optical IGSs, and plans to develop a constellation of eight satellites of both types plus two relay satellites.

To face the North Korean and Chinese missile threats, Japan is also working on space-based dual-band infrared sensors with early-warning functions, which could be piggybacked on *ALOS-3* for testing.[45] The 2020 Basic Plan on Space Policy further endorsed the start of a joint study with the United States on small early-warning satellites to be used in constellation.[46]

Another research agenda, pursued by JAXA, is related to a Super Low Altitude Test Satellite (SLATS), named *Tsubame*, which completed trial in late 2019.[47] Because they orbit at an altitude lower than 300 kilometers, such satellites provide high-resolution optical imagery and, if used in constellation, can track hypersonic missiles, based on the model of the US Hypersonic and Ballistic Tracking Space Sensor (HBTSS) system.[48] SLATSs are important to tackle the hypersonic glide vehicles (HGVs) deployed by the Chinese People's Liberation Army Rocket Force (PLARF). Because of their velocity, maneuverability and low-altitude flight, these HGVs reduce the tracking ability of high-altitude space sensors and ground-based radars.[49]

Streamlining military communications

Tokyo is deploying X-band military communications satellites to reinforce interoperability between the three SDF services, streamlining communications to better counter the North Korean threat and China's

43. Gunter's Space Page, "IGS-Optical 5, 6, 7," https://space.skyrocket.de.
44. W. Graham, "Japan's H-IIA Rocket Launches IGS Radar 6," *NASASpaceFlight.com*, June 2018, www.nasaspaceflight.com; Gunter's Space Page, "IGS-Radar 3, 4, 5, 6, Spare," https://space.skyrocket.de.
45. National Space Policy Secretariat, Japan's Cabinet Office, *Implementation Plan of the Basic Plan on Space Policy (revised FY2017)*, December 2017, www8.cao.go.jp.
46. Office of National Space Policy, *Uchū kihon keikaku*, 2020, p. 14.
47. National Research & Development Agency, Japan Aerospace Exploration Agency, "JAXA terminates the operation of TSUBAME, a Super Low Altitude Test Satellite (SLATS)," October 2019, https://global.jaxa.jp.
48. N. Strout, "The MDA Is Still in Charge of Hypersonic-tracking Space Sensors," *C4ISRNet*, March 2020, www.c4isrnet.com.
49. P. Fraioli (ed.), "Hypersonic Weapons and Strategy Stability," *Strategic Comments*, International Institute for Strategic Studies, 2020, Vol. 26, No. 4, www.iiss.org.

growing assertiveness in the East and South China Seas, and to project power farther away from Japanese shores. *Kirameki-2*, the first satellite owned and operated by the MoD, was put into orbit over the Indian Ocean in January 2017.[50] *Kirameki-1* was launched over the Pacific Ocean in April 2018 and *Kirameki-3* is scheduled to be orbited over Japan by fiscal 2022. The positioning function of QZSS is, along with military communications satellites, key to coordinate troop movements and to enable the SDF to strike targets with precision. QZSS operates since 2018 around the 135th meridian east based on four *Michibiki* satellites, and another three satellites are scheduled to be launched by fiscal 2023.[51]

Maritime domain awareness and environment monitoring

Japan has also deployed space-based assets for MDA operations that, in terms of national security, focus on enforcing international sanctions against North Korea, spotting ship-to-ship transfers of banned products, for example, and on monitoring Chinese maritime activities.[52] China's naval power-projection capability has expanded over the years, leading to an overlap of Chinese and Japanese maritime activities along the Ryūkyū Arc. Since 2012, China regularly sends vessels into Japanese territorial waters near the Senkaku Islands (claimed by Beijing under the name Diaoyu) to challenge Japan's control over the territory.

Besides other earth observation satellites, Japan's MDA capabilities in space chiefly rely on ALOSs. *ALOS-2*, orbited in 2014, is equipped with an automatic identification system (AIS, namely the Space-based AIS Experiment 2 or SPAISE2), which locates and identifies vessels by receiving their beacons' signals.[53] *ALOS-2* is also endowed with the Panchromatic L-band Synthetic Aperture Radar-2 (PALSAR-2), which allows ship tracking without AIS transmission, a useful asset because warships as well as vessels engaged in illegal transshipments often shut their AIS signals down.[54] The combination of SPAISE2 and PALSAR-2 provides Japan with a

50. Kyodo News, "Japan's Defense Ministry Successfully Launches First Communications Satellite," January 2017, www.japantimes.co.jp ; Y. Nagai *et al.*, "Assessment of Space Programs and Policies for Regional Cooperation in the Asia Pacific Region," paper presented at the 68th International Astronautical Congress, Adelaide, Australia, 25-29 September 2017, p. 2, http://eprints.nias.res.in.

51. National Space Policy Secretariat, Japan's Cabinet Office, "Overview of the Quasi-Zenith Satellite System (QZSS)," https://qzss.go.jp.

52. MDA is defined by the International Maritime Organization as "the effective understanding of any activity associated with the maritime environment that could impact upon the security, safety, economy or environment." International Maritime Organization, *Amendments to the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual*, May 2010, p. 1, www.imo.org.

