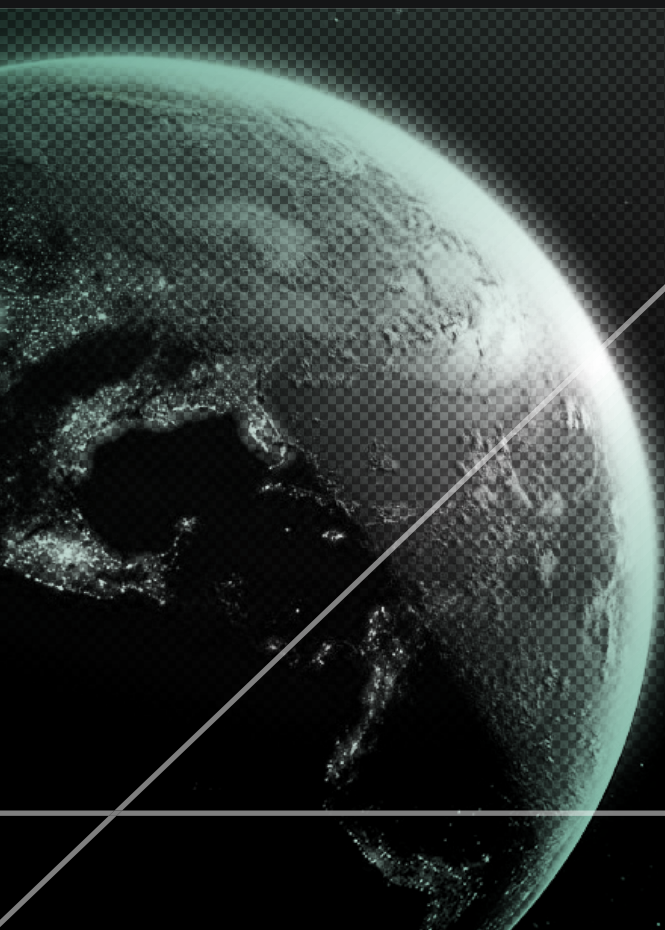




Challenges to Security in Space

Congestion, Competition,
and Cooperation



2026

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Cover image: An illustration of the Earth from space with the Moon and Sun in the background.

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Scope Note

This 2026 edition of *Challenges to Security in Space* provides an unclassified overview of the threats within the space domain that jeopardize U.S. and allied national defense including the overall space environment and space hazards such as debris. This report addresses ongoing developments that demonstrate the importance of space as well as the space systems and emerging threats from China, Russia, Iran and North Korea.^{1,2,3,4,5} This document briefly addresses additional details on the capabilities of the broader space community. Finally, this publication provides details on these nations' views of space governance, which often diverge from U.S. and partner views.

Challenges to Security in Space Publications

Challenges to Security in Space was first published in early 2019 to address the primary threats to U.S. and partner space capabilities and examine the space and counterspace strategies and systems pursued by China, Russia, Iran, and North Korea. The 2022 edition built on the prior *Challenges* publication to provide an updated overview of threats to U.S. and allied space capabilities, as well as implications of reliance on space in an era of competition.

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Executive Summary

China, Russia, Iran, and North Korea are developing, testing, deploying, and using space capabilities in a way that threatens the security of all space systems and their associated space benefits. China and Russia are developing a formidable spectrum of offensive capabilities to degrade or destroy space services of other countries, from kinetic destruction to sophisticated jamming and cyber operations.^{6,7,8} These countries have exhibited behaviors that often run counter to a safe, secure, and sustainable space domain.

The malign efforts of these four actors go beyond the development of novel technology and extend into the diplomatic and economic arenas. China and Russia have proposed unverifiable international space treaties and commitments such as “no first placement of weapons in outer space.” Yet each refuses to acknowledge their ongoing efforts to develop dual-use and counterspace weaponry and their dangerous or ambiguous behavior on-orbit.^{9,10,11,12,13,14}

China, Russia, Iran, and North Korea have expanded their bilateral cooperation on space-related activities, including China’s supply of space components to Russia.^{15,16,17,18,19,20} Furthermore, Beijing and Moscow are expanding their worldwide space cooperation, with both offering launch and satellite services to many other countries.^{21,22} China and Russia consider these international engagements opportunities to garner geopolitical influence and bolster their own scientific prestige. Both are pursuing a broader strategy to improve military force capabilities and technological innovation through

the integration of civilian, commercial, and academic space expertise into military programs.^{23,24}

Commercial space operations are rapidly expanding worldwide. The various services provided by commercial operators highlight the importance of an open and secure space domain.^{25,26} Sustained access to space is key to promoting global interconnectivity and expanding economic prosperity, and more nations are becoming reliant on space services for economic and national security activities.^{27,28,29,30,31,32}

The Russia-Ukraine war is demonstrating the advantages of commercial space capabilities to advance national security activities, including tactical advantages for the military. The effectiveness of commercial satellite communications services supporting Ukraine have driven the perception in Moscow that Russia needs more satellites to keep pace.^{33,34} Russia has responded by targeting the commercial constellations with jammers.³⁵ Russia also designated U.S. commercial space industry terminals and other commercial satellites supporting Ukraine as legitimate military targets.^{36,37} Since Russia’s 2022 invasion of Ukraine, the Russian government and military-related organizations have looked to China for space-based support for their operations in Ukraine and to maintain Russia’s space-based capabilities.^{38,39,40,41,42}

The production of cheaper, smaller, and simpler satellites, which are faster to develop and deploy, along with the expansion of commercially available launch services, are driving the rapid integration of commercial space alternatives to support national security.^{43,44,45} Space commercialization is making

previously government-centered space services available to interested parties with sufficient means, including state and non-state actors with malign interests.⁴⁶

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Defining Space

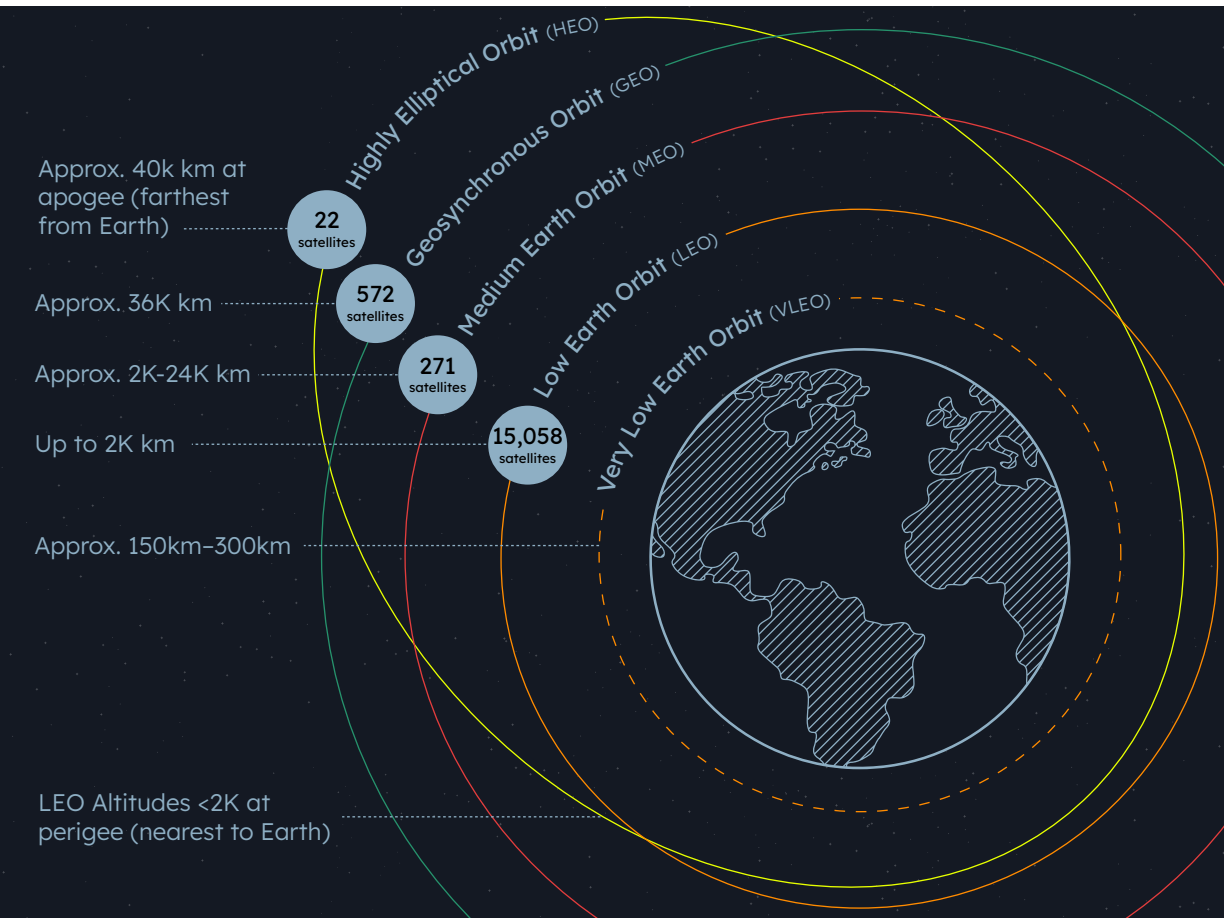
Satellite Numbers by Orbit^{47,48,49}

Space is a critical component of national security, including government and commercial satellites and infrastructure, as well as being a key driver for national and global development. Low Earth orbit (LEO) is experiencing a surge in deployed

satellites because of proliferated large constellations of communication satellites and some large intelligence, surveillance, and reconnaissance (ISR) constellations. The use of LEO is expanding, and the use of higher orbits has been declining due to satellites reaching end-of-life or otherwise becoming nonoperational.

Satellite Numbers by Orbit

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As of June 2026, the total number of satellites per orbit suggests the inventory of available space-based sensors is reaching unmatched levels. The number of satellites within each orbit provides a valuable datapoint for accurate representation of space capabilities.

Space Missions by Orbit^{50,51}

Space technologies connect urban and rural communities to services, education, and work opportunities. Satellite orbits traditionally align with the application of the sensor's payload; for example, satellites that need constant access to a location are placed in GEO, which is an orbit where a satellite's speed matches the rotation of the Earth and will naturally stay above the same point on the equator. Most satellites operate in orbits near Earth (i.e., LEO and VLEO) as being closer to the Earth lowers launch

costs, increases imagery resolution, and decreases time between when a satellite is overhead. Higher orbits such as MEO and GEO can be used to provide services (i.e., navigation, communications, etc.) to a larger area on Earth. HEO orbits can be used to provide near-persistent coverage of the Earth's North and South Poles. Communications and ISR satellites operate in higher orbits (i. MEO and GEO) to provide near-persistent coverage of the Earth, though coverage is less persistent over the Earth's polar regions.

Space Missions by Orbit

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Orbit	Uses			
Low Earth Orbit (LEO)	• SATCOM • SATNAV • EO	• SAR • SIGINT • Human Spaceflight	• Environmental Monitoring	• Scientific/Test
Medium Earth Orbit (MEO)	• SATCOM	• SATNAV	• EO	
Highly Elliptical Orbit (HEO)	• SATCOM • EO	• SAR • Early Warning	• Environment Monitoring	
Geosynchronous Earth Orbit (GEO)	• SATCOM • SATNAV	• SAR • Early Warning	• SIGINT	

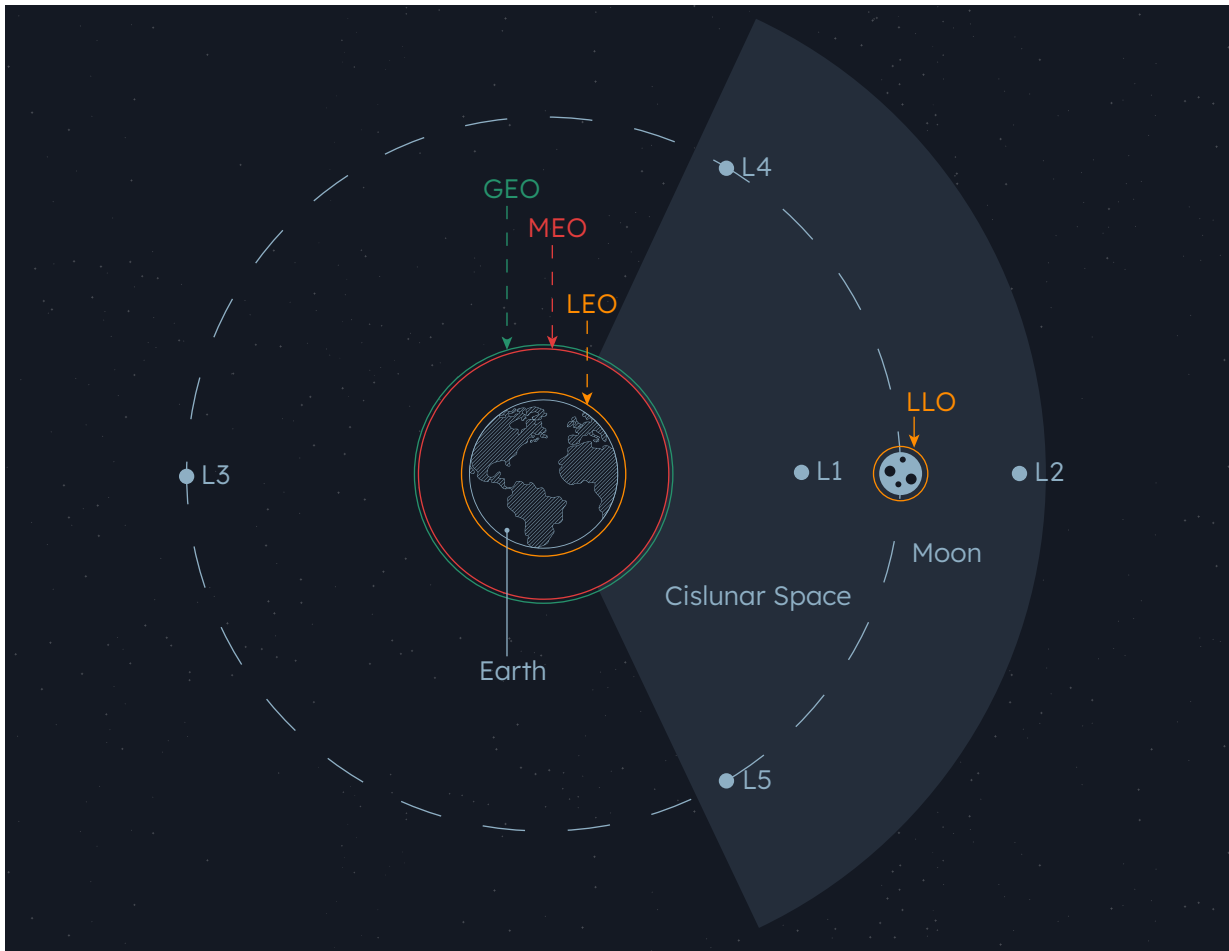
See Appendix for System Acronyms

Exploring cislunar space is of increasing interest to spacefaring nations for potential scientific and economic opportunities. Nations such as China may be exploring military applications from cislunar space. Additionally, the cislunar environment

provides unique opportunities for scientific missions and new technological discoveries. [See *Appendix I: Space Concepts* for additional details on employment of space capabilities.]

Cislunar Chart

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Cislunar space broadly refers to the areas subject to the gravitational influence of the Earth-Moon system, which includes the area between the Earth and the Moon, the Moon's orbit, and Lagrange points.^{52,53} Satellites placed at Lagrange points in various cislunar orbits or low lunar orbit (LLO) support cislunar operational requirements. Lagrange points are gravitationally stable positions in space between two celestial bodies. At Lagrange points, the balance between gravitational pull and centripetal force creates a center of gravity for satellites to orbit, reducing fuel requirements. The graphic above identifies Lagrange points L1 and L2—between the Moon and Earth and the far side of the Moon, respectively. Additionally, the graphic labels the three other Lagrange points associated with the Earth-Moon system: L3, L4, and L5.⁵⁴

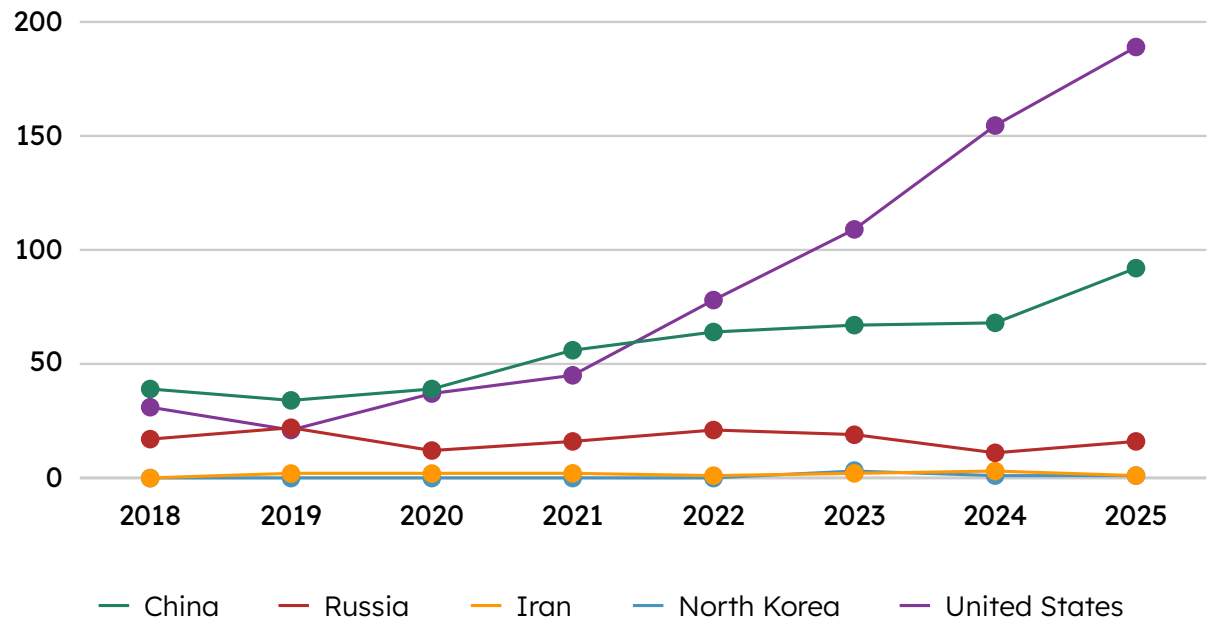
Launch Statistics Comparisons

The growth of satellite launch attempts for 2018 through 2025 is one illustration of the recent and continuing expansion of Chinese, Russian, Iranian, and North Korean operational space fleets. Launch

attempts are one metric for estimating the capacity of a nation's space launch capability, which could reveal the health of its space industry. Access to space expedites the ability of these actors to project their combat power beyond regional borders.

Total Orbital Launch Attempts

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The graph represents total launch attempts by year for China, Russia, Iran, North Korea, and the United States. The majority of these launch attempts from 2022-2025 are comprised of communications satellites for a U.S. commercial space provider.^{55,56,57,58,59} Between 2023-2025, emerging space powers such as North Korea attempted five launches, and Iran attempted seven launches. Since 2022, Russia has launched two remote sensing satellites for Iran.^{60,61,62,63}

Denying Access to Space

Counterspace weapons can deny, jam, temporarily disable, or permanently incapacitate space assets, along with the vital services they provide. Military, civil, and commercial providers deliver space services that collectively can be held at risk by an actor with the intent to interfere with military space services, since commercial and civil space services sometimes have connections to certain military capabilities. Although many counterspace weapons or tactics are intended to degrade space services temporarily, others can damage or destroy satellites permanently.⁶⁴

- Antisatellite (ASAT) missiles are designed to kinetically strike and destroy satellites. ASAT missiles could produce massive amounts of debris that can remain in orbit for decades or even centuries.^{65,66}
- Physical or cyberattacks against ground sites and other terrestrial infrastructure supporting space operations can also threaten satellite services.^{67,68} Cyber counterspace attacks target the satellite data within the transmission signal, along with the systems that use, transmit, and control the flow of data.
- Electronic attacks include jamming and spoofing techniques to target a nation's use of the electromagnetic spectrum. Electronic attacks can interfere with systems used for communications and command and control of military forces – to include for manned and unmanned vehicles. Electronic attacks target military uses of position,

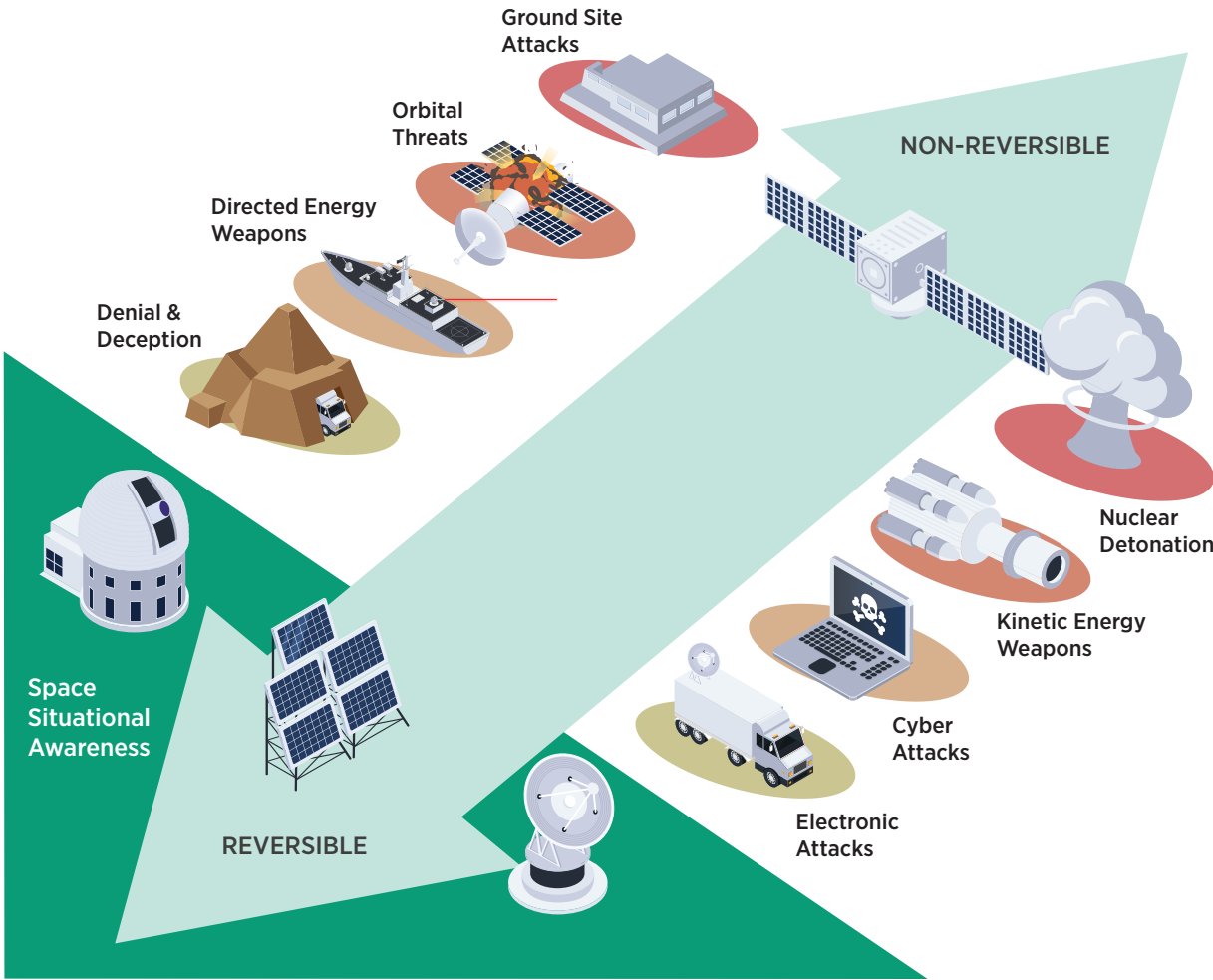
navigation, and timing (PNT) signals, such as from GPS, and often interfere with civilian use of these critical services in nearby areas.^{69,70,71,72}

- Directed-energy weapons (DEWs) can temporarily or permanently blind imagery satellites and affect overhead persistent infrared (OPIR) and weather sensors, thereby denying the ability to monitor, track, and target forces.

Countries with nuclear weapons can launch a warhead on a long-range booster, such as an intercontinental ballistic missile (ICBM) or space launch vehicle (SLV), and probably conduct a high-altitude nuclear detonation, or even place a nuclear weapon in space. In either case, a nuclear detonation in or near space would create widespread electromagnetic disruptions in space and on Earth, leading to potential damage or destruction of satellites.^{73,74} [See *Appendix II: Counterspace Concepts* for additional details.]

Counterspace Threat Continuum

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The counterspace continuum represents the range of threats to space-based services, arranged from reversible to nonreversible effects. Reversible effects from denial and deception and electronic warfare are nondestructive and temporary, and the system is able to resume normal operations after the incident. DEW, cyber threats, and orbital threats can cause temporary or permanent effects. Permanent effects from kinetic energy attacks on space systems, physical attacks against space-related ground infrastructure, and nuclear detonation in space would result in degradation or physical destruction of a space capability.

China

Beijing's goal is to become a fully capable space power.⁷⁵ Its rapidly growing space program is a source of national pride and part of the People's Republic of China (PRC) President Xi Jinping's objective to establish a powerful and prosperous China. The People's Liberation Army (PLA) manages China's military space program supporting both civilian and military interests, including strengthening China's science and technology sector, building international relationships, and modernizing the military.^{76,77,78,79,80,81} The China National Space Administration (CNSA) is responsible for civil space activities and international space cooperation, while the China Manned Space Agency (CMSA) manages China's human spaceflight program. The Chinese Communist Party (CCP) Central Military Commission (CMC) directs both the PLA and the CMSA, and the PLA works closely with the CNSA, ensuring military objectives are met through civil space activities as well.

Beijing aims to become the preeminent leader in space, to shape international norms to be more supportive of China's positions on space issues, and exploit other nation's perceived reliance on space-based systems to deter and counter China's military operations.^{82,83} China's rapidly expanding space program is second in size only to the U.S. space program: military, civil, and commercial. Since 2022, Xi's anti-corruption efforts have had an unclear effect on China's space industry, with PRC military and civil leadership voids being quickly filled by trusted CCP members. Since 2015, China has devoted extensive economic and technological resources to developing all aspects of its space program, including military space applications, human spaceflight, and

lunar and Martian exploration missions.^{84,85,86} Using space-related cooperation as an extension of its Belt and Road Initiative (BRI), China is strengthening its economic and diplomatic ties with African, Latin American, and Asian countries by providing training, jointly developing and launching satellites, and offering BeiDou satellite services.^{87,88,89} China, in partnership with Russia, spearheaded the creation of the International Lunar Research Station (ILRS), which seeks to create an international coalition of nations and organizations focused on lunar missions with China at the forefront.

China has more than tripled its space launches per year in the past decade, with 22 launches in 2016 and 93 launches in 2025.⁹⁰ Beijing also has deployed more than 9 times as many satellites in orbit per year during the past 8 years, increasing from 40 in 2016 to 384 in 2025.^{91,92,93}

In 2025 and 2026, China launched multiple batches of satellites for its national LEO proliferated large constellations, continuing to increase the number of its satellites on orbit.⁹⁴ Since 2011, China has placed three space stations in orbit, launching its most recent in 2021, which remains in orbit.^{95,96,97,98,99} Since 2022, Beijing has also flown four missions of its Shenlong spaceplane,¹⁰⁰ and displayed the Haolong-1 cargo spaceplane model in November 2024. The Haolong-1 is a commercial spaceplane that aims to provide low-cost cargo transportation for the Chinese space station.¹⁰¹ Furthermore, China has continued to deploy advanced robotics on both the Moon and Mars. China launched a robotic lander and rover to the far side of the Moon,¹⁰² two lander and sample return missions to the Moon in 2020 and



A Long March rocket with a Shenzhou-19 spacecraft atop takes off from the Jiuquan Satellite Launch Center in Jiuquan, north-western China on Oct. 30, 2024. | Image Source: AFP

2024,^{103,104,105,106,107,108} and an orbiter, lander, and rover together to Mars in 2021.^{109,110,111} China is also launching a range of satellites that substantially enhance its ISR capabilities; fielding advanced communications satellites able to transmit large amounts of data; increasing PNT capabilities; and deploying new weather and oceanographic satellites.¹¹²

China has developed and will continue to advance weapons for use against satellites in orbit to disrupt, damage, and destroy other nations' space capabilities.^{113,114} China continues to research, develop, test, and deploy multiple types of counterspace weapons, including ground-based ASAT missile systems capable of destroying satellites.^{115,116,117,118,119,120}

China's national military strategy emphasizes the safeguarding of national sovereignty and territorial integrity as Beijing's key objective and proclaims active defense—strategic defense paired with operational and tactical offense—as its guideline to contain and win wars.¹²¹ According to its national strategy and military literature, China identifies space as a strategic priority for military dominance and political influence.^{122,123} The Chinese military perceives space as a force multiplier that integrates cross-domain operations and platforms,^{124,125} an

enabler of modern warfighting capabilities¹²⁶ and a precondition for superiority and victories in other operational domains.¹²⁷ Consistent with its active defense guideline, Beijing views space deterrence as a facet of military deterrence and seeks to employ a wide range of options, including reversible and irreversible counterspace strikes, to maximize its operational effectiveness and flexibility.¹²⁸

Space Strategy and Doctrine

The PLA's objectives include space dominance: the ability to control the space-enabled information sphere and deny its adversaries their own space-based information gathering and communications capabilities. China views space dominance as a critical component to conduct modern “informatized warfare.”^{129,130,131,132} As early as 1971, PRC academics began reviewing foreign publications on space and counterspace capabilities to gather information on counterspace technologies. PRC space-related science and technology innovations accelerated in the 1980s, probably as a result of the U.S. space-focused Strategic Defense Initiative to defend against the former Soviet Union's nuclear weapons.¹³³ Subsequently, after observing the U.S. military's performance during the 1991 Gulf War and actions in Kosovo, Afghanistan, and the second Iraq War—where the United States leveraged space assets to support ground operations—the PLA began military modernization efforts across all domains, including space, as well as updating doctrine to focus on using and countering information-enabled warfare.¹³⁴

China is pursuing agreements in the United Nations for the “non-weaponization” of space.^{135,136} Nonetheless, China continues to improve its counterspace weapons capabilities to deter and compel other nations from taking actions Beijing deems counter to its national security interests.

Additionally, China has enacted military reforms to better integrate cyberspace, space, and electronic warfare (EW) into joint military operations.¹³⁷

Beijing judges space is central to the United States and its allies' operations. Beijing also considers space an offensive military domain, which has shaped integral components of PLA military planning and campaigns. China's active defense strategy, which emphasizes offensive action at the operational and tactical levels to counter another nations' actual or perceived military action, guides PLA planning for space operations.^{138,139} The PLA probably sees counterspace operations as a way to dissuade and prevent an intervention from other nations during a regional military conflict.^{140,141} China's defense academics suggest that reconnaissance, communications, navigation, and early warning satellites from other nations could be targets of attacks designed to "blind and deafen the enemy."¹⁴²

China's development of a wide range of counterspace capabilities suggests the PLA probably is taking a combined arms approach to space and seeks to threaten other nations' satellites with multiple types of weapons.¹⁴³ This combined arms approach would enable the PLA to tailor its responses to particular situations, taking actions ranging from those that create temporary effects at the lowest level of escalation to actions that create permanent, non-reversible effects.¹⁴⁴ PRC strategists very likely estimate that demonstrating counterspace capabilities during a crisis could threaten or incrementally degrade an adversary's space architecture as a prelude to war.^{145,146,147} PLA researchers assert that using space-related weapons to coerce a particular behavior will have a lower threshold for use than nuclear weapons, and is a more controllable, flexible, and credible option than nuclear deterrence, at least partially because these

systems' escalatory effects can also be modulated to disrupt, damage, or destroy.^{148,149}

CCP Direction of China's Space Organizations

The CCP is able to control elements of China's space program by appointing organizations to lead the critical programmatic decisionmaking process.¹⁵⁰ As a result, some Chinese companies funnel data to and directly support PLA military objectives. As an example, the State Council, not the CMC, was designated the lead during the approval process for China's human and robotic space exploration program.^{151,152} This structure allows the State Council to facilitate the coordination across PRC civil and military bureaucracy, while providing CCP leaders special oversight of accountability.¹⁵³ The hierarchy indicates there are considerable cross-department groups reporting to the State Council, which manage national defense scientific research and provide military production oversight.^{154,155}

Military Space Organizations

The PLA continues to be a primary driver for improving China's capabilities in space-based ISR, SATCOM, satellite navigation, human spaceflight, and robotic space exploration.¹⁵⁶ China invests in expanding its domestic industry, including space, and leverages its Military-Civil Fusion strategy (MCF) to take advantage of commercial capabilities that might address military requirements not met by PLA resources.^{157,158} Chinese officials have stated the intention to leverage MCF to achieve China's goal of becoming a "Space Great Power." Additionally, Chinese law indicates that Chinese companies could be required to supply data to directly support PLA military objectives.^{159,160,161}

China created the Strategic Support Force (SSF) in December 2015 to integrate cyber, space, EW, and communications architecture capabilities into joint military operations as part of its military reforms.^{162,163,164} Between 2016 and 2024, the SSF formed the core of China's information warfare force, supporting the entire PLA and reporting directly to the CMC.¹⁶⁵

Until its disbandment in 2024, the SSF oversaw three organizations: the Aerospace Force (ASF), which was responsible for military space operations; the Cyberspace Force (CSF), which handled military electromagnetic spectrum operations and information warfare; and the Information Communications Base (ICB), which managed national military communications networks security.^{166,167,168}

In April 2024, Beijing announced the SSF's dissolution, which aligned its subordinate forces directly under the CMC, and the establishment of a new Information Support Force (ISF). President Xi probably decided to disband the SSF to streamline CCP oversight of space support missions by removing a bureaucratic layer perceived as unnecessary.^{169,170} The CMC's direct management of the ISF suggests the ISF probably is comprised of the former SSF ICB and assumed its role in coordinating the military's networks and communications systems.^{171,172} As a strategic branch, the ISF is expected to provide support to other PLA branches, supporting the Aerospace Force and enabling joint force activity to fight and win modern wars.¹⁷³ Prior to 2024, the SSF routinely participated in PLA joint exercises and training, probably to evaluate and improve its ability to provide a range of support functions for joint operations.¹⁷⁴ During exercises in 2023, the SSF provided reconnaissance support from space- and terrestrial-based sensors, established and maintained command posts and communications,

and conducted electronic attack activities to support increased training realism during simulated combat scenarios involving air, maritime, and conventional missile operations, including precision strikes.¹⁷⁵

State-Owned & Commercial Space Organizations

The CNSA, subordinate to the State Administration for Science, Technology, and Industry for National Defense (SASTIND), serves as the public face of China's national space program's civilian space efforts.¹⁷⁶ China is using CNSA efforts to bolster relationships with countries around the world, especially BRI partners, to cooperate on space issues. For example, China is engaged in satellite navigation, lunar exploration, and space capability development cooperation with multiple countries including Pakistan, Saudi Arabia, Thailand, Egypt, and Nigeria.^{177,178,179,180} China claimed to have signed nearly 200 intergovernmental space cooperation agreements with over 50 countries and international organizations, as of May 2025.^{181,182,183}

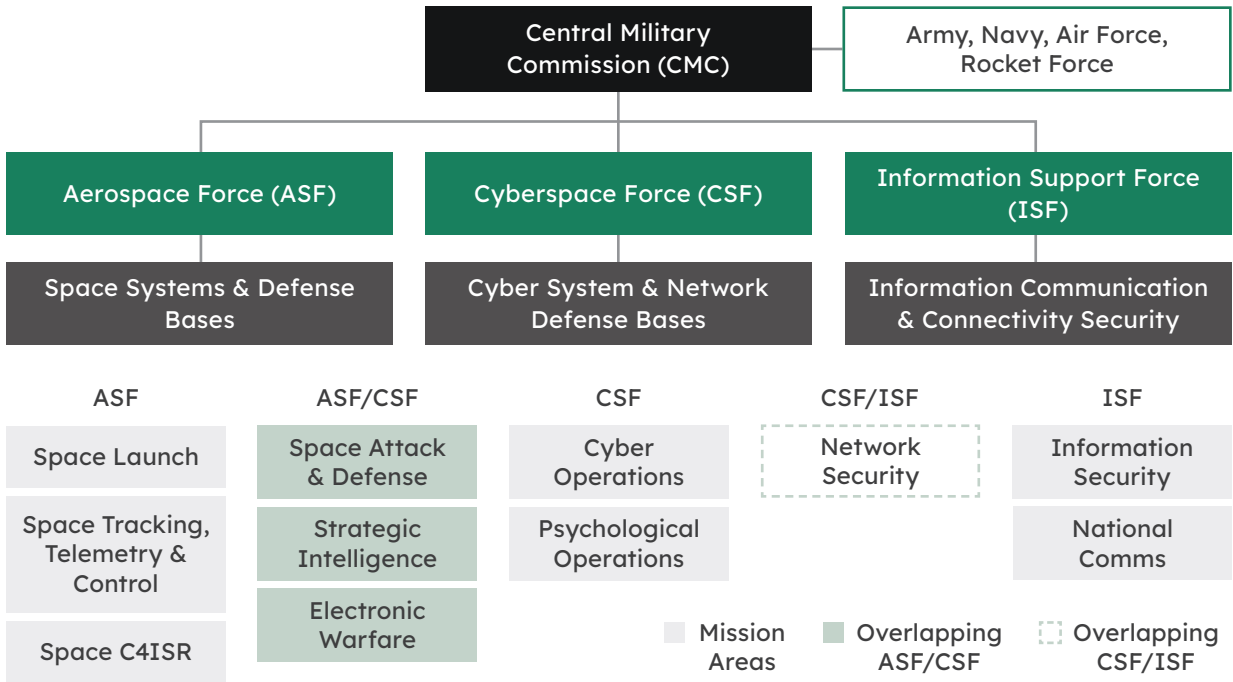
China emphasizes the phrase “military-civil fusion” to refer to the dual-use of technologies, policies, and organizations for both civilian and military benefit.¹⁸⁴ While the MCF strategy is mainly focused on the development of technology, there are indications in Chinese law that Chinese companies could be required to supply data that directly supports PLA military objectives.^{185,186,187,188} China has privately owned and state-run “commercial space launch” companies for SLV technologies, which serve both military and economic interests. China's commercial space sector also includes some partially state-owned enterprises—the China Satellite Network Group, Chang Guang Satellite Technology Ltd (CGSTL), Zhuhai Orbita, Expace, OK-Space, China Academy of Sciences (CAS) Space, and China

Rocket—focused on remote sensing, launch, and communications services.^{189,190,191,192,193,194,195} CGSTL intends to launch 138 satellites by 2030, providing the company 10-minute revisit times for imaging any location on Earth; it is currently far exceeding the launch and production rates required to achieve this goal.¹⁹⁶ Galactic Energy is a private rocket maker

in Beijing providing launch services for state-owned conglomerate China Aerospace Science and Technology Corporation (CASC). Galactic Energy supported the May 2024 launch of the Shanghai Academy of Spaceflight Technology (SAST) experimental payload Shiyan-23.¹⁹⁷

China's Military-Civil Fusion Strategy

China's MCF strategy is a state-directed program leveraging state and commercial power to strengthen China's military.^{198,199} In 2017, the PRC State Council called for an expansion of defense trade and international cooperation on the Space Information Corridor and remote sensing satellite constellations among Brazil, Russia, India, China, South Africa.²⁰⁰ The Space Information Corridor connects communications, navigation, and remote-sensing satellite constellations, supplemented by space-based resources and ground information sharing networks, to provide spatial information service capabilities for BRI nations.^{201,202}



The organization chart represents the overarching structure for China's military space mission areas and associated space support entities. This structure reflects the PLA's attempt to integrate cyber, space, and EW capabilities, as well as communications architecture capabilities into joint military operations.^{209,210,211,212,213}

Commercial Space Sector

China's rapidly expanding commercial space industry is quickly becoming a key pillar in Beijing's efforts to achieve domestic space goals and expand its share of the international market.^{214,215} China is currently second only to the United States in the amount of private capital it channels to space companies.^{216,217} In just over a decade since its commercial space industry's inception, China has established over 400 commercial space entities offering a range of commercial services to both domestic and international clients.^{218,219,220} China released a white paper, *China Space Program: A 2021 Perspective*,