53. Gunter's Space Page, "ALOS 2 (DAICHI 2)," https://space.skyrocket.de.

54. European Space Agency, "ALOS-2," https://earth.esa.int.

comprehensive and all-weather sea and ocean monitoring capacity.[55] The country plans to orbit *ALOS-4* in fiscal 2020, upgraded with the SPAISE3 and PALSAR-3 devices.[56]

Protecting space assets through space situational awareness

These space-based assets provide Japan with better understanding of its environment, help anticipate and tackle threats, and allow greater interoperability between the SDF services, boosting their combat prowess. As national security increasingly depends on space operations, SSA has taken prominence in Japan's space program.

Moreover, the Chinese threat has materialized in outer space as well. In January 2007, Beijing destroyed one of its old weather satellites using a kinetic ASAT. If the test demonstrated China's ability to target space-based assets, it produced a swarm of over 3,300 pieces of debris that endangered not only other countries' space operations, but also China's.[57] This, and the fact that the test triggered a diplomatic uproar, prompted Beijing to develop non-kinetic ASATs. These may include cyberattacks, spoofing, jamming, dazzling and killer satellites.[58] According to a report published in 2019 by the Japanese MoD, the main threats to Japan's space-based assets are Chinese ground- and aircraft-launched ASAT missiles, killer satellites, laser weapons and jammers.[59]

55. S. Shimizu *et al.*, "Ship Monitoring in Japan Using SAR, AIS and Earth Observation Satellites," paper presented at the 2019 International Geoscience and Remote Sensing Symposium, Yokohama, Japan, 28 July–2 August 2019, https://doi.org.

56. Japan Aerospace Exploration Agency, "Advanced Land Observing Satellite-4 (ALOS-4)," https://global.jaxa.jp; National Space Policy Secretariat, *Implementation Plan of the Basic Plan on Space Policy (revised FY2017).*

57. As of 2017, an estimated 2,800 pieces of debris originating from the 2007 test were still in orbit. Y. Otani and N. Kohtake, "Applicability of Civil and Defense Dual Use to Space Situational Awareness System in Japan," *Space Policy*, 2019, Vol. 47, p. 141.

58. Cyberattacks can be used to paralyze the terrestrial facilities that operate space-based assets or to disrupt information-sharing between ground and space; *spoofing* refers to the provision of false information about a satellite's status or position, which can lead the operator to wrongly alter its functioning or to modify its orbit and provoke a collision with another space object; *jamming* interferes with space-based communication by overwhelming emitters or receptors with energy; *dazzling* blinds satellites' sensors with highly concentrated energy beams, and *killer satellites* use electronic or kinetic means to impede the operations of nearby satellites. S. W. Harold et al., *The US-Japan Alliance and Deterring Gray Zone Coercion in the Maritime, Cyber, and Space Domains*, Santa Monica: RAND Corporation, 2017, pp. 87 and 97-8.

59. Japan's Ministry of Defense, *Defense of Japan 2019*, p. 163, www.mod.go.jp. See also: Office of National Space Policy, Japan's Cabinet Office, Uchū seisaku iinkai, *Uchū anzen hoshō bukai, Dai33kai kaigō, Giji jidai: 2. Uchū wo meguru jōsei henka ② Uchū anzen hoshō no jūyōsei no takamari* – Committee on National Space Policy, sectional meeting on space safety, 33rd meeting, agenda item: 2.

Space assets are easy and vulnerable targets because their orbits are predictable and their structures weak. Moreover, intentional attacks are difficult to deter for two reasons. First, similar to the use of militias or paramilitaries to seize a territory, such attacks could amount to "gray zone" incidents because they do not fit clearly within the peace-war spectrum.[60] The attacker can thus hope to avoid retaliation by remaining below the war threshold, especially if the responsibility to retaliate is entrusted to an ally (the United States in Japan's case). Second, attacks against space-based assets are difficult to detect and, if detected, are hard to attribute, many non-kinetic ASATs posing the same attribution problem as cyber offensives.[61]

SSA is vital to tackle the threats from ASATs and reinforce deterrence in space, and implies an in-depth monitoring of space.[62] Such monitoring allows easier identification and attribution of ASAT attacks, providing evidence for diplomatic, economic and/or military retaliation.[63] In the absence of reliable ways to harden space-based assets, deterrence by punishment is more effective in space than deterrence by denial.

Japan's MoD, working closely with the SDF and civilian entities like JAXA, is entitled to operate its own SSA system since the 2014 revision of its Basic Space Policy.[64] The system, to be connected to US forces and expected to start operating in fiscal 2023 at the earliest, will function based on ground and space assets.[65]

Ground-based devices include an optical telescope at Bisei Space Guard Center (BSGC) and a radar at Kamisaibara Space Guard Center (KSGC), both operated by JAXA since 2001 and 2004 respectively. The telescope observes geostationary orbits at an altitude of around 36,000 kilometers while the radar monitors low-altitude orbits between 200 and 1,000 kilometers.[66] Data from these devices are treated at Tsukuba Space Center, near Tokyo. The Air Self-Defense Force (ASDF) operates four active phased-

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Changes in orbital situation ② Growing importance of space safety), October 2019, pp. 15-7, www8.cao.go.jp.

60. H. *et al.*, *The US-Japan Alliance*, p. 83.

61. *Ibid.*, p. 94.