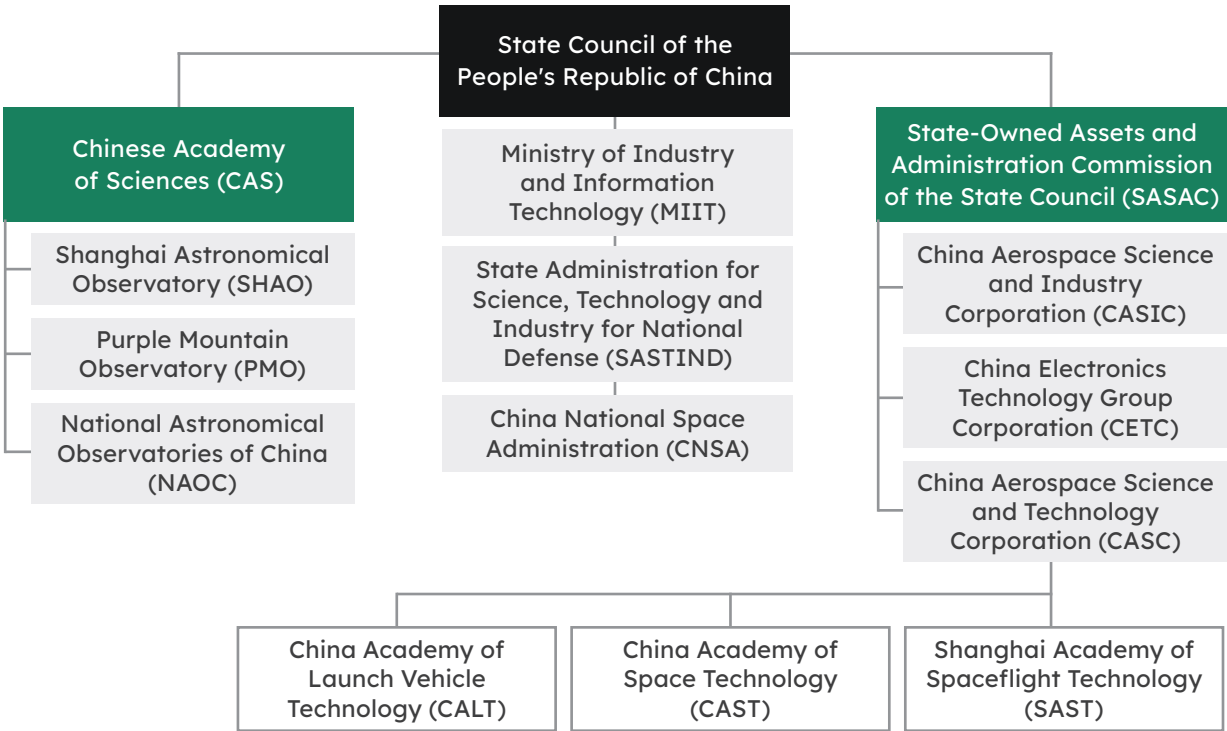
which emphasized commercial space activities and applications, in line with a 2014 policy change to open up the space sector to private capital.²²¹

China is an industry leader in several categories of commercial remote sensing capabilities, including electro-optical (EO) imaging, EO revisit rates, and multispectral imaging.^{222,223} Since 2020, China increased its number of commercial launch companies and established goals to complete multiple internet satellite projects by 2027.^{224,225} In the next 5-10 years, the increase in PRC companies that provide LEO broadband service could provide Beijing an opportunity to influence digital norms

and standards in countries that purchase China's space services.^{226,227,228} China will almost certainly continue to use nonmilitary and commercial space activities to expand its global influence, with state-owned enterprises and their subsidiaries remaining the primary players in its commercial space sector through 2030.^{229,230,231}

Acquisition of Foreign Space and Counterspace Technologies

China continues to use overt and covert acquisition of foreign technology to build its knowledge and advance technological modernization. China is building large industrial zones to expand its space-related research and development (R&D) efforts, while Beijing promotes its domestic companies as international leaders in all aspects of the space industry.^{232,233} China leverages traditional technical espionage, cyberespionage techniques, its open-source acquisition network, technology transfer organizations, and exploitation of overseas scholars and civilian partnerships as a supplement to its domestic research.^{234,235,236} Acquisition of foreign technology circumvents the costs of research and facilitates “leapfrog” development of technology.²³⁷



Private Commercial Launch Companies	Commercial Imagery	Commercial TT&C
Landspace	Chang Guang Satellite Technology Co. Ltd. (CGSTL)	Emposat
Deep Blue Aerospace	SpaceWill	Tianlian TT&C
iSpace	Spacety	Head Aerospace
Galactic Energy		
OneSpace		
Space Pioneer		

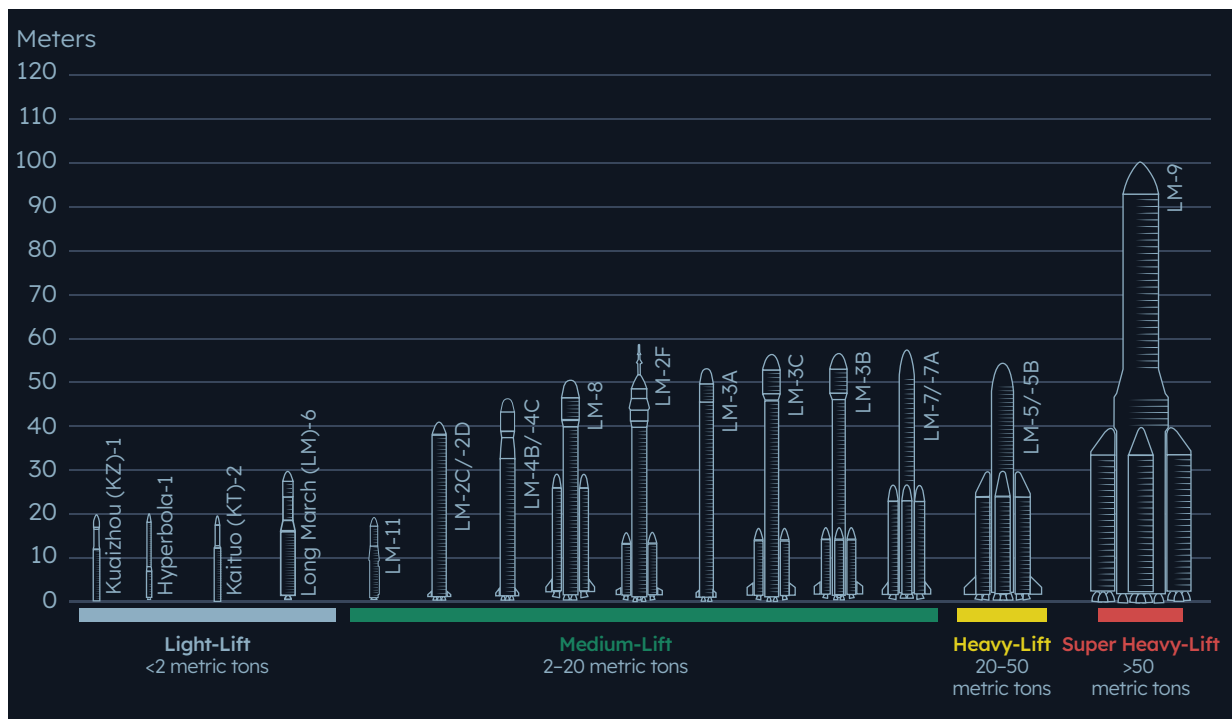
This chart contains China's primary civil and commercial space organizations. This chart does not represent all PRC space organizations, rather it provides a strategic overview of those entities that provide significant advancement to China's space program.

China's Global Outreach and Space Service Expansion

China's Belt and Road Space Information Corridor is emerging as an important component of China's BRI. The Corridor initiative features applications and services related to navigation and positioning, remote sensing, weather, and communications satellites.²⁴² China promotes the export of satellites and related technologies to BRI member countries, encouraging the use of Chinese technology and adoption of Chinese technology standards.²⁴³ Countries such as Egypt, plan to leverage China's help to develop their own space sector as part of BRI cooperation.²⁴⁴ Indonesia, Pakistan, and Russia have signed agreements under the BRI Space Information Corridor initiative to expand space technology sharing and make use of China's space services, such as PNT and launch.²⁴⁵

China's Space Launch Vehicles^{246,247,248,249,250,251}

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This graphic depicts some of China's most widely used Space Launch Vehicles (SLVs) and their associated lift capacity and size. China uses its light-lift vehicles to place small payloads into LEO and its medium-lift—specifically the LM-2, LM-3, and LM-4—to place larger satellites into LEO and MEO and smaller satellites in GEO. The LM-5 heavy-lift SLV supports launching crewed space station components to LEO and heavy payloads to GEO. The developmental super heavy-lift LM-9 will primarily support missions to the Moon and Mars.

Space Launch Capabilities

China is developing space launch capabilities to ensure it has an independent, reliable means to access space and to compete in the international space launch market. Beijing set a national record for space launches in 2025 with 93, including 25 commercial launches.^{252,253} There already have been 18 launches in the first quarter of 2026, with 6 being commercial launches.²⁵⁴ China is working to improve manufacturing efficiencies and launch capabilities, while trying to expand its human spaceflight and deep-space exploration missions, including to the Moon and Mars.²⁵⁵

China is developing multiple SLV designs to expand its launch capabilities, improving launch vehicle reliability and cost savings for launch campaigns. This includes modular SLVs such as Long March 5 (LM-5), LM-6, LM-7, and LM-8 series SLVs,^{256,257,258} which will enable China to tailor vehicles to the specific configuration required for each customer.²⁵⁹ China is also conducting component-level testing on a reusable, super heavy-lift SLV, called the LM-9, to support proposed, crewed lunar and Mars exploration missions, which China plans to execute by 2030 and 2050, respectively.^{260,261,262,263,264} China currently lags behind the United States in the development of heavy-lift launch SLVs, which could hinder Beijing's longer-term strategy to achieve space leadership.²⁶⁵

In addition to land-based launches, China's private and state-owned corporations have launched four SLVs from sea launch platforms: the LM-11, Jielong-3 ("SmartDragon-3"), Ceres-1, and Gravity-1.^{266,267,268} Notably, in 2024, Orienspace launched a commercially produced Gravity-1 rocket, which can carry up to 6.5 metric tons into LEO, from a ship off the coast of Haiyang.^{269,270} This capability enables

China to launch nearer to the equator than its land-based launch sites, which increases the rocket's carrying capacity and can lower launch costs.²⁷¹

Chinese private space launch companies are developing light-lift SLVs, probably intended to make China a more competitive provider of small satellite launch services.²⁷² Although the payload capacity is limited to LEO, a rapid launch capability also can support China's military operations during a conflict or civilian response to disasters.^{273,274,275,276,277} Compared with medium- and heavy-lift SLVs, these SLVs can expedite launch campaigns because they are transportable via road or rail. They can be stored launch-ready with solid fuel for longer periods than liquid-fueled SLVs.

China's space launch developers are probably developing reusable versions of existing SLVs to help Beijing meet broader military, civil, and commercial space goals.²⁷⁸ Reusable SLVs will help to lower launch costs and to achieve the launch rates needed to deploy and sustain multiple satellite proliferated large constellations or a space-based solar power station, a key emerging technology to collect and transmit power down to earth.^{279,280,281,282,283,284} Private PRC firms have taken the lead on developing reusable launch systems, as evidenced by the inaugural launch of Deep Blue Aerospace's Nebula-1 rocket in late 2023 and Landspace's 2025 launch of its Zhuque-3 reusable rocket.²⁸⁵ Additionally, the developmental reusable SLV Long March-12A launched on 30 April 2026, but the booster landing failed.²⁸⁶ CASC anticipates further inaugural test flights of developmental rockets in 2026.²⁸⁷

August 2024 China Space Launch Failure and Breakup

In August 2024, China's inaugural launch of its Starlink G60 constellation on an LM-6A resulted in the rocket body breaking up, creating more than 300 pieces of debris at roughly 800 kilometers of altitude that will pose risks to satellites in LEO for decades. Despite China's Foreign Ministry claiming that China took measures in response to the LM-6A breakup,²⁸⁸ China has released no information on those mitigation measures. China's continues to use the LM-6A in spite of another catastrophic breakup creating more than 50 pieces of debris in 2022.²⁸⁹

China's Domestic Space Enabling Infrastructure

China has five Yuanwang and one Liowang space support ships that contribute to its Telemetry, Tracking, and Control (TT&C) and its space domain awareness (SDA) systems. In 2025, China launched its first next generation space tracking ship, the Liaowang-1.^{290,291,292,293}

Tracking, and Control (TT&C) and its space domain awareness (SDA) systems. In 2025, China launched its first next generation space tracking ship, the Liaowang-1.^{290,291,292,293}

China's Domestic Space Enabling Infrastructure^{294,295}

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ASF's China Launch and Tracking Control unit operates the PLA's four launch sites and two main satellite control centers—Xian Satellite Control Center and the Beijing Space Information Transmission Center—along with the PLA TT&C system for all Chinese satellites.^{296,297,298} The satellite control centers serve as central organizational command centers for satellite operations, while TT&C centers relay signals and data between operators to satellites. The PLA operates five large phased array radars (LPAR) most likely used for missile warning and SDA. This graphic features PLA's LPARs and does not include other types of sensors that contribute to the PLA's SDA mission.



As of 7 September 2024, Yuanwan-1 space support ship moored at Jiangnan Shipyard, Shanghai, China. The four Yuanwang space tracking ships—based in Jiangyin, near Shanghai, and usually supporting space launch operations from positions in the Pacific and Indian Oceans—are part of China's TT&C network. These ships include a robust suite of space-tracking technology that could contribute to SDA missions in addition to satellite control and data relay. | Image Source: AFP

Human Spaceflight and Space Exploration Efforts

China's space program is one element of the CCP's goal of making China a more respected and influential global space power, with human spaceflight and space exploration central to its space diplomacy messaging strategy.²⁹⁹ China's human spaceflight program began with uncrewed missions in 1999. In 2003, China became the third country to achieve independent human spaceflight when it successfully orbited the crewed Shenzhou-5 spacecraft.^{300,301,302} China has since launched three space stations: the Tiangong-1 in 2011, the Tiangong-2 in 2016, and the Tiangong-3 in 2021.^{303,304,305,306,307} China completed construction of its three-module space station in November 2022 and has since launched ten Tianzhou supply vessels and eleven PRC crews.^{308,309,310} In 2027 China plans its first full test flight of a new crewed spacecraft, the Mengzhou New-Generation Manned Spaceship, which is expected to transit crews to the Tiangong space station and support future, crewed lunar missions.^{311,312,313}

Over the past several years, China cooperated with Russia and the European Space Agency (ESA) to advance lunar and deep-space exploration missions.^{314,315}

China has stated its goal of developing a cislunar space economy by 2045.³¹⁶ China's International Lunar Research Station (ILRS) program—jointly initiated by China and Russia in 2021—aims to build a lunar base to facilitate lunar research and exploration.³¹⁷ Several countries, organizations, and institutions have joined the program, including Azerbaijan, Pakistan, the United Arab Emirates, Asia-Pacific Space Cooperation Organization (APSCO), South Africa and Swiss company Nano-SPACE.³¹⁸ The PRC-led consortium aims to complete construction of a basic model of the ILRS by 2035.³¹⁹ China is also the first country to attempt sustained operations on the far side of the Moon, with numerous projects slated to support that effort through the next decade.³²⁰ China portrays its interest in cislunar space as peaceful, but PRC officials have also discussed pursuing military capabilities in cislunar space.³²¹



On 25 June 2024 Vice Premier Ding Xuexiang toured the Beijing Aerospace Control Center in Beijing to observe the Chang'e-6 landing, recovery, and return mission operations. Chang'e-6, launched in May 2024, is China's most recent lunar mission set to retrieve a lunar sample, supported by China's Queqiao-2 relay satellite that is in a stable orbit around an Earth-Moon Lagrange point.^{322,323,324,325,326} | Image Source: AFP

China's Space Exploration Missions

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Mission	Description	Launch Date
Tiangong	Modular space station designed to host PRC and foreign payloads and astronauts. ^{327,328,329,330,331,332}	2021–2022
Chang'e-6	Robotic mission that landed on the Moon, collected samples from the Moon's far side, and returned to Earth. ³³³	2024
Tianwen-2	Robotic mission to rendezvous with and return samples from a near-Earth asteroid. ³³⁴	2025
Chang'e-7	Orbiter, lander, rover, and flyby craft. The lander and rover will have ground-penetrating radar, a surface magnetometer, and a spectrometer. ^{335,336}	2027
Chang'e-8	Robotic test and verification mission for future lunar expeditions. Together with Chang'e-7 will form the basic model of a lunar research station. ^{337,338}	2028
Chinese Lunar Exploration Program	Human lunar exploration program to put astronauts on the Moon. ³³⁹	By 2030
Tianwen-3	Robotic mission to land on and return samples from Mars. ³⁴⁰	Around 2030
Tianwen-4	Robotic mission to explore Jupiter. ³⁴¹	Around 2030
International Lunar Research Station	Establish a research base on the Moon, primarily supported by robotic technology and capable of supporting human visits. ^{342,343,344}	By 2040

ISR Satellite Capabilities

China employs a robust space-based ISR capability designed to enhance its worldwide situational awareness and enable long-range strikes. Used for military and civilian remote sensing and mapping, terrestrial and maritime surveillance, and intelligence collection, China's ISR satellites are capable of providing EO and SAR imagery, as well as electronic and signals intelligence data.³⁴⁵ As of July

2026, China's ISR satellite fleet contained more than 510 systems, having more than tripled since 2018.^{346,347} While many of these ISR satellites are ostensibly affiliated with commercial and civil missions, the dual-use nature of their capabilities and possibly the Chinese military-civil fusion policies means the data or imagery they collect can be used by the PLA. China's expansive system of ISR satellites can be used to support global monitoring, tracking, and targeting of U.S. and allied forces worldwide, especially

throughout the Indo-Pacific region, including strategic locations such as the Korean Peninsula, Taiwan, the Philippines, the Indian Ocean, and the South China Sea.^{348,349,350} Chinese ISR companies also supply imagery to state actors banned by Western providers for supporting weapons proliferation.³⁵¹

To improve its space-based ISR capabilities, China continues to emphasize the development, procurement, and use of increasingly capable satellites with digital camera technology, along with space-based radar for all-weather, night and day coverage.³⁵² In 2023, China launched the world's first GEO SAR satellite, Ludi-Tance-4, which provides persistent radar access to much of the Indo-Pacific region.^{353,354,355} China's growing constellation of LEO satellites can provide images of any location on earth in 30 minutes or less. Meanwhile, China's GEO signals intelligence (SIGINT), EO, and SAR satellites provide persistent coverage with no latency. When used with other technologies, these satellites enable an indigenous capability to track objects throughout the entire Indo-Pacific region.³⁵⁶ These improvements have increased China's ability to monitor U.S. and allied aircraft carriers, expeditionary strike groups, and deployed air wings throughout the Pacific.^{357,358,359}

Satellite Communications

China is fielding advanced communications satellites capable of transmitting large amounts of data, including data relay satellites for transmitting critical targeting data between China's remote sensing satellites and its military operation centers.^{360,361,362,363,364,365} China operates hundreds of communications satellites, at least some of which are dedicated to military use.^{366,367} China is beginning to field communications proliferated large constellations in LEO (pLEO). To this end, China successfully filed for spectrum resources, funded

satellite manufacturing infrastructure, and began to populate satellites in LEO.^{368,369,370} One such major communications proliferated large constellation project is the state-owned Xingwang (or Guowang) pLEO constellation, but operator China Satellite Network Group (CSCN) has provided few concrete details about Xingwang's development.^{371,372} China launched its first batch of Xingwang satellites on 16 December 2024.³⁷³ In 2024, China also began launching commercial Qianfan satellites which belong to its other large communications constellation—Shanghai Spacecom Satellite Technology's Starlink G60 satellite internet constellation.³⁷⁴ As of July 2026, there are 177 Xingwang and 238 G60 Starlink satellites on orbit.^{375,376,377}

The Chinese Academy of Sciences (CAS), China's national academy for natural sciences, is continuing to test next-generation capabilities such as space-based quantum-enabled communications, which could eventually supply China the means to field highly secure communications systems.^{378,379,380} In June 2017, a team of CAS scientists claimed to have successfully tested satellite-based quantum entanglement on its Quantum Experiment at Space Scale satellite in LEO.³⁸¹ Testing satellite-based quantum entanglement would represent a major milestone in building a practical, global, and ultra-secure quantum network, but the widespread deployment and adoption of this technology still faces hurdles.^{382,383} In 2022, China launched the world's first quantum communications satellite, Mo Tzu, and in July 2022, the second, more advanced Jinan-1 satellite.³⁸⁴ In October 2023, CAS officials announced they had developed plans to further improve their quantum satellite technology, focusing on quantum key networking in LEO and quantum science experiments in GEO and MEO.^{385,386,387,388}

Positioning, Navigation, and Timing Capabilities

BeiDou is China's independently developed and operated satellite navigation system, providing worldwide PNT services. BeiDou supports national security, along with economic and social development for China. BeiDou is an instrument of national power for Beijing, which uses PNT for precise agricultural, vehicle, and ship monitoring, alongside support for civilian-focused services like search and rescue.^{389,390,391} Initially deployed to facilitate regional PNT services, BeiDou achieved worldwide initial operating capability in 2018.^{392,393} In June 2020, China successfully launched the final satellite in the BeiDou constellation, completing its global navigation system, which now includes 49 operational satellites (29 in MEO and 20 in GEO).^{394,395}

Of China's space programs, BeiDou represents a high potential for dual use and is a prime example of its civil-military integration efforts. China's military uses BeiDou's precise PNT services for troop movements and precision-guided munitions delivery.^{396,397,398,399,400,401,402,403,404} The BeiDou constellation offers additional capabilities beyond PNT, including text messaging and user tracking through its Regional Short Message Communication service. While this enables mass communications among BeiDou users, it may contribute to Chinese surveillance.⁴⁰⁵ The system also provides additional military Command and Control (C2) capabilities for the PLA.^{406,407,408}

BeiDou has more than 2 billion users, including some countries that plan to use BeiDou as the primary PNT system for critical infrastructure.⁴⁰⁹ China's international cooperation comes in a variety of forms, including training and education, the establishment of joint R&D centers, and the building

of ground infrastructure, such as continuously operating reference stations (CORS).

BeiDou has a worldwide positional accuracy standard of 10 meters; the system's accuracy in the Indo-Pacific region is within 5 meters.⁴¹⁰ The BeiDou program is an example of how China uses state-directed measures to gain technological and market advantage in critical industrial sectors.⁴¹¹ Notably, China is using its BeiDou constellation to offer enhanced PNT services to countries taking part in its Belt and Road Space Information Corridor initiative.^{412,413} China's efforts to promote BeiDou internationally include cooperative activities, military agreements and arms sales, activities in the polar regions, admission into international standards organizations, and interoperability and compatibility agreements.⁴¹⁴ Chinese entities conduct a wide range of activities related to BeiDou that aim to enhance China's status, influence, and military power globally.⁴¹⁵ For example, as of 2024, China installed BeiDou CORS in 11 Sub-Saharan African countries.⁴¹⁶ These efforts can lead to a reliance on BeiDou that could increase the risk of dependency on China, exposing those countries to influence if China were to deny or degrade BeiDou's signal.⁴¹⁷

Space Situational Awareness (SSA)

China has a robust network of space surveillance sensors capable of searching for, tracking, and characterizing satellites in all Earth orbits. This network includes various telescopes, radars, and other sensors worldwide that enable China to support its space-based missions, including intelligence collection, counterspace targeting, ballistic missile early warning (BMEW), spaceflight safety, satellite anomaly resolution, and space debris monitoring.^{418,419} CAS's astronomical observatories monitor the space environment to perform scientific

research but also to conduct surveillance of space objects to characterize them and monitor their operations.^{420,421,422} These organizations, including the Purple Mountain Observatory (PMO), National Astronomical Observatories of China (NAOC), and the Shanghai Astronomical Observatory (SHAO), often partner with academic and scientific institutions worldwide to host space environment monitoring equipment.^{423,424} In 2008, CAS established the PMO Key Lab of Space Target and Debris Observation. Since at least 2014, researchers and committee members have included officials and scientists designated by the CMC. Contributions from academic and commercial space situational awareness resources could expand the capabilities of the military and showcase MCF's central role in improving China's capability to support complex orbital maneuvers, threat mitigation, and potentially counterspace operations.^{425,426}



This photo, taken on 16 August 2023, shows the Wide Field Survey Telescope (WFST) in Lenghu Town in northwest China's Qinghai Province. A wide-field telescope measuring 2.5 meters in diameter, WFST is capable of surveying the entire sky from the Northern Hemisphere. | Image Source: AFP; Xinhua

China leads APSCO, a Beijing-based organization promoting space science and technology cooperation.⁴²⁷ As of 2026, APSCO included

Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand, and Turkey as full members, with Egypt and Indonesia as associate members.⁴²⁸ Mexico, Venezuela, the Inter-Islamic Network on Space Sciences & Technology, and the Arab Union for Astronomy and Space Sciences are observers.^{429,430} APSCO seeks to expand its cooperation with other states in the Asia-Pacific region.⁴³¹ One of APSCO's main collaborative efforts is the Asia-Pacific Space Science Observatories (APSSO) project, formerly the Asia-Pacific Ground-Based Optical Space Object Observation System.⁴³² APSCO is planning to improve optical system capabilities, coverage, and redundancy, as well as fill gaps within its data sharing networks.^{433,434,435,436} A part of APSSO aims to install 8 telescopes with diameters of 50cm or more in each member country.^{437,438,439} Previously, China provided Iran, Pakistan, and Peru 15cm APSCO network telescopes capable of tracking objects in LEO and out to GEO. Tasking information and subsequently collected observation data are funneled through the CAS NAOC of China.

China's Worldwide Overseas TT&C Sites

China is working to build a global, integrated information network to form a geographically diverse terrestrial infrastructure to enable uninterrupted monitoring along the satellites' orbit. Overseas space-related ground stations are an important element of China's space monitoring architecture, with overseas sites providing supplemental data for satellite tracking. Given China's military-civil fusion policy, it is able to leverage its space monitoring and tracking facilities overseas, which facilitate China's ability to maintain command, control, and communications to support its military and civil space missions.⁴⁴⁰ China has established locations worldwide to aid in TT&C of space missions

around the Earth, as well as in cislunar and deep space. China requires this type of space-enabling infrastructure throughout the globe to maintain uninterrupted communications between terrestrial and space-based capabilities.⁴⁴¹ China's space support sites have potential dual civilian-military uses, which has caused diplomatic concern. China is affiliated with ground stations in Argentina, Australia, Brazil, Canada, Chile, Ethiopia, France, Greenland, Kenya, Kiribati, Namibia, Norway, Pakistan, South Africa, Spain, and Sweden.⁴⁴²



Chinese-built ground station at the Entoto Observatory and Space Science Research Center in Addis Ababa. This ground station is part of a China-Ethiopia satellite data service partnership.

| Image Source: AFP

Separately, China operates five Antarctica-based scientific research stations—the Great Wall, Kunlun, Qinling, Taishan, and Zhongshan sites.^{443,444} Of those stations, at least two sites, the Great Wall and Zhongshan, are acknowledged to have BeiDou reference stations. BeiDou CORS improve the accuracy of the PNT signals for China's ships, aircraft, and vehicles traveling, mapping, and researching in the Antarctic region. China's continued investment in Antarctica displays Beijing's intent to become a polar power, and potentially create more opportunities to monitor the space facilities and signals of Australia and New Zealand.^{445,446}

Electronic Attack Capabilities

The PLA considers electronic attack capabilities critical to modern warfare, and its doctrine emphasizes using jamming to suppress or deceive enemy equipment.⁴⁴⁷ The PLA does not consistently define EW as distinct from electronic attack and electromagnetic spectrum warfare capabilities.⁴⁴⁸ PLA jamming capabilities include a combination of ground-based and on-orbit systems that enable it to leverage a variety of options during a conflict.⁴⁴⁹ To seize electromagnetic dominance, the PLA aims to leverage its electromagnetic spectrum warfare capabilities, which can disrupt and degrade space systems the PLA identifies as a threat. During its military exercises, the PLA routinely incorporates ground-based satellite uplink and downlink jamming and anti-jamming techniques, which probably are intended to deny multiple types of space-based communications, radar systems, and GPS navigation support to military movement and precision-guided munitions.⁴⁵⁰

The PLA is working to improve coordinating and leveraging its EW units. These units are subdivided into three main functions: technical reconnaissance, electronic attack, and electronic countermeasures.⁴⁵¹ In early 2024, PRC scientists claimed to have achieved seamless, wide bandwidth, real-time monitoring and analysis of the full electromagnetic spectrum to support future PLA EW operations.⁴⁵² China's commercial organizations are developing jammers for the PLA to target SAR, including military reconnaissance platforms.⁴⁵³ Additionally, China is probably developing jammers to target SATCOM over a range of frequency bands, including extremely high frequency communications used by the U.S. military.^{454,455,456} These capabilities can cause spillover effects that interfere with civilian uses of commercial SATCOM.



Cyberthreats to Space Capabilities

The PLA emphasizes offensive cyber capabilities as a major component of integrated warfare and could use its cyberwarfare capabilities to support military operations against space-based assets.^{458,459} Multiple aspects of space systems can act as access vectors to cyber actors, including the orbital, link, and terrestrial segments of space-based systems.⁴⁶⁰ The PLA probably intends to employ cyberattacks as part of strategic coercion and deterrence operations to constrain an adversary's actions or slow its mobilization and deployment.^{461,462} Such attacks might affect the segments of logistics, commercial activities, and network-based command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR).

The PLA also conducts cyberespionage against foreign space entities, consistent with broader state-sponsored industrial and technical espionage. These intelligence activities increase China's technological capabilities and the knowledge available to support military research, development, and acquisition. The PLA unit responsible for conducting signals intelligence has supported cyberespionage against U.S. and European satellite and aerospace industries since at least 2007.^{463,464}

Directed-Energy Capabilities

The PLA probably considers DEWs ideal counterspace systems because they can cause both reversible and nonreversible effects against satellites.^{465,466,467} China has multiple ground-based laser weapons with varying power levels to disrupt, degrade, or damage satellites in LEO; by the late-2020s, China may field space-based directed energy systems and higher-powered ground-based directed

energy systems capable of threatening satellites in higher orbits.^{468,469,470,471,472,473,474,475,476,477,478} In January 2021, PLA media asserted that laser weapons were entering a golden age; they cited dazzling (i.e., temporarily blinding a sensor) as one of the many operational uses of laser weapons.⁴⁷⁹

ASAT Missile Capabilities

Much of the PLA doctrine on the use of ASAT missiles characterizes the systems as useful deterrents against external involvement in a regional conflict or as a method to manage conflict escalation.⁴⁸⁰ In 2007, China destroyed its defunct weather satellite more than 800 kilometers above the Earth with an ASAT missile. The destructive test generated more than 3,500 pieces of trackable space debris. More than 2,400 of these pieces remain in orbit and will continue orbiting the Earth for decades, posing a persistent threat of collision with satellites in LEO.^{481,482}

In 2013, China launched an object on a ballistic trajectory to an altitude of 30,000 kilometers, suggesting it may have a missile capable of destroying satellites in GEO. The launch profile was inconsistent with traditional SLVs, ballistic missiles, or sounding rocket launches for scientific research. This launch suggests China may possess an ASAT capability for use against satellites in higher orbits than LEO.^{483,484}

To expand the range of its ASAT deterrent, China probably intends to deploy additional ASAT missiles that can destroy satellites in low, medium, and high orbits.⁴⁸⁵ However, if ASAT missiles were used in a conflict, China would have to contend with the resulting large debris fields threatening its own on-orbit systems and those of neutral parties.⁴⁸⁶

Orbital Threats

China is developing space-based technology, including on-orbit counterspace weapons, capable of holding space systems at risk.⁴⁸⁷ To research space debris cleanup, China has launched multiple satellites, such as the Shijian-21 in GEO, to conduct scientific experiments and test space maintenance technologies.^{488,489,490} Such systems, including the Shijian-17, a satellite with a robotic arm, can be used for grapppling other satellites.⁴⁹¹ In January 2022, Shijian-21 moved a derelict BeiDou navigation satellite to a high graveyard orbit above GEO.⁴⁹² In January 2025, China launched the Shijian-25 in GEO, which it claims will test orbital refueling and servicing capabilities.⁴⁹³

In December 2018, China launched into GEO what it claims is an experimental communications satellite: Tongxin Jishu Shiyan Weixing-3 (TJS-3). Multiple times in 2023, TJS-3 approached within 10 kilometers of other nations' spacecraft in GEO.^{494,495} In November 2023, China launched another satellite in the TJS series, TJS-10, which PRC state media claimed would test multi-band and high-speed communications technologies.^{496,497} These close approaches to foreign spacecraft are largely inconsistent with the stated mission of the satellites, suggesting China may have obfuscated their true mission.⁴⁹⁸ As of July 2026, China has launched 27 satellites in the TJS-series.⁴⁹⁹

Since at least 2006, government-affiliated academics have investigated aerospace engineering technologies associated with space-based kinetic weapons—a class of weapon used to attack ground, sea, or air targets from orbit. China's space-based kinetic weapons research included methods of reentry, separation of payload, delivery vehicles, and transfer orbits for targeting purposes.^{500,501,502,503,504,505,506}

In 2022, a PRC scientist published a report describing the effects of nuclear weapons as an ASAT capability; the study recognized the ability to neutralize multiple targets simultaneously with this type of capability.⁵⁰⁷ However, there is no indication that China plans to actively test or develop a nuclear ASAT weapon for use in space.⁵⁰⁸ China is a party to the Outer Space Treaty (OST), which prohibits the placement of any objects carrying nuclear weapons or any other kinds of weapons of mass destruction into orbit around the Earth.^{509,510,511,512,513} PRC leaders probably calculate the use of a nuclear weapon in space would be contrary to Beijing's economic interests, and use of such a device risks uncontrolled conflict escalation.

In July 2021, China conducted the first fractional orbital launch of an ICBM with a hypersonic glide vehicle (HGV) from mainland China. This test demonstrated the greatest distance flown (~40,000 kilometers) and longest flight time (~100+ minutes) of any Chinese land attack weapons system to date.⁵¹⁴

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Russia

Moscow recognizes its space program as a longstanding example of its leadership on the international stage and also essential to its national security. The International Space Station's (ISS) reliance on Russian space launch vehicles from 2011 to 2020 reinforced Moscow's status as a global leader in space, which garnered Russia a measure of prestige and economic support for its space program.⁵¹⁵ However, Russia's space program has contended with setbacks over the last several years. In 2020, the U.S. commercial space sector broke Russia's monopoly on human space launch, and Russia lost a significant source of revenue and prestige.⁵¹⁶



Former Russia Defense Minister Sergei Shoigu (right) briefed by Commander of Russia's Space Troops, Colonel General Alexander Golovko (left foreground), and Almaz-Antey Deputy CEO General Designer, Pavel Sozinov (left background).
| Image Source: syria.mil.ru

Russia's space program is more narrowly focused than China's program, and Moscow's budget is more limited than Beijing's because of competing priorities from Russia's broader military modernization efforts and its war in Ukraine.^{517,518,519} Over the past decade, both Russia's civilian and military space programs have faced various obstacles. Pervasive corruption



A Russian Soyuz rocket blasts off successfully to carry a pair of Iranian satellites into orbit, a launch that reflected growing cooperation between Moscow and Tehran. The launch occurred from Vostochny launchpad in far eastern Russia and put its payload into a designated orbit nine minutes after the launch.

| Image Source: AFP

has stalled developments,⁵²⁰ budget cuts and sanctions have delayed projects,^{521,522,523} and negligible private space investment has stymied growth and innovation.⁵²⁴

Since Russia's 2014 initial invasion of Ukraine—and especially following its 2022 full-scale invasion—Russia has faced greater difficulties launching and maintaining healthy constellations.^{525,526,527,528,529} Sanctions, export controls, and international backlash have cut into its space program revenue^{530,531,532} and component inventory. “Brain drain”—the loss of engineers and other experts who expatriate due to war and repression—has also eroded Russia's fundamental space competency.^{533,534,535} In 2023, former Director of the Russian Federal Space Agency (commonly called “Roscosmos”) Yuri Borisov stated publicly that Russia was receiving space components from China to address sanctions-induced shortages.⁵³⁶ PRC commercial companies also provided satellite imagery of Ukraine to support operations there by Russian private military company Vagner, prompting additional U.S. sanctions.^{537,538}

Space Strategy and Doctrine

Russian military doctrine and publications indicate that Russia identifies space as a warfighting domain and that achieving space supremacy is a decisive factor in winning modern conflicts. Russian military thinkers assert the importance of space will continue to expand, largely due to the growing centrality of precision weapons and satellite-supported information networks in all types of conflict.^{539,540} Russia maintains this perspective despite Russia publicly supporting arms control agreements to prevent the weaponization of space.^{541,542,543,544,545} Moscow regularly expresses concern about space weapons and is pursuing legally binding space arms control agreements to constrain perceived U.S. and allied advantages from space operations and capabilities.^{546,547,548} At the same time, Russia is developing an arsenal of counterspace capabilities to attack U.S. and allied assets.^{549,550,551,552,553,554,555,556,557,558,559}

As Russia continues to modernize its military, it will increasingly integrate space services into its armed forces. Russia has a strong foundation of technical knowledge and expertise fostered by more than 60 years of experience in space. However, Moscow sees overreliance on space as a potential vulnerability and is determined to avoid becoming too militarily dependent on space to conduct its national defense mission.^{560,561,562,563} Russia has developed terrestrial redundancies to complement or replace space services that may be denied in a wartime environment.⁵⁶⁴

Russia recognizes space is a critical enabler of U.S. precision-strike and military force projection capabilities. Moscow calculates that a dependence on space is a critical vulnerability, which it plans

to exploit during a conflict. Russia is pursuing counterspace systems to neutralize or deny space-based services from both military and commercial providers that Moscow considers a threat to its objectives during war.^{565,566,567} Moscow has pursued counterspace capabilities to offer its military leaders the ability to manage escalation of a conflict through selective targeting of adversary space systems.^{568,569} To that end, Russian counterspace doctrine advocates the use of ground-, air-, cyber-, and space-based systems to target an adversary's satellites with attacks ranging from temporary jamming or sensor blinding to destruction of enemy spacecraft and supporting infrastructure.^{570,571,572,573}

Military Space Organizations

Russia's Aerospace Forces (VKS) has three administrative branches, or "combat arms": the Air Force, the Air and Missile Defense Troops, and the Space Troops.^{574,575,576} The Space Troops conduct space launches and operate Russia's BMEW systems, the satellite control network, the SDA network, and elements of counterspace weapons control.^{577,578,579,580,581} To accomplish space and counterspace operational tasks, the 15th Special Purpose Aerospace Army is organized into the 820th Main Missile Attack Warning Center, the 821st Main Space Surveillance Center, and the 153rd Titov Main Test and Space Systems Control Center.^{582,583,584,585,586}

Russia's 1st State Test Cosmodrome (1 GIK) occupies a sprawling complex located about 800 kilometers northeast of Moscow called the Plesetsk Missile and Space Test Center (more commonly the "Plesetsk Cosmodrome"), where it is responsible for space launch operations.^{587,588,589} The Plesetsk Cosmodrome encompasses space launch, assembly, checkout, tracking, instrumentation, communications, and

control sites.^{590,591} It is Russia's primary space launch site for military satellites.⁵⁹²

Although not subordinate to the Space Troops, the Russian military also maintains a separate jamming service—the Radioelectronic Warfare Troops—with units integrated across virtually all of Russia's major service components and commands.^{593,594} The Radioelectronic Warfare Troops conduct counterspace tasks, among other missions.^{595,596,597,598} They play a crucial role in executing Russia's

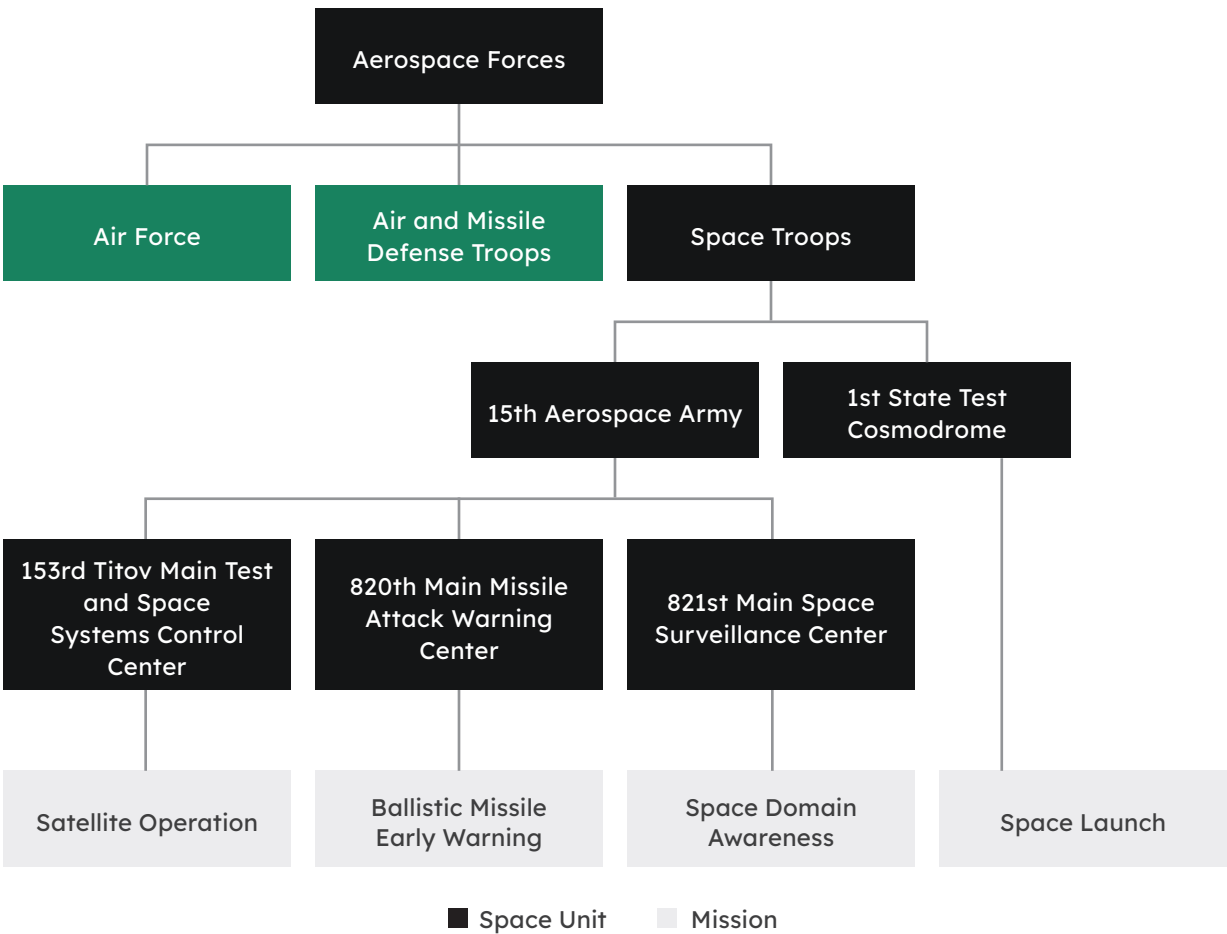
counterspace doctrine, which emphasizes the need to counter adversary information superiority gained through space-based systems.^{599,600}

Russia's Space Organizations

In 2015, Russia reorganized its space enterprise to address inefficiencies across the industry and readjust from the loss of control over former Soviet space production enterprises in Ukraine.^{601,602} As a result, the Russian space industry is now

Russia's Military Space Structure

2408-00066

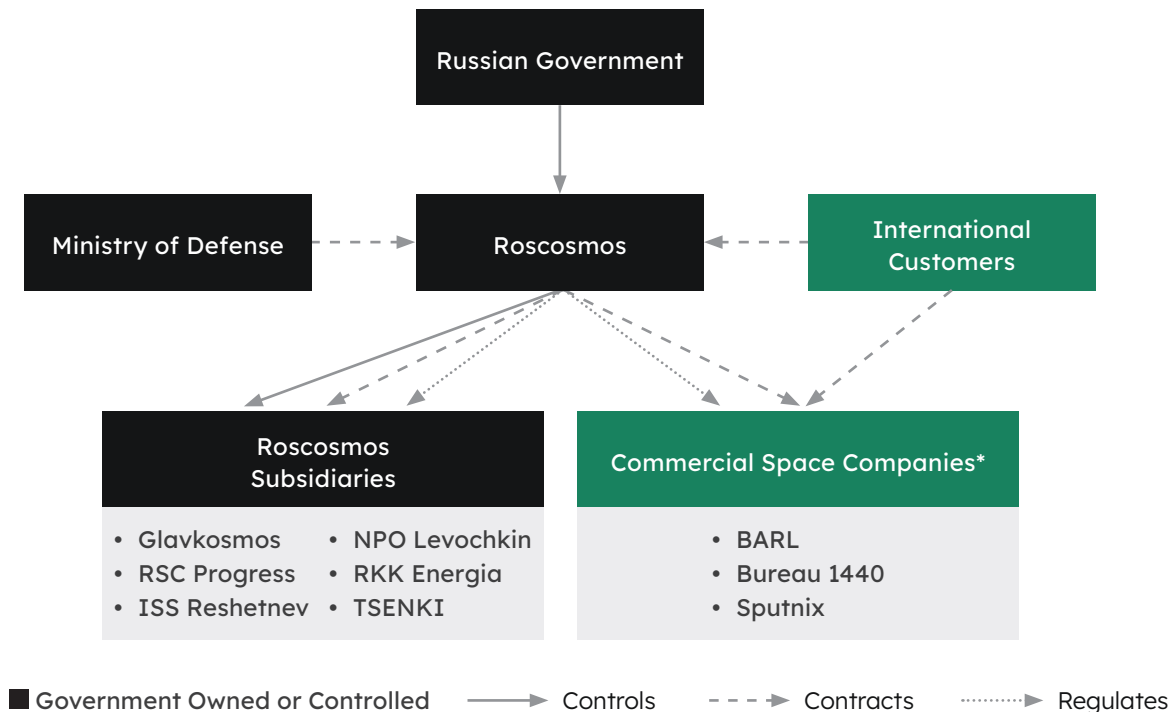


almost exclusively owned or controlled by State Corporation Roscosmos, which is also the federal body responsible for management of the space industry.^{603,604,605} Roscosmos is comprised of over 75 design bureaus, enterprises, and companies that carry out research, development, and production of Russia's space infrastructure, technologies, satellites,

and SLVs.^{606,607} Roscosmos is responsible for both the execution of Russia's civilian space program and the supply of satellites and support to the military, with the former director stating in 2022 that Roscosmos had "essentially become part of our Armed Forces."^{608,609,610}

Russia's Space Industry^{611,612,613,614,615,616}

2408-00066



*These lists are not comprehensive, and are intended to show a sample of active organizations within each category.

Space and Counterspace in the War in Ukraine

Space supports Russian forces operating in Ukraine. Satellite communications systems have provided encrypted communications, while space-based PNT services have enabled theater precision strikes, along with navigation support for air, naval, and ground units.⁶¹⁷ For satellite surveillance, Russia has often turned to systems operated by Roscosmos to help fill gaps in its optical imagery capabilities.⁶¹⁸

Using select counterspace capabilities, specifically jamming and cyberattacks, Russian forces have targeted space assets supporting Ukraine.⁶¹⁹ Russia has used jammers to target SATCOM and SATNAV systems in Ukraine, including GPS signals over Russian territory.⁶²⁰ Early in the conflict, Russia also targeted ViaSat, a commercial SATCOM provider used by Ukrainian forces, with wiper malware.⁶²¹

The rapid expansion of commercial space services and their employment by Ukraine are driving Moscow's calculus that it needs more satellites to keep pace and counterspace systems to target them.^{622,623,624,625} Commercial space services have provided durable communications for the Ukrainian military since the early days of the conflict,⁶²⁶ prompting Russia to target the constellations with jammers⁶²⁷ and to list U.S. commercial space industry terminals and other commercial satellites supporting Ukraine as legitimate military targets.^{628,629}

Acquisition of Foreign Space and Counterspace Technologies

Moscow uses a whole-of-government approach to acquire foreign space and counterspace technologies in support of Russia's economic and military goals. Since 2014, Moscow has exploited multiple collection paths to mitigate U.S. and European Union (EU)

sanctions and export controls restricting Russia's access to space technology, information, and expertise; however, sanctions continue to slow production of space systems.⁶³⁰ Following additional sanctions in 2022, representatives of Russia's private space companies commented that sanctions would slow down but not stop Russia's space industry, as government subsidies could support increased domestic production of necessary space components.⁶³¹ Russia has also increasingly adopted Chinese alternatives as sanctions degrade its access to Western microelectronics.⁶³²



On 21 March 2023, President Vladimir Putin and President Xi Jinping shake hands after delivering a joint statement following their talks at the Kremlin in Moscow. | Image Source: AFP

Russia Receiving Space Support from PRC Entities

Since Russia's 2022 invasion of Ukraine, the Russian government and military-related organizations have looked to China for space-based support for operations in Ukraine and to maintain space-based capabilities. In July 2022, then-Roscosmos Director Yuri Borisov admitted Western sanctions on electronic components were affecting Russian satellite production. In January 2023, Borisov stated Russia had agreed to purchase space components from China.^{633,634} Meanwhile, Russian private military company Vagner signed contracts with PRC commercial satellite companies in November 2022 to acquire two imagery satellites and obtain imagery from PRC entity CGSTL to support operations in Ukraine and Africa.^{635,636} Spacety, another PRC commercial company, provided Vagner with SAR satellite images of Ukraine.⁶³⁷

Space Launch Capabilities

Russia is updating and improving its space launch capabilities to enhance reliability, alleviate environmental concerns, increase manufacturing efficiencies, and support future human spaceflight and deep-space exploration missions.^{638,639} Russia primarily relies on light- and medium-lift launch vehicles and is developing larger rockets for multi-payload launches.⁶⁴⁰ Russia plans to use Angara-A5, a heavy-lift launch vehicle, for deep-space exploration and building the Russian Orbital Station (ROS). Russia completed its first Angara-A5 launch from Vostochny Cosmodrome in April 2024.⁶⁴¹ The Yenisei super heavy-lift launch vehicle intended to support spaceflight to the Moon and Mars, has not restarted development since at least November 2024.^{642,643,644}

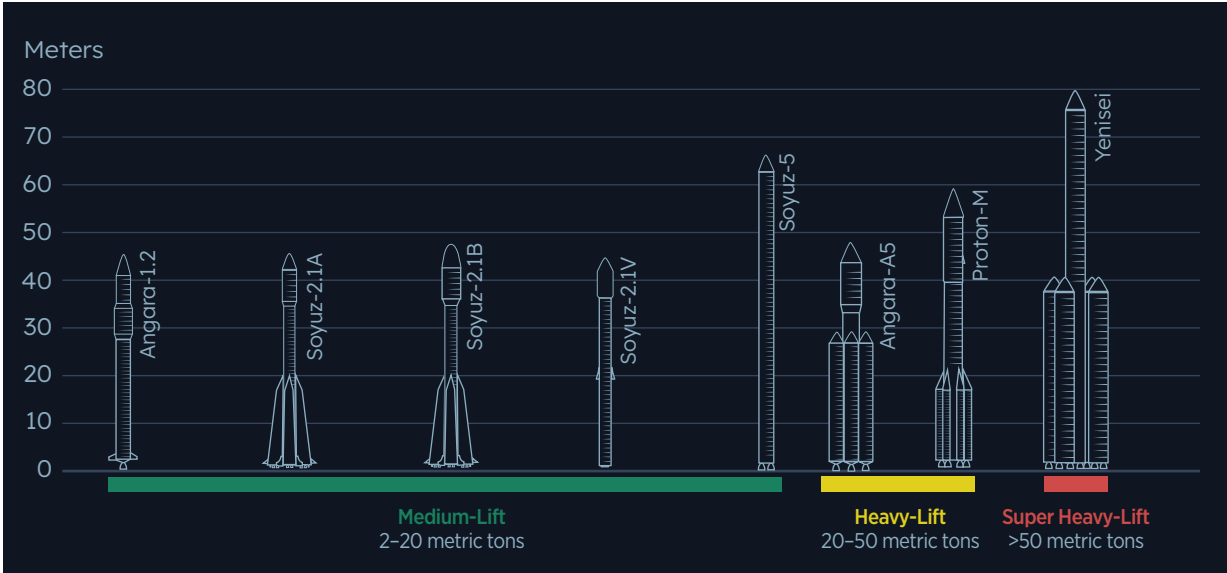
Western sanctions in response to Russia's 2022 invasion of Ukraine have stymied Russia's role as a commercial launch provider.⁶⁴⁵ In the spring of 2022, then-Director of Roscosmos Dmitry Rogozin responded to these sanctions by suspending joint rocket launches with the ESA at the Kourou

spaceport in French Guiana and refusing to conduct several previously scheduled satellite launches.^{646,647}

As a result, former Roscosmos customers have turned to commercial launch providers, such as SpaceX, with Russia losing nearly all of its commercial launch output between 2022 and 2024.⁶⁴⁸ Russia is seeking to remain a competitive launch provider and is pursuing projects—such as reusable launch vehicles—to lower launch costs.⁶⁴⁹

Russia's Space Launch Vehicles

2408-00066



Russia uses its Soyuz-2 vehicles to launch the majority of its military, civil, and commercial payloads to multiple orbits.⁶⁵⁰ Russia is expanding its Soyuz family of medium-lift launch vehicles with Soyuz-5, which it launched in 2026.⁶⁵¹ Russia is also developing heavy and super heavy-lift launch vehicles to support launches of heavier payloads into higher orbits.^{652,653} Russia is phasing out its heavy-lift Proton-M launch vehicle and replacing it with Angara-A5, which has a higher lift capacity.⁶⁵⁴

Russia's Space Enabling Infrastructure

2408-00110

Sources: 655,656,657,658,659,660,661,662,663,664,665,666,667,668,669,670,671,672,673,674,675,676,677,678,679,680,681



Russia owns two of its launch sites and leases one from Kazakhstan. The Plesetsk Cosmodrome is Russia's primary military launch site. While still active at Baikonur Cosmodrome in Kazakhstan, Russia has begun using the new domestic Vostochny Cosmodrome as the primary site for civilian launches. In 2022, Russia ceased operations at the Kourou Spaceport in French Guiana in response to sanctions related to its invasion of Ukraine. Russia's satellite control centers are spread across Russia for effective satellite C2. Global Navigation Satellite System (GLONASS) TT&C stations are similarly spread across Russia to ensure timely control of its space constellation. Moscow also maintains nine radars at eight locations across the country to enable a dual BMEW and SSA mission.

Human Spaceflight and Space Exploration Efforts

Russia remains committed to space exploration initiatives: continuing lunar missions, building a Russian space station, resuming deep-space exploration, and possibly pursuing future Mars exploration.^{682,683,684} Russia and other former Soviet states also launched several Mars exploration missions; however, only two Mars missions were successful, the most recent in 1971.^{685,686,687}

Following Russia's 2022 invasion of Ukraine, Russia discussed withdrawing from the ISS by 2024 but has since stated it is committed to the effort through at least 2028.^{688,689} Russia has plans to build ROS by 2032 to replace its participation in the ISS.⁶⁹⁰ In the meantime, Russia's LUCH relay satellites allow Moscow to communicate between the ISS and Earth without relying on the National Aeronautics and

Space Administration's (NASA) SATCOM systems.⁶⁹¹ Additionally, Russia has offered to sell seats on its crewed Soyuz spacecraft to other international partners, such as the United Arab Emirates, for additional revenue.^{692,693}

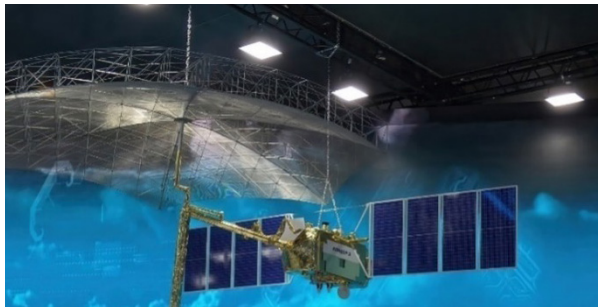
Like other spacefaring nations, Russia has ambitious plans for lunar exploration and settlement during the next 40 years. China and Russia signed a memorandum of understanding in March 2021 to build the International Lunar Research Station (ILRS).^{694,695} However, in August 2023, Russia's first lunar mission since the Soviet era, Luna-25, crashed into the surface of the Moon,⁶⁹⁶ leading observers to question Russia's ability to actualize its planned ILRS contributions.^{697,698} Nonetheless, Russia continues preparations for two additional missions, Luna-26 and Luna-27, to explore the Moon's north and south poles.^{699,700,701}

Russia's Lunar and Space Exploration Missions 2023-2040

2408-00110

Mission	Description	Launch Date
Luna-25	Lander mission to the lunar south pole; crashed after equipment malfunction. ⁷⁰²	2023 ⁷⁰³
Luna-26	Lunar orbital mapping mission. ⁷⁰⁴	2027 ⁷⁰⁵
Luna-27	Lander mission to the lunar south pole with same goals as Luna-25. ⁷⁰⁶	2028 ⁷⁰⁷
Venera-D	Venus lander and environmental research mission. ⁷⁰⁸	2029 ⁷⁰⁹
Luna-28	Lunar sample return mission. ⁷¹⁰	2030 ⁷¹¹
Boomerang	Sample return mission from Mars' moon Phobos. ⁷¹²	After 2030 ⁷¹³
International Lunar Research Station	Joint project with China to establish a research base on the Moon, primarily supported by robotic technology and capable of supporting human visits. ⁷¹⁴	By 2040 ⁷¹⁵

ISR Satellite Capabilities



Russia's Kondor radar reconnaissance satellite, photographed at the 2021 Moscow Air Show (MAKS). | Image Source: Kirill Borisenko taken at MAKS-2021

Setbacks have hindered Russia's ability to produce, launch, and maintain its military-dedicated ISR satellites, leading to increased use of its civilian satellites for military tasks.⁷¹⁶ Russia operates satellites that provide EO imagery, multiple radar observation platforms, missile warning, and electronic and signals intelligence.^{717,718,719,720,721} Many of Russia's ISR satellites, including civilian satellites, are also used for military purposes.^{722,723} Space-based sensors provide Russia strategic warning of ballistic missile launches, support targeting for Russian antiship cruise missiles,⁷²⁴ and support EO imagery requirements for Russian military operations.^{725,726} Russia completed the orbital segment of its space-based missile early warning system in November 2022 with six satellites.^{727,728} Many of Russia's ISR systems are nearing or have already exceeded their design lifespan.⁷²⁹

Satellite Communications Capabilities

Russia owns and operates a diverse constellation of commercial and military communications satellites capable of providing mobile and fixed SATCOM

services from various orbital altitudes. Russia's SATCOM satellites can support worldwide military deployments, enabling Moscow to maintain C2 of its military units.^{730,731,732,733,734,735,736} Russia's SATCOM modernization plans are among its most ambitious space goals: by 2035, it plans to launch hundreds of new communications satellites.^{737,738,739} The first Sfera satellite launched in October 2022, but the project has since faced significant delays.^{740,741} Russia also makes use of foreign commercial SATCOM providers, such as Thuraya, to support Russian commercial, civil, and military customers.⁷⁴²



LUCh 5A relay satellite in the Space Pavilion at the Cosmonautics and Aviation Center at the Russian Exhibition of Achievements of the National Economy. | Image Source: Sputnik via AFP

Positioning, Navigation, and Timing Capabilities

GLONASS provides Russia worldwide satellite navigation services and supports its economic and national security interests.⁷⁴³ Russia's military also uses GLONASS to enable military system deployments, force movement, and precision-guided munitions delivery.^{744,745,746} Following deterioration of the GLONASS constellation in the late 1990s, Russia committed to reconstituting GLONASS during the 2000s.⁷⁴⁷ GLONASS regained full operating capability in 2011; however, since 2020, Russia has fallen short in replacing outdated

satellites with next-generation GLONASS-K satellites due to on-orbit technical issues and production delays caused by sanctions.^{748,749,750,751,752} As of May 2026, Russia and China had reiterated their commitment to strengthening GLONASS-BeiDou interoperability.^{753,754,755}

Space Situational Awareness

Russia uses space observation data for its various missions, including intelligence collection, counterspace targeting, spaceflight safety, satellite anomaly resolution, and space debris monitoring. Russia's space surveillance network, managed by the 821st Main Space Surveillance Center, uses data from a variety of worldwide telescopes, radars, and other sensors. It can search for, track, and characterize

satellites in all Earth orbits. Some of these sensors are BMEW radars that perform space surveillance as a secondary mission.^{756,757} In April 2023, then-Roscosmos Director Borisov announced President Putin had approved “Milky Way,” a new program unifying civil and military sensors to enhance Russia's space domain awareness.^{758,759,760} Russia touted the program as a global network of terrestrial observation stations and orbiting satellites that will provide a much more comprehensive picture of the situation in space.^{761,762,763,764} The Roscosmos Milky Way system proposal indicates a need to support all aspects of Russian space operations, including supporting Russian military space operations, but as of 2026 the system has not materialized.⁷⁶⁵

Russian International SSA Collaboration



Russia has various non-military organizations operating ground-based optical space surveillance sensors worldwide, supplementing Russia's understanding of foreign on-orbit assets and space debris. These organizations range from those operating under academic auspices, including the Russian Academy of Sciences' Keldysh Institute of Applied Mathematics, International Scientific Optical Network (ISON), and Institute of Astronomy, along with privately-owned networks, such as ISON-Ballistika Service and the Astronomic Scientific Center.^{766,767,768}

Electronic Attack Capabilities

The Russian military identifies jamming as an essential tool for gaining and maintaining information superiority over its adversaries, allowing Russia to seize the operational initiative by disrupting adversary C4ISR capabilities.⁷⁶⁹ Russia uses jamming (and possibly spoofing) to deny SATNAV and SATCOM systems, reducing adversary situational awareness.^{770,771,772,773} Russia also uses jamming to prevent ISR collection and mitigate attacks by precision-guided munitions from airborne platforms.^{774,775}

Russia uses several GPS jamming systems to counter a variety of SATNAV-reliant systems.^{776,777} Russia's R-330Zh Zhitel is a vehicle-based jamming system that can automatically detect targets and jam SATCOM downlink signals and GPS receivers.^{778,779} In 2016, the Russian Ministry of Defense announced their Pole-21 jammer, which can jam systems that rely on GPS, GLONASS, Galileo, or BeiDou satellites for navigation and guidance.⁷⁸⁰ Additionally, Russia fields, and probably is employing jammers that can target SAR satellites.^{781,782}

Since the start of the war in Ukraine, Russian forces have intermittently jammed GPS signals over Russian-controlled territory, especially along the border with Ukraine.⁷⁸³ In late 2023, tracking website gpsjam.org detected GPS jamming over territories across the Baltic Sea, including Finland, Estonia, Latvia, Poland, Sweden, and Russia.⁷⁸⁴ Estonia's Consumer Protection and Technical Regulatory Authority blamed Russia for jamming the GPS systems.⁷⁸⁵ Russian sources also claim to have used the Tirada mobile jamming system to disrupt the Starlink constellation.⁷⁸⁶ In November 2023, the ESA's Sentinel-1 SAR satellite experienced interference in imagery taken over Russian-occupied Crimea, which

was similar to interference it experienced in 2021 over a nearby region of Russia.^{787,788,789}

Cyberthreat to Space Capabilities

Since at least 2010, the Russian military has prioritized the development of forces and capabilities, including cyber operations, for what it calls "information confrontation"—a holistic concept for ensuring information superiority. Russia considers the information sphere, including space-enabled information collection and transmission, strategically decisive and has taken steps to modernize its information attack and defense organizations and capabilities.⁷⁹⁰ On 24 February 2022, Russia prepared the battlespace immediately before its forces invaded Ukraine: Russian malware targeted customers of Viasat's high-speed satellite communications service and disrupted service for 50,000 users across Ukraine and other European countries.⁷⁹¹

Directed-Energy Weapon Capabilities

Russia currently fields ground-based lasers that can dazzle satellite sensors. Russia's Peresvet, a ground-based laser system, is designed to dazzle enemy satellites' optical systems to mask the movement of Russia's strategic missile systems.^{792,793,794,795} As of 2019, Russia had deployed Peresvet to five of its strategic missile divisions, where they remain today.^{796,797}

Another Russian ASAT laser system, Kalina, is located in Russia's Krona space surveillance complex in southwest Russia.⁷⁹⁸ Similar to Peresvet, Kalina is intended to dazzle adversary satellites Russia perceives are attempting to image strategic sites in its territory.^{799,800,801,802,803} However, Kalina will have the ability to blind, or permanently damage, satellite sensors and could pose a threat to other satellite

components, not just electro-optical sensors.^{804,805} Originally scheduled for deployment in 2014, Kalina experienced multiple delays; however, new construction has begun at the facility as recently as 2022, and the system may be nearing completion.^{806,807,808}



The Russian Peresvet laser weapon is probably intended for use against satellites (photograph taken July 2018).
| Image Source: AFP

ASAT Missile Capabilities

Russia has developed terrestrial ASAT missiles capable of destroying U.S. and allied space systems in LEO. Russia has developed and tested a mobile missile, called Nudol, which Russian sources describe as a “counterspace attack complex” capable of destroying low-orbiting satellites.^{809,810,811} A live fire test of the Nudol system in November 2021 destroyed a defunct Russian satellite at 470 kilometers.^{812,813} Since 2021, Moscow may be incorporating an ASAT capability into its next-generation ballistic missile defense systems.⁸¹⁴ The Nudol live fire test created over 1,700 pieces of trackable space debris and tens of thousands of pieces of lethal but nontrackable debris, some of which remains in orbit.⁸¹⁵ This debris endangers spacecraft of all nations in LEO, including

astronauts and cosmonauts on the ISS and China’s Tiangong space station.

Orbital Threats

Russia continues to research and develop sophisticated orbital capabilities that could serve counterspace purposes. Russia has launched several satellites over the last few years which conducted test activities on orbit for technologies that could enable attacks on other countries’ satellites and result in temporary or permanent damage.^{816,817,818}

In 2017, Russia deployed what it called an “inspector satellite capable of diagnosing the technical condition of a Russian satellite from the closest possible distance,” possibly as part of its Nivelir program, which is a potential Russian on-orbit satellite inspection project started in 2011.⁸¹⁹

However, the satellite’s behavior was inconsistent with on-orbit inspection or SSA activities.^{820,821}

In 2019, Russia launched satellite Cosmos 2542, which released a second satellite, Cosmos 2543. Cosmos 2543 then began following a U.S. national security satellite and approached it multiple times at a distance close enough to create potentially dangerous operating conditions.^{822,823,824} In 2020, after moving away from the U.S. satellite, Cosmos 2543 fired a projectile into orbit as part of a space-based ASAT weapons test.^{825,826,827}

In 2022, Russia launched Cosmos 2558, which also approached a U.S. government satellite.^{828,829} In May 2024, Russia launched Cosmos 2576, which is similar to Cosmos 2542. Russia launched Cosmos 2576 into the same orbit as yet another U.S. national security satellite and began moving towards it, per Russian media.⁸³⁰ In May 2025, Russia launched military satellite Cosmos 2588, which has conducted

maneuvers within approximately 93 kilometers of a U.S. government satellite.^{831,832}

In February 2025, Russia launched three satellites—Cosmos 2581, 2582, and 2583—from Plesetsk Cosmodrome. Once in orbit, the satellites began a series of maneuvers at close proximity. On March 18, Cosmos 2583 released a subsatellite and conducted maneuvers with the object.⁸³³

Russia is developing kinetic orbital systems to permanently disable, or “kill,” satellites.⁸³⁴ Moscow’s Burevestnik is a developmental, co-orbital air-launched ASAT weapon for killing spacecraft in LEO.^{835,836} The system involves launching a rocket from a modified MiG-31, placing the satellite into orbit with little or no warning.^{837,838} Roscosmos is also creating a satellite intended for GEO operations, which will have potentially dual-use orbital servicing capabilities.⁸³⁹

Russia Developing Nuclear Weapon for Space

Russia is developing a satellite designed to carry a nuclear weapon despite its obligation to comply with the 1967 Outer Space Treaty, which prohibits the placement of any objects carrying nuclear weapons or any other kinds of weapons of mass destruction into orbit around Earth.^{840,841} A space-based capability such as this could cause rapid and sudden loss or degradation of thousands of satellites operated by countries and companies around the world, as well as to the vital communications, navigation, scientific, meteorological, commercial, and national security services they provide.⁸⁴² Beyond its immediate effects, a nuclear detonation in space would also leave lingering radiation belts, which could persist for years and damage satellites that initially were only temporarily disrupted.^{843,844} In February 2022, Russia launched a satellite called Cosmos 2553, which Moscow claimed at the time was testing the effects of space radiation on electronic systems.⁸⁴⁵ This satellite was launched into an unusual and isolated orbit not used by any other spacecraft.⁸⁴⁶ In December 2024, the international community voted 167-4 (Iran, Russia, North Korea, and Syria), with six abstentions to adopt the WMD in Outer Space resolution during the UN General Assembly.⁸⁴⁷

Emerging Space Powers

Iran

Iran is pursuing both civilian and military space programs to boost its national prestige, economic development, and military modernization.^{848,849,850,851,852,853} In 2021, former Iranian president Ebrahim Raisi's administration acknowledged space as an instrument of national power and set a goal to become the most capable space power in the region within the next 10 years.^{854,855} President Raisi advocated investing in domestic space capabilities, including space launch, with the goal of eventually placing an Iranian communications satellite in GEO.^{856,857}

In 2023, Iran outlined its space-related goals in a 10-year strategic plan created by the Supreme Space Council.⁸⁵⁸ Under the 10-year plan, Iran aims

to develop and launch at least eight new satellites, along with a telecommunications constellation of 10 small satellites called the General Soleimani Satellite System.^{859,860} Additionally, Tehran plans to offer launch services to other countries once the Chabahar Space Launch Center is operational and aims to place domestic satellites into GEO by 2033.^{861,862,863,864} Historically, Iran sets ambitious timelines for space launch and satellite development, with mixed success rates over the last 10 years.^{865,866}

Iran is pursuing a human spaceflight program with the goal of sending Iranian astronauts into space by 2029.^{867,868} The Aerospace Research Institute (ARI) leads Tehran's human space program and works with domestic universities and the Iranian aerospace industry to advance the program's goals.

Iranian Space Agency



industry, and foreign partners to develop satellites to test communications and remote-sensing technologies.^{871,872} These entities have built more satellites than Iran can launch, leading to a backlog of unlaunched satellites.⁸⁷³

The Iranian Space Agency (ISA) and Iranian Space Research Center (ISRC)—subordinate to the Ministry of Information and Communications Technology—oversee part of the country's satellite development programs.^{869,870} ISA and ISRC work closely with Iran's Ministry of Defense and Armed Forces Logistics (MODAFL). ISA and ISRC collaborate with Iranian universities, private



Iran has two space launch sites in Semnan province known as Imam Khomeini Launch Complex and Shahrud Launch Site. Iran has a third launch site under development in the coastal city of Chabahar in southeastern Iran.^{874,875}

Space Launch Vehicles

MODAFL and Iran's Islamic Revolutionary Guard Corps-Aerospace Force (IRGC-ASF) oversee Iran's SLV development programs. MODAFL's two-stage

Safir SLV had many failures, but four successful launches, and was retired in 2020.^{876,877,878} Since 2020, MODAFL and IRGC-ASF collectively have conducted seven successful launches using domestically developed SLVs, placing eleven satellites into LEO,

including remote sensing and communications satellites for civil and military use.^{879,880,881,882,883,884}

In 2024, MODAFL launched three satellites into LEO with a single launch from its liquid-fueled Simorgh SLV, marking the first successful Simorgh launch since its inauguration in 2016 and Iran's first multi-payload single SLV launch.⁸⁸⁵ This success will inform the development of larger and more capable SLVs, including the Sarir and Soroush.⁸⁸⁶ Separately, the IRGC-ASF developed the hybrid liquid- and solid-fueled Ghased SLV, with successful launches in 2020, 2022, and 2023.^{887,888,889} Tehran claims its Nour-series military satellites have imaged U.S. military bases in the Middle East, including Al-Udeid Airbase in Doha, Qatar and U.S. 5th Fleet headquarters in Manama, Bahrain.⁸⁹⁰ In 2024, the IRGC-ASF successfully launched the Ghaem-100 SLV. The IRGC-ASF also announced its intent to launch satellites for neighboring countries and to develop future models for GEO launch capability.^{891,892,893,894,895,896,897,898,899,900} Iran has also revealed plans for a larger, four-stage Ghaem-105 SLV, which could support Iran's goal of placing satellites in GEO.^{901,902} Because of inherent overlapping technology between ICBMs and SLVs, some Western analysts are concerned that Iran's development of booster technology for larger, more capable SLVs will improve Iran's ICBM potential.^{903,904,905,906}

As of February 2026, while Iran claims to have completed Phase 1 of the Chabahar space launch center, it appears that the site is not close to being completed.^{907,908,909,910} The launch facility is geographically positioned to support inserting satellites into GEO and Sun-Synchronous Orbit (SSO).⁹¹¹



In January 2024, Iran's Islamic Revolutionary Guard Corps-Aerospace Force (IRGC-ASF) successfully launched the Ghaem-100 SLV that placed the indigenously produced Soraya satellite into LEO.^{912,913}

6 December 2024	Success	Simorgh Semnan Launch Site
14 September 2024	Success	Ghaem-100 Shahrud Launch Site
28 January 2024	Success	Simorgh Semnan Launch Site
20 January 2024	Success	Ghaem-100 Shahrud Launch Site
27 September 2023	Success	Ghased Shahrud Launch Site 1
8 March 2022	Success	Ghased Shahrud Launch Site 1
26 December 2021	Failure	Simorgh Semnan Launch Site 6
29 June 2021	Failure	Ghased Semnan Launch Site 1
22 April 2020	Success	Ghased Shahrud Launch Site 1
9 February 2020	Failure	Simorgh Semnan Launch Site 1
4 February 2019	Failure	Safir Semnan Launch Site 1
14 January 2019	Failure	Simorgh Semnan Launch Site 6
27 July 2017	Failure	Simorgh Semnan Launch Site 6
2 February 2015	Success	Safir Semnan Launch Site 1

ⁱ Does not include suborbital tests or launches without clear space-related nexus.



An Iranian-made Safir satellite carrier rocket on display at Azadi in Western Tehran on 11 February 2024. | Image Source: AFP



Iranian-made Simorgh satellite carrier rocket photographed during a rally in western Tehran, Iran, on 11 February 2024. | Image Source: AFP

External Assistance Improves Space Capabilities

In recent years, Russia has launched two remote sensing satellites for Iran.^{915,916,917} Russia launched Iran's Khayyam Earth observation satellite, which was built by Russian companies, on a Soyuz rocket in 2022. This launch marked the first time Russia built and launched a satellite for Iran.⁹¹⁸ Tehran claims Khayyam has a maximum resolution of one-meter and is capable of sending images back to earth up to four times per day.⁹¹⁹ Additionally, Tehran intends to sell Khayyam's imagery on the commercial market, claiming 80 different civilian applications.⁹²⁰ Russian aerospace company NPK Barl and the All-Russian Scientific Research Institute of Electromechanics provided the Khayyam ground system and satellite, respectively. An Iranian state-run trade company, Bonyan Danesh Shargh, operates Khayyam.^{921,922} In 2023, Tehran and Moscow entered into talks to develop additional satellites, including a remote-sensing satellite, a small GEO satellite, a telecommunications satellite, and a next-generation version of Khayyam.⁹²³ In February 2024, Russia launched Iran's Pars-1 remote-sensing satellite, with follow-on satellites Pars-2 and Pars-3 under development.^{924,925,926} In 2005, Iran joined China-led APSCO to collaborate on international space projects, including APSCO's global SSA network, and Tehran hopes to expand its cooperation with the organization.^{927,928,929} As of June 2025, Iran has ordered thousands of tons of ammonium perchlorate from China. This chemical is a key ingredient for making solid rocket fuel that can be used in SLVs as well as ballistic missiles.⁹³⁰

Counterspace Capabilities

In October 2023, the Iranian minister of defense, Brigadier General Mohammad Reza Gharaei Ashtiani, declared that, amid the tensions in the Middle East, Iran must support national defense beyond its borders by harnessing space and cyber capabilities.⁹³¹ Iran recognizes the strategic value of counterspace capabilities and has shown willingness to use these capabilities to deny an adversary use of space.^{932,933,934,935} Iran established its first domestic space domain awareness center in 2013,⁹³⁶ and Tehran has publicly acknowledged it has developed capabilities to jam space-based communications and GPS signals.^{937,938,939} Iran may also contribute to the proliferation of jamming equipment: since 2010, state-owned Iran Electronics Industries has marketed several GPS jammers on its website.^{940,941,942,943,944}

Iran uses several land-based GPS jamming systems, such as the Nazir, Fajr-3, and Zolfaqr to disrupt communications and navigations systems.⁹⁴⁵ In June 2026, multiple organizations reported jamming near the Strait of Hormuz that disrupted U.S. aircraft and shipping vessels.^{946,947} In 2026, with the onset of Operation EPIC FURY, the U.S. and Iran took offensive actions against each others' space capabilities to degrade and disrupt military actions on both sides.⁹⁴⁸ Iran is also focused on improving guidance and navigation systems resistance to electronic attack.^{949,950}

North Korea

North Korea's space program is expanding slowly and has experienced multiple launch failures and few successes spanning over two decades. Its space program has enabled testing of technology used in ballistic missiles under the guise of peaceful use of

space.^{951,952,953} These systems provided North Korea with valuable data for developing long-range and multi-stage ballistic missiles.⁹⁵⁴

North Korea's space program began in the early 1980s. In 1998, Pyongyang attempted its first satellite launch, the Kwangmyongsong-1, from the Tonghae Satellite Launching Station located on the east coast. The launch failed, and subsequent launches yielded mixed results.⁹⁵⁵ In 2012, North Korea successfully placed the Kwangmyongsong-3 satellite into orbit, but later observations revealed it was tumbling and non-operational.^{956,957} In January 2021, Leader Kim Jong Un announced Pyongyang had completed a new satellite design and emphasized North Korea was undertaking "full-scale work" toward space capabilities.^{958,959} As of November 2023, North Korea has one operational satellite, the Malligyong-1 (MY-1), for military reconnaissance in LEO.^{960,961}

The Pyongyang General Control Center and the Reconnaissance Satellite Operations Center are two additional North Korean space-related organizations that are subordinate to National Aerospace Technology Administration (NATA).⁹⁶² North Korea has been a party to the OST since 2009. Pyongyang has also passed national legislation to internally regulate its space activities.



Kim Jong Un and his daughter, Kim Ju Ae visiting a Malligyong assembly facility in May 2023. A Malligyong satellite (or mock-up thereof) can be seen in the background.

| Image Source: AFP/KCNA

North Korea's Launch Sites

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Sohaе Satellite Launching Station is North Korea's primary space launch complex and is located on the northwest coast. Tonghae is the original and older space launch site on the east coast, which has not been used for a launch since 2009.^{963,964} Associated space tracking and satellite support facilities and organizations are located in Pyongyang.

Space Launch Vehicles

North Korea used the SCUD and No Dong-1 ballistic missile systems and hardware to develop its earliest SLVs, Paektusan-1 (Taepodong-1) and Unha (Taepodong-2). Both were designed to lift small satellites into LEO. Work on these systems probably began in the early 1990s. In August 1998, the Paektusan-1 failed in its first and only test launch. Starting in 2009, North Korea attempted to orbit a satellite using the Unha rocket on five separate occasions over a ten-year period. The fourth and fifth missions—December 2012 and February 2016—successfully placed small satellites into LEO, but they were nonoperational.⁹⁶⁵

Since May 2023, North Korea has conducted multiple tests of a new SLV, the Chollima-1, from the Sohae Satellite Launching Station. Each SLV was reportedly carrying a military reconnaissance satellite.⁹⁶⁶ In November 2023, North Korea completed its only successful Chollima-1 launch, placing the MY-1 reconnaissance satellite into LEO.⁹⁶⁷

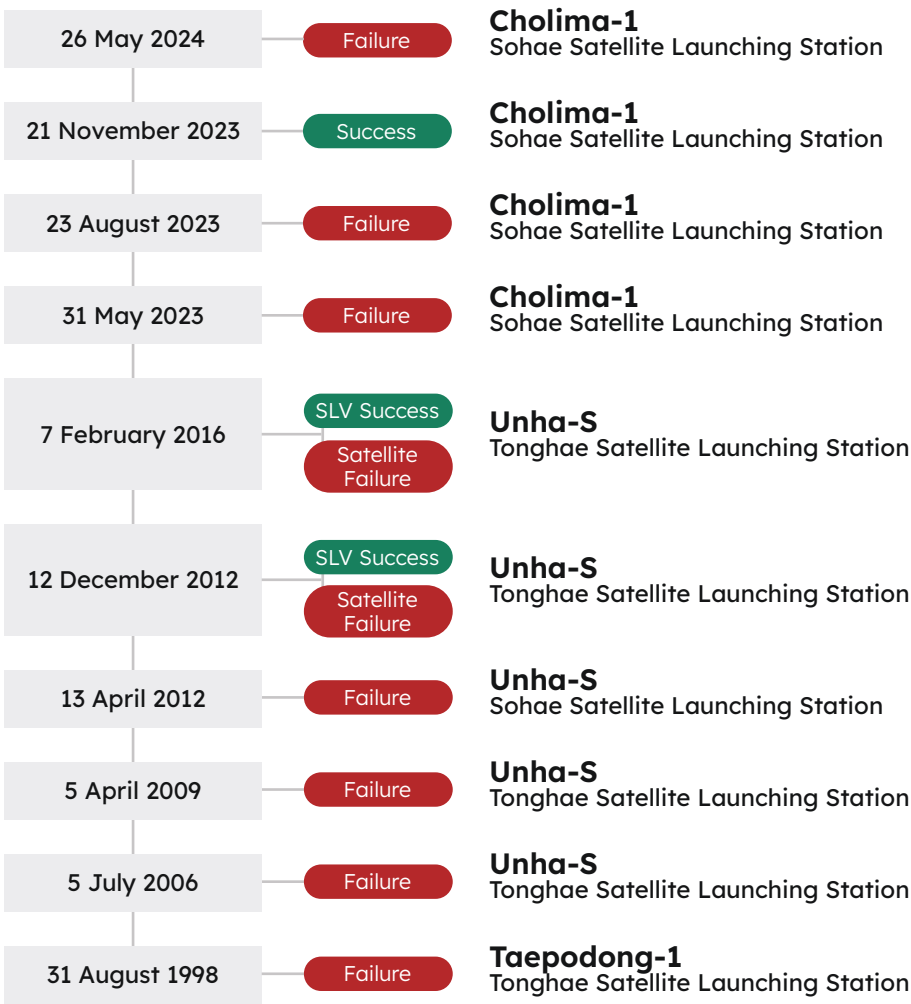
After the successful launch of MY-1, Kim directed the launch of three additional reconnaissance satellites in 2024.⁹⁶⁸ Aiming to meet Kim's satellite launch ambitions, NATA launched another satellite on 26 May 2024—probably for reconnaissance—into LEO, which ended in a catastrophic SLV failure.⁹⁶⁹

National Aerospace Technology Administration



In April 2013, facing international condemnation over the conduct of its space program, Pyongyang passed a Law of Space Development, establishing its civilian space agency, the National Aerospace Development Administration (NADA).⁹⁷⁰ In September 2023, the 14th Supreme People's Assembly announced the reorganization of NADA to focus on the militarization of space and re-

designated it as the NATA.⁹⁷¹ NATA publicly claims its mission is to develop space for peaceful purposes. Additionally, NATA now oversees R&D for all of North Korea's launch vehicles and satellites, along with its military and civilian aircraft.^{972,973,974}



Counterspace Capabilities

Pyongyang has demonstrated its jamming capabilities by interfering with civilian GPS navigation in the vicinity of the South-North border and along its coastal areas. These GPS interference incidents appear to have been deliberately targeting civilian receivers, including events coinciding with joint South Korea-U.S. military exercises.^{977,978,979} In these incidents, North Korea used a technique called downlink jamming, which targets GPS receivers within range of the source of the jamming signal but has no effect on the GPS satellites themselves. North Korea may also be developing jammers effective against military GPS signals, since Pyongyang has the ability to jam satellite communications and also routinely jams terrestrial broadcasts from foreign sources, such as the BBC, Radio Free Asia, and South Korea's KBS.⁹⁸⁰

North Korean actors consistently conduct cyberoperations against foreign partners' defense industries and have attempted to compromise various U.S. government networks.⁹⁸¹ Multiple North Korean hacker groups have targeted the U.S. aerospace industry, potentially gaining information or access to space technologies.^{982,983,984}

North Korea's ICBMs and SLVs may have the ability to serve as basic ASAT platforms to target U.S. and partner satellites in a conflict.^{985,986} North Korea has publicly stated its intent to develop sophisticated ASAT weapons after the North's successful satellite launch in November 2023.⁹⁸⁷ Pyongyang threatened to destroy U.S. satellites if Washington "tries to violate the legitimate territory" of North Korea, referring to its satellite program.⁹⁸⁸

External Assistance Improves Space Capabilities



Russian President Vladimir Putin and North Korean President Kim Jong Un meet at the Vostochnyy Cosmodrome on 13 September 2023.

| Image Source: AFP/credit KCNA

In September 2023, Kim travelled to Russia's Far East to meet President Vladimir Putin and visit key military sites. In exchange for North Korea supplying conventional arms to refill Russia's ammunition stocks drained in its war with Ukraine, Putin offered to help support North Korea's space program during talks with Kim at the Cosmodrome Vostochnyy spaceport, where the leaders later inspected Russian space technologies and facilities.⁹⁸⁹ In June 2024, Putin met with Kim to discuss space technology collaboration and future space engagement topics.⁹⁹⁰

Key Space Developments Through 2040

Reusable Space Systems

Access to space traditionally requires expendable spacecraft: single-use launch vehicles, satellites, and one-time use capsules designed to maximize performance. Reliance on expendable vehicles has made access to space expensive and exclusive. Reusable technologies, while even more difficult and expensive to develop and build, stand to greatly reduce the cost of spaceflight by recovering, refurbishing, and reusing rocket stages, fairings, and capsules.