62. SSA can be defined as the "knowledge of the energy and particle fluxes in near-Earth space, natural and artificial objects passing through or orbiting within this space, including the past, present and future state of these components." J. A. Kennewell and B.-N. Vo, "An Overview of Space Situational Awareness," paper presented at the 16th International Conference on Information Fusion, Istanbul, Turkey, 9-12 July 2013, http://ba-ngu.vo-au.com.

63. Harold et al., *The US-Japan Alliance*, p. 102.

64. Japan's Ministry of Defense, U*chū kaihatsu riyō ni kansuru kihon hōshin ni tsuite* – About the Basic Policy related to the use of space), August 2014, pp. 7-8, www.mod.go.jp.

65. National Space Policy Secretariat, *Implementation Plan of the Basic Plan on Space Policy (revised FY2017)*.

66. Japan Aerospace Exploration Agency, U*chū jōkyō haaku [SSA] shisutemu* – Space Situational Awareness [SSA] system," www.jaxa.jp.

array radar *J/FPS-5* which, although primarily dedicated to air defense and BMD missions, can track space objects.[67] The MoD is currently developing SSA laser ranging devices and a next-generation air defense radar endowed with the multiple-input multiple-output (MIMO) technology, which will also carry out SSA activities in high-altitude orbits.[68] In addition to these ground-based assets, Japan plans to launch telescope-endowed SSA satellites during fiscals 2024 to 2028. The MoD requested 3.3 billion yen ($31 million) for its development in fiscal 2020.[69]

Apart from tackling the Chinese ASAT threat, SSA is essential to protect space-based assets against orbital debris, allowing them to bypass congested areas, for example. These assets are vulnerable to debris because, due to the nature of space activities, they are light and equipped with fragile components, and some (such as solar panels) cannot be hardened. There are in orbit today about 20,000 pieces of debris larger than 10 centimeters and 500,000 smaller than that.[70] Japan is developing precise SSA sensors to track them. The KSGC radar is being upgraded to detect 10 centimeter-class objects at an altitude of 650 kilometers; the BSGC telescope will be able to observe debris of less than one meter in high-altitude orbits, and the overall observation frequency will increase from 200 to 10,000 per day.[71] Japan is also working on debris-removal systems to clear orbits, despite the failure in 2017 of JAXA's Kounotori Integrated Tether Experiment (KITE), a fishing net-like electrodynamic tether to collect debris.[72]

Interoperability and C4ISR: the multi-domain response

Modern warfare and national defense put a premium on interoperability between different military elements. And proper interoperability cannot be achieved without a robust command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) infrastructure, which depends heavily on space-based assets. Japan's growing autonomy in conventional domains of warfare logically extends to outer space. The latest

67. Otani and Kohtake, "Applicability of Civil and Defense Dual Use," p. 142.

68. Acquisition, Technology and Logistics Agency, Japan's Ministry of Defense, "Research on Next-Generation Air Defense Radar," www.mod.go.jp; Japan's Ministry of Defense, *Medium Term Defense Program (FY2019–FY2023)*, December 2018, p. 7, www.mod.go.jp.

69. Japan's Ministry of Defense, Defense Programs and Budget of Japan: Overview of FY2020 Budget Request, p. 4, www.mod.go.jp.

70. Harold *et al.*, *The US-Japan Alliance*, pp. 93-4.

71. Japan Aerospace Exploration Agency, "*Uchū jōkyō haaku [SSA] shisutemu*"

72. Research and Development Directorate, Japan Aerospace Exploration Agency, "Ensuring the Safety of Space Missions Now and in the Future," www.kenkai.jaxa.jp ; I. O'Neill, "A Japanese Space Junk Removal Experiment Has Failed in Orbit," *Space.com*, February 2017, www.space.com.

NDPG, released in late 2018, replaced the Dynamic Joint Defense Force concept enshrined in the 2013 version with the Multi-Domain Defense Force (MDDF) to deepen jointness between the SDF services beyond conventional domains and "organically fuse capabilities in all domains including space, cyberspace and electromagnetic spectrum."[73]

The 2018 NDPG also provided for the creation inside the ASDF of a special unit responsible for coordinating space operations. Established in May 2020 at Fuchū Air Base near Tokyo and initially staffed with some twenty personnel, the Space Domain Mission Unit (SDMU) will grow in fiscal 2023 into a squadron-size, fully operational entity expected to be named Space Operations Squadron (SOS).[74] Tasked with "conduct[ing] persistent monitoring of situations in space, and […] ensur[ing] superiority in use of space at all stages from peacetime to armed contingencies," the unit's primary mission is to protect against the elimination of space-based assets, which would blind and paralyze the SDF and leave Japan vulnerable to attacks.[75] SSA is therefore at the center of its activities.[76] Although modest in size, the SDMU and SOS are undoubtedly the first step toward a more ambitious structure, space operations becoming increasingly indispensable to Japan's national security. This is reflected by the government's intention to rename the ASDF to Aerospace Self-Defense Force by 2023.[77]

Despite important changes over the past decade, Japan's space program remains almost purely non-offensive in nature. The country is not militarizing outer space beyond what is necessary to guarantee the proper functioning of the SDF. This is partly due to legal, political and budget constraints, including opposition to a more assertive defense posture and the informal ceiling on military expenditure at one percent of gross domestic product. Although the dual-use nature of the space domain allows diverting toward military programs parts of the national budget dedicated to space-related activities, some 365 billion yen ($3.4 billion), the MoD's space budget request stood at a mere 52.4 billion yen ($488 million) for fiscal

73. Japan's Ministry of Defense, *National Defense Program Guidelines for FY2019 and Beyond*, December 2018, p. 11, www.mod.go.jp.

74. Japan's Ministry of Defense, U*chū ryōiki senmon butai no shinpen* – Creation of the Space Domain Mission Unit," www.mod.go.jp ; Japan's Ministry of Defense, Defense Programs and Budget of Japan, p. 4; Jiji Press, "SDF Launches New Unit to Step Up Defense in Outer Space," May 2020, www.japantimes.co.jp.

75. Japan's Ministry of Defense, *National Defense Program Guidelines for FY2019 and Beyond*, p. 27.

76. Japan Air Self-Defense Force, "Defending Japan's Peace from the Skies, Build a Structure for Defending Japan," www.mod.go.jp.

77. Kyodo News, "*Kōkūuchūjieitai ni kaishō chōsei* – Name Change to Aerospace Self-Defense Force" May 2020, https://this.kiji.is.

2020.[78] For these reasons, cooperation with international partners remains crucial for Japan to ensure national security and develop key space assets.

78. Japan's Ministry of Defense, Defense Programs and Budget of Japan, p. 4; National Space Policy Secretariat, Japan's Cabinet Office, *Reiwa 2 nendo tōsho yosanan oyobi reiwa gannendo hosei yosanan ni okeru uchū kaihatsu riyō kankei yosan ni tsuite* – About the initial budget for fiscal 2020 and the revised budget for fiscal 2019 related to the use of space), January 2020, www8.cao.go.jp. Christopher Hughes and Paul Kallender estimate that the diversion of national budget toward defense-related programs amounts to up to 10 percent of the MoD's space budget. P. Kallender and C. W. Hughes, "Hiding in Plain Sight? Japan's Militarization of Space and Challenges to the Yoshida Doctrine," *Asian Security*, 2019, Vol. 15, No. 2, p. 191.

International Cooperation: the United States and Beyond

Priority cooperation with the US

Japan's cooperation with the United States on space activities remained highly technical until the early 2010s. It mainly related to the development of BMD technologies. As Japan increasingly relied on space-based assets for security, bilateral cooperation has evolved into more strategic exchanges, although Tokyo has yet to formally extend the scope of CSD to the space domain.[79]

The first Japan-US Space Security Dialogue took place in September 2010, and the first whole-of-government Japan-US Comprehensive Dialogue on Space was held in March 2013.[80] These consultations resulted in the first recognition of the importance of space cooperation, in the form of guidelines for the operationalization of the Japan-US alliance. In the latest guidelines, released in April 2015, the SDF and US forces pledged to assist each other in early-warning, ISR, MDA and SSA, and in protecting space-based assets and reconstituting them if damaged.[81] More concrete dialogues ensued through the Space Cooperation Working Group, first held in October 2015 and aimed at promoting policy consultations, information-sharing and joint exercises. At a more operational level, the new SDMU cooperates with the US Space Force, established in late 2019 as an independent branch of the American armed forces.[82]

The scope of the Japan-US alliance has expanded since the end of the Cold War. It now encompasses "the Asia-Pacific region and beyond."[83] Operating in such a wide area implies heavy reliance on space-based assets. Tokyo and Washington have so far focused their cooperation on positioning services, MDA and SSA.

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79. S. M. Pekkanen, "Japan's Space Power," *Asia Policy*, 2020, Vol. 15, No. 2, p. 33.

80. Japan's Ministry of Defense, *Defense of Japan 2019*, p. 321.

81. Japan-US Security Consultative Committee (2+2), *The Guidelines for US-Japan Defense Cooperation*, April 2015, p. 22, https://archive.defense.gov.

82. R. Hinata-Yamaguchi, "One Small Step for Japan's Space Security Strategy," *East Asia Forum*, April 2020, www.eastasiaforum.org.

83. Japan-US Security Consultative Committee (2+2), *The Guidelines for US-Japan Defense Cooperation*, p. 18.

Japan's QZSS aims at complementing, and in case of dysfunction substituting for, the American GPS in the Asia-Pacific, a decision taken at the 2013 Japan-US Comprehensive Dialogue on Space. Strengthening the resilience of positioning services through duplication is crucial given the dependence of Japanese and US forces on vulnerable space assets to operate in the region. Positioning devices help coordinate movements among allies by determining the location of friendly and adversarial forces.[84] They are thus useful for MDA when it comes to warships and vessels. Military radio systems using frequency-hopping spread spectrum as well as electronic intelligence also rely on the timing function of positioning services to synchronize.[85] Japanese warships began using the timing function of QZSS as a substitute for GPS in 2019.[86] Lastly, QZSS is more precise than GPS and allows better strike accuracy.[87]

SSA is at the center of Japan-US cooperation in outer space. Bilateral collaboration became more concrete after the conclusion in May 2014 of an agreement on SSA information-sharing between JAXA and US Joint Space Operations Center (JSpOC).[88] Since 2016, Japan is a full participant in the annual table-top SSA exercise Global Sentinel, organized by US Strategic Command (STRATCOM), and the Japan-US Security Consultative Committee decided in April 2019 to work toward equipping with American SSA payloads the three QZSS *Michibiki* satellites to be launched by fiscal 2023.[89]