The United States is the only country that currently fields an operational reusable SLV (R-SLV) program, while Beijing hopes to be the second.^{991,992,993,994,995} PRC space launch enterprises are pursuing R-SLVs to help Beijing meet broader military, civil, and commercial space goals. R-SLVs present a more attractive option for PRC launch companies to achieve the launch rates needed to orbit and sustain multiple satellite proliferated large constellations.^{996,997,998,999,1000,1001}

Worldwide there are numerous commercial space launch companies and space programs developing and planning to test R-SLVs by 2033, including programs in China, Russia, Japan, and Spain.^{1002,1003,1004,1005} To reduce launch costs, Roscosmos plans to develop the reusable Amur-SPG methane-fueled rocket by 2030, which will eventually replace the Soyuz-2 family of SLVs.^{1006,1007} As of February 2024, Roscosmos successfully completed experimental trials for a developmental ultra-light launch vehicle.¹⁰⁰⁸ Roscosmos has discussed designs



A key capability for reusable space activities are spaceplanes like this PRC Spaceplane captured by Maxar. Spaceplanes can launch into orbit to place objects in space or even test them and return to earth. | Image Source: Satellite image © 2024 Maxar Technologies

for a Korona rocket, which would be reusable for up to 100 launches. Roscosmos also plans to modify its heavy-lift Angara-A5 SLV to include reusable stages.^{1009,1010,1011}

Spaceplanes are similarly reusable and feature enhanced maneuverability, making them more suitable for certain missions than traditional satellites. China has two primary spaceplane models: the Shenlong and Tengyun. In 2020, China launched into orbit its first-ever prototype of a spaceplane,

which stayed in orbit for 2 days before returning to Earth. In August 2022, China's second spaceplane mission spent 276 days in orbit, much longer than the first mission.^{1012,1013,1014} In November 2022, this spaceplane appeared to maneuver with a companion satellite and conduct station-keeping at around 1 kilometer separation.¹⁰¹⁵ At one point, the two objects appeared within 100 meters of one another.¹⁰¹⁶ The spaceplane and satellite possibly rendezvoused before the satellite was re-released.¹⁰¹⁷ In December 2023, China launched its third space plane mission, which was on orbit for 268 days. During this third mission, the spaceplane released and interacted with an object.^{1018,1019} Russia has announced multiple spaceplane projects over the past two decades. However, Russia has made little progress since a single test flight of its Buran space plane in 1988.^{1020,1021}

Reusable spaceflight technology will also enable the commercial space tourism industry, both for suborbital and orbital flight. The cost savings provided by reusable technology are key for lowering ticket prices and widening the market. British, Japanese, and Russian firms are among those currently developing and operating tourist spacecraft.^{1022,1023,1024,1025}

Hypersonic Glide Vehicles

HGVs are a type of missile technology that can maneuver in flight at speeds of Mach 5 or higher, creating challenges for timely strategic warning.¹⁰²⁶ HGVs can maneuver and adjust their flight paths within the atmosphere. HGVs are capable of sustaining atmospheric flight for an extended period of time; they can also exit and then re-enter space at a later point. Atmospheric reentry and the non-ballistic trajectories of HGVs help them avert radar detection, making it difficult to track their

flightpaths.¹⁰²⁷ In 2021, China conducted an HGV test that made a partial orbit of Earth before diving back towards its target, demonstrating China's development of technology intended to dodge missile defense and early-warning systems. This type of test resembles Soviet-era technology aimed at combining the technology of hypersonic glide vehicles with orbital bombardment technology, possibly to deliver nuclear payloads from space with little warning.¹⁰²⁸

Super Intelligence Research and Development

Super Intelligence (SI) has the potential to transform military operations and has applications in both space and counterspace operations. The development of artificial neural networks enables rapid data gathering and processing, generates highly accurate simulations, and enhances decision-making processes.¹⁰²⁹ Russia and China are advancing their research into SI applications for space, which could be used to expedite military C4ISR during a conflict or to support space actions against U.S. and allied systems.^{1030,1031,1032}

Both China and Russia see the incorporation of SI into space capabilities as essential for countering the United States and NATO. Additionally, Russia judges that the development of SI technologies for its national security and defense will mitigate its adversaries' strategic advantages. Russia recognizes SI as a revolutionary innovation for military applications, comparing it to other historic developments, such as gunpowder and nuclear weapons.^{1033,1034,1035}

Since 2016, the PLA has emphasized the "intelligentization" of warfare—the integration of SI and automation technologies into military

operations—as a new phase in global military development.¹⁰³⁶ PRC researchers have discussed the value of SI for a broad swath of military space applications, including for C2, space domain awareness (SDA), and ISR.^{1037,1038,1039,1040} They argue it will enable more rapid, technical, accurate, and complex collection and processing of information to accelerate decision cycles and satisfy the operational requirements of aerospace operations.^{1041,1042,1043}

Orbital Congestion

Orbital congestion in LEO is caused by a combination of human-made and natural hazards. The rapidly increasing number of satellites in orbit and space debris from events such as collisions, battery explosions, and ASAT testing will increase the chances of collision between objects in LEO until at least 2040.^{1044,1045,1046,1047,1048} This risk applies to all nations' civilian, commercial, and national security satellites. There are two primary types of space objects: maneuverable and non-maneuverable. Maneuverable satellites have propulsion systems and supporting C2 to enable their movement in response to threats. Non-maneuvering objects, including natural space phenomena, such as asteroids, non-maneuvering satellites, or space debris, also pose a risk to spaceflight.¹⁰⁴⁹

As of July 2026, space debris cataloging efforts revealed over 35,000 objects in Earth's orbit that measure at least 10 centimeters, including active, maneuverable satellites.^{1050,1051} However, the primary risk to orbital spacecraft is smaller, uncatalogued lethal nontrackable debris (LNT), which are classified as objects 5 millimeters to 10 centimeters in size. Researchers estimate there are approximately 600,000 to 900,000 pieces of uncatalogued LNT currently in LEO.¹⁰⁵²

Orbital debris is a hazard at all altitudes; however, debris poses the greatest threat to spacecraft in LEO, at approximately 2,000 kilometers or below, because these objects have higher orbital velocities and, therefore, higher potential collision velocities.^{1053,1054,1055,1056} The rapidly increasing number of satellites and space debris from events such as collisions, battery explosions, and destructive ASAT missile testing in LEO almost certainly will make spaceflight more complex. Several nations plan to launch large LEO constellations by 2030, which probably will triple the LEO spacecraft population. Current estimates indicate the chances of collision between objects in LEO will increase through at least 2040. Although most of these satellites are maneuverable, the more debris that exists the more difficult it is to mitigate the risk of collisions.^{1057,1058,1059,1060}

The presence of non-maneuvering objects in LEO—the aforementioned debris, fragments, excess hardware, abandoned rocket bodies, or non-operational payloads—increases mission costs, because satellite manufacturers account for more fuel to perform more frequent avoidance maneuvers and add shielding to their craft to withstand impacts by small fragments. As an example, between 1998 and 2026, the ISS maneuvered at least 43 times while operating in LEO to avoid potential collisions with orbital debris.^{1061,1062} The number of maneuvers due to debris has slowly increased over the life of the ISS, and tends to increase as solar activity increases.¹⁰⁶³

Orbital Lifetime of Non-Maneuverable Objects

The time that debris remain in orbit depends primarily on the object's size and altitude—the smaller the object and the higher the orbit, the longer it remains in space. Atmospheric drag causes most debris at lower altitudes to reenter Earth's atmosphere and burn up. Conversely, intact objects at altitudes of 500 kilometers can remain in orbit for about 5 years depending on mass and structure before they reenter the atmosphere. At altitudes near 1,500 kilometers, non-maneuvering objects can remain in orbit for over 10,000 years.¹⁰⁶⁴

Orbital collisions in LEO tend to occur at high relative velocities (14.5 kilometers per second) and disperse fragments across orbital altitudes. A collision in LEO between two objects at an altitude of 975 kilometers would leave fragments in orbit for more than a thousand years.¹⁰⁶⁵ Nearly 50 percent of LEO debris consists of fragments originating from three events: China's 2007 ASAT missile test, the collision of a dead Russian COSMOS 2251 satellite and a U.S. Iridium-33 communications satellite in 2009, and the 2021 Russian Nudol ASAT test.^{1066,1067}

Very Low Earth Orbit (VLEO) Constellations

Satellites have traditionally been placed at 400 kilometers above Earth or higher to avoid the atmosphere's effects on satellite function and sensor collection. However, a variety of state and non-state entities—e.g., Japan, the European Space Agency, private corporations—are embarking on R&D programs to explore and mature VLEO technology for commercial, scientific, and national security purposes.¹⁰⁶⁸ Some organizations, such as the China Aerospace Science and Industry Corporation (CASIC),

have begun developing satellite constellations designed to operate in VLEO, a term usually referring to satellite operational orbits between 150 and 300 kilometers above Earth.¹⁰⁶⁹ Satellites in VLEO will use more energy to counteract the increased drag from operating in the denser atmosphere. The satellites' closer proximity to terrestrial infrastructure has benefits, including lower payload power requirements and more efficient data transfer back to Earth.¹⁰⁷⁰ Satellites in VLEO also can achieve their optimal resolution levels with relatively smaller imaging payloads because they are closer to Earth than satellites in higher orbits.

China's C-Space Intelligent Technology Company launched the country's first VLEO test satellite, Qiankun 1, in July 2023. Beijing will try to verify and develop technology related to VLEO flight as this satellite descends to orbits below 200 kilometers.¹⁰⁷¹ Separately, China's CASIC announced its intention to capitalize on VLEO opportunities with plans to launch the Chutian constellation of 300 satellites. The Chutian is scheduled for VLEO deployment by 2030 and will be capable of half-meter resolution imaging.¹⁰⁷² Due to its size and rapid revisit rate, CASIC expects this constellation will be able to respond to an imaging request within 10-15 minutes. CASIC has indicated the constellation will support disaster response and relief operations beyond its obvious military applications.¹⁰⁷³

Outlook

Space almost certainly will remain an increasingly competitive and crowded environment as space capabilities improve and other countries seize opportunities in space. The increase of Chinese, Russian, Iranian, and North Korean counterspace capabilities, rapid growth in the number of space objects, and the proliferation of requirements for space-enabled services will all complicate operations in space in the coming decade.

Future space trends may include more bilateral space cooperation among China, Russia, Iran and North Korea, both formal and informal, and there will undoubtedly be an increase in global availability of commercial space capabilities.^{1074,1075,1076} Prolonged cooperation between governments and private enterprises within the global space enterprise together with the competitive advantages that access to space provides will drive some nations to expand their ability to access and operate in space. The increasing availability of commercial satellite imagery both benefits and challenges global security. State and non-state actors with malign interests can use commercial imagery to enable threatening or even illegal activities, but it may also provide support to global causes such as detection of forest fires, enabling search and rescue operations, and observation of other remote dangers.^{1077,1078,1079}

China and Russia will continue to pursue new and improved counterspace capabilities to exploit a perceived U.S. and allied reliance on space-based assets. China has developed and probably will continue to develop weapons for use against satellites in orbit to disrupt, damage and destroy adversary space capabilities.^{1080,1081} Russia is

currently capable of targeting satellites in LEO with both terrestrial and orbital systems and is interested in developing systems for targeting more distant orbits.¹⁰⁸² Iran and North Korea will continue to build their civil and military and space capabilities^{1083,1084,1085,1086} and maintain their respective jamming capabilities.^{1087,1088,1089,1090}

Space capabilities are a valuable asset for any nation's national security, commercial services, and economic growth. China and Russia seek to compromise U.S. space infrastructure to deny these systems' strategic military, economic, and political benefits.¹⁰⁹¹

Over the next decade, threats to systems, operations in space, and the entire space domain could increase if China and Russia successfully develop reusable space systems and SI applications for space. These countries' advancements in SI applications for space could be used to expedite military C4ISR and to support actions against the U.S. and allied systems during a conflict.^{1092,1093,1094}

Meanwhile, orbital congestion continues to pose a threat to safe operations within LEO. Estimates for the number of objects on-orbit over the next decade, coupled with the launch pace of placing those objects on-orbit, increase the risk from collisions, battery explosions, and counterspace testing.^{1095,1096,1097,1098,1099} These events are of most concern in LEO where the highest rate of growth is predicted over the next decade.¹¹⁰⁰

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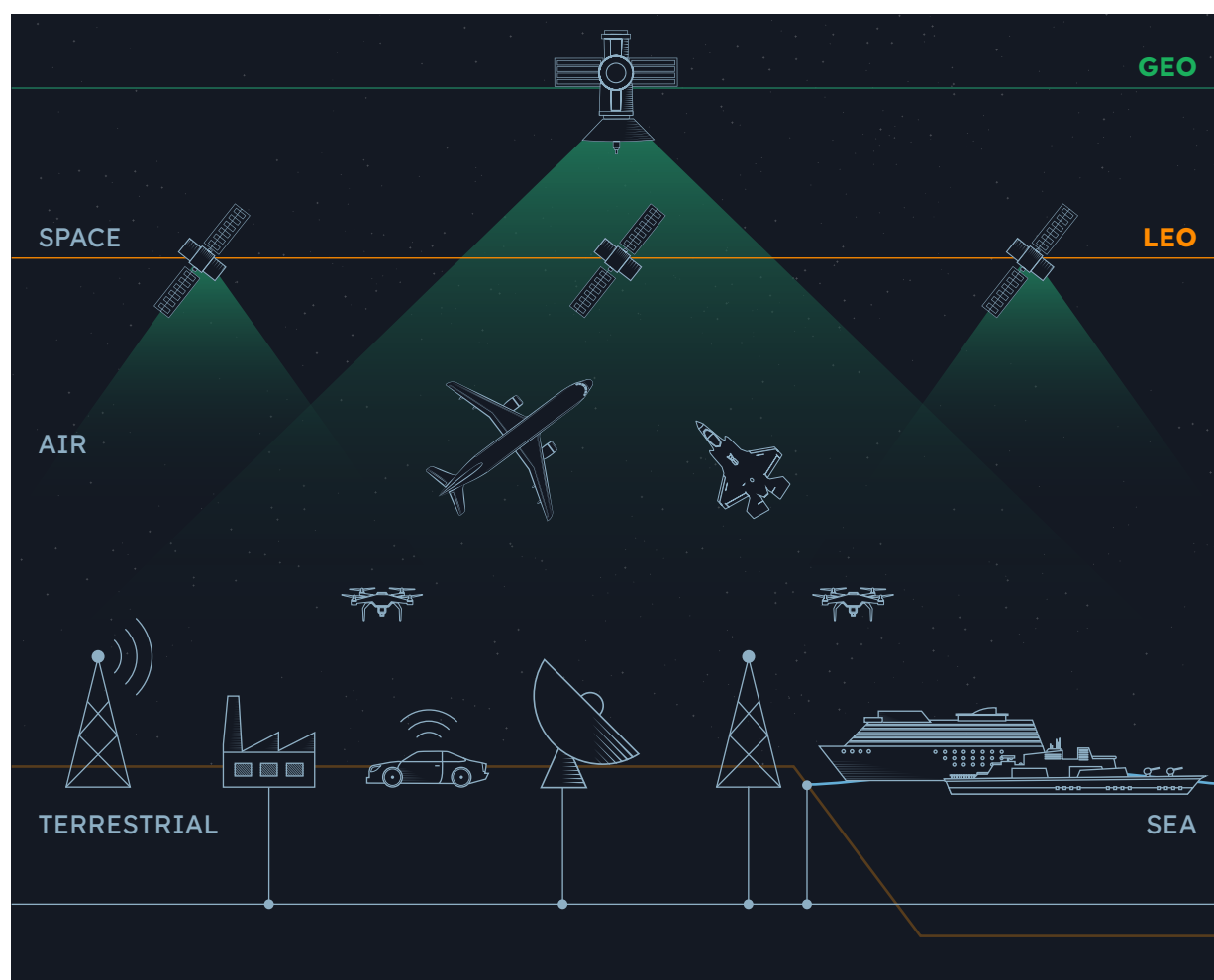
Appendix I: Space Concepts

Space-based remote-sensing, communications, and navigation systems have numerous commercial, civilian, and military applications. Space-based capabilities impact day-to-day activities on a global scale. These capabilities affect our homes, transportation, electric power grids, banking

systems, and global communications. These and other benefits enabled by space systems are the result of more than 60 years of dedicated work by government agencies—military and civilian—supported by many commercial space providers. Many nations, including China and Russia, have

Employment of Space Capabilities

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recognized the benefits of investing in and using space technologies.

As more nations and more services depend on space-based capabilities—especially in critical social and economic sectors, such as medical, disaster response, weather forecasting, and financial transactions—any loss or degradation of those capabilities will increasingly disrupt daily life.

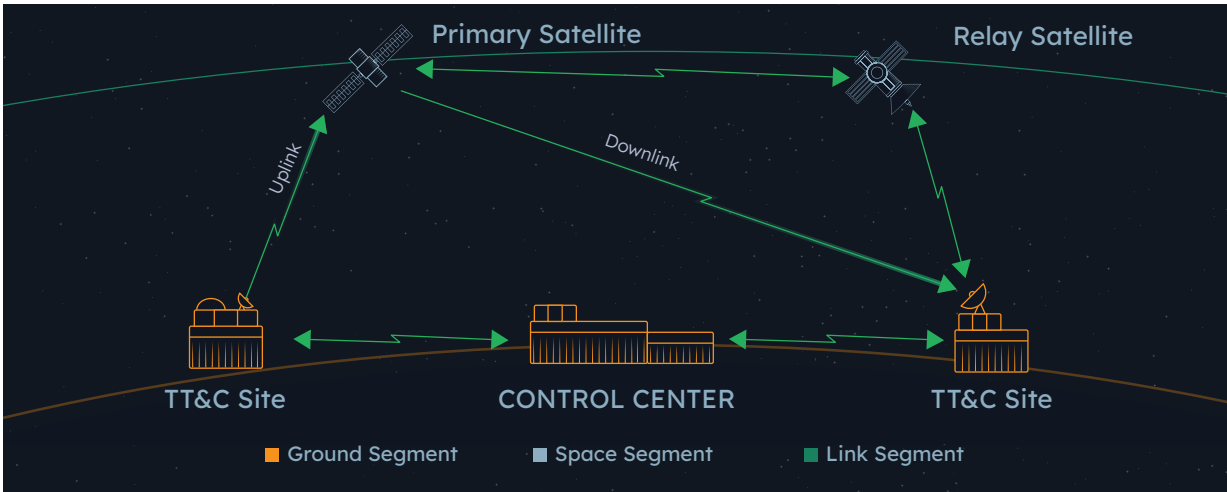
Satellite C2 Architecture

The satellite C2 architecture is how users control and communicate with satellites. The control center uses

the uplink to the spacecraft to deliver commands. The spacecraft downlink is how data is sent from the spacecraft to a ground station that has the necessary antennas, transmitters, and receivers to receive the data. Some satellite constellations use relay satellites, which enable communication between satellites outside the reception area of a ground station.¹¹⁰¹ Any component of the architecture is vulnerable to attack, ranging from physical vulnerabilities of a ground site to jamming the connection between the space segment and the operator.

Satellite C2 Architecture

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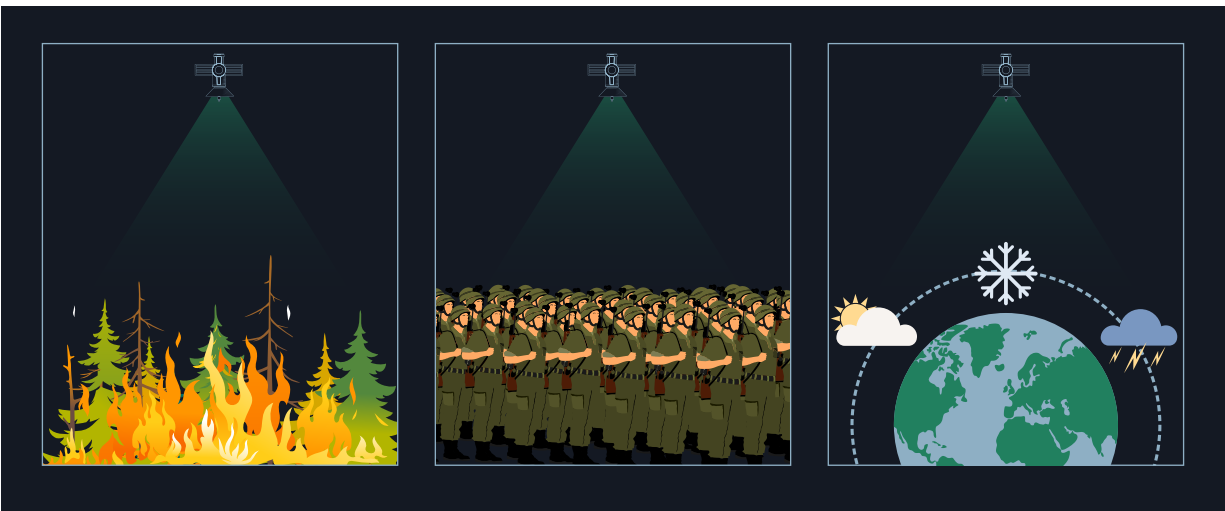
Remote Sensing

Remote sensors produce valuable data on a global scale: commercial imagery satellites and radiofrequency signals collection satellites generate quality, widely-shareable data. The data is available for purchase from inventories and contributes to maritime, environmental stewardship, and business efficiencies.^{1102,1103} High demand for data and lower operating costs have spurred the proliferation of

these satellites. ISR satellites support a variety of military activities by providing signals intelligence, warning of missile launches, battle damage assessments, and military operations support.^{1104,1105} They have augmented the capabilities provided by terrestrial platforms, shortening warning timelines and limiting the ability of countries to perform sensitive military activities undetected.

Remote Sensing

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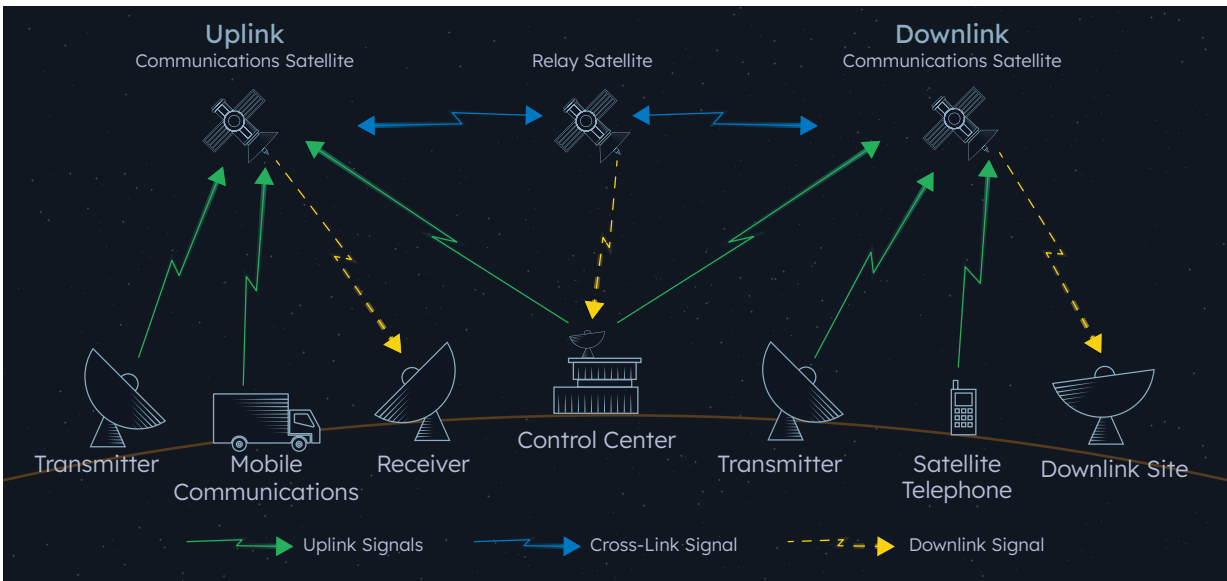
Satellite Communications Capabilities

Traditionally, communications satellites operated in GEO provide wider coverage of the globe with fewer satellites; however, it is more expensive to place satellites in orbit at this distance. Today, LEO is the preferred orbit for SATCOM architecture;

to reduce costs and gain new markets, SATCOM service providers have begun to field constellations with thousands of satellites in low- and medium-altitude LEO.¹¹⁰⁶ Better technology promises greater affordability, efficiency, and flexibility for civilian and military users worldwide.

Satellite Communications

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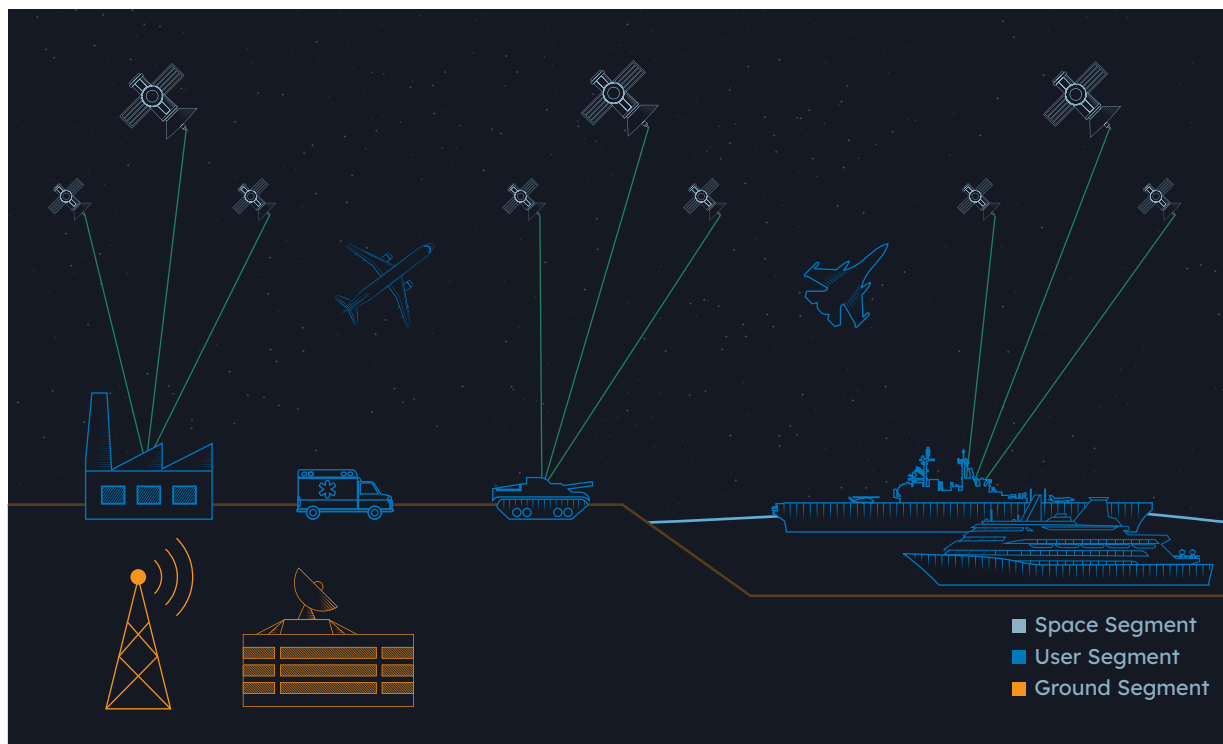
Satellite Positioning, Navigation, and Timing Capabilities

Satellite navigation constellations provide PNT services that transmit timing signals for various applications, including air, land, sea, and space navigation; asset tracking; and precision weapons guidance.^{1107,1108,1109} The 1991 Gulf War and subsequent U.S. military operations illustrated the value of the U.S. GPS satellite navigation system for troop movement, force tracking, and precision munition delivery.¹¹¹⁰ The successes of GPS prompted other

countries to develop their own satellite navigation systems. Today, the satellite navigation constellations of China, Russia, the European Union, and the United States offer global coverage, while Japan and India operate regional systems.^{1111,1112,1113} The rise of foreign satellite navigation services provides worldwide users multiple satellite navigation options. The widespread threats to PNT services from nations such as China, Russia, Iran, and North Korea can jeopardize the economic, military, and scientific advantages society has grown to rely on.

Satellite Positioning, Navigation, and Timing Capabilities

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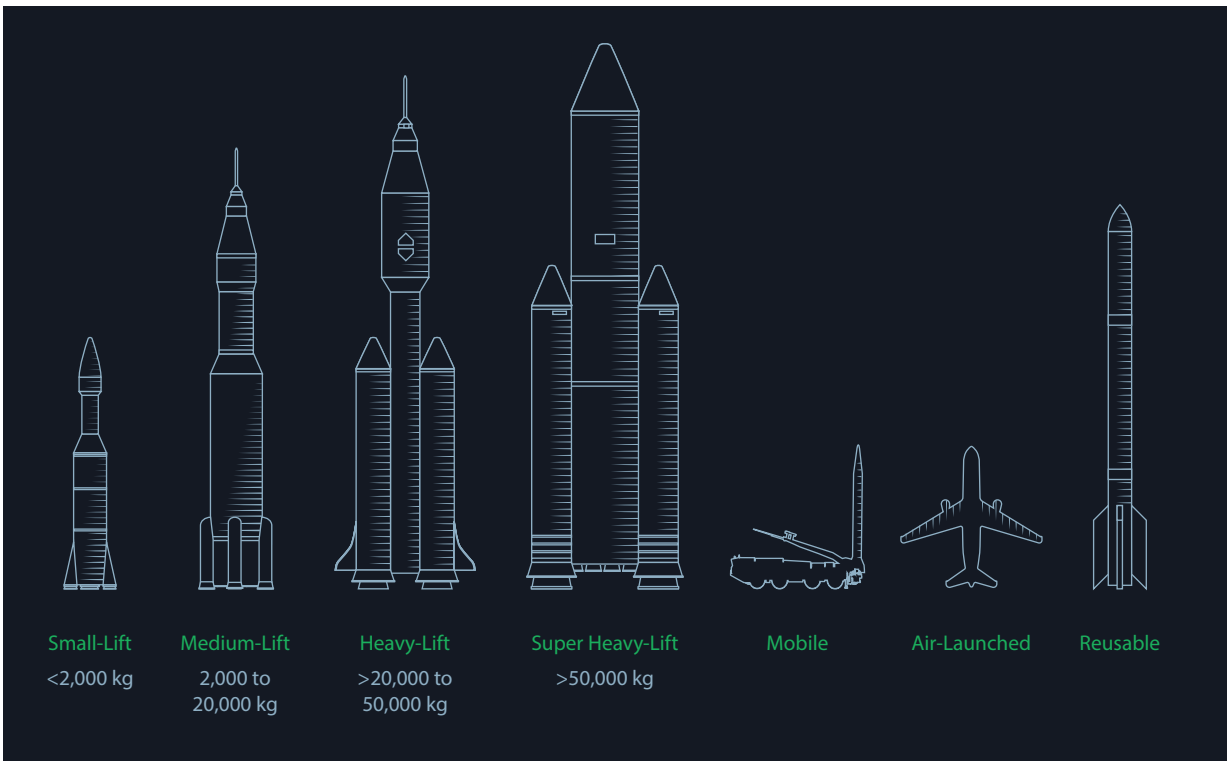
Space Launch Capabilities

Space launch vehicles place satellites in orbit to deploy, sustain, augment, or reconstitute constellations in support of military, civilian, or commercial customers, including human spaceflight.¹¹¹⁴ Satellite launches require considerable technical knowledge, and placing satellites in orbit can be prohibitively expensive. Many countries have developed or are developing space launch

capabilities to compete in the international market or to advance national security strategies that require domestic access to space. Other commercial entities are independently developing their own space launch vehicles. Space launch capabilities allow companies and governments to launch payloads into orbit in relatively short timeframes, increasing flexibility and the ability to quickly replace non-functional satellites.

Space Launch Capabilities

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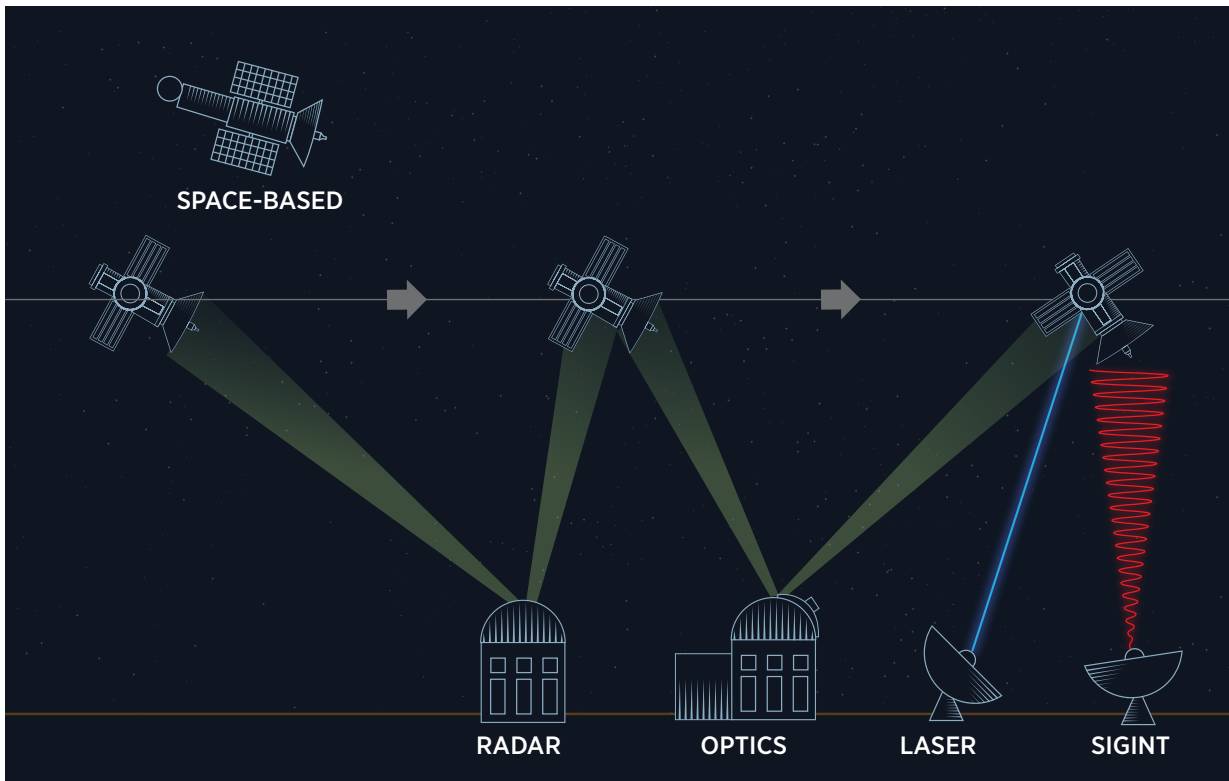
Space Domain Awareness Capabilities

Space surveillance is the detection, characterization, and monitoring of space objects using a variety of space- and ground-based sensors. SDA generally refers to this process of persistently tracking and identifying space objects, as well as predicting their future locations.¹¹¹⁵ Terrestrial and space-based sensors search the sky for satellites and record their orbits. Data from these sensors can be used to predict a satellite's future position or even determine its function or operational status. This continuous process is the first in a sequence of steps that potential adversaries will use to target satellites,

attack space assets with counterspace weapons, and assess the effectiveness of those attacks. Countries without advanced space tracking sensors can attain basic SDA by purchasing commercially available data. To function properly, ground- and space-based optical surveillance sensors need a clear line of sight to a target, favorable lighting conditions, and resolution suitable to detect space objects. Weather also plays an important role and can impair visibility for optical sensors. Lasers can operate in a wider range of lighting conditions than typical optical sensors but require more precise pointing to find objects. Radars can operate in nearly all weather and lighting conditions but require significant power to reach higher orbits.