Because space assets circumnavigate earth, with the exception of geostationary satellites, and most current SSA devices are ground-based, closing blind spots is necessary for constant monitoring of orbiting objects, which helps avoid collisions with debris and prevent opponents from disabling space assets undetected. Despite its extensive network of sensors, data collected by the United States on geosynchronous orbits above the 135th meridian east are insufficient for effective SSA.[90] The development of Japan's SSA capabilities allows Washington to cover blind spots over China

84. Harold *et al.*, *The US-Japan Alliance*, p. 77.
85. *Idem*.
86. Y. Koshino, "Japan's New Space Domain Mission Unit and Security in the Indo-Pacific Region," *Military Balance Blog*, International Institute for Strategic Studies, May 2020, www.iiss.org.
87. Vijayakumar, "To Infinity and Beyond."
88. Y. Nagai et al., "Specifics of Space Cooperation Potential Between Japan and India," paper presented at the 67th International Astronautical Congress, Guadalajara, Mexico, 26-30 September 2016, p. 9, www.researchgate.net.
89. Japan-US Security Consultative Committee (2+2), "Joint Statement of the Security Consultative Committee," April 2019, www.mofa.go.jp; Otani and Kohtake, "Applicability of Civil and Defense Dual Use," p. 142.
90. Otani and Kohtake, "Applicability of Civil and Defense Dual Use," p. 142.

and North Korea, while Tokyo benefits from the American global SSA network.[91]

Regional cooperation with India

India is another important partner of Japan, although bilateral cooperation has yet to reach its potential. The evolutions of the two countries' space programs have many similarities. Both matured through civilian and scientific projects before turning to security-related space activities.[92] Tokyo and New Delhi also share concerns about changes in Asian geopolitical dynamics. India's Act East Policy and Japan's Free and Open Indo-Pacific converge in trying to adjust to China's rise. Consequently, if bilateral space cooperation initially revolved around domains such as disaster management, it is today refocusing toward MDA, positioning services and SSA, the three main items on the agenda of the first Japan-India Space Dialogue, held in March 2019.[93]

MDA is central to both countries, given their dependence on maritime trade and their worries about China's growing assertiveness at sea. Because Japan's economy relies on energy imports, close MDA cooperation with India is logical to secure stable sea lines of communication (SLOCs) from the Middle East through the Indian Ocean and the South China Sea, where the Chinese naval presence has increased in recent years.[94] The two countries have deployed space-based MDA assets. In addition to other earth observation satellites, Japan operates *ALOS-2* and is about to launch *ALOS-4*. India pilots *ResourceSat-1* and AIS-endowed *ResourceSat-2* and *-2A*, and is on the verge of orbiting the *ResourceSat-3* series.[95] Pooling these resources helps Tokyo and New Delhi expand sea and ocean monitoring across the Asia-Pacific.[96] The Maritime Self-Defense Force (MSDF) and the Indian Navy signed the Implementing Arrangement for Deeper Cooperation in 2018 and began sharing MDA information in 2019.[97]

91. Harold *et al.*, *The US-Japan Alliance*, p. 102.
92. Nagai *et al.*, "Assessment of Space Programs and Policies for Regional Cooperation," pp. 8-9.
93. H. Siddiqui, "First ever India-Japan Space Dialogue: Both Countries to Focus on Surveillance and Maritime Awareness," *Financial Express*, March 2019, www.financialexpress.com.
94. T. Basu, "India in Japan's Strategic Thinking: Charting Convergences in the Indo-Pacific," *The Diplomat*, January 2020, https://thediplomat.com.
95. Gunter's Space Page, "Resourcesat 2, 2A," https://space.skyrocket.de; Gunter's Space Page, "Resourcesat 3, 3A, 3B," https://space.skyrocket.de; Gunter's Space Page, "Resourcesat 3S, 3SA," https://space.skyrocket.de.
96. Nagai *et al.*, "Specifics of Space Cooperation Potential," p. 9.
97. F.-S. Gady, "India, Japan Begin Negotiations Over Military Base Sharing Agreement," *The Diplomat*, October 2018, https://thediplomat.com; Japan's Ministry of Foreign Affairs, "Joint Statement: First Japan-India 2+2 Foreign and Defence Ministerial Meeting," November 2019, www.mofa.go.jp.

Japanese and Indian space-based assets are also complementary in regard to positioning services. Like Japan's QZSS, the Indian Regional Navigation Satellite System (IRNSS) has a regional outreach, centered on India and encompassing a rectangle from latitudes 50 degree north to 30 degree south, and from longitudes 30 degree east to 130 degree east.[98] As QZSS revolves around the 135th meridian east, combining it with IRNSS would expand the latter's coverage to the east while providing Japan with positioning data in the strategic South China Sea and Indian Ocean. Moreover, research highlights that integrating IRNSS and QZSS would much reduce positioning errors.[99]

Another avenue for deeper cooperation is SSA. New Delhi is striving to further SSA capabilities, as reflected by the recent establishment of the Directorate of Space Situational Awareness and Management and the creation in August 2019 of the Space Situational Awareness Control Centre near Bangalore.[100] India operates several optical telescopes, although only a few have been upgraded to monitor space objects, and a new multi-object tracking radar (MOTR) based at Satish Dhawan Space Centre.[101] As India already collaborates with the United States on SSA, joining forces with Japan would result in triangular cooperation and boost SSA efficiency over the Asia-Pacific.

Global cooperation with European countries

Japan has cultivated ties with countries beyond the region, and especially in Europe, to jointly develop space technologies, pursue deep-space exploration, cooperate on positioning services and set international norms for space activities. JAXA's Paris Office is the hub of Japan's collaboration with European countries and space industry, and maintains close relations with the European Space Agency (ESA).[102] JAXA and ESA have together reached several milestones in space technology, including the first communication between optical satellites in December 2005. JAXA is currently developing reusable first stages to cut rocket launch costs and plans to test-fly the technology in 2022 on the CALLISTO experimental

98. Indian Space Research Organisation, India's Department of Space, "Indian Regional Navigation Satellite System (IRNSS): NavIC," www.isro.gov.in.
99. K. Wang *et al.*, "Precise Regional L5 Positioning with IRNSS and QZSS: Stand-Alone and Combined," *GPS Solutions*, 2019, Vol. 23, No. 1, https://doi.org.
100. T.E. Narasimhan, "Isro to Set Up New Centre to Protect Indian Satellites from Space Debris," *Business Standard*, August 2019, www.business-standard.com.
101. Nagai *et al.*, "Specifics of Space Cooperation Potential," p. 9.
102. Japan Aerospace Exploration Agency, "Overseas Offices," https://global.jaxa.jp.

vehicle, a project led by the French National Centre for Space Studies (CNES) and the German Aerospace Center (DLR).[103]

Regarding deep-space exploration, CNES and DLR cooperated in building the Mobile Asteroid Surface Scout (MASCOT), a lander embarked on JAXA's *Hayabusa-2* spacecraft. The latter reached the asteroid Ryugu in June 2018 and is to return to earth with samples in late 2020.[104] JAXA and ESA have also joined forces to probe Mercury. The BepiColombo mission involves two spacecraft, JAXA's Mercury Magnetospheric Orbiter and ESA's Mercury Planetary Orbiter, expected to start orbiting the planet in late 2025.[105]

Formal cooperation between Japan and the European Union (EU) in positioning services began in 2016 with the first Public and Private Global Navigation Satellite System Roundtable Meeting. During the second meeting held in March 2017, Japan and the European Commission concluded a Cooperation Agreement to bolster policy coordination and the use by businesses of positioning services provided by QZSS and the European Galileo system.[106] The fourth meeting took place in March 2019, focusing on the use of positioning services for automated driving systems, drone guidance and agriculture. The Japan-EU Strategic Partnership Agreement, signed in July 2018, further promoted space cooperation, including in "security aspects of space activities."[107]

Even before the Strategic Partnership Agreement, Japan and the EU had advocated international norms for the conduct of space activities. Following China's 2007 ASAT test, the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) swiftly adopted the Space Debris Mitigation Guidelines, which called on countries to refrain from "intentional destruction and other harmful activities" that generate debris.[108] The EU wanted to go beyond these guidelines. It began working on an International Code of Conduct for Outer Space Activities in 2007, adopted a first draft in 2008, and continued with international consultations.[109] The March 2014

103. Kyodo News, "JAXA to start flight tests in June to develop reusable rocket tech," March 2020, https://english.kyodonews.net; Research and Development Directorate, Japan Aerospace Exploration Agency, "Cooperative Action Leading to Launcher Innovation for Stage Toss-back Operation (CALLISTO) Pre-project," www.kenkai.jaxa.jp.
104. German Aerospace Center, "MASCOT on board Hayabusa2," www.dlr.de.
105. European Space Agency, "BepiColombo: Fact Sheet," https://sci.esa.int.
106. National Space Policy Secretariat, Japan's Cabinet Office, "4th EU-Japan Public and Private GNSS Roundtable Meeting by the Cabinet Office and the European Commission," April 2019, https://qzss.go.jp.
107. Japan's Ministry of Foreign Affairs, *Strategic Partnership Agreement between the European Union and its Member States, of the one part, and Japan, of the other part*, July 2018, p. 17, www.mofa.go.jp.
108. Office for Outer Space Affairs, United Nations, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, 2010, p. 3, www.unoosa.org.
109. C. Johnson, "Draft International Code of Conduct for Outer Space Activities Fact Sheet," *Secure World Foundation*, February 2014, https://swfound.org.

version of the draft called on countries to "refrain from the threat or use of force" and reminded of the right of "individual or collective self-defense," thereby aiming at strengthening deterrence in space.[110]

While China and Russia, among others, have rejected the International Code, Japan was one of the first non-European countries to support it.[111] In January 2012, before the first international consultation was held in Vienna in June, Hirofumi Katase, National Space Policy Secretariat's Deputy Secretary-General, called for global endorsement.[112] Minister for Foreign Affairs Kōichirō Gemba declared the same month that Tokyo welcomed the European initiative and would "make efforts so that we can gain the participation of the related countries."[113] Although discussions on the code have been a bumpy ride, Japan and the EU remain close partners in space norm-making.