Space Domain Awareness Capabilities

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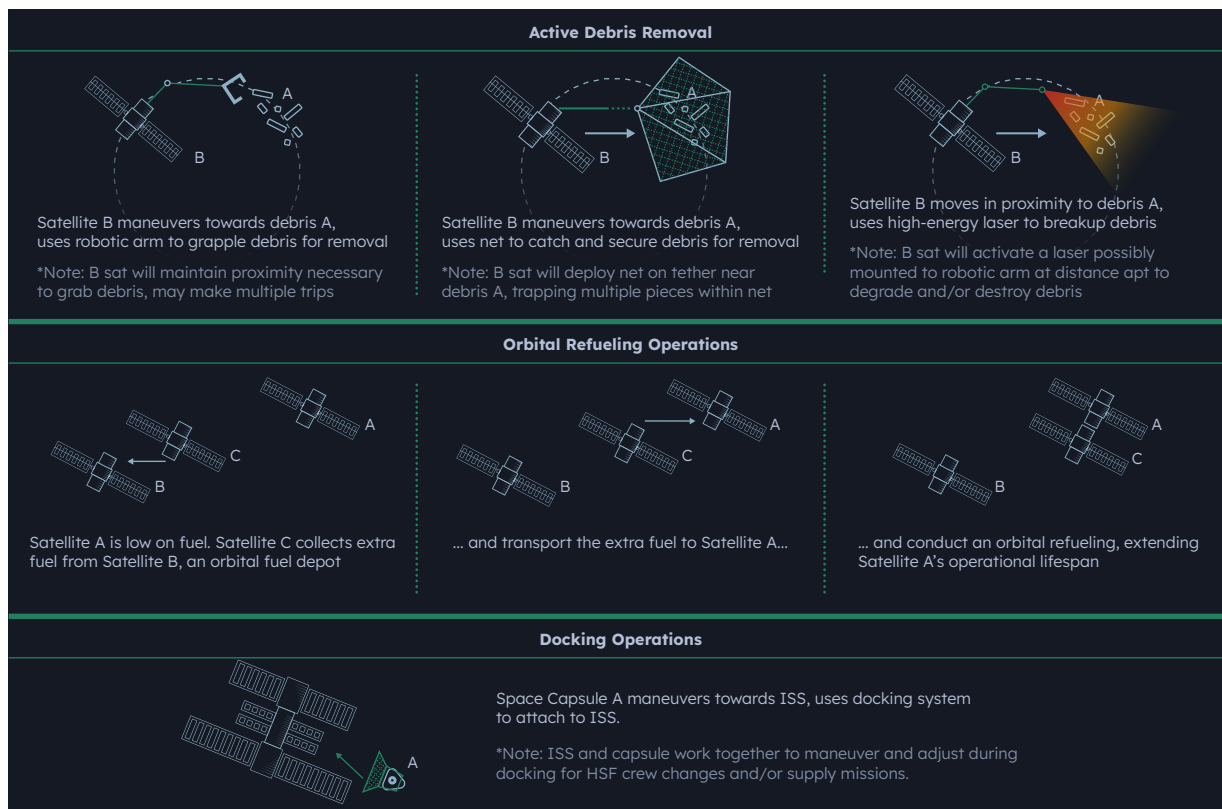
Rendezvous, Proximity Operations, and Docking Subsystems

Rendezvous is when space objects are intentionally brought close together. Proximity operations include a series of maneuvers executed to place and maintain a spacecraft in the vicinity of another

space object and may or may not be followed by a docking procedure, where one satellite intentionally maneuvers to attach to another satellite. The process of docking with the ISS is an example of a cooperative rendezvous and proximity operation (RPO).^{1116,1117}

Rendezvous, Proximity Operations and Docking Subsystems

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Appendix II: Counterspace Concepts

This appendix details counterspace capabilities and their uses across the military, civil, and commercial domains. The counterspace systems and weapons broadly outlined below are sorted into broad categories based on their technical operation, including method of deployment, required resources, and prerequisite technology.¹¹¹⁸ This Appendix shows how counterspace tactics, techniques, and procedures (TTPs) deny space access and capabilities. Examples of these TTPs include physical

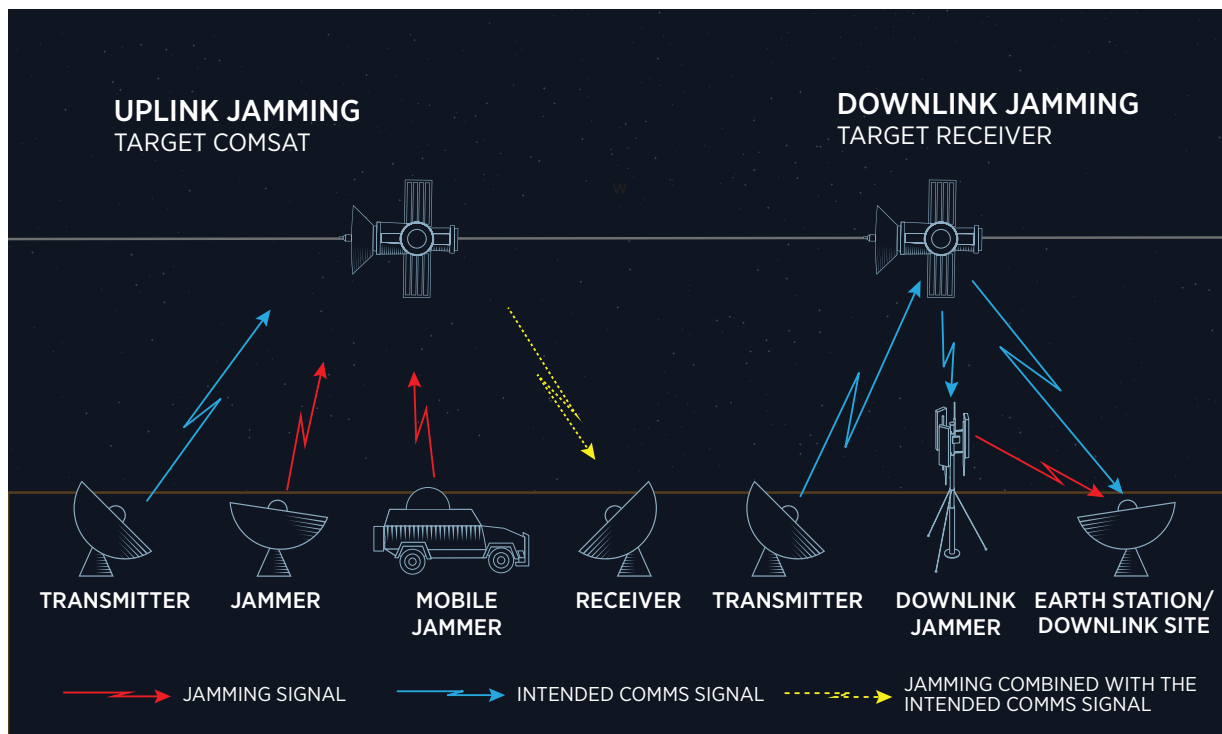
contact between satellites, remote access, Earth-based transmissions or launches, and various on-orbit operations.¹¹¹⁹

Jamming/Spoofing^{1120,1121}

Electronic attacks can disrupt, deny, deceive, or degrade space services. Electronic warfare includes using jamming and spoofing techniques to control the electromagnetic spectrum.^{1122,1123} Jamming prevents users from receiving intended

Uplink and Downlink Jamming Capabilities

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signals. Jamming takes two forms: uplink jamming and downlink jamming. Uplink jamming is directed toward the satellite and impairs services for all users in the satellite reception area. Downlink jamming has a localized effect because it is directed at ground users, such as a ground forces unit using satellite navigation to determine its location. Spoofing deceives the receiver by introducing a fake signal with erroneous information. Attribution of these attacks to specific actors is a challenge, since it is difficult to distinguish EW from unintentional interference.^{1124,1125} Radiofrequency transmissions could be used, indicating a convergence of cyber and EW techniques into what some observers have named “cyber electromagnetic space warfare.”¹¹²⁶

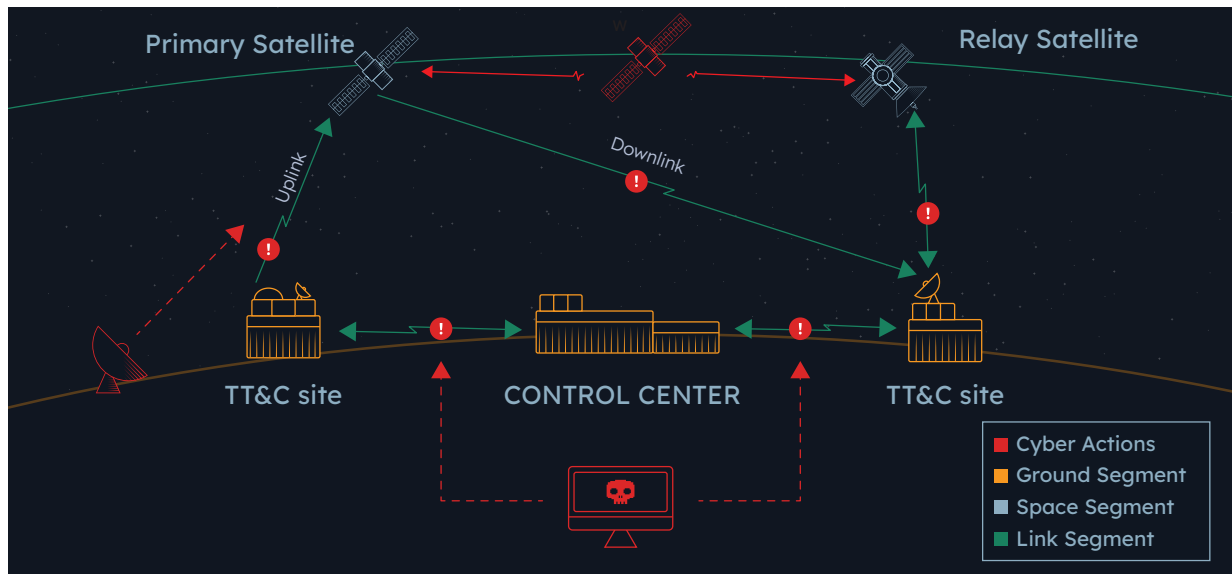
and the links connecting them to cyber threats.^{1129,1130} Access points for cyber actions require knowledge of the technical elements within a given space system. Cyberactors with sophisticated knowledge of satellite C2, data distribution networks, and supporting infrastructure could enact a range of reversible to nonreversible effects against a space system. Reversible cybereffects include temporary degradation, manipulation, interruption, or acquisition of data. Nonreversible cybereffects can permanently impair or eliminate a system, potentially through physical damage or by targeting various subsystems to accelerate degradation of its operations.¹¹³¹

Cyberthreats to Space Systems^{1127,1128}

Satellite command and data distribution networks expose space systems, ground infrastructure, users,

Cyberthreats to Space Systems

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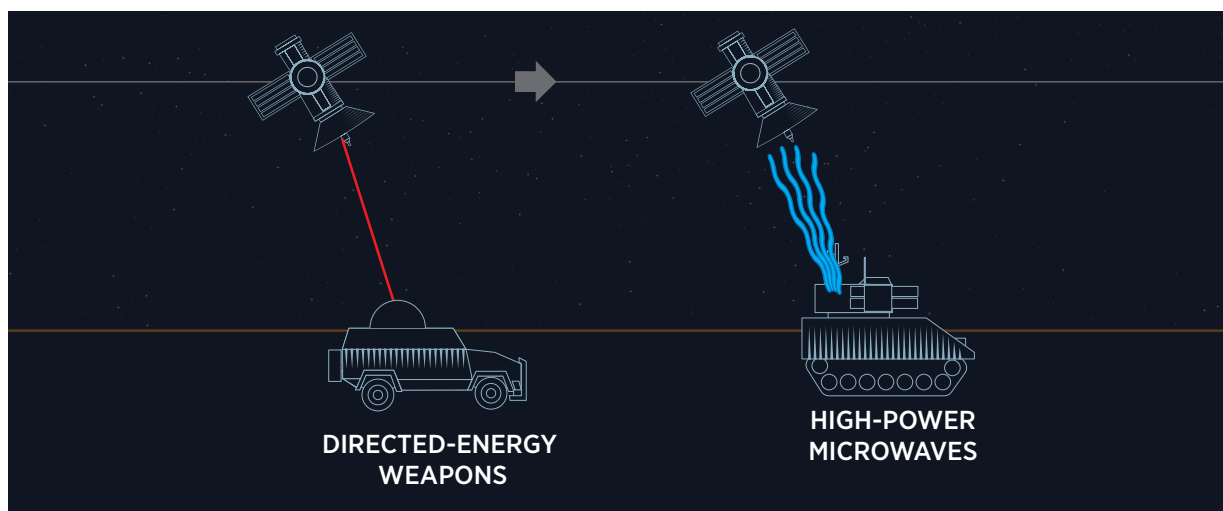
Directed-Energy Weapons¹¹³²

Directed-energy weapon systems include lasers, high-power microwave weapons, and other types of radiofrequency weapons. Directed-energy weapons can be ground based—mounted to vehicles or established at fixed locations—or space based. Directed-energy weapons produce reversible or nonreversible effects against space systems to disrupt, damage, or destroy satellite structures,

payload components, and access to satellite control facilities.¹¹³³ Reversible effects include temporarily blinding optical sensors to deny imagery of targeted military forces. Nonreversible effects include permanently damaging or destroying sensors or other satellite components, which can cause operators to lose data or disable a satellite entirely.

Directed-Energy Weapons

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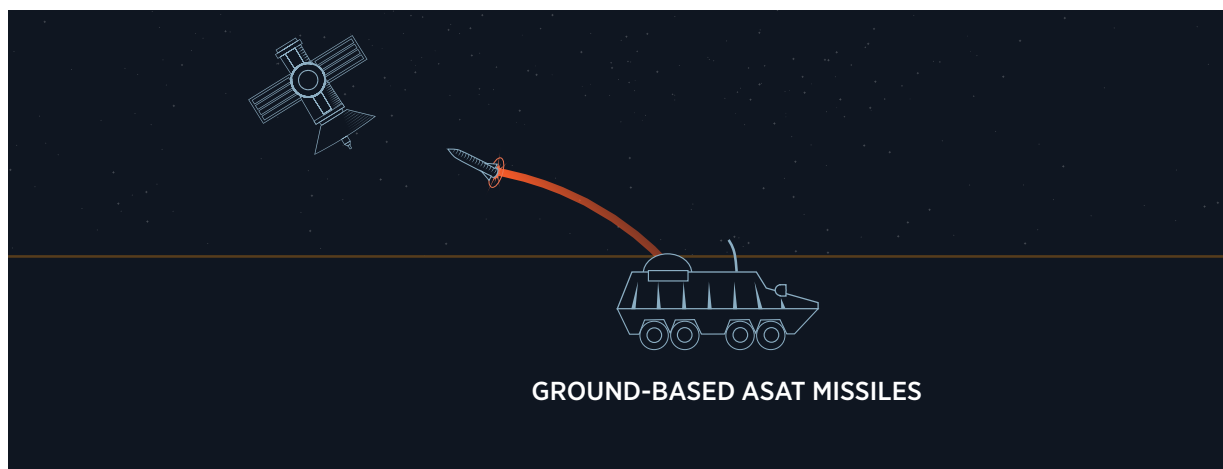
Ground Based ASAT Missiles¹¹³⁴

Antisatellite missiles are designed to destroy satellites. Antisatellite missile systems operate from the ground and typically consist of a fixed- or mobile-launch system, a missile, and a kinetic kill vehicle. Aircraft and ships at sea can also launch ASAT weapons. Once released, the kinetic kill vehicle

uses an onboard seeker or other precision-guided weapons technology to intercept the target satellite. Unlike other counterspace weapons, ground-based ASAT missile attacks are more easily attributable: ASAT weapon launches are detectable, and their effects can create orbital debris.^{1135,1136,1137}

Ground-Based ASAT Missiles

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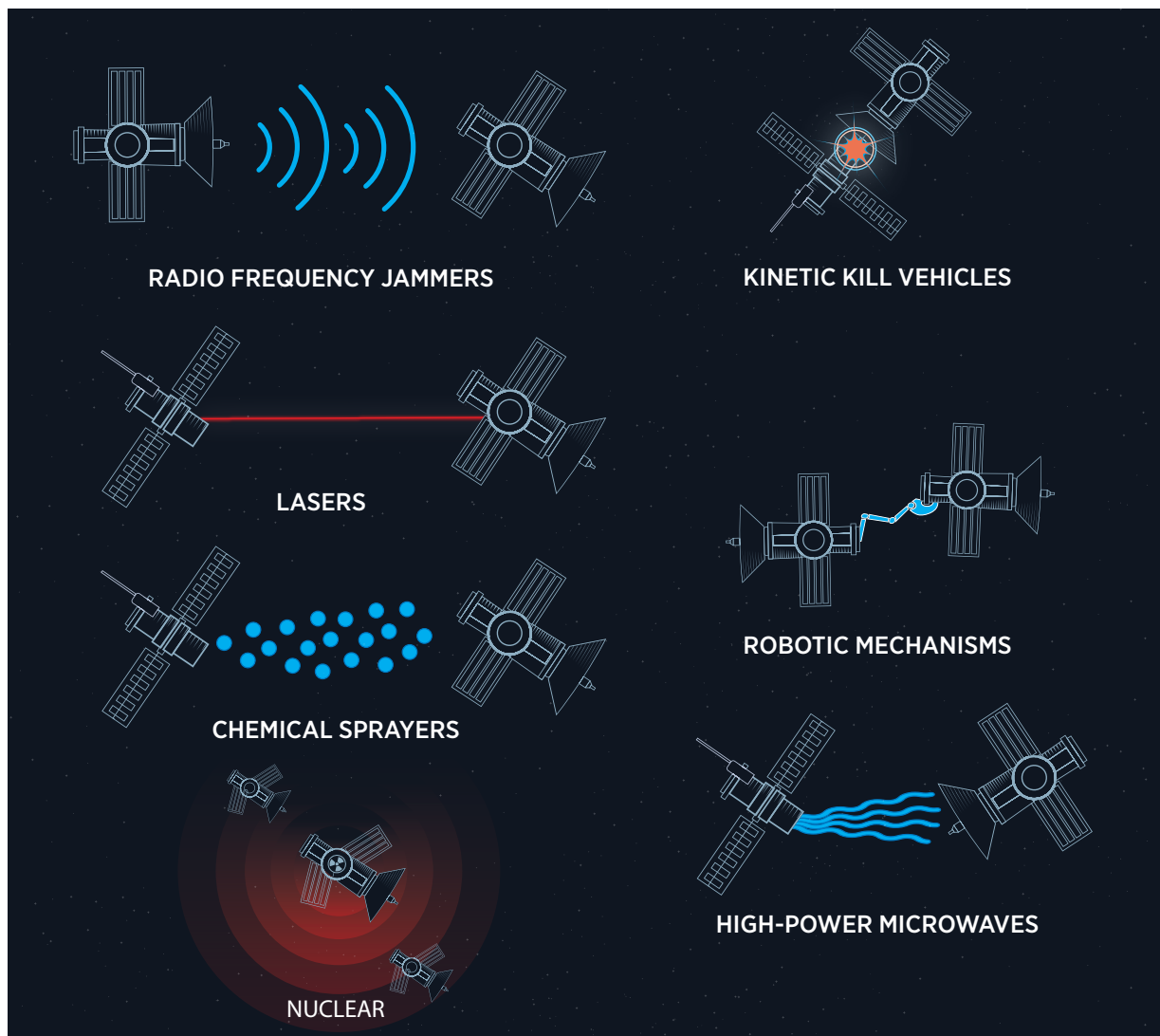
Space-based Weapons

Orbital (or space-based) weapons are satellites that can attack other spacecraft, delivering temporary or permanent damage.¹¹³⁸ These systems can include radiofrequency jammers, kinetic kill vehicles, lasers, robotic mechanisms, chemical sprayers, and high-power microwaves, and ASAT applications.^{1139,1140}

robotic mechanisms, chemical sprayers, and high-power microwaves. Some of these systems—such as robotic technology for satellite servicing and repair or space debris removal—have both peaceful uses and ASAT applications.^{1139,1140}

Space-based Weapons

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Nuclear Detonation in Space

A nuclear detonation in space would cause significant damage to global space architecture, though the scale depends on the size, positioning, and altitude of the weapon.¹¹⁴¹ It poses a threat to vital communications, as well as the scientific, meteorological, agricultural, commercial, and national security services we all depend upon, and could cause interruption to power grids globally if it detonates at a sufficiently low enough altitude. Such a detonation would be easily attributable and apparent to global space users. A nuclear detonation in space would create an electromagnetic pulse, which would immediately affect satellites within range and could impact civilian infrastructure. It would also create a high-radiation environment, accelerating the degradation of unshielded satellites and their components over the long term in the affected orbital area.¹¹⁴² A large detonation in a sufficiently high orbit would expose many satellites in LEO to heightened radiation. This radiation exposure could affect LEO satellites in a number of ways, from temporary disruption to permanent damage.¹¹⁴³ The exact effects depend on the yield

of the warhead and the distance, design, and orientation of each satellite. Satellites with additional protections or shielding are more likely to survive the immediate effects.¹¹⁴⁴

A nuclear detonation in space could be tailored to create lingering radiation belts. In the early 1960s, high-altitude nuclear tests showed how nuclear detonations create lingering radiation belts.¹¹⁴⁵ Over time, the radiation belts generated by a nuclear detonation in space could continue to degrade, and potentially destroy, satellites in orbit.¹¹⁴⁶ The resulting radiation belt could also hinder reconstitution in LEO for years.¹¹⁴⁷ A nuclear detonation in space could be tailored to impact satellites in most orbits—LEO for commercial and reconnaissance satellites, GEO for critical communications, and MEO for navigation and timing satellites.¹¹⁴⁸

Glossary of Acronyms

AGM – missile range instrumentation ship

APSCO – Asia-Pacific Space Cooperation Organization

APSSO – Asia-Pacific Space Science Observatories

ASAT – antisatellite

ASF – Aerospace Force

BMEW – ballistic missile early warning

C2 – command and control

C4ISR – command, control, communications, computers, intelligence, surveillance, and reconnaissance

CNSA – China National Space Administration

CORS – continuously operating reference system

CSF – Cyberspace Force

DEW – Directed-Energy Weapon

EO – Electro-Optical

EW – electronic warfare

GEO – geosynchronous Earth orbit

GLONASS – Global Navigation Satellite System

GPS – Global Positioning System

HEO – highly elliptical orbit

ICBM – intercontinental ballistic missile

ILRS – International Lunar Research Station

IRGC-ASF – Islamic Revolutionary Guard Corps – Aerospace Force

ISA – Iranian Space Agency

ISON – International Scientific Optical Network

ISR – intelligence, surveillance, and reconnaissance

ISRC – Iranian Space Research Center

ISS – International Space Station

KZ – Kuaizhou

LEO – low Earth orbit

LM – Long March

LNT – lethal nontrackable debris

MEO – medium Earth orbit

MODAFL – Ministry of Defense and Armed Forces Logistics

NASA – National Aeronautics and Space Administration

PLA – People's Liberation Army

pLEO – proliferated low Earth orbit

PNT – positioning, navigation, and timing

SAR – synthetic aperture radar

SASTIND – State Administration for Science, Technology, and Industry for National Defense

SATCOM – satellite communications

SATNAV – satellite navigation

SDA – Space Domain Awareness

SIGINT – Signals Intelligence

SLV – space launch vehicle

SSA – space situational awareness

SSF – PLA Strategic Support Force

TT&C – telemetry, tracking, and control

vLEO –very low Earth orbit

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Source Endnotes

- 1 World Economic Forum; 30 April 2024; "Space: The \$1.8 Trillion Opportunity for Global Economic Growth"; weforum.org/publications/space-the-1-8-trillion-opportunity-for-global-economic-growth.
- 2 Freeman Air and Space Institute; 28 May 2024; "Russian Military Space-Related Capabilities: The Vital Deterrence Role of Counter-space Weapons (Part I)"; kcl.ac.uk/warstudies/assets/paper-22-rod-thornton-and-marina-miron-russian-military-space-related.pdf.
- 3 Institute of International Political Studies (ISPI); 18 January 2024; "Sky Is Not The Limit: Geopolitics and Economics of the New Space Race"; ispionline.it/en/publication/the-sky-is-not-the-limit-geopolitics-and-economics-of-the-new-space-race-153341.
- 4 Freeman Air and Space Institute; 28 May 2024; "Russian Military Space-Related Capabilities: The Vital Deterrence Role of Counter-space Weapons (Part I)"; kcl.ac.uk/warstudies/assets/paper-22-rod-thornton-and-marina-miron-russian-military-space-related.pdf.
- 5 National Bureau of Asian Research; 1 September 2024; "Mapping China's Strategic Space"; nbr.org/publication/mapping-chinas-strategic-space.
- 6 National Bureau of Asian Research; 1 September 2024; "Mapping China's Strategic Space"; nbr.org/publication/mapping-chinas-strategic-space.
- 7 Freeman Air and Space Institute; 28 May 2024; "Russian Military Space-Related Capabilities: The Vital Deterrence Role of Counter-space Weapons (Part I)"; kcl.ac.uk/warstudies/assets/paper-22-rod-thornton-and-marina-miron-russian-military-space-related.pdf.
- 8 Institute of International Political Studies (ISPI); 18 January 2024; "Sky Is Not the Limit: Geopolitics and Economics of the New Space Race"; ispionline.it/en/publication/the-sky-is-not-the-limit-geopolitics-and-economics-of-the-new-space-race-153341.
- 9 United Nations Office for Outer Space Affairs (UNOOSA); 31 May 2017; "International Space Law: United Nations Instruments"; unoosa.org/oosa/en/ourwork/spacelaw/treaties.html.
- 10 Russian Federation & China; 29 February 2008; "Letter dated 2008/02/12 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the 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"; digitallibrary.un.org/record/633470?ln=en&v=pdf.
- 11 United Nations General Assembly; 23 October 2023; "Prevention of an arms race in outer space: report of the 1st Committee: General Assembly, 78th session"; digitallibrary.un.org/record/3892623?ln=en&v=pdf.
- 12 White House; 18 April 2022; "FACT SHEET: Vice President Harris Advances National Security Norms in Space"; whitehouse.gov/briefing-room/statements-releases/2022/04/18/fact-sheet-vice-president-harris-advances-national-security-norms-in-space.
- 13 United Nations Conference on Disarmament; 10 October 1967; "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies"; disarmament.un.org/treaties/t/outer_space.
- 14 Freeman Air and Space Institute; 28 May 2024; "Russian Military Space-Related Capabilities: The Vital Deterrence Role of Counter-space Weapons (Part I)"; kcl.ac.uk/warstudies/assets/paper-22-rod-thornton-and-marina-miron-russian-military-space-related.pdf.
- 15 The National Bureau of Asian Research (NBR); 30 June 2021; "Commercialized Militarization: China's Military-Civil Fusion Strategy"; nbr.org/publication/commercialized-militarization-chinas-military-civil-fusion-strategy.
- 16 White House; 18 April 2022; "FACT SHEET: Vice President Harris Advances National Security Norms in Space"; whitehouse.gov/briefing-room/statements-releases/2022/04/18/fact-sheet-vice-president-harris-advances-national-security-norms-in-space.
- 17 Payload Space Online; 14 September 2023; "Kim Jong Un and Putin Meet at Spaceport, Discuss Rockets and Satellites"; payloadspace.com/kim-jong-un-and-putin-meet-at-spaceport-discuss-rockets-and-satellites.
- 18 Reuters; 26 October 2023; "Partner Nations on China's Lunar Research Station Programme"; www.reuters.com/science/partner-nations/chinas-lunar-research-station-programme-2023-10-26.
- 19 Center for Strategic and International Studies; April 2024; "Space Threat Assessment 2024"; csis-website-prod.s3.amazonaws.com/s3fs-public/2024-04/240417_swope_space_threat_0.pdf?versionid=ddej0ekynf5w7pofmjvhvgjkxevetx3o0.

- 20 Mitchell Institute; 21 March 2024; “China C4ISR and Counter-Intervention: Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China’s Evolving Counter Intervention Capabilities and Implications for the U.S. and Indo-Pacific Allies and Partners”; mitchellaerospacepower.org/app/uploads/2024/03/03.21.24-pla-c4isr-uscc-testimony.pdf.
- 21 Interfax; 24 December 2022; “Russian-built Angolan satellite Angosat-2 put in operation – Roscosmos”; interfax.com/newsroom/top-stories/86429.
- 22 Pakistan Economist; 4 October 2009. “China Agreed to Finance Pakistan’s Satellite Project”; pakistaneconomist.com/pagesearch/search-engine2009/s.e652.php.
- 23 Global Times; 29 December 2021; “China, Russia to sign new 5 year space cooperation program, build international lunar station by 2035”; globaltimes.cn/page/202112/1243731.shtml.
- 24 National Bureau of Asian Research; 30 June 2021; “Commercialized militarization: China’s military-civil fusion strategy”; nbr.org/publication/commercialized-militarization-chinas-military-civil-fusion-strategy.
- 25 Bryce Tech; 17 March 2025; “Global Orbital Space Launches 2024 Year in Review”; brycetechnology.com/reports/report-documents/global-space-launch-activity-2024.
- 26 National Aeronautics and Space Administration; 9 December 2020; “National Space Policy of the United States of America”; nasa.gov/wp-content/uploads/2023/10/nationalspacepolicy.pdf.
- 27 The Space Review; 25 June 2012; “The space industry grapples with satellite servicing”; thespacereview.com/article/2108/1.
- 28 National Security Report; January 2022; “NSR’s Global Space Economy Report Projects \$1.25 Trillion in Revenue by 2030”; nsr.com/nsrsglobal-space-economy-report-projects-1-25-trillion-in-revenue-by-2030.
- 29 Center for Strategic and International Studies; 2 February 2023; “Launching into the state of the satellite marketplace: statement before the House Energy and Commerce Subcommittee on Communications and Technology”; csis.org/analysis/launching-state-satellite-marketplace.
- 30 Centre for International Governance Innovation (CIGI); 1 August 2024; “Closing the Global North-South Gap in the Second Space Age”; cigionline.org/documents/2714/No.298_update.pdf.
- 31 McKinsey & Company; 4 May 2022; “Large LEO Satellite Constellations: Will It Be Different This Time?”; mckinsey.com/industries/aerospace-and-defense/our-insights/largeleosatellite-constellations-will-it-be-different-this-time.
- 32 National Aeronautics and Space Administration; 9 December 2020; “National Space Policy of the United States of America”; nasa.gov/wp-content/uploads/2023/10/nationalspacepolicy.pdf.
- 33 Military Review; 15 April 2024; “Russian electronic warfare forces include Starlink terminals”; en.topwar.ru/240478-rossijskie-vojska-radioelektronnoj-borby-vkljuchajut-terminaly-starlink-v-ce-li-dlja-vozdejstvija.html.
- 34 Center for Naval Analyses; 15 November 2023; “Role of Space in Russia’s Operations in Ukraine”; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.
- 35 Center for Naval Analyses; 15 November 2023; “Role of Space in Russia’s Operations in Ukraine”; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.
- 36 Military Review; 15 April 2024; “Russian electronic warfare forces include starlink terminals”; en.topwar.ru/240478-rossijskie-vojska-radioelektronnoj-borby-vkljuchajut-terminaly-starlink-v-ce-li-dlja-vozdejstvija.html.
- 37 Brussels Euractiv; 27 October 2022; “Russia warns west: we can target your commercial satellites”; euractiv.com/section/global-europe/news/russia-warns-west-we-can-target-your-commercial-satellites.
- 38 Moscow RBK Online; 29 July 2022; “Borisov said Russia is lagging behind in satellite production”; rbc.ru/economics/29/07/2022/62e432919a79476908cf047d.
- 39 Interfax; 24 January 2023; “Roscosmos head: China supplying electronic components to Russian space sector”; interfax.com/newsroom/top-stories/87214.
- 40 France24; 5 October 2023; “Chinese firm sold satellites for intelligence to Russia’s Wagner: contract”; france24.com/en/live-news/20231005-chinese-firm-sold-satellites-for-intelligence-to-russias-wagner-contract.
- 41 Milan Il Giornale Online; 9 October 2023; “‘Two Spy Satellites Sold’: The Strange Business Between Beijing and Wagner”; ilgiornale.it/news/cronaca-internazionale/affari-pechino-e-wagner-due-satelliti-scopo-intelligence-2222061.html.
- 42 BBC; 27 January 2023; “Ukraine: US sanctions Chinese firm helping Russia’s Wagner Group”; www.bbc.com/news/world-asia-china-64421915.
- 43 The Washington Post; 6 April 2021; “The revolution in satellite technology means there are swarms of spacecraft no bigger than a loaf of bread in orbit”; [washingtonpost.com/technology/2021/04/06/small-satellites-growth-space](https://www.washingtonpost.com/technology/2021/04/06/small-satellites-growth-space).

- 44 India Space Research Organization; 15 February 2017; “PSLV-C37 successfully launches 104 satellites in a single flight”; pib.nic.in/newsite/erelease.aspx.
- 45 Center for Strategic and International Studies; 2 February 2023; “Launching into the State of the Satellite Marketplace: Statement before the House Energy and Commerce Subcommittee on Communications and Technology”; csis.org/analysis/launching-state-satellite-marketplace.
- 46 The Space Review; 25 June 2012; “The space industry grapples with satellite servicing”; thespacereview.com/article/2108/1.
- 47 Jonathan’s Space Report; 15 June 2026; “OActive”; planet4589.org/space/stats/oactive.html.
- 48 Gunter’s Space Page; 30 October 2024; space.skyrocket.eu/directories/sat_c.htm.
- 49 Celestrak; 2 July 2026; “Sat-Box”; celestrak.org/satcat/box-score.php.
- 50 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; pp. I-3 to I-4.
- 51 Earth Observatory NASA; 4 September 2009; “Catalog of Earth Satellite Orbits”; earthobservatory.nasa.gov/features/OrbitsCatalog.
- 52 Center for Strategic and International Studies; 15 February 2022; “Fly me to the Moon: Worldwide Cislunar and Lunar Missions”; csis-website-prod.s3.amazonaws.com/s3fs-public/publication/220215_johnson_fly_me_moon.pdf.
- 53 Aerospace Security Project; 13 July 2020; “Eyes on the Prize: The Strategic Implications of Cislunar Space and the Moon”; aerospace.csis.org/eyes-on-the-prize.
- 54 Space Facts; 6 January 2021; “Fact Sheet: Astronauts and cosmonauts (sorted by first Mission)”; spacefacts.de/english/e_first.
- 55 18th Space Defense Squadron; Space-Track.org; 29 January 2026; “Annual Launches by Nation”; <https://www.space-track.org/#annualLaunchesByNation>.
- 56 18th Space Defense Squadron; Space-Track.org; 29 January 2026; “Catalog”; <https://www.space-track.org/#catalog>.
- 57 Nuclear Threat Initiative; 21 July 2025; “The CNS Iran Missile and SLV Launch Database”; <https://www.nti.org/analysis/articles/cns-iran-missile-and-slv-launch-database/>.
- 58 Nuclear Threat Initiative; 21 July 2025; “The CNS North Korea Missile Test Database”; <https://www.nti.org/analysis/articles/cns-north-korea-missile-test-database/>.
- 59 Gunther’s Space Page; 29 January 2026; “Chronology of Space Launches”; <https://space.skyrocket.de/directories/chronology.htm>.
- 60 NK News; 22 November 2023; “North Korea Says It Successfully Placed Military Spy Satellite into Orbit”; pp. 1, 3; nknnews.org/2023/11/north-korea-says-it-successfully-placed-military-spy-satellite-into-orbit.
- 61 The New Arab; 11 March 2024; “Why Middle East space geopolitics are back in the spotlight”; newarab.com/analysis/why-middle-east-space-geopolitics-are-back-spotlight.
- 62 The Jerusalem Post; 5 March 2024; “Islamic Republic claims new satellite launch from Russia”; jpost.com/middle-east/iran-news/article-789588.
- 63 Sputnik Online; 1 January 2024; “Iran’s Khayyam Satellite Turns Nation into Remote Sensing Heavyweight”; sputnikglobe.com/20240102/irans-khayyam-satellite-turns-nation-into-remote-sensing-heavyweight-1115948426.html.
- 64 Center for Strategic and International Studies; April 2024; “Space Threat Assessment 2024”; csis.org/analysis/space-threat-assessment-2024.
- 65 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.
- 66 U.S. Space Command Public Affairs; 15 November 2021; “Russian direct-ascent anti-satellite missile test creates significant, long-lasting space debris”; spacecom.mil/news/article-display/article/2842957/russia-direct-ascent-anti-satellite-missile-creates-significant-long-last.
- 67 *Harvard National Security Journal*, Vol. 6; June 2015; “Rethinking Warfare: The Ambiguity of Cyber Attacks”; harvardnsj.org/wp-content/uploads/2015/06/Chayes.pdf.
- 68 Lawfare; 28 January 2024; “The United States Needs a New Way to Think about Cyber”; lawfaremedia.org/article/the-united-states-needs-a-new-way-to-think-about-cyber.
- 69 Joint Chiefs of Staff; February 2025; “DoD Dictionary of Military and Associated Terms”; p. 71.
- 70 War on the Rocks; 13 November 2023; “Is Military Space-Based Jamming Normal? Some Worry It Is”; warontherocks.com/2023/11/is-military-space-based-jamming-normal-some-worry-it-is.
- 71 ADS-B Exchange; “GPSJAM”; gpsjam.org.
- 72 Politico; 11 August 2023; “For the First Time, U.S. Government Lets Hackers into Satellite in Space”; politico.com/news/2023/08/11/def-con-hackers-space-force-00110919.

- 73 Comprehensive Nuclear Test Ban Treaty Organization; 5 November 2020; "9 July 1962: 'Starfish Prime,' Outer Space"; ctbto.org/specials/testing-times/9-july-1962starfish-prime-outer-space.
- 74 Department of Defense and Department of Energy; 1977; "The Effects of Nuclear Weapons"; pp. 479, 487, 522; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.
- 75 The State Council of the People's Republic Of China; 28 December 2016; "Full text of white paper on China's space activities in 2016"; english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm.
- 76 Center for Strategic and International Studies; April 2024; "Space Threat Assessment 2024"; csis.org/analysis/space-threat-assessment-2024.
- 77 State Council of the People's Republic of China; 28 January 2022; "Full Text: China's Space Program: A 2021 Perspective"; xinhuanet.com/english/20220128/eb9fb038ebfe4a3d93887b9f120ef74a/c.html.
- 78 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020"; pp. 63-65; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.
- 79 US-China Economic and Security Review Commission; 8 September 2017; "China's Position on a Code of Conduct in Space"; p. 2; uscc.gov/sites/default/files/Research/USCC_China's%20Position%20on%20a%20Code%20of%20Conduct%20in%20Space.pdf.
- 80 Carnegie Corporation; 16 October 2009; "A Place for One's Mat: China's Space Program, 1956-2003"; p. 15; media.carnegie.org/filer_public/34/26/34264093-10f5-4f7c-a02c-6611514f5ee7/ccny_grant-ee_2009_china.pdf.
- 81 The Diplomat; 15 October 2018; "Waking Up to China's Space Dream"; thediplomat.com/2018/10/waking-up-to-chinas-space-dream.
- 82 South China Morning Post; 18 July 2024; "China seeks space supremacy and to exploit it 'to our detriment': US intelligence head"; scmp.com/news/china/article/3270871/china-seeks-space-supremacy-and-exploit-it-our-detriment-us-intelligence-head.
- 83 State Council of the People's Republic of China; 28 January 2022; "Full Text: China's Space Program: A 2021 Perspective"; xinhuanet.com/english/20220128/eb9fb038ebfe4a3d93887b9f120ef74a/c.html.
- 84 NASA Spaceflight; 22 July 2020; "China seeks 'Heavenly Questions' with ambitious Tianwen-1 mission to Mars"; nasaspaceflight.com/2020/07/china-ambitious-tianwen1-mars.
- 85 Center for Strategic and International Studies; April 2024; "Space Threat Assessment 2024"; csis.org/analysis/space-threat-assessment-2024.
- 86 China Aerospace Studies Institute; 2 October 2020; "China's Space Narrative"; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 87 Center for Strategic and International Studies; April 2024; "Space Threat Assessment 2024"; csis.org/analysis/space-threat-assessment-2024.
- 88 Ministry of Foreign Affairs; 25 April 2025; "Foreign Ministry Spokesperson Guo Jiakun's Regular Press Conference on April 25, 2025"; mfa.gov.cn/eng/xw/fyrb/lxjzh/202504/t20250425_11604503.html.
- 89 People's Daily Online; 2 June 2025; "China's space exploration benefits the world"; en.people.cn/n3/2025/0425/c9000020307055.html.
- 90 Bryce Tech; 8 April 2026; "Global Orbital Space Launches 2025 Year in Review"; brycetek.com/reports/report-documents/global-orbital-activity-2025.
- 91 Bryce Space and Technology; 31 October 2020; "2020 Orbital Launches Year in Review"; brycetek.com/reports/report-documents/orbital_launches_year_in_review_2020.pdf.
- 92 Bryce Space and Technology; 30 May 2020; "China's Orbital Launch Activity"; brycetek.com/reports/report-documents/China_Orbital_Launch_Activity_2020.pdf.
- 93 Bryce Tech; 8 April 2026; "Global Orbital Space Launches 2025 Year in Review"; brycetek.com/reports/report-documents/global-orbital-activity-2025.
- 94 Space.com; 17 October 2025; "China launches internet satellites on 600th mission of Long March rocket (video)"; www.space.com/space-exploration/launches-spacecraft/china-launches-internet-satellites-on-600th-mission-of-long-march-rocket-video.
- 95 Gunther's Space Page; 14 September 2020; "Tiangong-1 (TG-1)"; space.skyrocket.eu/doc_sdat/tg-1.htm.
- 96 Space.com; 26 March 2018; "Tiangong-1: China's First Space Station"; space.com/27320-tiangong-1.html.
- 97 Gunther's Space Page; 14 September 2020; "Tiangong-2 (TG-2)"; space.skyrocket.eu/doc_sdat/tg-2.htm.
- 98 Space Flight Insider; 22 May 2016; "China reveals design for planned Tiangong 3 space station"; spaceflightinsider.com/missions/human-spaceflight/china-reveals-design-planned-tiangong-3-space-station.