Among EU member states, France stands out as a crucial ally of Japan in space-related activities. In June 2019, Tokyo and Paris agreed to a roadmap promoting cooperation in dealing with orbital debris, including through norm-making in COPUOS, in using space-based assets to monitor the Asia-Pacific environment, and in deep-space exploration and technological innovation.[114] CNES and Japan's National Institute of Information and Communications Technology (NICT) have been working on optical satellite communications since 2012, reaching breakthroughs in satellite-to-ground optical links in 2015.[115] CNES also signed an agreement with JAXA in June 2019 to participate in technology studies in preparation

110. European Union, *Draft: International Code of Conduct for Outer Space Activities*, March 2014, p. 4, https://eeas.europa.eu

111. China and Russia countered the EU initiative in February 2008 by introducing a Draft Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT). For the June 2014 version, see: United Nations Conference on Disarmament, *Letter dated 10 June 2014 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Acting Secretary-General of the Conference transmitting the updated Russian and Chinese texts of the draft treaty on prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects (PPWT) introduced by the Russian Federation and China*, June 2014, https://documents-dds-ny.un.org

112. R. P. Rajagopalan, "International Code of Conduct for Outer Space Activities: Major Asian Perspectives," *Asia Dialogue*, October 2014, https://theasiadialogue.com

113. Japan's Ministry of Foreign Affairs, "Press Conference by Minister for Foreign Affairs Koichiro Gemba," January 2012, www.mofa.go.jp.

114. Japan's Ministry of Foreign Affairs, *Feuille de route sur la coopération franco-japonaise pour ouvrir de nouveaux horizons entre la France et le Japon dans le cadre du partenariat d'exception (2019-2023)*, June 2019, p. 8, www.mofa.go.jp; Spacewatch, "Japan and France Strengthen Space Cooperation in Preparation for Macron Visit," June 2019, https://spacewatch.global.

115. Centre national d'études spatiales, "CNES and NICT Announce New Satellite-To-Ground Optical Links," December 2015, www.defense-aerospace.com; National Institute of Information and Communications Technology, "Framework Agreement for Cooperation Signed with CNES," November 2012, www.nict.go.jp.

for Japan's Martian Moons eXploration (MMX) mission.[116] MMX, planned for launch in the mid-2020s, aims at exploring Mars' two moons, Deimos and Phobos, and at collecting samples from the latter.[117]

116. Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation, "Coopération spatiale franco-japonaise : signature de deux accords portant sur l'exploration de Mars et sur l'astéroïde Ryugu," June 2019, www.enseignementsup-recherche.gouv.fr.
117. Japan Aerospace Exploration Agency, "MMX," mmx.isas.jaxa.jp.

Toward a "Weaponization" of Space?

Although Japan's space program is today almost purely non-offensive in nature, the intra-alliance hedging strategy implies a potential weaponization of space. This offensive use of space could materialize through the acquisition of strike capabilities, and the development of Japan's own ASATs or of active defense systems for space assets.

Strike capabilities

The Japanese debate on strike capabilities has evolved in parallel with the deployment of space-based assets for security, some of which are essential to identify and hit targets. Strike capabilities are emerging as an important element of Japan's defense against North Korea and China. The growing stealthiness and accuracy of North Korea's missiles and its ability to launch saturation attacks undermine the trust of many Japanese in BMD, while China's expanding military power calls for a more active deterrence posture, in the East China Sea in particular. And, although strike capabilities are still provided by the United States through the alliance framework, as exemplified by the 5th Air Force and the 7th Fleet, doubts about Washington's reliability have led Tokyo to acquire its own spear.[118]

The 2013 NSS was instrumental in this regard, reflecting both Japan's increasing reliance on space for security and a move toward a more offensive defense posture aimed at "deterring threats from directly reaching Japan."[119] In April 2014, Prime Minister Shinzō Abe called for strengthening Japan's "own deterrence and coping capabilities."[120] Although the idea of preemptive strike on an opponent's territory was rejected, the legality of retaliating against an attack was reaffirmed in August 2015 by both Defense Minister Gen Nakatani and Director-General of the Cabinet Legislation Bureau Yusuke Yokobatake.[121]

118. L. P. Fatton, "A New Spear in Asia: Why Is Japan Moving toward Autonomous Defense?", *International Relations of the Asia-Pacific*, 2019, Vol. 19, No. 2, pp. 297-325.
119. Japan's Cabinet Office, *National Security Strategy*, pp. 5 and 19-20.
120. J. L. Schoff and D. Song, "Five Things to Know about Japan's Possible Acquisition of Strike Capability," *Carnegie Endowment for International Peace*, August 2017, http://carnegieendowment.org.
121. *Idem*.

Bestowed with political and legal backing, the MoD requested 2.19 billion yen ($20 million) in December 2017 to purchase the Joint Strike Missile (JSM) and to study the introduction of the Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER).[122] For fiscal 2020, the MoD's budget request comprised 10.2 billion yen ($95 million) to acquire additional JSMs for *F-35* fighter jets and 39 billion yen ($363 million) to upgrade *F-15* jets, partly to allow them to carry standoff missiles like the JASSM-ER.[123] If the JSM possesses both anti-ship and anti-surface capabilities, the JASSM-ER is exclusively dedicated to striking targets on land.[124] Japan is also working on two hypersonic missiles. One is an HGV and the other a hypersonic cruise missile, for the development of which 28.5 billion yen ($265 million) and 16.1 billion yen ($150 million), respectively, were requested by the MoD in fiscal 2020.[125] Expected to enter service in the 2030s endowed with either armor-piercing or explosively formed projectile (EFP) warheads, early versions of the two missiles will be tested during the 2024 to 2028 period.[126]