- 99 NASA Spaceflight; 28 June 2021; “China launches Tianhe module, start of ambitious two-year station construction effort”; nasaspaceflight.com/2021/04/china-station-construction-begins.
- 100 18th Space Defense Squadron; Space-Track.org; “Catalog”; space-track.org/catalog.
- 101 Universe Today; 18 November 2024; “China’s Proposed Cargo Shuttle, the Haolong, Has Entered Development”; universetoday.com/articles/chinas-proposed-cargo-shuttle-the-haolong-has-entered-development.
- 102 The New York Times; 7 December 2018; “China’s Chang’e-4 Launches on Mission to the Moon’s Far Side”; nytimes.com/2018/12/07/science/china-moon-change-4.html.
- 103 BBC; 16 December 2020; “China’s Chang’e-5 Moon mission probe touches down”; bbc.com/news/science-environment-55148998.
- 104 NASA Spaceflight; 23 November 2020; “China launches world’s first lunar sample return mission since 1976”; nasaspaceflight.com/2020/11/change5-sample-return-launch.
- 105 NASA Spaceflight; 1 December 2020; “China lands on Moon after causing deep confusion by stopping broadcast”; nasaspaceflight.com/2020/12/china-preparing-to-land-sample-return-mission-on-the-moon.
- 106 Associated Press; 17 December 2020; “Chinese capsule returns to Earth carrying moon rocks”; apnews.com/article/technology-china-moon-da510a5fd9a97505296ddb5749c393.
- 107 BBC; 16 December 2020; “China’s Chang’e-5 Moon mission probe touches down”; bbc.com/news/science-environment-55148998.
- 108 Space Daily; 27 December 2024; “Chang’e-6 study highlights dynamic history of lunar magnetic field”; chinadaily.com.cn/a/202302/13/ws63e98abea31057c47ebae5a2_3.html.
- 109 NASA Spaceflight; 22 July 2020; “China seeks ‘Heavenly Questions’ with ambitious Tianwen-1 mission to Mars”; nasaspaceflight.com/2020/07/china-ambitious-tianwen1-mars.
- 110 NASA Spaceflight; 10 February 2021; “China, with Tianwen-1, begins tenure at Mars with successful orbital arrival”; nasaspaceflight.com/2021/02/china-ready-to-begin-mars-tenure-with-tianwen-1-orbit-insertion.
- 111 Space.com; 14 May 2021; “China’s 1st Mars rover ‘Zhurong’ lands on the Red Planet”; space.com/china-mars-rover-landing-success-tianwen-1-zhurong.
- 112 US-China Economic and Security Review Commission; 30 March 2020; “China’s Space and Counterspace Capabilities and Activities”; p. 28; uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf.
- 113 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.
- 114 Office of the Director of National Intelligence; 5 February 2024; “Annual Threat Assessment of the U.S. Intelligence Community”; dni.gov/index.php/newsroom/reports-publications/reports-publications-2024/3787-2024-annual-threat-assessment-of-the-u-s-intelligence-community.
- 115 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.
- 116 Office of the Director of National Intelligence; 6 February 2023; “Annual Threat Assessment of the U.S. Intelligence Community”; dni.gov/index.php/newsroom/reports-publications/reports-publications-2023/3676-2023-annual-threat-assessment-of-the-u-s-intelligence-community.
- 117 Office of the Director of National Intelligence; 5 February 2024; “Annual Threat Assessment of the U.S. Intelligence Community”; dni.gov/index.php/newsroom/reports-publications/reports-publications-2024/3787-2024-annual-threat-assessment-of-the-u-s-intelligence-community.
- 118 Office of the Secretary of Defense; 19 October 2023; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2023”; media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.
- 119 NPR; 10 April 2018; “Beijing Reportedly Installs Communications Jamming Equipment in South China Sea”; npr.org/sections/parallels/2018/03/02/589876233/the-u-s-positions-warships-intense-asia-pacific-waters.
- 120 Crunch Network; 21 September 2016; “Cybersecurity is threatening America’s military supremacy”; rntfnd.org/2016/09/26/china-jamming-us-forces-gps.
- 121 Foreign Languages Press Co., Ltd.; July 2019; “China’s National Defense in the New Era.”
- 122 Foreign Languages Press Co., Ltd.; July 2019; “China’s National Defense in the New Era.”
- 123 PLA National Defense University; September 2020; “The Science of Military Strategy (2020)”; pp. 86, 142; airuniversity.af.edu/CASI/Display/Article/2913216/in-their-own-words-2020-science-of-military-strategy/7.
- 124 Jiang, Lianju, and Wang Liwen, eds; 2013; *Lectures on the Study of Space Operations*; pp. 6, 86, 148, 183, 192, 218-219; airuniversity.af.edu/Portals/10/CASI/documents/Translations/2022-08-12%20Lectures%20on%20the%20Science%20of%20Space%20Operations.pdf.

- 125 People's Liberation Army (PLA) Daily; 05 January 2022; "Implementation of PLA Joint Operations Outline"; www.81.cn/jfjbmap/content/2022-01/05/node_9.htm.
- 126 Jiang, Lianju and Wang Liwen, eds; 2013; *Lectures on the Study of Space Operations*; pp. 86, 169; airuniversity.af.edu/Portals/10/CASI/documents/Translations/2022-08-12%20Lectures%20on%20the%20Science%20of%20Space%20Operations.pdf.
- 127 Jiang, Lianju and Wang Liwen, eds; 2013; *Lectures on the Study of Space Operations*; pp. 6-7, 192-193; airuniversity.af.edu/Portals/10/CASI/documents/Translations/2022-08-12%20Lectures%20on%20the%20Science%20of%20Space%20Operations.pdf.
- 128 Jiang, Lianju and Wang Liwen, eds; 2013; *Lectures on the Study of Space Operations*; pp. 59, 63, 182, 153-156, 213; airuniversity.af.edu/Portals/10/CASI/documents/Translations/2022-08-12%20Lectures%20on%20the%20Science%20of%20Space%20Operations.pdf.
- 129 RAND Corporation; 10 November 2017; "The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations"; pp. ix, 7; rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2058/RAND_RR2058.pdf.
- 130 Johns Hopkins School of Advanced International Studies Foreign Policy Institute; 26 October 2016; "Crisis Stability in Space: China and Other Challenges"; static1.squarespace.com/static/6463bfb83d77656c7431be0c/t/6536b8905351b7035cf34846/1698085009122/crisis_stability_in_space_china_and_other_challenges.pdf.
- 131 Office of Director of National Intelligence; 13 February 2018; "Statement for the record: worldwide threat assessment of the US Intelligence Community"; p. 13; dni.gov/files/documents/newsroom/testimonies/2018-ata---unclassified-ssci.pdf.
- 132 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China"; pp. 81-82; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.
- 133 Union of Concerned Scientists; 1 July 2009; "Anti-Satellite (ASAT) Technology in Chinese Open-Source Publications"; ucsa.org/sites/default/files/2019-09/Kulacki-Chinese-ASAT-Literature-6-10-09.pdf.
- 134 Academy of Equipment Command Technology; January 2005; "Military Astronautics"; pp. 247-266.
- 135 Office of the Director of National Intelligence; 13 February 2018; "Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community"; p. 13; dni.gov/files/documents/newsroom/testimonies/2018-ata---unclassified-ssci.pdf.
- 136 China Aerospace Studies Institute; 26 February 2024; "Coercive Space Activities – The View from PRC Sources"; p. iii; airuniversity.af.edu/CASI/Display/Article/3674437/coercive-space-activities-the-view-from-prc-sources.
- 137 China Aerospace Studies Institute; 26 February 2024; "Coercive Space Activities – The View from PRC Sources"; p. iii; airuniversity.af.edu/CASI/Display/Article/3674437/coercive-space-activities-the-view-from-prc-sources.
- 138 China Aerospace Studies Institute; 28 February 2024; "Coercive Space Activities – The View from PRC Sources"; p. viii; airuniversity.af.edu/CASI/Display/Article/3674437/coercive-space-activities-the-view-from-prc-sources.
- 139 National Bureau of Asian Research; 26 September 2023; "China's Military Decision-making in Times of Crisis and Conflict"; p. 44; nbr.org/wp-content/uploads/pdfs/publications/chinas-military-decision-making_sep2023.pdf.
- 140 US-China Economic and Security Review Commission; 2 March 2015; "China Dream, Space Dream – China's Progress in Space Technologies and Implications for the United States"; p. iv; uscc.gov/sites/default/files/Research/China%20Dream%20Space%20Dream_Report.pdf.
- 141 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2018"; pp. 72, 74; media.defense.gov/2018/Aug/16/2001955282/-1/-1/1/2018-CHINA-MILITARY-POWER-REPORT.PDF.
- 142 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020"; p. 65; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.
- 143 China Aerospace Studies Institute; 26 February 2024; "Coercive Space Activities – The View from PRC Sources"; pp. iii-v; airuniversity.af.edu/CASI/Display/Article/3674437/coercive-space-activities-the-view-from-prc-sources.
- 144 Jiang, Lianju, and Wang Liwen, eds.; 2013; *Lectures on the Study of Space Operations*; pp. 57-58; airuniversity.af.edu/Portals/10/CASI/documents/Translations/2022-08-12%20Lectures%20on%20the%20Science%20of%20Space%20Operations.pdf.
- 145 PLA National Defense University; September 2020; "The Science of Military Strategy (2020)"; p. 142; airuniversity.af.edu/CASI/Display/Article/2913216/in-their-own-words-2020-science-of-military-strategy/7.
- 146 Joint Force Quarterly, (1st Quarter 2011). "Chinese Views on Deterrence." No. 60; ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-60/jfq-60_92-94_Cheng.pdf.

- 147 Jiang, Lianju, and Wang Liwen, eds. 2013; *Lectures on the Study of Space Operations*.
- 148 Center for Naval Analyses; 16 February 2023. PRC Writings on Strategic Deterrence Technological Disruption and the Search for Strategic Stability"; cna.org/reports/2023/04/PRC-Writings-on-Strategic-Deterrence.pdf.
- 149 Center for Naval Analyses; 16 February 2023. PRC Writings on Strategic Deterrence Technological Disruption and the Search for Strategic Stability"; cna.org/reports/2023/04/PRC-Writings-on-Strategic-Deterrence.pdf.
- 150 China Aerospace Studies Institute; 25 July 2022; "Understanding China's Space Leading Small Groups - The Best Way to Determine the PLA's Influence"; airuniversity.af.edu/CASI/Display/Article/3093873/understanding-chinas-space-leading-small-groups-the-best-way-to-determine-the-pdf.
- 151 Li, Chengzhi, and Xiang Li Bingtao Ma; 2 May 2022; "The Decision-Making Process of China's Human Space-flight Program"; sciencedirect.com/science/article/abs/pii/S0265964622000182?via%3Dihub.
- 152 China Aerospace Studies Institute; 25 July 2022; "Understanding China's Space Leading Small Groups - The Best Way to Determine the PLA's Influence"; airuniversity.af.edu/CASI/Display/Article/3093873/understanding-chinas-space-leading-small-groups-the-best-way-to-determine-the-pdf.
- 153 China Aerospace Studies Institute; 25 July 2022; "Understanding China's Space Leading Small Groups - The Best Way to Determine the PLA's Influence"; airuniversity.af.edu/CASI/Display/Article/3093873/understanding-chinas-space-leading-small-groups-the-best-way-to-determine-the-pdf.
- 154 China Aerospace Studies Institute; 25 July 2022; "Understanding China's Space Leading Small Groups - The Best Way to Determine the PLA's Influence"; airuniversity.af.edu/CASI/Display/Article/3093873/understanding-chinas-space-leading-small-groups-the-best-way-to-determine-the-pdf.
- 155 Epoch Times; 20 April 2024; "The Split of The Chinese Communist Party's Strategic Support Force Is a Disguised Purge"; epoch-times.com/gb/24/4/19/n14229625.htm.
- 156 The Jamestown Foundation; 8 October 2019; "Military-Civil Fusion: Beijing's 'Guns AND Butter' Strategy to Become a Technological Superpower"; jamestown.org/program/military-civil-fusion-beijings-guns-and-butter-strategy-to-become-a-technological-superpower.
- 157 Global Times; 15 November 2013; "China to tackle monopolies, introduce competition: CPC"; globaltimes.cn/content/825209.shtml.
- 158 China Aerospace Studies Institute; 2 October 2022; "China's Space Narrative"; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 159 China Aerospace Studies Institute; 15 June 2020; "China's Military-Civil Fusion Strategy, A view from Chinese Strategists"; airuniversity.af.edu/Portals/10/CASI/documents/Research.
- 160 Xinhua; 27 June 2017; "National Intelligence Law of the People's Republic of China"; news.xinhuanet.com/politics/2017-06/28/c_1121222418.htm.
- 161 Office of the Secretary of Defense; 19 October 2024; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2024"; pp. 22-29; <https://media.defense.gov/2024/dec/18/2003615520/-1/-1/0/military-and-security-developments-involving-the-peoples-republic-of-china-2024.pdf>.
- 162 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020"; pp. viii, 61; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.
- 163 The Jamestown Foundation; 8 February 2016; "The Strategic Support Force: China's Information Warfare Service"; jamestown.org/program/the-strategic-support-force-chinas-information-warfare-service.
- 164 RAND Corporation; August 2017; "The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations"; p. ix; rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2058/RAND_RR2058.pdf.
- 165 Defense News; "Why China axed the Strategic Support Force and reshuffled the military"; 26 April 2024; defensenews.com/global/asia-pacific/2024/04/26/why-china-axed-the-strategic-support-force-and-reshuffled-the-military.
- 166 Office of the Secretary of Defense; 19 October 2023; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2023"; p. 41; media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.
- 167 Mitchell Institute; 21 March 2024; "China C4ISR and Counter-Intervention: Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China's Evolving Counter Intervention Capabilities and Implications for the U.S. and Indo-Pacific Allies and Partners"; mitchellaerospacepower.org/app/uploads/2024/03/03.21.24-pla-c4isr-uscc-testimony.pdf.
- 168 Epoch Times; 20 April 2024; "The Split of The Chinese Communist Party's Strategic Support Force Is a Disguised Purge"; epoch-times.com/gb/24/4/19/n14229625.htm.

- 169 Defense News; 26 April 2024; "Why China Axed the Strategic Support Force and reshuffled the military"; defense.news.com/global/asia-pacific/2024/04/26.
- 170 China Daily Online; 20 April 2024; "Xi: Crucial role for new PLA force"; global.chinadaily.com.cn/a/202404/20/WS66229544a31082fc043c2fa9.html.
- 171 Mitchell Institute; 21 March 2024; "China C4ISR and Counter-Intervention: Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China's Evolving Counter Intervention Capabilities and Implications for the U.S. and Indo-Pacific Allies and Partners"; mitchellaerospacepower.org/app/uploads/2024/03/03.21.24-pla-c4isr-uscc-testimony.pdf.
- 172 Epoch Times; 20 April 2024; "The Split of the Chinese Communist Party's Strategic Support Force Is a Disguised Purge"; epoch-times.com/gb/24/4/19/n14229625.htm.
- 173 The Financial Express, 22 April 2024. "Shifting Gears: The PLA's strategic calculus behind reorganising the strategic support force into information support force: ISF will integrate PLA's joint operation system, carry out Information support operations precisely and effectively, and facilitate"; financialexpress.com/business/defence-shifting-gears-the-plas-strategic-calculus-behind-reorganising-the-strategic-support-force-into-information-support-force-3463920.
- 174 Epoch Times; 20 April 2024; "The Split of the Chinese Communist Party's Strategic Support Force Is a Disguised Purge"; epoch-times.com/gb/24/4/19/n14229625.htm.
- 175 Global Times; 20 August 2023; "PLA's sudden, swift joint drills around Taiwan island highlighted by live munitions, multi-source intelligence support"; globaltimes.cn/page/202308/1296611.shtml.
- 176 GB Times; 25 May 2018; "China appoints new space agency administrator"; spacetechnasia.com/zhang-kejian-appointed-administrator-of-chinas-space-agency.
- 177 State Council of the People's Republic of China; 28 January 2022; "Full Text: China's Space Program: A 2021 Perspective"; xinhuanet.com/english/20220128/eb9fb038ebfe4a3d93887b9f120ef74a/c.html.
- 178 UNOOSA; 28 May 2018; "Handbook: China Space Station and its Resources for International Cooperation"; unoosa.org/documents/doc/psa/hsti/CSS_1stAO/CSS_1stAO_Handbook_2018.pdf.
- 179 Luxembourg Ministry of Economy; 17 January 2018; "The National Space Science Center of the Chinese Academy of Sciences to establish a Research Laboratory in Luxembourg"; gouvernement.lu/en/actualites/toutes_actualites/communiqués/2018/01-janvier/17-schneider-agreement-china-en.html.
- 180 China Aerospace Studies Institute; 25 July 2022; "Understanding China's Space Leading Small Groups - The Best Way to Determine the PLA's Influence"; airuniversity.af.edu/CASI/Display/Article/3093873/understanding-chinas-space-leading-small-groups-the-best-way-to-determine-the-p.
- 181 China Aerospace Studies Institute; 1 March 2021; "China's Ground Segment: Building the Pillar of a Great Space Power"; p. 62; airuniversity.af.edu/portals/10/casi/documents/research/space/2021-03-01_chinas_ground_segment.pdf.
- 182 Prague Security Studies Institute; 31 March 2019; "State Actor Strategies in Attracting Space Sector Partnerships: Chinese and Russian Economic and Financial Footprints"; p. 11.
- 183 Ministry of Foreign Affairs; 25 April 2025; "Foreign Ministry Spokesperson Guo Jiakun's Regular Press Conference on April 25, 2025"; mfa.gov.cn/eng/xw/fyrb/lxjzh/202504/t20250425_11604503.html.
- 184 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020"; p. 138; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.
- 185 China Aerospace Studies Institute; 15 June 2020; "China's Military - Civil Fusion Strategy, A view from Chinese Strategists"; airuniversity.af.edu/Portals/10/CASI/documents/Research.
- 186 Xinhua; 27 June 2017; "National Intelligence Law of the People's Republic of China", pp. 4, 6; news.xinhuanet.com/politics/2017-06/28/c_1121222418.htm.
- 187 Office of the Secretary of Defense; 19 October 2024; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2024"; pp. 22-29; media.defense.gov/2024/dec/18/2003615520/-1/-1/0/military-and-security-developments-involving-the-peoples-republic-of-china-2024.pdf.
- 188 Xinhua; 1 July 2015; "National Security Law of the People's Republic of China", pp. 23-24; chinadaily.com.cn/hqcj/zgj/2015-07-01/content_13912103.html.
- 189 OK-Space; 5 May 2017; "OK and CASC 1st Academy carry out cooperation and exchange"; ok-space.cn/article/index/id/93/cid/8.html.
- 190 China Spaceflight; 16 September 2017; "Orbita - China Spaceflight"; chinaspaceflight.com/bbs/viewtopic.php?f=3&t=55.
- 191 NASA Spaceflight; 8 November 2020; "Introducing China's new commercial rocket, Ceres-1"; nasaspaceflight.com/2020/11/introducing-chinas-new-commercial-rocket-ceres-1.

192 Expace Technology Co., Ltd.; 17 April 2018; “KZ Promotional Flier”; p. 1; expace.com.cn.

193 Weibo.com; 18 July 2024; “Kuaizhou-1A Rocket in the Rocket Industrial Park”; p. 1; weibo.com/5658451754/Oo9B2guiF?page-type=profilefeed&layerid=5057567643929725.

194 Space News; 2 February 2024; “Shanghai firm behind G60 megaconstellation raises \$943 million”; spacenews.com/shanghai-firm-behind-g60-megaconstellation-raises-943-million.

195 China Aerospace Studies Institute; 2 October 2022; “China’s Space Narrative”; p. 82; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.

196 Haiwai.com; 31 July 2023; “Chang Guang Satellite Leading Chinas Commercial Spaceflight”; news.haiwainet.cn/n/2023/0731/c3541093-32637099.html.

197 China Daily Online; 12 May 2024; “China Launches Long March 4C Rocket to Send New Satellite”; chinadaily.com.cn/a/202405/12/WS664025d0a31082fc043c69ee.html.

198 Jamestown; 8 October 2019; “Military-Civil Fusion and Electromagnetic Spectrum Management in the PLA.” China Brief; jamestown.org/program/military-civil-fusion-and-electromagnetic-spectrummanagement-in-the-pla.

199 China Aerospace Studies Institute; 2 October 2022; “China’s Space Narrative”; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.

200 China Aerospace Studies Institute; 15 June 2020; “China’s Military-Civil Fusion Strategy, A view from Chinese Strategists”; airuniversity.af.edu/Portals/10/CASI/documents/Research.

201 National Reform and Development Commission; 23 November 2016; Guiding Opinion on Accelerating the Construction and Application of the ‘Belt and Road’ Space Information Corridor”; ndrc.gov.cn/fzggw/jgsj/kfs/sjdt/201611/t20161123_1086163.html.

202 China Aerospace Studies Institute; 15 June 2020; “China’s Military -Civil Fusion Strategy, A view from Chinese Strategists”; airuniversity.af.edu/Portals/10/CASI/documents/Research.

203 Office of the Secretary of Defense; 19 October 2023; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2023”; p. 41; media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

204 Mitchell Institute; 21 March 2024; “China C4ISR and Counter-Intervention: Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China’s Evolving Counter Intervention Capabilities and Implications for the U.S. and Indo-Pa-

cific Allies and Partners”; mitchellaerospacepower.org/app/uploads/2024/03/03.21.24-pla-c4isr-uscc-testimony.pdf.

205 Epoch Times; 20 April 2024; “The Split of the Chinese Communist Party’s Strategic Support Force Is a Disguised Purge”; epoch-times.com/gb/24/4/19/n14229625.htm.

206 Mitchell Institute; 21 March 2024; “China C4ISR and Counter-Intervention: Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China’s Evolving Counter Intervention Capabilities and Implications for the U.S. and Indo-Pacific Allies and Partners”; mitchellaerospacepower.org/app/uploads/2024/03/03.21.24-pla-c4isr-uscc-testimony.pdf.

207 Epoch Times; 20 April 2024; “The Split Of The Chinese Communist Party’s Strategic Support Force Is A Disguised Purge”; epoch-times.com/gb/24/4/19/n14229625.htm.

208 Epoch Times; 20 April 2024; “The Split Of The Chinese Communist Party’s Strategic Support Force Is A Disguised Purge”; epoch-times.com/gb/24/4/19/n14229625.htm.

209 The Jamestown Foundation; 8 February 2016; “The Strategic Support Force: China’s Information Warfare Service”; jamestown.org/program/the-strategic-support-force-chinas-information-warfare-service.

210 RAND Corporation; 10 November 2017; “The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations”; p. ix; rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2058/RAND_RR2058.pdf.

211 Office of the Secretary of Defense; 19 October 2023; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2023”; p. 41; media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

212 Mitchell Institute; 21 March 2024; “China C4ISR and Counter-Intervention: Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China’s Evolving Counter Intervention Capabilities and Implications for the U.S. and Indo-Pacific Allies and Partners”; mitchellaerospacepower.org/app/uploads/2024/03/03.21.24-pla-c4isr-uscc-testimony.pdf.

213 Epoch Times; 20 April 2024; “The Split of The Chinese Communist Party’s Strategic Support Force Is a Disguised Purge”; epoch-times.com/gb/24/4/19/n14229625.htm.

214 Satellite Today; 28 May 2024; “China’s Push for a More Commercial Space Industry”; interactive.satellitetoday.com/via/june-2024/chinas-push-for-a-more-commercial-space-industry.

215 Space News; 12 January 2022; “China’s Megaconstellation Project Establishes Satellite Cluster in Chongqing”; spacenews.com.

com/chinas-megaconstellation-project-establishes-satellite-cluster-in-chongqing.

216 Satellite Today; 28 May 2024; “China’s Push for a More Commercial Space Industry”; interactive.satellitetoday.com/via/june-2024/chinas-push-for-a-more-commercial-space-industry.

217 Space News; 12 January 2022; “China’s Megaconstellation Project Establishes Satellite Cluster in Chongqing”; spacenews.com/chinas-megaconstellation-project-establishes-satellite-cluster-in-chongqing.

218 China Global Television Network; 17 December 2023; “Tech Breakthroughs Boost China Commercial Space Industry Development”; news.cgtn.com/news/2023-12-17/Tech-breakthroughs-boost-China-s-commercial-space-industry-development-1pBq9fEzPa/index.html.

219 Space News; 12 January 2022; “China’s Megaconstellation Project Establishes Satellite Cluster in Chongqing”; spacenews.com/chinas-megaconstellation-project-establishes-satellite-cluster-in-chongqing.

220 Satellite Today; 28 May 2024; “China’s Push for a More Commercial Space Industry”; interactive.satellitetoday.com/via/june-2024/chinas-push-for-a-more-commercial-space-industry.

221 Chinese National Space Administration (CNSA); 29 January 2022; “Full text of white paper on China’s space activities in 2021”; cnsa.gov.cn/english/n6465652/n6465653/c6813088.

222 SpaceNews; October 2024; “U.S. Faces Stiff Competition from China in Satellite Remote Sensing”; spacenews.com/u-s-faces-stiff-competition-from-china-in-satellite-remote-sensing/.

223 Center for Strategic and International Studies; October 2024; “Gold Rush: The 2024 Commercial Remote Sensing Global Rankings”; csis.org/analysis/gold-rush-2024-commercial-remote-sensing-global-rankings.

224 EuroConsult; 11 May 2021; “Chinese Space Sector Continues World-Leading Post-Covid Rebound: Euroconsult Quarterly Report”; euroconsult-ec.com/press-release/chinese-space-sector-continues-worldleading-post-covid-rebound-euroconsult-quarterly-report.

225 Space News; 19 April 2024; “China to Leverage Growing Commercial Space Sector to Launch Megaconstellations”; spacenews.com/China-to-Leverage-Growing-Commercial-Space-Sector-to-Launch-Megaconstellations.

226 Space News; 19 April 2024; “China to Leverage Growing Commercial Space Sector to Launch Megaconstellations”; spacenews.com/China-to-Leverage-Growing-Commercial-Space-Sector-to-Launch-Megaconstellations.

227 Xinhua; 13 March 2021; “The Fourteenth Five-Year Plan for National Economic and Social Development of the People’s Republic of China and Outline of the Vision for 2035”; gov.cn/xinwen/2021-03/13/content_5592681.htm.

228 Center for Strategic and International Studies; 2 February 2023; “Launching into the State of the Satellite Marketplace: Statement before the House Energy and Commerce Subcommittee on Communications and Technology”; csis.org/analysis/launching-state-satellite-marketplace.

229 The State Council of the People’s Republic of China; 29 January 2022; “Full text of white paper on China’s space activities in 2021”; cnsa.gov.cn/english/n6465652/n6465653/c6813088.

230 Center for Strategic and International Studies; 2 February 2023; “Launching into the State of the Satellite Marketplace: Statement before the House Energy and Commerce Subcommittee on Communications and Technology”; csis.org/analysis/launching-state-satellite-marketplace.

231 Satellite Today; 28 May 2024; “China’s Push for a More Commercial Space Industry”; interactive.satellitetoday.com/via/june-2024/chinas-push-for-a-more-commercial-space-industry.

232 National Institute for Defense Studies; 2021; “Japanese Defense Ministry’s Policy Research Institute Publishes ‘China Security Report 2021’”; p. 55; nids.mod.go.jp/publication/chinareport/pdf/chi-na_report_EN_web_2021_A01.pdf.

233 The Jamestown Foundation; 8 October 2019; “Military-Civil Fusion: Beijing’s ‘Guns AND Butter’ Strategy to Become a Technological Superpower”; p. 2; jamestown.org/program/military-civil-fusion-beijings-guns-and-butter-strategy-to-become-a-technological-superpower.

234 NPR; 22 August 2023; “U.S. restrictions on tech investment in China bolster China’s policy of self-reliance”; npr.org/2023/08/22/1195172661/u-s-restrictions-on-tech-investment-in-china-bolster-chinas-policy-of-self-reli.

235 The Jamestown Foundation; 8 October 2019; “Military-Civil Fusion: Beijing’s ‘Guns AND Butter’ Strategy to Become a Technological Superpower”; jamestown.org/program/military-civil-fusion-beijings-guns-and-butter-strategy-to-become-a-technological-superpower.

236 CE Noticias Financieras English; 11 May 2024; “Chinese espionage infiltrates across Europe and alarms its leaders”; es-us.noticias.yahoo.com/deportes/espionaje-chino-infiltra-europa-alarma-080000298.html.

237 Hannas, Mulvenon and Puglisi; 2013; *Chinese Industrial Espionage: Technology Acquisition and Military Modernization*; 1st Edition; pp. 19, 22–23, 33–34, 78, 176, 189, 204–205, 216.

- 238 China Aerospace Studies Institute; 22 July 2024 “PLA Aerospace Power: A Primer on Trends in China’s Military Air, Space, and Missile Forces”; 4th edition; pp. 112-121; airuniversity.af.edu/Portals/10/CASI/documents/Research/Other-Topics/2024-07-16%20Primer%204th%20ed.pdf.
- 239 China Aerospace Studies Institute; 2020; “China’s Military –Civil Fusion Strategy, A view from Chinese Strategists”; airuniversity.af.edu/Portals/10/CASI/documents/Research.
- 240 Max Zhang & Xiaonan Yang; 2023; “China’s emerging commercial space industry: Current developments, legislative challenges, and regulatory solutions”; *Acta Astronomica* 202 (2023) 9-16; doi: [org/10.1016/j.actaastro.2022.10.011](https://doi.org/10.1016/j.actaastro.2022.10.011).
- 241 Chinese Academy of Sciences; “Guide to CAS Institutes”; pp. 34-35; 117-118; 137-138; English.cas.cn/CASI/in/200909/P020091021600391195528.pdf
- 242 Embassy of the People’s Republic of China in Uganda; “The Belt and Road Initiative: A Key Pillar of the Global Community of Shared Future”; ug.china-embassy.gov.cn/eng/xwdt/202310/t20231010_11158960.htm.
- 243 China Aerospace Studies Institute; 2 October 2022; “China’s Space Narrative”; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 244 National Bureau of Asian Research; September 2019; “Securing the Belt and Road Initiative: China’s Evolving Military Engagement Along Silk Roads”; Special Report #80, pp. 1-5, 19-25; nbr.org/publication/securing-the-belt-and-road-initiative-chinas-evolving-military-engagement-along-the-silk-roads.
- 245 National Bureau of Asian Research; September 2019; “Securing the Belt and Road Initiative: China’s Evolving Military Engagement Along Silk Roads”; Special Report #80, pp. 1-5, 19-25; nbr.org/publication/securing-the-belt-and-road-initiative-chinas-evolving-military-engagement-along-the-silk-roads.
- 246 China Daily Online; 5 January 2024; “Satellite Launch Marks Beginning of China’s Space Plans For 2024”; Reference Kuaizhou-1A (KZ-1A), p. 1; chinadaily.com.cn/a/202401/05/WS65981a28a3105f21a507ad75.html.
- 247 WeChat; 25 April 2024; “Kuaizhou-6 Rocket, A New Type Of Reusable Liquid Oxygen-methane Rocket, Debuts”; p. 1; mp.weixin.qq.com/s?biz=MzA4NjQ0NzY3NA==&mid=2451120912&idx=6&sn=5845091fc8f3a12f82d733f36906b56b&ch.
- 248 Beijing Interstellar Glory Space Technology Co., Ltd; 16 May 2022; “Reusable Liquid Launch Vehicle - Hyperbola-2”; Hyperbola-2 (aka SQX-2) (developmental); i-space.com.cn/index.php?m=contentt&c=index&a=lists&catid=4.
- 249 WeChat; 7 June 2021; “Reusable Launch Vehicle Hyperbola-3 Successfully Passed the Program Demonstration and Transferred to the Review”; mp.weixin.qq.com/s/xPbMUwc_CfAXxm3syZW8rQ.
- 250 Xinhua; 24 February 2024; “China Focus: China Embraces, Anticipates a ‘Loong’ Year of Tech Achievements”; english.news.cn/20240224/51a0f0c4a35445388100fd45f981c75a/c.html.
- 251 CAS Space Website; 26 June 2023; “Successful inaugural Flight: Kinetica-1 Launch Vehicle”; en-cas-space.com/index/index/technology.
- 252 Bryce Tech; 8 April 2026; “Global Orbital Space Launches 2025 Year in Review”; brycetechnology.com/reports/report-documents/global-orbital-activity-2025.
- 253 Bryce Space and Technology; 24 June 2025, “Global Orbital Space Launches Q1 2025”; brycetechnology.com/reports/report-documents/bryce-briefing-2025-Q1.pdf.
- 254 Bryce Space and Technology; 15 June 2026, “Global Orbital Space Launches Q1 2026”; brycetechnology.com/reports/report-documents/bryce-briefing-2026-Q1/.
- 255 GlobalSecurity.org; 12 July 2022; “Chinese Space Launch Vehicles”; globalsecurity.org/space/world/china/launch-intro.htm.
- 256 Toutiao.com; 22 March 2020; “Launch Vehicle Modularization and Intelligence Development In Terms of Long March 7 Rocket”; toutiao.com/a6807016439338238468.
- 257 China Daily Online; 30 March 2022; “China Sends Long March-6A On Maiden Flight”; chinadaily.com.cn/a/202203/29/WS6242e86ba310fd2b29e53fd4.html.
- 258 China Academy of Launch Vehicle Technology (CALT); 21 October 2014; “The New Generation of Launch Vehicles in China”; liuqiankkt.blog.163.com/blog/static/121264211201492155621755.
- 259 GlobalSecurity.org; 12 July 2022; “Chinese Space Launch Vehicles”; globalsecurity.org/space/world/china/launch-intro.htm.
- 260 Space News; 5 July 2018; “China reveals details for super-heavy-lift Long March 9 and reusable Long March 8 rockets”; spacenews.com/china-reveals-details-for-super-heavy-lift-long-march-9-and-reusable-long-march-8-rockets.
- 261 China National Space Administration; 27 February 2024; “The name of the new aircraft for China’s manned lunar exploration mission has been official determined”; cnsa.gov.cn/n6758823/n6758823/c10476060/content.html.
- 262 Center for Strategic and International Studies; April 2024; “Space Threat Assessment 2024”; csis.org/analysis/space-threat-assessment-2024.

- 263 Space; 18 October 2024; "The Moon, Mars, Asteroids and Jupiter: China Reveals Ambitious Space Exploration Plans"; www.space.com/china-exploration-roadmap-moon-mars-asteroids-jupiter.
- 264 China Aerospace Studies Institute; May 2025; "The Real Space Race: China Will Send a Crew to Orbit Mars by 2050"; airuniversity.af.edu/casi/display/article/4164891/the-real-space-race-china-will-send-a-crew-to-orbit-mars-by-2050/.
- 265 Phys.org; 14 December 2023; "China's Space Program: Five things to know"; phys.org/news/2023-12-china-space.html.
- 266 Space News; 10 August 2023; "Chinese startup launches 7th Ceres-1 rocket, preps for first sea launch"; spacenews.com/chinese-startup-launches-7th-eres-1-rocket-preps-for-first-sea-launch.
- 267 China Daily Online; 5 September 2023; "China's Commercial Rocket Launches 4 Satellites from Sea"; chinadaily.com.cn/a/202309/05/WS64f7365aa310d2dce4bb412f.html.
- 268 Xinhua; 24 February 2024; "China Focus: China Embraces, Anticipates a 'Loong' Year of Tech Achievements"; english.news.cn/20240224/51a0f0c4a35445388100fd45f981c75a/c.html.
- 269 Gadget Technology; 16 January 2024; "The Chinese company Orienspace announced the launch of the most powerful solid-propellant rocket Gravity-1"; gadgettendency.com/the-chinese-company-orienspace-announced-the-launch-of-the-most-powerful-solid-propellant-rocket-gravity-1.
- 270 People's Daily Online; 15 March 2024; "China's commercial space industry embraces rapid growth"; en.people.cn/n3/2024/0315/c90000-20145682.html.
- 271 China Daily Online; 1 August 2019; "New Port Will Host Sea-Based Space Launches"; chinadaily.com.cn/a/201908/01/WS5d-4238f8a310d830564021f8.html.
- 272 Space News; 3 April 2023; "China's Space Pioneer reaches orbit with liquid propellant rocket"; spacenews.com/chinas-space-pioneer-reaches-orbit-with-liquid-propellant-rocket.
- 273 GlobalSecurity.org; "Chinese Space Launch Vehicles"; globalsecurity.org/space/world/china/launch-intro.htm.
- 274 US-China Economic and Security Review Commission; 17 November 2015; "2015 Report to Congress of the U.S.-China Economic and Security Review Commission"; uscc.gov/sites/default/files/annual_reports/2015%20Annual%20Report%20to%20Congress.PDF.
- 275 NASA Spaceflight; 9 January 2017; "Chinese Kuaizhou-1A rocket launches several small satellites"; nasaspaceflight.com/2017/01/chinese-kuaizhou-1a-launches-several-small-satellites.
- 276 Xinhua; 5 June 2020; "China Plans to Develop New Solid Fueled Carrier Rocket"; xinhuanet.com/english/2020-06/05/c_139116817.htm.
- 277 Jingchu; 7 December 2022; "Kuaizhou eleven flying! The rocket carrying factor is the world's leading, and Hubei's commercial aerospace has added a 'sharp weapon'"; news.cnhubei.com/content/2022-12/07/content_15299524.html.
- 278 The Science Times; 30 August 2022; "China Heads Toward the Reusable Rocket Trend Through its Long March 2D"; sciencetimes.com/articles/39622/20220830/china-heads-toward-reusable-rocket-trend-through-long-march-2d.htm.
- 279 China Aerospace Studies Institute; 2 October 2022; "China's Space Narrative"; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 280 China Academy of Space Technology; 7 March 2018; "Strong Space Power: 'Our journey is the Sea of Stars'"; cast.cn/3g/show.asp?m=1&d=6281.
- 281 China Daily Online; 30 August 2018; "CASC Clarifies Building a Strong Space Power with a Roadmap"; chinadaily.com.cn/interface/toutiaonew/53002523/2018-08-30/cd_36846561.html.
- 282 Xinhua; 19 October 2017; "Fu Yifei: China Became a Space Power in 2020, More than 200 Orbiting Spacecraft, Annual Launch 30 Times"; xinhuanet.com/politics/2017-10/19/c_1121823300.htm.
- 283 Xinhua; 27 June 2019; "CASC: To Strive to Push China to Forward Ranks of Strong Space Powers by 2030"; xinhuanet.com/science/2019-06/27/c_138177326.htm.
- 284 Popular Science; 19 July 2018; "China's super-sized space plans may involve help from Russia"; www.popsci.com/china-russia-space-rocket.
- 285 Space News; 19 April 2024; "China to Leverage Commercial Space Sector to Launch Megaconstellations"; spacenews.com/China-to-Leverage-Growing-Commercial-Space-Sector-to-Launch-Megaconstellations.
- 286 Space News; 22 December 2025; "Long March 12A reaches orbit in first reusable launch attempt, but landing fails"; spacenews.com/long-march-12a-reaches-orbit-in-first-reusable-launch-attempt-but-landing-fails/.
- 287 South China Morning Post; 17 September 2025; "China's Large Reusable Tianlong 3 Rocket Passes 1,000 Tonne Thrust 'Major Exam'"; www.scmp.com/news/china/science/article/3325747/chinas-large-reusable-tianlong-3-rocket-passes-1000-tonne-thrust-major-exam.

- 288 Wall Street Journal; 23 August 2024; "World News: Chinese Rocket Breakup Fans Debris Concerns"; [wsj.com/world/china/china-rocket-space-debris-5e02a603](https://www.wsj.com/world/china/china-rocket-space-debris-5e02a603).
- 289 18th Space Defense Squadron; Space-Track.org; "Catalog"; space-track.org/catalog.
- 290 Ministry of National Defense of the People's Republic of China; 27 August 2023; "Space-craft tracking ship Yuanwang-5 sets sail on new missions"; eng.mod.gov.cn/xb/News_213114/TopStories/4907368.html.
- 291 People's Daily Online; 28 November 2023; "Chinese space-tracking ship sets sail for new missions"; global.chinadaily.com.cn/a/202302/20/WS63f331a3a31057c47ebafc56.html.
- 292 CE Noticias Financieras English; 16 April 2025; "China's new 'sentinel of the sea' Liaowang-1 tracks rockets, ICBMs and military satellites in real time"; es-us.noticias.yahoo.com.
- 293 Sri Lanka Guardian; 10 May 2025; "China Launches the World's Largest Space Support Ship"; global.chinadaily.com.cn/a/202503/12/WS67d0ed13a310c240449da5aa.html.
- 294 China Aerospace Studies Institute; 1 March 2021; "China's Ground Segment: Building the Pillar of a Great Space Power"; pp. 66, 75, 79, 81; airuniversity.af.edu/portals/10/casi/documents/research/space/2021-03-01_chinas_ground_segment.pdf.
- 295 U.S. Geological Survey; "The Aerospace Information Research Institute (AIR)"; landsat.usgs.gov/snc.
- 296 China Aerospace Studies Institute; 1 March 2021; "China's Ground Segment: Building the Pillar of a Great Space Power"; p. 22; airuniversity.af.edu/portals/10/casi/documents/research/space/2021-03-01_chinas_ground_segment.pdf.
- 297 The Jamestown Foundation; 29 May 2019; "The People's Liberation Army Strategic Support Force: Update 2019"; jamestown.org/program/the-peoples-liberation-army-strategic-support-force-update-2019.
- 298 Dayoo; 17 December 2020; "Tianlian-2-01 Satellite Provides Data Relay Support for Chang'e Search and Rescue"; news.dayoo.com/gzrbrmt/202012/17/158562_53715168.htm.
- 299 China Aerospace Studies Institute; 2 October 2022; "China's Space Narrative "; p. 82; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 300 Gunther's Space Page; 23 May 2020; "Shenzhou Flight History"; space.skyrocket.eu/doc_sat/shenzhou_hist.htm.
- 301 Gunther's Space Page; 14 September 2020; "Shenzhou 1, 2, 3, 4, 5, 6, 7 (SZ 1, 2, 3, 4, 5, 6, 7)"; space.skyrocket.eu/doc_sdat/sz-1.htm.
- 302 Gunther's Space Page; 14 September 2020; "Shenzhou 8, 9, 10, 11, 12 (SZ 8, 9, 10, 11, 12)"; space.skyrocket.eu/doc_sdat/sz-8.htm.
- 303 Gunther's Space Page; 14 September 2020; "Tiangong-1 (TG-1)"; space.skyrocket.eu/doc-sdat/tg-1.htm.
- 304 Space.com; 26 March 2018; "Tiangong-1: China's First Space Station"; space.com/27320-tiangong-1.html.
- 305 Gunther's Space Page; 14 September 2020; "Tiangong-2 (TG-2)"; space.skyrocket.eu/doc-sdat/tg-2.htm.
- 306 Space.com; 29 February 2024; "China names the space-craft that will put its astronauts on the moon"; space.com/china-names-spacecraft-astronaut-moon-missions.
- 307 NASA Spaceflight; 28 June 2021; "China launches Tianhe module, start of ambitious two-year station construction effort"; nasa-spaceflight.com/2021/04/china-station-construction-begins.
- 308 China in Space; 8 May 2026; "Tianzhou-10 Cargo Spacecraft Rolls out Ahead of Tiangong Resupply"; china-in-space.com/p/tianzhou-10-cargo-spacecraft-rolls.
- 309 Space Daily; 12 December 2022; "China's new space station opens for business in an increasingly competitive era of space activity"; www.spacedaily.com/reports/Chinas_new_space_station_opens_for_business_in_an_increasingly_competitive_era_of_space_activity_999.html.
- 310 Space.com; 24 May 2026; "China just launched 3 astronauts to Tiangong Space Station. One will stay for a full year"; space.com/space-exploration/human-spaceflight/china-shenzhou-23-astronaut-launch-tiangong-space-station.
- 311 Space.com; 29 February 2024; "China names the space-craft that will put its astronauts on the moon"; space.com/china-names-spacecraft-astronaut-moon-missions.
- 312 China Daily Online; 8 May 2020; "Spacecraft re-entry Model Test Successful"; p. 1; chinadaily.com.cn/a/202005/09/WS5eb-4f803a310a8b2411543eb.html.
- 313 Capital News Online; 26 February 2024; "Chinese lunar lander and new crew spaceship names revealed"; p. 1; chinadaily.com.cn/a/202402/24/ws65d9506aa31082fc043b8df2.html.
- 314 State Council of the People's Republic of China; 28 January 2022; "Full Text: China's Space Program: A 2021 Perspective"; xinhuanet.com/english/20220128/eb9fb038ebfe4a3d93887b9f120ef74a/c.html.
- 315 Xinhua; 25 April 2018; "China Outlines Roadmap for Deep Space Exploration"; xinhuanet.com/english/2018-04/25/c_137136188.htm.

316 China Aerospace Studies Institute; 28 August 2023; “Trends That Impact Perceptions of the Chinese Space Program”; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2023-08-28%20Trends%20That%20Impact%20Perceptions%20of%20the%20Chinese%20Space%20Program.pdf.

317 Azerbaijan News Gazette; 10 October 2023; “China, Azerbaijan ink agreements on international lunar research station program”; azertag.az/en/xeber/china_azerbaijan_ink_agreements_on_international_lunar_research_station_program-2780881.

318 Azerbaijan News Gazette; 10 October 2023; “China, Azerbaijan ink agreements on international lunar research station program”; azertag.az/en/xeber/china_azerbaijan_ink_agreements_on_international_lunar_research_station_program-2780881.

319 France 24; 3 May 2024; “China launches probe to collect samples from far side of the moon”; france24.com/en/asia-pacific/20240503-china-launch-probe-space-collect-samples-far-side-moon.

320 Planetary Society; “Chang’e-4 and Yutu-2, China’s Mission to the Moon’s Far Side”; planetary.org/space-missions/change-4.

321 China Daily Online; 8 March 2016; “Exploiting Earth-Moon Space: China’s Ambition After Space Station”; chinadaily.com.cn/china/2016-03/08/content_23775949.htm.

322 China Daily Online; 6 May 2024; “Mission To Shed Light On Dark Side Of The Moon”; p. 1; chinadaily.com.cn/a/202405/06/WS66381ed7a31082fc043c550e.html.

323 SpaceChina.com; 20 March 2024; “China Aerospace Science and Technology Corporation (CASC): The Long March 8 carrier rocket successfully launched the Queqiao-2 relay satellite”; p. 1; cnsa.gov.cn/english/n6465652/n6465653/c10489434/content.html.

324 The New York Times; 7 December 2018; “China’s Chang’e-4 Launches on Mission to the Moon’s Far Side”; nytimes.com/2018/12/07/science/china-moon-change-4.html.

325 Spaceflight Now; 7 December 2018; “China launches historic mission to land on far side of the moon”; spaceflightnow.com/2018/12/07/china-launches-historic-mission-to-land-on-far-side-of-the-moon.

326 China Daily Online; 30 June 2024; “Xi Focus: Bearing China’s Lunar Exploration Endeavors In Mind”; chinadaily.com.cn/a/202406/30/ws66813b34a31095c51c50b86d.html.

327 Futurism.com; 8 October 2020; “China Names 18 More Crewmembers for its Upcoming Space Station”; futurism.com/the-byte/china-names-18-crewmembers-upcoming-space-station.

328 UN Office of Outer Space Affairs; 2018; “China Space Station and International Cooperation”; unoosa.org/documents/doc/psa/hsti/CSS_1stAO/CSS_1stAO_Handbook_2018.pdf.

329 Sputnik News; 8 August 2018; “China to launch space station Tiangong in 2022, welcomes foreign astronauts”; sputniknews.com/science/201808071067030662-china-to-launch-space-station-tiangong.

330 Space News; 29 April 2020; “Long March 5B rolled out for crewed spacecraft, space station test launch”; spacenews.com/long-march-5b-rolled-out-for-crewed-spacecraft-space-station-test-launch.

331 Space News; 11 September 2019; “China’s Space Station Core Module Passes Review but Faces Delays”; spacenews.com/chinese-space-station-core-module-passes-review-but-faces-delays.

332 Space News; 21 June 2019; “China’s Moon, Mars and Space Station Missions May be Facing Delays”; spacenews.com/chinas-moon-mars-and-space-station-missions-may-be-facing-delays.

333 Moon Daily Online; 1 July 2024; “China hauls back nearly 2 kilograms of lunar samples from Moon’s far side”; p. 1; moondaily.com/reports/china_hauls_back_nearly_2_kilograms_of_lunar_samples_from_s_far_side_999.html.

334 China Daily Online; 28 June 2024; “Nation To Launch Asteroid Probe Next Year.” p. 1; chinadaily.com.cn/a/202406/28/WS667da2bea31095c51c50b381.html.

335 China Daily Online; 25 November 2020; “Future Probes Already Mapped Out By Administration”; chinadaily.com.cn/a/202011/25/WS5fbdeec9a31024ad0ba965fa.html.

336 Scientific American; 24 August 2026; “China delays ambitious Chang’e 7 moon mission until 2027”; scientificamerican.com/article/china-delays-ambitious-change-7-moon-mission-until-2027/.

337 China Daily Online; 25 November 2020; “Future Probes Already Mapped Out by Administration”; chinadaily.com.cn/a/202011/25/WS5fbdeec9a31024ad0ba965fa.html.

338 China Daily Online; 3 October 2023; “China Invites Chang’e 8 Lunar Probe Mission Global Collaboration”; chinadaily.com.cn/a/202310/03/WS651b8919a310d2dce4bb8de5.html.

339 Chinese Lunar Exploration Program; 29 April 2024; spacecentre.co.uk/news/space-now-blog/chinese-lunar-exploration-program/.

340 China Daily Online; 27 June 2024; “Nation to Launch Asteroid Probe Next Year”; chinadaily.com.cn/a/202406/28/WS667da2bea31095c51c50b381.html.

- 341 China Daily Online; 27 June 2024; "Nation to Launch Asteroid Probe Next Year"; chinadaily.com.cn/a/202406/28/WS667da2be-a31095c51c50b381.html.
- 342 Xinhua; 25 April 2018; "China Outlines Roadmap for Deep Space Exploration"; xinhuanet.com/english/2018-04/25/c_137136188.htm.
- 343 Space News; 26 April 2021; "China, Russia open moon base project to international partners, early details emerge"; spacenews.com/china-russia-open-moon-base-project-to-international-partners-early-details-emerge.
- 344 Xinhua; 24 April 2023; "China Focus: China Advances Lunar Exploration Program"; english.news.cn/20230424/16bc29dc6bb94df-cad68acae75604731/c.html.
- 345 Harvey, Brian; 2013; "China in Space: The Great Leap Forward"; Springer Science & Business Media; pp. 105-119, 184-214.
- 346 The Economist; 7 March 2024; "China's Satellites are Improving Rapidly - The PLA Will Benefit"; economist.com/china/2024/03/07/chinas-satellites-are-improving.
- 347 U.S. Space Force; July 2026; "Space Threat Fact Sheet"; spaceforce.mil/About-Us/Fact-Sheets/Fact-Sheet-Display/Article/4297159/space-threat-fact-sheet/.
- 348 Dingsheng Military Forum; 8 October 2015; "Jilin-1 Satellite Lift-off into Space: US Aircraft Carrier has Nowhere to Hide"; dingsheng.com/portal.php?mod=view&aid=6852.
- 349 Sina (China Youth Network Reprint); 4 October 2015; "China's High Score 4 satellite will be able to lock down U.S. aircraft carriers by global surveillance at the end of the year"; mil.news.sina.com.cn/2015-10-04/0936840350.html.
- 350 Union of Concerned Scientists; 1 May 2023; "Satellite Database"; ucsusa.org/resources/satellite-database.
- 351 U.S. Department of Treasury; 24 October 2025; "Specially Designated Nationals List"; pp. 605, 606, 627, 628, 2371; treasury.gov/ofac/downloads/sdnlist.pdf
- 352 Space Daily; 21 May 2025; "China Places Six Satellites in Orbit with Latest Kinetic 1 Mission"; www.spacedaily.com/reports/China_places_six_satellites_in_orbit_with_latest_Kinetic_1_mission_999.html.
- 353 China Global Television Network (CGTN); 21 August 2023; "World's First High-Orbit Synthetic Aperture Radar Satellite Enters Operational Orbit"; news.cgtn.com/news/2023-08-21/World-s-first-high-orbit-SAR-satellite-enters-operational-orbit-1mrMskM6OVq/index.html.
- 354 Center for Strategic and International Studies; 19 January 2024; "No Place to Hide: A Look into China's Geosynchronous Surveillance Capabilities"; csis.org/analysis/no-place-hide-look-chinas-geosynchronous-surveillance-capabilities.
- 355 Baidu Baijiahao; 29 September 2023; "PLA Defense System Upgrade! China's Very Large Satellite Never Blinks, US Fleets Have Nowhere to Hide"; baijiahao.baidu.com/s?id=1776721048972857087&wfr=spider&for=pc.
- 356 The Economist; 7 March 2024; "China's Satellites are Improving Rapidly - The PLA Will Benefit"; economist.com/china/2024/03/07/chinas-satellites-are-improving.
- 357 US-China Economic and Security Review Commission; 30 March 2020; "China's Space and Counterspace Capabilities and Activities"; p. 33; uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf.
- 358 *Defense Science and Technology*, Vol. 29, No. 4; 2008; "An Analysis on the Influence of Military Satellite Information Systems on Missile Operations."
- 359 US-China Economic and Security Review Commission; 30 March 2020; "China's Space and Counterspace Capabilities and Activities"; p. 33; uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf.
- 360 US-China Economic and Security Review Commission; 30 March 2020; "China's Space and Counterspace Capabilities and Activities"; p. 28; uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf.
- 361 Moon Daily Online; 28 Apr 2008; "China Blasts Off First Data Relay Satellite"; moondaily.com/reports/China_Blasts_Off_First_Data_Relay_Satellite_999.html.
- 362 *Systems Engineering and Electronics*, Vol. 29, No. 6; 1 June 2007; "Modeling and Simulation of Missile Satellite-Missile Link Channel in Flying-Control Data-Link"; pp. 971-973.
- 363 *Chinese Journal of Space Science*; 1 May 2015; "Using Tracking and Data Relay Satellite for Low and Middle Earth Orbit Satellite Launch and On-orbit Control"; pp. 611-617.
- 364 China Aerospace Studies Institute; 22 July 2024; "PLA Aerospace Power: A Primer on Trends in China's Military Air, Space, and Missile Forces"; 4th edition, p. 53; airuniversity.af.edu/Portals/10/CASI/documents/Research/Other-Topics/2024-07-16%20Primer%204th%20ed.pdf.
- 365 Satellite Markets; 4 December 2020; "Constellation Watch: China's Incubating Answer to Starlink"; satellitemarkets.com/constellation-watch-china-incubating-answer-starlink.
- 366 China Daily Online; 7 Aug 2024; "First Batch of Satellites for Network Launched"; chinadaily.com.cn/a/202408/07/WS66b2c-3b6a3104e74fddb8ca4.html

- 367 Union of Concerned Scientists; 1 May 2023; "Satellite Database"; ucsusa.org/resources/satellite-database.
- 368 Chengdu University of Information Technology, 7 May 2021, "China Satellite Network Group Established"; rfic.cuit.edu.cn/info/2095/1173.htm.
- 369 New York Light Reading; 20 June 2024; "Chinese Telcos Tip Cash Into Satellite"; lightreading.com/satellite/chinese-telcos-tip-cash-into-satellite.
- 370 New York Light Reading; 7 August 2024; "China finally gets into the LEO satellite race"; lightreading.com/satellite/china-finally-gets-into-the-leo-satellite-race.
- 371 Space News; 2 February 2024; "Shanghai firm behind G60 mega-constellation raises \$943 million"; spacenews.com/shanghai-firm-behind-g60-megaconstellation-raises-943-million.
- 372 Center for Strategic and International Studies; 17 April 2024; "Space Threat Assessment 2024"; csis.org/analysis/space-threat-assessment-2024;
- 373 Nanfang Daily News, 17 December 2024, "Long March 5B and Yuan Zheng 2 take off"; epaper.nfnews.com/nfdaily/html/202412/17/content_10121461.html
- 374 South China Morning Post, 16 October 2024, "China Launches More Satellites For Starlink Rival G60 As It Races To Meet Target"; scmp.com/news/china/science/article/3282631/china-launches-more-satellites-starlink-rival-g60-it-races-meet-target.
- 375 Tasnim News Agency; 17 December 2024; "China Launches 10 Internet Satellites in First Step toward Guowang Constellation"; www.tasnimnews.com/en/news/2024/12/17/3221206/china-launches-10-internet-satellites-in-first-step-toward-guowang-constellation
- 376 The China Space Monitor; 14 May 2025; "The China Space Monitor: Review in Chinese Space: January to April"; www.tasnimnews.com/en/news/2024/12/17/3221206/china-launches-10-internet-satellites-in-first-step-toward-guowang-constellation
- 377 18th Space Defense Squadron; Space-Track.org; "Catalog"; space-track.org/catalog.
- 378 Science News; 13 December 2017; "A quantum communications satellite proved its potential in 2017"; sciencenews.org/article/global-quantum-communication-top-science-stories-2017-yir.
- 379 Gunther's Space Page; 14 September 2020; "QSS (QUESS, Mozi)"; space.skyrocket.eu/doc_sdat/qss.htm.
- 380 Space.com; 30 Oct 2023; "China plans to take 'hack-proof' quantum satellite technology to new heights"; space.com/china-quantum-communications-satellite-higher-orbit-plans.
- 381 Xinhua; 16 June 2017; "China's Quantum Satellite Establishes Photon Entanglement Over 1,200 Km"; xinhuanet.com/english/2017-06/16/c_136370705.htm.
- 382 Asia Times; 17 June 2020; "China claims quantum supremacy with satellite test"; asiatimes.com/2020/06/chinese-team-claim-quantum-supremacy-with-satellite-test.
- 383 US-China Economic and Security Review Commission; 30 March 2020; "China's Space and Counterspace Capabilities and Activities"; pp. 64-65; uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf
- 384 Nezavisimaya Gazeta Online; 13 December 2022; "High-tech flight of the Chinese dragon"; ng.ru/science/2022-12-13/9_9814_dragon.html.
- 385 Space.com; 30 October 2023; "China plans to take 'hack-proof' quantum satellite technology to new heights"; space.com/china-quantum-communications-satellite-higher-orbit-plans.
- 386 Technology Times; 2 May 2023; "China Launches First Science Popularization Exhibition Free for Public"; technologytimes.pk/2023/05/02/china-launches-first-science-popularization-exhibition-free-for-public.
- 387 Asia Times; 17 June 2020; "China claims quantum supremacy with satellite test"; asiatimes.com/2020/06/chinese-team-claim-quantum-supremacy-with-satellite-test.
- 388 US-China Economic and Security Review Commission; 30 March 2020; "China's Space and Counterspace Capabilities and Activities"; pp. 64-65; uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf.
- 389 Space News; 28 February 2020; "China to complete its answer to GPS with Beidou navigation satellite launches in March, May"; spacenews.com/china-to-complete-its-answer-to-gps-with-beidou-navigation-satellite-launches-in-march-may.
- 390 Xinhua; 30 June 2020; "Commentary: China's BeiDou system primed for serving whole world"; xinhuanet.com/politics/2020-06/30/c_1126179360.htm.
- 391 Space News; 8 April 2024; "America is losing its GPS dominance to China's BeiDou satnav"; spacenews.com/america-losing-gps-dominance-china-beidou-satnav.
- 392 International Committee of Global Navigation Satellite Systems (ICG); 16 October 2023; "Development of BeiDou Navigation Satellite System"; unoosa.org/documents/pdf/icg/2023/icg-17/icg17.01.03.pdf.
- 393 Xinhua; 27 December 2018; "China's BeiDou navigation system starts global service"; xinhuanet.com/english/2018-12/27/c_137702496.htm.

- 394 Space.com; 23 June 2020; "China launches final Beidou satellite to complete GPS-like navigation system"; space.com/china-launches-final-beidou-navigation-satellite.html?jwsourcel=cl.
- 395 Union of Concerned Scientists; 1 May 2023; "Satellite Database"; ucsusa.org/resources/satellite-database.
- 396 China Central Television; 28 August 2020; "China PLA 74th Group Army's Amphibious Brigade Holds Joint Land-Sea-Air Island Landing Drill."; cctvi.com.cn
- 397 *Journal of the Military Transportation University*, Vol. 21, No. 2; 1 February 2019; "Development of Carriers for Strategic Projection in Response to National Security Needs", pp. 9-13.
- 398 Navigation; 11 December 2018; "Introduction to BeiDou-3 navigation satellite system"; onlinelibrary.wiley.com/doi/abs/10.1002/navi.291.pdf.
- 399 Navigation; 3 January 2019; "Introduction to the special issue on the BeiDou navigation system."; onlinelibrary.wiley.com/doi/abs/10.1002/navi.293.pdf.
- 400 Navigation; 16 December 2018; "Overview of BDS III new signals"; onlinelibrary.wiley.com/doi/abs/10.1002/navi.296.pdf.
- 401 NASA Spaceflight; 22 June 2020; "China Launches final Beidou-3 with Long march 3B Return to Flight"; nasaspaceflight.com/2020/06/china-complete-beidou-constellation-long-march-3b.
- 402 International GNSS Service; 11 August 2020; "BeiDou"; mgex.igs.org/IGS_MGEX_Status_BDS.php.
- 403 BeiDou Navigation Systems Website; 19 March 2020; "China Successfully Launched the 54th BDS Satellite"; en.beidou.gov.cn/WHATNEWS/202004/t20200401_20279.html.
- 404 Space News; 28 February 2020; "China to complete its answer to GPS with Beidou navigation satellite launches in March, May"; spacenews.com/china-to-complete-its-answer-to-gps-with-beidou-navigation-satellite-launches-in-march-may.
- 405 China Aerospace Studies Institute; May 2024; "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-based PNT"; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20Beidou.pdf.
- 406 Xinhua; 26 May 2014; "Beidou to help safeguard fishermen on the high seas"; chinadaily.com.cn/china/2014-05/26/content_17539874.htm.
- 407 Beijing Review; 17 May 2012; "Beidou Navigation System Installed on More Chinese Fishing Boats"; bjreview.com/science/txt/2012-05/18/content_453628.htm.
- 408 BeiDou Navigation Systems Website; December 2019; "Development of the BeiDou Navigation Satellite System (Version 4.0)"; beidou.gov.cn/xt/gfxz/201912/P020191227430565455478.pdf.
- 409 China Aerospace Studies Institute; May 2024; "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-based PNT"; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20Beidou.pdf.
- 410 BeiDou Navigation Systems Website; December 2019; "Development of the BeiDou Navigation Satellite System (Version 4.0)"; beidou.gov.cn/xt/gfxz/201912/P020191227430565455478.pdf.
- 411 China Aerospace Studies Institute; May 2024; "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-based PNT"; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20Beidou.pdf.
- 412 The State Council of the People's Republic of China; 4 November 2022; "China's BeiDou Navigation Satellite System in the new Era"; english.www.gov.cn/archive/whitepaper/202211/04/content_ws-63647de9c6d0a757729e249d.html.
- 413 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020"; p. 64; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.
- 414 China Aerospace Studies Institute; May 2024; "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-based PNT"; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20Beidou.pdf.
- 415 China Aerospace Studies Institute; May 2024; "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-based PNT"; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20Beidou.pdf.
- 416 Space News; 8 April 2024; "America is losing its GPS dominance to China's BeiDou satnav"; spacenews.com/america-losing-gps-dominance-china-beidou-satnav.
- 417 China Aerospace Studies Institute; May 2024; "To Be More Precise: BeiDou, GPS, and the Emerging Competition in Satellite-based PNT"; airuniversity.af.edu/Portals/10/CASI/documents/Research/Space/2024-05-20%20To%20Be%20More%20Precise%20Beidou.pdf.
- 418 Proceedings from the American Astronautical Society (AAS) Conference; 4 August 2011; "Simulating Space Surveillance Networks"; pp. 8-9; agi.com/getmedia/8e3d8763-08c9-465d-a500-

cba8b1300050/Simulating-Space-Surveillance-Networks.pdf?ext=.pdf.

419 National Military Standard of the People's Republic of China; 25 May 2009; "GJB 6776-2009: Space Objects Orbits Cataloging Method."

420 Defense & Aerospace Week; 9 October 2024; "Investigation of Factors Affecting the Reflectance Spectra of Geo Satellites"; doi.org/10.1016/j.asr.2024.06.059

421 *Journal of Engineering*; 11 September 2023; Studies in the Area of Remote Sensing Reported from Chinese Academy of Sciences; doi.org/10.3390/rs17030465.

422 Defense & Aerospace Week; 29 December 2021; "Space Debris; New Data from Chinese Academy of Sciences Illuminate Research in Space Debris"; mdpi.com/2072-4292/13/23/4878.

423 Invest Chile Blog; 18 March 2019; "Astronomy: China to install megaproject in Chile"; blog.investchile.gob.cl/astronomy-china-to-install-megaproject-in-chile.

424 Xinhua; 30 December 2018; "China Focus: China's great changes seen through telescope"; xinhuanet.com/english/2018-12/30/c_137709176.htm

425 China Aerospace Studies Institute; 11 September 2023; "The PLA's New Base for Space Situational Awareness – Opportunities and Challenges for the U.S."; airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-09-11%20The%20PLA's%20New%20Base%20for%20SSA.pdf.

426 China Aerospace Studies Institute; 2022; "China's Space Situational Awareness Capabilities for Beyond GEO"; airuniversity.af.edu/CASI/Display/Article/3154886/chinas-space-situational-awareness-capabilities-for-beyond-geo.

427 Istanbul University Press; 10 October 2022; "Collaboration Potential and Possibilities with APSCO"; cdn.istanbul.edu.tr/file/JTA6CLJ8T5/C8158F63A0CE4FD280E614B362FC9389.

428 Asia-Pacific Space Cooperation Organization (APSCO); 2026; "What is APSCO?"; apSCO.int.

429 Ozeren, Ferhat Fikri; 10 October 2022; "Collaboration Potential and Possibilities with APSCO"; Istanbul University Press; cdn.istanbul.edu.tr/file/JTA6CLJ8T5/C8158F63A0CE4FD280E614B-362FC9389.

430 APSCO; 2024; "APSCO Highlights 2023, Part I"; apSCO.int/upload/file/20240307/20240307164407337.pdf.

431 APSCO; 2024; "APSCO Highlights 2023, Part II"; apSCO.int/upload/file/20240307/202403071644047337.pdf.

432 APSCO; 2023; "APSCO Highlights 2022"; apSCO.int/upload/file/20230313/2023031316105317071.pdf.

433 APSCO; 2024; "Asia-Pacific Space Cooperation Organization Brochure"; p. 5; apSCO.int/html/comp1/category/Apscobrochure/20-1.shtml.

434 China National Space Administration; 15 November 2018; "China to Enhance Space Science, Technology Sharing in Asia-Pacific"; CNSA.gov.cn/english/n6465652/n6465653/c6804017/content.html.

435 APSCO; 1 March 2019; "Ground-Based Space Object Observation Network"; apSCO.int/html/comp1/content/APOSOS/2019-03-01/59-261-1.shtml.

436 APSCO; 5 July 2018; "The Final Acceptance Review Meeting and Training on APOSOS Project Phase I"; apSCO.int/html/comp1/content/News-Highlights/2018-07-05/54-182-1.shtml.

437 APSCO; 18 October 2021; "APSCO's Contribution to the Long Term Sustainable Development in Outer Space."

438 Mehr News Online; 14 April 2019; "Iran participates in Asia-Pacific Space Observatories project"; en.mehrnews.com/news/144099/Iran-participate-in-Asia-Pacific-Space-Observatories-project.

439 APSCO; "Ground-Based Space Object Observation Network"; apSCO.int/html/comp1/content/APOSOS/2019-03-01/59-261-1.shtml.

440 Center for Strategic and International Studies; 21 May 2024; "Space, Speed, and Sovereignty: Hypersonic Tensions in the Southern Hemisphere"; p1-7; csis.org/analysis/space-speed-and-sovereignty-hypersonic-tension-southern-hemisphere.

441 Center for Strategic and International Studies; 21 May 2024; "Space, Speed, and Sovereignty: Hypersonic Tensions in the Southern Hemisphere"; p1-7; csis.org/analysis/space-speed-and-sovereignty-hypersonic-tension-southern-hemisphere.

442 China Aerospace Studies Institute; 1 March 2021; "China's Ground Segment: Building the Pillar of a Great Space Power"; pp. 75, 79-81; airuniversity.af.edu/portals/10/casi/documents/research/space/2021-03-01/chinas-ground-segment.pdf.

443 People's Daily Online; 28 June 2025; "Qinling Station in Antarctica starts operation"; global.chinadaily.com.cn/a/202302/20/WS63f331a3a31057c47ebafc56.html.

444 China Aerospace Studies Institute; 1 March 2021; "China's Ground Segment: Building the Pillar of a Great Space Power"; pp. 75, 79, 81; airuniversity.af.edu/portals/10/casi/documents/research/space/2021-03-01/chinas-ground-segment.pdf.

445 Australian Strategic Policy Institute; August 2017; "China's Expanding Antarctic Interests: Implications for Australia"; p. 15;

ad-aspi.s3.ap-southeast-2.amazonaws.com/2017-08/SR109%20Chinas%20expanding%20interests%20in%20Antarctica.pdf.

446 ABC News; 18 August 2024; “China has expanded its presence in Antarctica with its new Qinling base. Should Australia be worried?”; abc.net.au/news/2024-08-18/antarctica-china-qinling-stations-australia-is-concerned/104220114.

447 Office of the Secretary of Defense; 1 September 2020; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2020”; pp. 73, 83–84; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

448 China Aerospace Studies Institute; 1 December 2023; “PLA Counterspace Command and Control”; airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-12-11%20Counterspace-%20web%20version.pdf.

449 War on the Rocks; 13 November 2023; “Is Military Space-Based Jamming Normal? Some Worry It Is”; warontherocks.com/2023/11/is-military-space-based-jamming-normal-some-worry-it-is.

450 Office of the Secretary of Defense; 1 September 2020; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2020”; pp. 82–83; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

451 China Aerospace Studies Institute; 1 December 2023; “PLA Counterspace Command and Control”; airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-12-11%20Counterspace-%20web%20version.pdf.

452 South China Morning Post; 6 February 2024; “Nowhere to hide: Chinese scientists develop game-changing military surveillance device for electronic warfare”; scmp.com/news/china/science/article/3250752/nowhere-hide-chinese-scientists-develop-game-changing-military-surveillance-device-electronic.

453 Jane’s Defence Weekly; 7 May 2024; “Chinese manufacturer showcases aperture radar jammer”; janes.com/osint-insight/defence-news/c4isr/dsa-2024-chinese-showcases-aperture-radar-jammer.

454 *Aerospace Electronic Warfare*, Vol. 26, No. 3; March 2010; “Study on Countermeasure against Satellite Adaptive Null-Steering Technique”; pp. 1–4.

455 *Radio Communications Technology*, Vol. 35, No. 2; 2009; “Analysis on Anti-jamming Measures of Mobile User Objective System”; pp. 46–49.

456 Center for Strategic and International Studies; 2 March 2021; “Defense Against the Dark Arts in Space, Protecting Space Systems from Counterspace Weapons”; aerospace.csis.org/wp-content/

uploads/2021/03/032321_HarrisonJohnsonYoung_DefenseAgainst-DarkArtsInSpace_Report_Update-compressed.pdf.

457 ABC News; 18 August 2024; “China has expanded its presence in Antarctica with its new Qinling base. Should Australia be worried?”; abc.net.au/news/2024-08-18/antarctica-china-qinling-stations-australia-is-concerned/104220114

458 Office of the Secretary of Defense; 1 September 2020; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2020”; pp. 82–83; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

459 Office of the Director of National Intelligence; 13 February 2018; “Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community”; p. 13; dni.gov/files/documents/newsroom/testimonies/2018-ata---unclassified-ssci.pdf.

460 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; pp. I-8 to I-9.

461 PLA National Defense University; September 2020; “The Science of Military Strategy (2020)”; pp. 151–152; airuniversity.af.edu/CASI/Display/Article/2913216/in-their-own-words-2020-science-of-military-strategy/7.

462 China Aerospace Studies Institute; 26 February 2024; “Coercive Space Activities – The View from PRC Sources”; p. 14; airuniversity.af.edu/CASI/Display/Article/3674437/coercive-space-activities-the-view-from-prc-sources.

463 CrowdStrike Global Intelligence Team; 9 June 2014; “CrowdStrike Intelligence Report: PUTTER PANDA”; cdn0.vox-cdn.com/assets/4589853/crowdstrike-intelligence-report-putter-panda.original.pdf.

464 Office of the Secretary of Defense; 16 May 2018; “Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China”; pp. 53, 88; media.defense.gov/2018/Aug/16/2001955282/-1/-1/1/2018-CHINA-MILITARY-POWER-REPORT.PDF.

465 Academy of Equipment Command Technology; January 2005; “Military Astronautics”; pp. 290–291.

466 South China Morning Post; 11 August 2023; “Chinese military scientists claim to have achieved a ‘huge breakthrough’ on laser weapon technology”; scmp.com/news/china/science/article/3230589/chinese-military-scientists-claim-have-achieved-huge-breakthrough-laser-weapon-technology.

467 South China Morning Post; 7 January 2022; “The powerful Chinese megawatt laser ‘small enough for a satellite’”; scmp.com/news/

china/science/article/3162566/chinese-megawatt-laser-powerful-small-enough-be-used-satellite.

468 Office of Director of National Intelligence; 11 December 2020; "Support to U.S. Space Command Messaging"

469 Secure World Foundation; 1 July 2023; "Chinese Direct Ascent Anti-Satellite Testing"; swfound.org/media/207604/fs23-01_chinese-da-asat-testing_0723.pdf.

470 53rd Institute of Electronic Research; 1 April 2002; "Ground High Power Laser Anti-Satellite Reconnaissance Technology"; pp. 9-12.

471 *Laser & Infrared*, Vol. 40 No. 2; February 2010; "Efficiency research of laser jamming photoelectric detector in early-warning satellite of infrared system based on the sky"; pp.1-4.

472 *Optical Technique*, Vo. 28, No. 1; January 2002; "Evaluation of high energy laser effecting on remote distance photoelectron sensor system"; pp. 28-35.

473 Office of the Director of National Intelligence; 13 February 2018; "Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community"; p. 13; dni.gov/files/documents/newsroom/testimonies/2018-ata---unclassified-ssci.pdf.

474 Cai Yi (LeBac Consulting); 25 September 2009; "Analysis of the PLA's strategic deterrence and strike capabilities."

475 War on the Rocks; 13 November 2023; "Is Military Space-Based Jamming Normal? Some Worry It Is"; warontherocks.com/2023/11/is-military-space-based-jamming-normal-some-worry-it-is.

476 *Spacecraft Environment Engineering*, Vol. 35, No. 3; June 2018; "Simulation of space debris de-orbiting by space-based laser ablation"; pp. 217-222.

477 *High Power Laser and Particle Beams*, Vol. 34, No.1, January 2022; "Removal of space debris by pulsed laser: Overview and future perspective"; pp. 1-15.

478 *Infrared and Laser Engineering*, Vol 52, No. 4; April 2023; "On-orbit application research and imaging simulation analysis of GSSAP satellites"; pp. 1-11.

479 China Aerospace Studies Institute; 1 December 2023; "PLA Counterspace Command and Control"; airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-12-11%20Counterspace-%20web%20version.pdf.

480 China Aerospace Studies Institute; 1 December 2023; "PLA Counterspace Command and Control"; airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-12-11%20Counterspace-%20web%20version.pdf.

481 Joint Chiefs of Staff; 26 October 2020; "Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)"; p. 1-13.

482 18th Space Control Squadron; "Box Score"; space-track.org/boxscore.

483 Office of the Secretary of Defense; April 2015; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015"; p. 14; dod.defense.gov/Portals/1/Documents/pubs/2015_China_Military_Power_Report.pdf.

484 Office of the Secretary of Defense; 1 September 2020; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2020"; p. 65; media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

485 China Aerospace Studies Institute; 1 December 2023; "PLA Counterspace Command and Control"; airuniversity.af.edu/Portals/10/CASI/documents/Research/PLASSF/2023-12-11%20Counterspace-%20web%20version.pdf.

486 C4ISRNET; 14 September 2024; "US seizes initiative on space security for the first time in decades"; c4isrnet.com/opinion/2023/09/14/us-seizes-initiative-on-space-security-for-the-first-time-in-decades.

487 Office of the Director of National Intelligence; 6 February 2023; "Worldwide Threat Assessment of the US Intelligence Community 2023"; p. 8; dni.gov/files/ODNI/documents/assessments/ATA-2023-Unclassified-Report.pdf.

488 Space News; 24 October 2021; "China launches classified space debris mitigation technology satellite"; spacenews.com/china-launches-classified-space-debris-mitigation-technology-satellite.

489 *Advances in Mechanical Engineering*, Vol. 10, No. 4; 8 February 2018; "Whole-body Compliance for Multi-Arm Space Robotic Capturing of Large Tumbling Target in Connection Compliant Phase"; pp. 1-19.

490 69th International Astronautical Congress; 1 October 2018; "Mission Planning and Simulation System Study on Active Debris Removal with Space-based Laser System"; iafastro.directory/iac/archive/browse/IAC-18/A6/IP/45136/.

491 Office of Director of National Intelligence; 11 December 2020; "Support to U.S. Space Command Messaging."

492 Space News; 27 January 2022; "China's Shijian-21 Towed Dead Satellite to a High Graveyard Orbit"; spacenews.com/chinas-shijian-21-spacecraft-docked-with-and-towed-a-dead-satellite.

- 493 China Daily Online; 7 January 2025; "China Launches First Space Mission in 2025"; global.chinadaily.com.cn/a/202503/12/WS67d0e-d13a310c240449da5aa.html
- 494 Space.com; 3 March 2023; "A Chinese spacecraft has been checking out US satellites high above Earth"; space.com/chinese-spacecraft-tjs-3-inspecting-us-satellites.
- 495 Space News; 6 November 2023; "China launches mystery satellite on Long March 7A rocket (photo)"; space.com/china-tjs-10-mystery-satellite-launch.
- 496 China Daily Online; 23 February 2024 "China launches new communication technology experiment satellite"; global.chinadaily.com.cn/a/202402/23/WS65d89f02a31082fc043b8d38.html.
- 497 Space.com; 6 November 2023; "China launches mystery satellite on Long March 7A rocket (photo)"; space.com/china-tjs-10-mystery-satellite-launch.
- 498 Wall Street Journal; 28 March 2023; "Pentagon Prepares for Space Warfare as Potential Threats From China, Russia Grow"; [wsj.com/world/pentagon-prepares-for-space-warfare-as-potential-threats-from-china-russia-grow-62a0623b](https://www.wsj.com/world/pentagon-prepares-for-space-warfare-as-potential-threats-from-china-russia-grow-62a0623b).
- 499 18th Space Control Squadron; "SATCAT, TJS"; space-track.org.
- 500 National University of Defense Technology; 1 November 2006; "Conceptual Research on Space to Ground Release Technologies for Spacecrafts."
- 501 *Control Technology and Tactical Missile*, Vol. 50, No. 3; 1 September 2005; "A Hybrid Reentry Guidance Method for Space-Based Ground Attack Weapon System"; pp. 30-33.
- 502 *Journal of Solid Rocket Technology*; 25 March 2008; "A Terminal Guidance Law Applied to Space-to-Surface Precision Attack Weapons"; pp. 11-14.
- 503 *Aerospace Control*, Vol. 27, No. 4; 1 August 2009; "Application of Pseudo-Spectral Method in Rapid Orbit Optimization for Space-To-Ground Kinetic Weapons"; pp. 3-7.
- 504 *Journal of System Simulation*, Vol. 21, No. 14; July 2009; "Simulation Research on Attacking Process of a Kind of Space-based Strike Weapon to Fixed Target on Ground"; pp. 4497-4500.
- 505 *Journal of Tactical Missile Technology*; 1 January 2017; "Research on Attack Mode of Space-to-ground Kinetic Weapon"; pp. 93-97.
- 506 Office of the Secretary of Defense; 19 October 2023; "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2023"; media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.
- 507 South China Morning Post; 20 October 2022; "Chinese Physicists Simulate Nuclear Blast against Satellites"; scmp.com/news/china/science/article/3196629/chinese-physicists-simulate-nuclear-blast-against-satellites.
- 508 South China Morning Post; 20 October 2022; "Chinese Physicists Simulate Nuclear Blast against Satellites"; scmp.com/news/china/science/article/3196629/chinese-physicists-simulate-nuclear-blast-against-satellites.
- 509 Chinese Ministry of Foreign Affairs; 16 May 2024; "Joint Statement of the People's Republic of China and the Russian Federation on Deepening the Comprehensive Strategic Partnership of Coordination in the New Era on the Occasion of the 75th Anniversary of the Establishment of Diplomatic Relations between the Two Countries (Full Text)"; fmprc.gov.cn/web/zqzxw/202405/t20240516_11305860.shtml.
- 510 United Nations General Assembly (UNGA); 15 July 2024; "Report of the Committee on the Peaceful Uses of Outer Space"; unoosa.org/res/oosadoc/data/documents/2024/a/a7920_0_html/A_79_020E.pdf.
- 511 Committee on the Peaceful Uses of Outer Space (CUPU-OS); 17 April 2024; "Compendium on mechanisms adopted in relation to non-legally binding United Nations instruments on outer space"; unoosa.org/res/oosadoc/data/documents/2024/aac_105c_22024crp/aac_105c_22024crp_6_0_html/AC105_C2_2024_CRP06E.pdf.
- 512 Russian Federation & China; 29 February 2008; "Letter dated 2008/02/12 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the 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"; digitallibrary.un.org/record/633470?ln=en&v=pdf.
- 513 United Nations General Assembly; 10 November 2023; "Prevention of an arms race in outer space: report of the 1st Committee: General Assembly, 78th session"; digitallibrary.un.org/record/4028236?ln=en&v=pdf.
- 514 U.S. Department of Defense; 2022; Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2022.
- 515 Vesti Online; 27 June 2020; "Roscosmos Named Crew Dragon's Weaknesses"; vesti.ru/article/2425350.
- 516 Lenta; 9 January 2021; "A Leap Forward in Space"; lenta.ru/articles/2021/01/09/space2021.

- 517 Le Monde Online; 24 May 2024; "Russia is challenging the dominance of the United States in space"; [lemonde.fr/en/international/article/2024/05/26/russia-challenges-the-us-dominance-in-space_6672674_4.html](https://www.lemonde.fr/en/international/article/2024/05/26/russia-challenges-the-us-dominance-in-space_6672674_4.html).
- 518 Ars Technica; 4 October 2023; "Russia Talks A Big Future In Space While Its Overall Budget Is Quietly Cut"; arstechnica.com/space/2023/10/russia-talks-a-big-future-in-space-while-its-overall-budget-is-quietly-cut.
- 519 Space News; 4 October 2017; "60 years after Sputnik, Russia is lost in space"; spacenews.com/60-years-after-sputnik-russia-is-lost-in-space.
- 520 Interfax; 28 November 2019; "Illegal enrichment schemes existed in Roscosmos enterprise for decades – Head of State Corporation's Internal Audit Service"; interfax.ru/685982.
- 521 Jamestown Foundation; 22 June 2021; "Roscosmos Suffers From Russia's Confrontation With the US"; jamestown.org/program/ros-cosmos-suffers-from-russias-confrontation-with-the-us.
- 522 Broadband TV News Online; 29 August 2014; "Sanctions hit Russian satellite industry"; broadbandtvnews.com/2014/08/29/sanctions-hit-ru.
- 523 Space Daily; 28 September 2016; "Import Substitution: Glonass Satellites to Switch to Russian Electronics"; spacedaily.com/reports/import_substitution_glonass_satellites_to_switch_to_russian_electronics_999.html.
- 524 Foreign Policy Research Institute (FPRI); 22 July 2024; "Russia's Space Program After 2024"; p. 7; fpri.org/wp-content/uploads/2024/07/final-russias-space-program-after-2024.pdf.
- 525 Reuters; 3 March 2022; "Russia halts deliveries of rocket engines to the U.S."; reuters.com/world/russia-halts-deliveries-rocket-engines-us-2022-03-03.
- 526 Russian Space Web; 10 February 2022; "Soyuz launches the 12th OneWeb cluster"; russianspaceweb.com/oneweb12.html.
- 527 Les Echos; 3 March 2022; "Satellites the OneWeb Constellation Paralyzed by Tensions with Moscow"; lesechos.fr/industrie-services/air-defense/satellites-la-constellation-oneweb-paralysee-parles-tensions-avec-moscou-1391118.
- 528 War on the Rocks; 10 June 2022; "Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War"; warontherocks.com/22/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war.
- 529 Interfax; 24 January 2023; "Roscosmos head: China supplying electronic components to Russian space sector"; interfax.com/newsroom/top-stories/87214.
- 530 Russian Space Web; 10 February 2022; "Soyuz launches the 12th OneWeb cluster"; russianspaceweb.com/oneweb12.html.
- 531 Les Echos; 3 March 2022; "Satellites the OneWeb Constellation Paralyzed by Tensions with Moscow"; lesechos.fr/industrie-services/air-defense/satellites-la-constellation-oneweb-paralysee-parles-tensions-avec-moscou-1391118.
- 532 War on the Rocks; 10 June 2022; "Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War"; warontherocks.com/22/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war.
- 533 Orr, Matthew; 2 March 2026; "The Myth of Russian Decline"; foreignanalysis.com/the-myth-of-russian-decline/.
- 534 The New Zealand Herald; 22 August 2023; "Failed lunar mission dents Russian pride and reflects deeper problems with Moscow's space industry"; nzherald.co.nz/world/failed-lunar-mission-dents-russian-pride-and-reflects-deeper-problems-with-moscows-space-industry/4IITFQ5VDFBZK64P-W4T-2JLGJ4.
- 535 Riga Novaya Gazeta; 30 January 2024; "Hundreds of scientists fled Russia after invasion of Ukraine"; novayagazeta.eu/articles/2024/01/30/haemorrhaging-brains-en.
- 536 Interfax; 24 January 2023; "Roscosmos head: China supplying electronic components to Russian space sector"; interfax.com/newsroom/top-stories/87214.
- 537 U.S. Department of Treasury; 26 January 2023; "Treasury Sanctions Russian Proxy Wagner Group as a Transnational Criminal Organization"; home.treasury.gov/news/press-releases/jy1220.
- 538 U.S. Department of State; 12 April 2023; "Further Curbing Russia's Efforts to Evade Sanctions and Perpetuate Its War Against Ukraine"; 2021-2025.state.gov/further-curbing-russias-efforts-to-evade-sanctions-and-perpetuate-its-war-against-ukraine.
- 539 Russian Military Blog; 26 December 2014; "Military Doctrine of the Russian Federation, approved by Russian Federation President V. Putin"; rusmilsec.blog/wp-content/uploads/2021/08/mildoc_rf_2014_eng.pdf.
- 540 Moskovskiy Komsomolets; 9 August 2016; "How They Will Wage War in the Future: Tanks Rumbled Across the Sky"; mk.ru/politics/2016/08/09/kak-stanut-vesti-voynu-vbudushhem.html.
- 541 Office of the Director of National Intelligence; 13 February 2018; "Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community"; p. 13; dni.gov/files/documents/newsroom/testimonies/2018-ata---unclassified-ssci.pdf.