Lastly, Japan is extending the power projection capabilities of fighter jets to conduct air-to-ground and air-to-ship operations. The MoD will establish a Squadron for Aerial Refueling and Transport centered on *KC-46A* aircraft, currently being procured.[127] And in December 2018, the MoD decided to purchase *F-35B* short take-off and vertical landing (STOVL) fighter jets and to refit the two *Izumo*-class helicopter carriers in order to integrate the jets into their air wings.[128]

These strike capabilities rely heavily on space-based assets. While military communications satellites and QZSS help coordinate attacks, the latter as well as MDA devices and IGSs allow detecting and hitting targets with precision. For example, the two hypersonic missiles in development will use a combination of QZSS data and an inertial navigation system (INS) to ensure guidance and mobility at high speed.[129] The acquisition of strike capabilities entails using space for potential offensive operations, although it does not involve a weaponization of this domain of warfare *per se*.

122. Kyodo News, "Defense Ministry Says It Will Seek Funding for Long-Range Cruise Missiles," December 2017, www.japantimes.co.jp.
123. Japan's Ministry of Defense, Defense Programs and Budget of Japan, pp. 13 and 15.
124. Lockheed Martin Corp., "JASSM," www.lockheedmartin.com.
125. Japan's Ministry of Defense, Defense Programs and Budget of Japan, pp. 28 and 46.
126. Acquisition, Technology and Logistics Agency, Japan's Ministry of Defense, *Kenkyū kaihatsu bijyon: stando ofu bōei nōryoku no torikumi* – Research and development vision: Efforts on defensive standoff capacity, March 2020, pp. 10-1, www.mod.go.jp.
127. Japan's Ministry of Defense, Defense Programs and Budget of Japan, p. 13.
128. Japan's Ministry of Defense, *Medium-Term Defense Program (FY2019–FY2023)*, pp. 10-1 and 36.
129. Acquisition, Technology and Logistics Agency, *Kenkyū kaihatsu bijyon*, p. 7.

ASATs and active defense systems?

Japan could weaponize outer space through the development of its own ASATs. Even though the probability of this happening in the near future is remote, official documents have already opened the door to counterspace technologies. In its report *Defense of Japan 2019*, the MoD said it aims at building "the capability to disrupt [the] C4I (command, control, communication, computer, and intelligence) of opponents" in order to maintain superiority in space, a responsibility that would rest with the SDMU and later SOS.[130] And Japan has the capacity, being in the electromagnetic, cyber or ballistic domains, to develop ASATs. JAXA's orbital debris removal system projects could also be used to disable space assets.[131] The MoD is allegedly considering the acquisition of jamming capabilities.[132] Even non-kinetic ASATs like jamming would trigger domestic opposition, however, as they could infringe the principle of non-offensive use of space.

Another way Japan could weaponize outer space would be by equipping space-based assets with active defense systems, like missile interceptors.[133] Although these are arguably in line with the non-offensive principle because of their defensive nature, no country has so far managed to produce such systems. On the other hand, when it comes to security affairs, Japan has surprised many observers in recent years.

130. Japan's Ministry of Defense, *Defense of Japan 2019*, pp. 289-90. A similar reference to counterspace capabilities appeared in the 2018 NDPG: Japan's Ministry of Defense, *National Defense Program Guidelines for FY2019 and Beyond*, p. 27.

131. Harold *et al.*, *The US-Japan Alliance*, p. 93.

132. Wilson, "Japan's Gradual Shift toward Space Security," p. 13.

133. Harold *et al.*, *The US-Japan Alliance*, p. 79.

Conclusion

Japan's space program has greatly evolved since the end of the Cold War, driven by a rapidly changing geopolitical environment, and tailored by the emergence of an intra-alliance hedging strategy. Initially based on the principle of peaceful use of space, the program has transformed in less than two decades into one emphasizing the need to guarantee national security through space technologies. And, although the Japanese space program still sticks to the non-offensive principle, indications of a possible future weaponization of outer space are already coming to light.

Whether Japan will follow this path depends on a variety of factors. On the domestic side, political dynamics will be decisive. The record tenure of Shinzō Abe as prime minister has once again demonstrated that political stability is a precondition for the swift adaptation of Japan's security policy to its environment. Internationally, the reinforcement of global norms regulating space activities could mitigate Tokyo's temptation to weaponize outer space. This seems unlikely in the near term, however, given the current state of arms-control discussions and the paralysis of forums such as the United Nations Conference on Disarmament. The evolution of the United States' grand strategy and involvement in the Asia-Pacific will be the most influential factor. The more Tokyo doubts Washington's ability and readiness to fulfill its security commitments, the more intense its intra-alliance hedging strategy becomes, further penetrating and transforming the Japanese space program.

Japan has not joined the big three in the 21st century military space race. More than the United States, China and Russia, Japan is still inhibited by domestic constraints when it comes to military-related affairs, and thus the use of space for security purposes. These constraints are not insurmountable, however, given the right geostrategic incentives. As the Chinese and North Korean threats cannot be expected to subside anytime soon, the level of trust between Tokyo and Washington will be key. This may be the only constant in Japan's post-war history: the United States is at the center of its security equation – at least until now.

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