- 542 Moskovskiy Komsomolets; 9 August 2016; “How They Will Wage War in the Future: Tanks Rumbled Across the Sky”; mk.ru/politics/2016/08/09/kak-stanut-vesti-voynu-vbudushhem.html.
- 543 Russian Military Blog; 26 December 2014; “Military Doctrine of the Russian Federation, approved by Russian Federation President V. Putin”; rusmilsec.blog/wp-content/uploads/2021/08/mildoc_rf_2014_eng.pdf.
- 544 *Moscow Military Thought*, Vol. 4, No. 10; 1 October 2013; “The Nature and Content of a New-Generation War”, pp. 12-23.
- 545 *Moscow Military Thought*, Vol. 4, No. 10; 1 October 2015; “A Forecast for Future Wars: Meditations on What They Will Look Like.”
- 546 Zhongguo Taikong Wang; 17 October 2017; “China Plans To Ban Space Weaponization, Manage Debris, Ensure Research, Work With Russia”; taikongmedia.com/Item/Show.asp?m=1&d=24901.
- 547 Warsaw Intersection; 25 October 2017; “Space Power: What is Russia’s Military Strategy in Outer Space?”; intersectionproject.eu/article/security/space-power-what-russias-military-strategy-outer-space.
- 548 Ministry of Foreign Affairs of the Russian Federation; 6 July 2017; “Preventing the placement of weapons in space”; mid.ru/ru/foreign_policy/international_safety/disarmament/predotvrashchenie_gonki_vooruzheniy_v_kosmose/1424255.
- 549 Army Recognition; 5 June 2019; “Russian VKS test fire new anti-ballistic missile at Sary-Shagan range in Kazakhstan”; armyrecognition.com/news/aerospace-news/2019/russian-vks-test-fire-new-anti-ballistic-missile-at-sary-shagan-range-in-kazakhstan.
- 550 *Izvestiya*; 19 April 2019; “Taking Aim at the Stars: What is Known About the New Anti-Satellite Weapons”; iz.ru/868986/aleksei-ramm/zvezdy-pod-pritelcom-chto-izvestno-o-novom-proti-vosputnikovom-oruzhii.
- 551 Office of the Director of National Intelligence; 11 May 2017; “Statement for the Record: Worldwide Threat Assessment of the U.S. Intelligence Community”; p. 9; intelligence.senate.gov/sites/default/files/documents/os-coats-051117.pdf.
- 552 Argumenty Nedeli; 16 April 2015; “Russian Potential for Combating, Acquiring Prompt Global Strike Capability Examined”; argumenti.ru/army/n484/396359.
- 553 Jane’s Intelligence Review; 9 November 2018; “New Russian missile likely to be part of anti-satellite system”; janes.com/images/assets/554/84554/New_Russian_missile_likely_to_be_part_of_antisatellite_system.pdf.
- 554 *Newsweek*; 12 March 2018; “Russia’s Military has Laser Weapons that Can Take out Enemies in Less than a Second”; newsweek.com/russia-military-laser-weapons-take-out-enemies-less-second-841091.
- 555 Reuters; 14 August 2018; “U.S. Warns on Russia’s new space weapons”; reuters.com/article/us-russia-usa-space-idUSKBN1KZ0T1.
- 556 Pravda-TV; 20 February 2019; “Russian Ministry of Defense: Everything is Ready for the ‘Peresvet’ Laser”; pravda-tv.ru/2019/02/20/407149/minoborony-rf-dlya.
- 557 Interfax; 26 October 2017; “Russia Tests Military Satellite Capable of Approaching other Spacecraft – Newspaper”; militarynews.ru/story.asp?rid=1&nid=465067.
- 558 Jane’s Intelligence Review; 27 September 2018; “Russia Develops Co-Orbital Anti-Satellite Capability”; janes.com/images/assets/463/83463/Russia_develops_co-orbital_anti-satellite_capability.pdf.
- 559 Time; 10 February 2020; “Exclusive: Strange Russian Spacecraft Following U.S. Spy Satellite”; time.com/5779315/russian-spacecraft-spy-satellite-space-force.
- 560 GPS World Online; 17 February 2022; “Russia expected to ditch GLONASS for Loran in Ukraine invasion”; gpsworld.com/russia-expected-to-ditch-glonass-for-loran-in-ukraine-invasion.
- 561 *Vozdushno-Kosmicheskaya Oborona*; 14 July 2009; “Impact of Information and Space Superiority on High-Tech Military Operations.”
- 562 Russian Military Blog; 26 December 2014; “Military Doctrine of the Russian Federation, approved by Russian Federation President V. Putin”; rusmilsec.blog/wpcontent/uploads/2021/08/mildoc_rf_2014_eng.pdf.
- 563 *Moscow Military Thought*, Vol. 1; 20 June 2013; “Russia: Asymmetrical Actions to Maintain Russia’s Military Security.”
- 564 *Izvestiya*; 14 August 2013; “Russia Building Ground-Based Backup for Glonass”; iz.ru/news/554793.
- 565 *Moscow Military Thought*, 12 April 2023; “Armed Struggle in Space-Continuity and Differences of Tactical Principles”; vm.ric.mil.ru/Stati/item/484129.
- 566 Moskovskiy Komsomolets; 9 August 2016; “How They Will Wage War in the Future: Tanks Rumbled Across the Sky”; mk.ru/politics/2016/08/09/kak-stanut-vesti-voynu-vbudushhem.html.
- 567 *Svobodnaya Pressa*; 28 October 2018; “Star Wars: Will Russia Find an Antidote to the X-37; the Space Arms Race Enters a New Orbit”; svpressa.ru/war21/article/214435.
- 568 *Moscow Military Thought*, Vol. 3, No. 1; 1 January 2012; “Strategic Deterrence and Russia’s National Security Today.”

- 569 *Moscow Military Thought*, Vol. 26, No. 4; 1 October 2017; “Choosing Priorities in Developing Kinetic Energy Weapons for Military Conflicts.”
- 570 Svobodnaya Pressa; 28 October 2018; “Star Wars: Will Russia Find an Antidote to the X-37; the Space Arms Race Enters a New Orbit”; svpressa.ru/war21/article/214435.
- 571 *Moscow Military Thought*, Vol. 26, No. 4; 1 October 2017; “Choosing Priorities in Developing Kinetic Energy Weapons for Military Conflicts.”
- 572 *Izvestiya*; 14 December 2017; “Space Is a Battlefield: Krasukha-2 Counter-Space Broadband Jamming System, US Space Efforts”; iz.ru/680335/dmitrii-kornev/kosmos-kak-pole-boia.
- 573 *Moscow Gazeta*; 27 August 2016; “Russian Missile Defense Advances, Status of A-235 NUDOL Advanced Missile Defense System”; news.rambler.ru/articles/34565327-kuda-prodvinulas-rossiyskaya-pro.
- 574 *Milkavkaz.net*; 23 December 2015; “Russia: Aerospace Forces Order of Battle”; milkavkaz.net/2015/12/vozdushno-kosmicheskiesily.html.
- 575 *Moscow Life*; 26 November 2016; “GLONASS vs. GPS: VKS Colonel on the state of Russian military space”; life.ru/t/3byk/937760/glonass_protiv_gps_polkovnik_vks_o_sostoianii_rossiiskogho_voennogho_kosmosa.
- 576 *Moscow Gazeta*; 2 March 2017; “What vulnerabilities did the VKS inspection reveal?”; gazeta.ru/army/2017/03/02/10552511.shtml.
- 577 *The Moscow Times*; 3 August 2015; “Russian Military Merges Air Force and Space Command”; themoscowtimes.com/2015/08/03/russian-military-merges-air-force-and-space-command-a48710.
- 578 25 March 2011; “Russia’s Space Troops: Armaments and Facilities”; en.topwar.ru/3884-kosmicheskies-vojska-rossii-vooruzhenie-i-obekty.htm.
- 579 *Moscow Ekho Moskvy Online*; 9 December 2014; “Aerospace Defense Troops Space Command’s Primary Mission Is to Ensure Russia’s Security in Space”; echo.msk.ru/programs/voensovet/1445704-echo.
- 580 TASS; 4 January 2021; “In 2020, Russian Space Forces tracked more than 80 launches of foreign and domestic rockets”; tass.ru/armiya-i-opk/10397921.
- 581 *Vozdushno-Kosmicheskaya Oborona Online*; 31 December 2015; “Integrated Command and Control Entity Required.”
- 582 *Scientific Journal of the Military University of Land Forces*, Vol. 51, Issue 4; 16 December 2019; “The Network of the Aerospace Forces of the Russian Federation”; pp. 717-732; zeszyty-naukowe.awl.edu.pl/fapi/file/download/195945/1079428.pdf.
- 583 Russian Ministry of Defense; 31 July 2019; “Space Forces”; eng.mil.ru/en/structure/forces/cosmic/structure.htm.
- 584 RIA Novosti; 2010; “Russian Space Force”; sputniknews.com/infographics/2011004167368531.
- 585 Russian Ministry of Defense; 31 July 2019; “Space Forces”; eng.mil.ru/en/structure/forces/cosmic/structure.htm.
- 586 *Novosti Kosmonavтики*; 28 February 2003; “Russian Space Forces”; web.archive.org/web/20090201000712/http://novosti-kosmonavтики.ru/content/numbers/243/30.shtml.
- 587 *Moscow Ekho Moskvy Online*; 29 April 2015; “Russia: Commander Describes Plesetsk Cosmodrome’s Putin-Era Recovery”; echo.msk.ru.
- 588 Russian Space Web; 5 March 2025; “GLONASS-K (Uragan-K) Satellite”; russianspaceweb.com/uragan_k.html.
- 589 Government of the Russian Federation; 26 August 2010; “Vostochny Cosmodrome”; archive.premier.gov.ru/visits/ru/11940/info/11921/print.
- 590 Russian Space Web; 5 March 2025; “GLONASS-K (Uragan-K) Satellite”; russianspaceweb.com/uragan_k.html.
- 591 Government of the Russian Federation; 26 August 2010; “Vostochny Cosmodrome”; archive.premier.gov.ru/visits/ru/11940/info/11921/print.
- 592 *Moscow Ekho Moskvy Online*; 29 April 2015; “Russia: Commander Describes Plesetsk Cosmodrome’s Putin-Era Recovery”; echo.msk.ru/programs/voensovet/1528224-echo.
- 593 Russian Ministry of Defense; 31 May 2013; “Radio-Technical Troops”; eng.mil.ru/en/structure/forces/air/structure/radio.htm.
- 594 Federal Book; 13 March 2015; “Russia: Prospects for Development of Radioelectronic Combat up to 2020”; federalbook.ru/projects/opk/structura-9.html.
- 595 *Informatsionnyy Most*; 1 January 2018; “Materials of The EW Troops of The Russian Federation”; pp. 25, 34, 44.
- 596 Russian Ministry of Defense; 31 May 2013; “Radio-Technical Troops”; eng.mil.ru/en/structure/forces/air/structure/radio.htm.
- 597 Federal Book; 13 March 2015; “Russia: Prospects for Development of Radioelectronic Combat Up to 2020”; federalbook.ru/projects/opk/structura-9.html.
- 598 *Krasnaya Zvezda Online*; 20 April 2020; “The development of the electronic warfare system is a priority task for ensuring the Russian Federation”; pp. 717-732; zeszyty-naukowe.awl.edu.pl/fapi/file/download/195945/1079428.pdf.

ing Russia's military security"; redstar.ru/wp-content/uploads/2020/04/040-15-04-2020.pdf.

599 Informationsnyy Most; 1 January 2018; "Materials of the EW Troops of the Russian Federation"; pp. 25, 34, 44.

600 Foreign Policy Research Institute; 23 February 2022; "Electronic Warfare: Russia's Approach"; fpri.org/wp-content/uploads/2022/02/electronic-warfare-022222.pdf.

601 Space News; 23 January 2015; "Putin Approves Roscosmos Merger with Conglomerate"; spacenews.com/putin-approves-roskosmos-merger-with-conglomerate.

602 Roscosmos; 8 September 2020; "Roscosmos 2019 Annual Report"; report.rosatom.ru/go/rosatom/go_rosatom_2019/rosatom_2019_ru.pdf.

603 Space News; 23 January 2015; "Putin Approves Roscosmos Merger with Conglomerate"; spacenews.com/putin-approves-roskosmos-merger-with-conglomerate.

604 Roscosmos; 8 September 2020; "Roscosmos 2019 Annual Report"; report.rosatom.ru/go/rosatom/go_rosatom_2019/rosatom_2019_ru.pdf.

605 Russian Space Web; 9 May 2023; "The Russian Space Agency, Roskosmos"; russianspaceweb.com/roskosmos.html.

606 Interfax; 21 December 2015; "Roscosmos management has decided on the future"; interfax.ru/russia/486114.

607 State Corporation Roscosmos Website; 3 August 2021; "State Corporation Organizations"; roskosmos.ru/24028.

608 State Corporation Roscosmos Website; 3 August 2021; "State Corporation Organizations"; roskosmos.ru/24028.

609 Government of the Russian Federation; 13 January 2025; "State Corporation for Space Activities Roscosmos"; government.ru/departments/363/about.

610 Interfax; 2 June 2022; "Rogozin said that Roscosmos has become part of the Russian Armed Forces"; interfax.ru/russia/844352.

611 Aliberti, M., and K. Lisitsyna; *Studies in Space Policy*, Vol. 18; 2019; "Russia's Posture in Space: Prospects for Europe."

612 Roscosmos; "Organizations of the State Corporation Roscosmos"; space4kids.ru/950.

613 Real Time; 2015; "Organizations subordinated to and within the sphere of jurisdiction of Roscosmos, revenue, thousand rubles"; realnoevremya.ru/attachments/181.

614 Moscow Kommersant Online; 14 February 2024; "Borisov called for developing the space services market instead of 'magic kicks'; kommersant.ru/doc/6510070.

615 TASS; 28 December 2024; "Roscosmos buys Earth observation satellite data from private company for first time"; tass.com/science/1894855.

616 Military-Industrial Complex (Voyenno-promyshlennyy kompleks); 7 August 2024; "First Deputy Director General of Roscosmos: we are consolidating the industry around the Russian orbital station. Roscosmos lost 180 billion rubles due to the termination of contracts with Western countries"; vpk.name/en/898534_first-deputy-director-general-of-roskosmos-consolidating-industry-around-the-russian-space-station.html.

617 Center for Naval Analyses; 15 November 2023; "Role Of Space in Russia's Operations in Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

618 Center for Naval Analyses; 15 November 2023; "Role Of Space in Russia's Operations in Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

619 Center for Naval Analyses; 15 November 2023; "Role Of Space in Russia's Operations in Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

620 Center for Naval Analyses; 15 November 2023; "Role Of Space in Russia's Operations in Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

621 Bleeping Computer; 31 March 2022; "VIASat confirms modems were wiped with AcidRain malware"; bleepingcomputer.com/news/security/viasat-confirms-satellite-modems-were-wiped-with-acidrain-malware.

622 Center for Naval Analyses; 15 November 2023; "Role Of Space in Russia's Operations in Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

623 Center for Naval Analyses; 15 November 2023; "Role Of Space in Russia's Operations in Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

624 Military Review; 15 April 2024; "Russian electronic warfare forces include starlink terminals"; en.topwar.ru/240478-rossijskie-vojska-radioelektronnoj-borby-vkljuchajut-terminaly-starlink-v-celi-dlja-vozdejstvija.html.

625 Brussels Euractiv; 27 October 2024; "Russia Warns West: We Can Target Your Commercial Satellites"; euractiv.com/section/global-europe/news/russia-warns-west-we-can-target-your-commercial-satellites.

626 Military Review; 15 April 2024; “Russian electronic warfare forces include starlink terminals”; en.topwar.ru/240478-rossijskie-vojs-ka-radioelektronnoj-borby-vkljuchajut-terminaly-starlink-v-ce-li-dlja-vozdejstvija.html.

627 Center for Naval Analyses; 15 November 2023; “Role Of Space in Russia's Operations in Ukraine”; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.

628 Military Review; 15 April 2024; “Russian electronic warfare forces include starlink terminals”; en.topwar.ru/240478-rossijskie-vojs-ka-radioelektronnoj-borby-vkljuchajut-terminaly-starlink-v-ce-li-dlja-vozdejstvija.html.

629 Brussels Euractiv; 27 October 2022 “Russia Warns West: We Can Target Your Commercial Satellites”; euractiv.com/section/global-europe/news/russia-warns-west-we-can-target-your-commercial-satellites.

630 War on the Rocks; 10 June 2022; “Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War”; warontherocks.com/22/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war.

631 Izvestiya; 8 March 2022; “Reset Musk: Private Space Companies to Take Over Import Substitution”; iz.ru/1300773/olga-kolentcova/sbrosit-masku-chastnye-kosmicheskie-kompanii-zaimutsia-importozameshcheniem.

632 Interfax; 24 January 2023; “Roscosmos head: China supplying electronic components to Russian space sector”; interfax.com/newsroom/top-stories/87214.

633 Moscow RBK Online; 29 July 2022; Borisov said Russia is lagging behind in satellite production; rbc.ru/economics/29/07/2022/62e432919a79476908cf047d.

634 Interfax; 24 January 2023; “Roscosmos head: China supplying electronic components to Russian space sector”; interfax.com/newsroom/top-stories/87214.

635 France24; 5 October 2023; “Chinese firm sold satellites for intelligence to Russia's Wagner: contract”; france24.com/en/live-news/20231005-chinese-firm-sold-satellites-for-intelligence-to-russias-wagner-contract.

636 Milan Il Giornale Online; 9 October 2023; Machine Translation: “Italy: ‘Two spy satellites sold’: the strange deals between Beijing and Wagner”; ilgiornale.it/news/cronaca-internazionale/affari-pecchino-e-wagner-due-satelliti-scopo-intelligence-2222061.html.

637 BBC; 27 January 2023; “Ukraine: US sanctions Chinese firm helping Russia's Wagner Group”; bbc.com/news/world-asia-china-64421915.

638 GlobalSecurity.org; “Russian Space Launch Vehicles”; globalsecurity.org/space/world/russia/launch.htm.

639 Moscow Interfax-AVN; 29 May 2012; “The Phobos-Grunt drama is a powerful catalyst for improving the quality of our work”; militarynews.ru/story.asp?rid=2&nid=298581.

640 The Caspian Post; 26 December 2025; “Kazakhstan's Soyuz-5 Rocket Launch from Baikonur Set for Early 2026”; <https://caspianpost.com/kazakhstan/kazakhstan-s-soyuz-5-rocket-launch-from-baikonur-set-for-early-2026>.

641 Interfax; 23 January 2024; “First launch of Angara-A5 heavy-lift rocket from Vostochny Cosmodrome scheduled for early April - Roscosmos chief”; interfax.com/newsroom/top-stories/98675.

642 Military Industrial Courier; 7 February 2022; “Russian Space - Choosing The Path”; vpk-news.ru/articles/65715.

643 RIA Novosti; 28 November 2024; “Roscosmos provides update on development of super-heavy-lift rocket”; ria.ru/20241128/roskosmos-1986318437.html.

644 RBK Online; 12 April 2024; “Manturov announced the launch of more than 100 satellites by the end of the year”; rbc.ru/technology_and_media/12/04/2024/66191c9a9a79477874815b10.

645 War on the Rocks; 10 June 2022; “Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War”; warontherocks.com/22/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war.

646 War on the Rocks; 10 June 2022; “Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War”; warontherocks.com/22/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war.

647 The Moscow Times; 25 October 2023; “Russia's Invasion Has Thrown Its Space Scientists Out of Orbit”; themoscowtimes.com/2023/10/25/russias-invasion-has-thrown-its-space-scientists-out-of-orbit-a82888.

648 War on the Rocks; 10 June 2022; “Sanctions and Satellites: The Space Industry After the Russo-Ukrainian War”; warontherocks.com/22/06/sanctions-and-satellites-the-space-industry-after-the-russo-ukrainian-war.

649 Interfax; 3 October 2023; “The Korona and Amur-SPG reusable rocket projects have attracted interest from foreign partners - head of Roscosmos”; interfax-russia.ru/rossiya-i-mir/proekty-mnogorazovyh-raket-korona-i-amur-spg-vyzvali-interes-u-inostrannyh-partnerov-glava-roskosmosa.

650 Space Flight 101; 8 November 2021; “Soyuz 2-1B - Rockets”; spaceflight101.com/spacerockets/soyuz-2-1b/1/10.

- 651 Supporting the Hague Code of Conduct; 30 April 2026; "First Flight of Soyuz-5"; nonproliferation.eu/hcoc/first-flight-of-soyuz-5/.
- 652 RBK Online; 11 April 2024; "Roscosmos called the task of the first launch of Angara from Vostochny completed"; rbc.ru/technology_and_media/11/04/2024/66180ccd9a79477aa9d93ccf.
- 653 Interfax; 13 July 2022; "Roscosmos has postponed the preparation of manned flights to the moon"; interfax.ru/russia/851853.
- 654 TASS; 25 August 2017; "Khrunichev Center shifts production from Proton-M to Angara-A5 – Rogozin"; tass.ru/kosmos/4507428.
- 655 Center for Strategic and International Studies; March 2019; "Spaceports of the World"; researchgate.net/profile/Thomas_Roberts24/publication/332211453_Spaceports_of_the_World/links/5ca6590a4585157bd322dc39/Spaceports-of-the-World.pdf.
- 656 Zvezda TV; 8 May 2021; "Russian complex "Okno-M" detected increased space Activity"; tvzvezda.ru/news/202158931-66F05.html.
- 657 Federation of American Scientists; 30 December 2008; "Source-book on the Okno (В/ч 52168), Krona (В/ч 20096) and Krona-N (В/ч 20776) Space Surveillance Sites"; fas.org/spp/military/program/track/okno.pdf.
- 658 IMINT & Analysis; 13 June 2008; "Soviet & Russian Space Surveillance Facilities"; geimint.blogspot.com/2008/06/soviet-russian-space-surveillance.html.
- 659 Russian Strategic Nuclear Forces; 21 June 2011; "Daryal-U radar in Mishelevka demolished"; russianforces.org/blog/2011/06/daryal-u_radar_in_mishelevka_d.shtml.
- 660 WW2.DK; 2011; "46th independent Radio-Technical Unit"; ww2.dk/new/pvo/radar/46ortu.htm.
- 661 Sity Shooter; 2011; "Radar 'Dniester' – 'Dnepr-M'"; panoramio.com/photo-to/58798723.
- 662 Russian Strategic Nuclear Forces; 23 December 2009; "Radar in Lekhtusi accepted for service"; russianforces.org/blog/2009/12/radar_in_lekhtusi_accepted_for.shtml.
- 663 Russian Strategic Nuclear Forces; 23 December 2009; "Radar in Lekhtusi accepted for service"; russianforces.org/blog/2009/12/radar_in_lekhtusi_accepted_for.shtml.
- 664 Russian Strategic Nuclear Forces; 14 February 2009; "Two radars at Armavir"; russianforces.org/blog/2009/02/two_radars_at_armavir.shtml.
- 665 APA Azerbaijan Online; 15 December 2011; "Russia's Baltic Radar to be fully operational by 2014"; en.apa.az/cis-countries/161834.
- 666 Russian Strategic Nuclear Forces; 21 June 2011; "Daryal-U radar in Mishelevka demolished"; russianforces.org/blog/2011/06/daryal-u_radar_in_mishelevka_d.shtml.
- 667 Lenta; 12 December 2011; "Upgrading early warning radars in the Northwest District will begin in 2015"; lenta.ru/news/2011/12/12/modernize.
- 668 TASS; 2 June 2013; "Construction of a missile warning radar system began in Altay"; tasstelecom.ru/news/one/20215.
- 669 TASS; 2 December 2012; "Three advanced early warning radars enter service in Russia"; tass.com/defense/981965.
- 670 Interfax; 14 January 2013; "RTI General Director Boyev on New Missile Attack Warning System Radars"; militarynews.ru/story.asp?rid=2&nid=340021.
- 671 RIA Novosti; 9 February 2012; "St. Petersburg Radar to be Put on Alert in Feb"; en.rian.ru/military_news/20120209/171237484.html.
- 672 Izvestiya; 11 August 2011; "Russia restores the "missile umbrella"; vz.ru/news/2011/8/11/513987.html.
- 673 Air and Space Defense; 1 July 2012; "Warning about Attack on Our Territory."
- 674 Arms Trade; 1 June 2015; "TSAMTO /Of the news /Vladimir Putin appeared at the ceremony of the discovery of international military technical forum 'the army-2015"; armstrade.org/includes/periodics/news/2015/0616/165029697/detail.shtml.
- 675 Russian Strategic Nuclear Forces; 2 June 2024; "New Voronezh-M radar in Mishelevka entered trials"; russianforces.org/blog/2012/03/new_voronezh-m_radar_in_mishel.shtml.
- 676 Russian Ministry of Defense; 27 December 2014; "Archived Copy" function.mil.ru/news_page/country/more.htm?id=12004148@egnews.
- 677 Russian Strategic Nuclear Forces; 2 June 2014; "Voronezh-DM radar in Yeniseysk"; russianforces.org/blog/2014/06/voronezh-dm_radar_in_yeniseysk.shtml.
- 678 Russian Strategic Nuclear Forces; 17 September 2014; "Location of the Barnaul early-warning radar"; russianforces.org/blog/2014/09/location_of_the_barnaul_early-.shtml.
- 679 Russian Strategic Nuclear Forces; 19 September 2014; "Voronezh-M early-warning radar in Orsk located"; russianforces.org/blog/2014/09/voronezh-m_early-warning_radar.shtml.
- 680 U.S. Coast Guard Navigation Center; 16 September 2008; "GLONASS Status and Progress"; navcen.uscg.gov/pdf/cgsicmeetings/48/reports/internationalsubcommittee/%5b24%5d_glonass_cgsic_16.09.2008.pdf.

681 European Space Agency; 18 September 2014; “GLONASS Ground Segment”; gssc.esa.int/navipedia/index.php?title=glonass_ground_segment.

682 Ankara Anadolu Agency Online; 12 April 2023; “Russia will continue working on space exploration: Putin”; aa.com.tr/en/world/russia-will-continue-working-on-space-exploration-putin/2870448.

683 Interfax; 29 December 2023; “Russia Returns to Deep Space Exploration”; interfax-russia.ru/main/rossiya-vozvrashchaetsya-k-izucheniyu-dalnego-kosmosa-glava-roskosmosa.

684 Moscow RBK Online; 25 March 2023; “Roscosmos began to study the possibility of studying Mars without ESA”; 26 March 2023; rbc.ru/rbcfreenews/641f79b39a7947e1b2831e4a.

685 Russian Space Web; 30 July 2020; “Robotic Missions to Mars”; russianspaceweb.com/spacecraft_planetary_mars.html.

686 NASA; “Yuri Gagarin: First Man in Space”; nasa.gov/mission_pages/shuttle/sts1/gagarin_anniversary.html.

687 Russian Space Web; 30 July 2020; “Robotic Missions to Mars”; russianspaceweb.com/spacecraft_planetary_mars.html.

688 NASA Spaceflight; 30 April 2021; “Roscosmos discusses ISS withdrawal strategy and new space station for mid-2020s”; nasaspaceflight.com/2021/04/roscomos-future-for-mid-2020s.

689 Interfax; 12 April 2023; “Russia extends ISS operation to 2028, confirms Moon plans”; interfax.com/newsroom/top-stories/89526.

690 X post; 3 July 2024; “The General plan for the creation of the Russian Orbital Station #ROS itself (thanks for the scan to <https://t.me/space78125> (<https://t.co/yznezlvolume>). @ShuttleAlmanac (<https://x.com/shuttlealmanac>) I think it will be interesting for you.”; twitter.com/katlinegrey/status/1808425637025386547.

691 Interfax; 2 August 2020; “The Russian segment of the International Space Station (ISS) has been connected to a broadband satellite communication channel with Earth”; interfax.ru/russia/719977.

692 Izvestiya; 31 May 2020; “What will change the successful flight of Elon Musk’s ship to the ISS”; iz.ru/1017898/mariia-nediuk-olga-kolentcova/vse-na-svoikh-chto-izmenit-uspeshnyi-polet-korabli-ilona-maski-mks.

693 WAM; 24 September 2019; “Mohamed bin Zayed learns about final preparations for First Emirati Astronaut’s Expedition to ISS”; wam.we/en/article/hszr96e8-mohamed-bin-zayed-learns-about-final-preparations.

694 Space News; 26 April 2021; “China, Russia open moon base project to international partners, early details emerge”; spacenews.com/china-russia-open-moon-base-project-to-international-partners-early-details-emerge.

china-russia-open-moon-base-project-to-international-partners-early-details-emerge.

695 Space News; 26 April 2021; “China, Russia enter MOU on international lunar research station”; spacenews.com/china-russia-open-moon-base-project-to-international-partners-early-details-emerge.

696 Moon Daily Online; 20 January 2024; “Space Daily: US space company upbeat on next Moon mission despite lander’s demise”; moondaily.com/reports/US_space_company_upbeat_on_next_Moon_mission_despite_landers_demise_999.html.

697 South China Morning Post; 23 August 2023; “Despite Luna 25 Spacecraft Crash, China Expected to Continue Working with Russia in Race for Moon Base”; scmp.com/news/china/science/article/3231901/despite-luna-25-spacecraft-crash-china-expected-continue-working-russia-race-moon-base.

698 Riga Meduza; 13 October 2023; “The first Russian lunar mission in half a century ended in failure”; meduza.io/feature/2023/10/13/pervaya-za-polveka-rossiyskaya-lunnaya-missiya-okonchilas-provalom-pochemu-stantsiya-luna-25-ne-dobralas-do-poverhnosti-sputnika-kto-vinovat-v-avarii.

699 Interfax; 3 October 2023; “Next lunar missions may be launched ahead of schedule”; interfax.com/newsroom/top-stories/95078.

700 Moscow RBK Online; 5 March 2024; “Borisov admitted that Russia will send two spacecraft to the Moon at once”; rbc.ru/rbc-free-news/65e73dfc9a794766be37dfe3.

701 Moscow RBK Online; 24 April 2024; “RAS has prepared Russia’s lunar program until 2050”; rbc.ru/technology_and_media/24/04/2024/6628e46c9a794742d00c826.

702 Interfax; 3 October 2023; “Next lunar missions may be launched ahead of schedule”; hinterfax.com/newsroom/top-stories/95078.

703 Moon Daily Online; 20 January 2024; “Space Daily: US space company upbeat on next Moon mission despite lander’s demise”; moondaily.com/reports/US_space_company_upbeat_on_next_Moon_mission_despite_landers_demise_999.html.

704 Interfax; 3 October 2023; “Next lunar missions may be launched ahead of schedule”; interfax.com/newsroom/top-stories/95078.

705 Interfax; 3 October 2023; “Next lunar missions may be launched ahead of schedule”; interfax.com/newsroom/top-stories/95078.

706 Interfax; 3 October 2023; “Next lunar missions may be launched ahead of schedule”; interfax.com/newsroom/top-stories/95078.

707 Interfax; 3 October 2023; “Next lunar missions may be launched ahead of schedule”; interfax.com/newsroom/top-stories/95078.

- 708 Interfax; 19 March 2025; "Launch of Russian mission to Venus could be moved to 2034-2035 - Space Research Institute"; interfax.com/newsroom/top-stories/110489.
- 709 Interfax; 19 March 2025; "Launch of Russian mission to Venus could be moved to 2034-2035 - Space Research Institute"; interfax.com/newsroom/top-stories/110489.
- 710 Roscosmos; 9 November 2021; "Russia has begun testing a device for geological exploration of the Moon from orbit"; roscosmos.ru/33277.
- 711 Roscosmos; 9 November 2021; "Russia has begun testing a device for geological exploration of the Moon from orbit"; roscosmos.ru/33277.
- 712 Moscow RBK Online; 7 May 2024; "Roscosmos CEO Suggests Trusting Musk's Words About Aliens"; rbc.ru/rbcfree-news/663ab1769a7947a832ae0318.
- 713 Moscow RBK Online; 8 May 2024; "Roscosmos CEO Suggests Trusting Musk's Words About Aliens"; rbc.ru/rbcfree-news/663ab1769a7947a832ae0318.
- 714 Space News; 26 April 2021; "China, Russia open moon base project to international partners, early details emerge"; spacenews.com/china-russia-open-moon-base-project-to-international-partners-early-details-emerge.
- 715 Space News; 26 April 2021; "China, Russia open moon base project to international partners, early details emerge"; spacenews.com/china-russia-open-moon-base-project-to-international-partners-early-details-emerge.
- 716 Moscow Gazeta; 28 July 2016; "Kommersant: The Ministry of Defense Ordered a New Space Reconnaissance System"; gazeta.ru/army/news/8930795.shtml.
- 717 Military Review; 27 May 2019; "Roscosmos to spend over 3 bln rubles within 3 years on operating remote sensing satellites"; en.topwar.ru/98622-minoborony-zakazalo-novye-sputniki-dlya-novoy-sistemy-kosmicheskoy-razvedki.html.
- 718 UAWire; 8 May 2019; "Russia to monitor entire planet with radar surveillance system"; uawire.org/russia-to-monitor-entire-planet-with-radar-surveillance-system.
- 719 TASS; 2 July 2020; "Russia to Complete Creation of Unified Space System Group by 2024"; tass.ru/armiya-i-opk/8875281.
- 720 Procosmos Blog; 5 July 2024; "Russian Satellite 'Kondor FKA' No. 1 was put into operation"; prokosmos.ru/2024/07/05/rossiiskii-sputnik-kondor-fka-1-vveden-v-ekspluatatsiyu.
- 721 Center for Naval Analyses; 15 November 2023; "Role Of Space In Russia's Operations In Ukraine"; cna.org/reports/2023/11/role-of-space-in-russia-operations-in-ukraine.
- 722 Universe Magazine; 9 November 2023; "What Russian satellites see"; universemagazine.com/en/what-russian-satellites-see.
- 723 Space News; 10 August 2020; "Upgrading Russia's Fleet of Optical Reconnaissance Satellites"; thespacereview.com/article/4006/1.
- 724 Live Journal Online Blog; 11 March 2020; "The Falklands War was watched at the USSR General Staff"; arctus.livejournal.com/1165154.html.
- 725 Izvestiya; 22 September 2017; "Military Expert Anton Lavrov Documents Need for Optical Reconnaissance Satellite Array"; iz.ru/645741/anton-lavrov/orbitalnaia-gruppirovka-ot-pravilas-na-voinu-v-sirii.
- 726 Riga Meduza; 17 November 2015; "Russia has deployed strategic forces in Syria"; meduza.io/news/2015/11/17/rossiya-zadeystvovala-v-sirii-strategicheskie-raketonostsy.
- 727 Gunter's Space Page; 12 November 2025; "Tundra (Kupol, EKS, 14F142)"; space.skyrocket.de/doc_sdat/tundra.htm.
- 728 Moscow Gazeta; 4 June 2020; "The Space Tundra: Russia Has Been Covered by a Dome"; www.gazeta.ru.
- 729 Slate; 21 March 2017; "Russia's Space Program Is Struggling Mightily"; slate.com/technology/2017/03/russias-space-program-is-in-trouble.html.
- 730 RIA Novosti; 12 June 2024; "Russia will launch six new communications satellites in 2028-2030"; ria.ru/20240605/sputnik-1950723653.html.
- 731 Russian Space Web; 22 February 2019; "The Meridian satellite (14F112)"; russianspaceweb.com/meridian.html.
- 732 Gonets Satellite Company; 2018; "Gonets Satellite Company' Public Corporation"; gonets.ru.
- 733 Russian Space Web; 15 June 2019; "Yamal Satellite Series"; russianspaceweb.com/yamal.html.
- 734 Satellite World in Russian; 5 June 2020; "Satellite 'Express AMU7 Assembled'; satsis.info/news/17231-sputnik-ekspress-amu7-sobran.html.
- 735 Russian Space Web; 23 April 2020; "Russian communications satellites"; russianspaceweb.com/spacecraft_comsats.html.
- 736 Defense Intelligence Agency; 28 June 2017; "Russia Military Power: Building a Military to Support Great Power Aspirations"; pp. 35-

37; [dia.mil/Portals/27/Documents/News/Military%20 Power%20 Publications/Russia%20Military%20Power%20Re- port%202017.pdf](https://dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Russia%20Military%20Power%20Report%202017.pdf).

737 Moscow RBK Online; 18 October 2022; "Streaming from a plane: how satellite Internet is developing in the world"; trends.rbc.ru/trends/industry/634e7cb59a79471d3eb9d934.

738 Interfax; 23 October 2022; "The first satellite of the Sfera orbital group, Skif-D, as well as three Gonets-M communications satellites, have been launched into orbit"; interfax.ru/russia/869077.

739 Interfax; 16 February 2024; "First Marafon-IoT satellite launch postponed - Roscosmos (Part 2)"; interfax.com/newsroom/top-stories/99513.

740 Interfax; 23 October 2022; "Interfax: The first satellite of the Sfera orbital group, Skif-D, as well as three Gonets-M communications satellites, have been launched into orbit"; interfax.ru/russia/869077.

741 Interfax; 16 February 2024; "First Marafon-IoT satellite launch postponed - Roscosmos (Part 2)"; interfax.com/newsroom/top-stories/99513.

742 SatellitePro ME; 16 May 2012; "Thuraya Launches Mobile Satellite Services in Russia - SatellitePro ME"; satelliteprome.com/news/thuraya-launches-mobile-satellite-services-in-russia.

743 GLONASS-IAC; 14 April 2025; "GLONASS Constellation Status"; glonass-iac.ru/en/sostavog.

744 Rossiyskaya Gazeta; 31 August 2020; "Eliminating Targets: Air Bombs are Quickly Becoming Smarter"; rg.ru/2020/08/31/rossiiskie-umnye-aviabomby-stali-odnimi-iz-samyh-effektivnyh-v-mire.html.

745 Suvorovskiy Natisk (Newspaper of Russia's Eastern Military District), No. 45; 20 November 2020; "Secrets of Mastery of 'Gods of War'"; p. 3.

746 Strazh Baltiki (Newspaper of Russia's Baltic Fleet); 20 November 2020; "Khризantemas in Battle Order"; pp. 1, 5.

747 ISS Reshetnev; 12 October 2018; "Glonass-K Project"; iss-reshetnev.ru/projects.

748 RIA Novosti; 14 January 2023; "Russia Will Launch Three Next-Generation GLONASS Satellites In 2023"; ria.ru/2023014/glonass-1844786128.html.

749 TASS; 26 April 2022; "Up to 15 of the Newest Glonass-K2 Navigational Satellites to Be Launched by 2030"; tass.ru/kosmos/14476545.

750 International Committee on Global Navigation Satellite Systems (ICG): Annual Meeting 2016; 12 October 2016; "GLONASS Programme Update"; unoosa.org/pdf/icg/2016/icg11/01.pdf.

751 Eurasia Daily Monitor; Vol. 21, No. 69; 6 May 2024; "Russia's Satellite Constellation Deteriorates, Increasing Dependency on China"; jamestown.org/program/russias-satellite-constellation-deteriorates-increasing-dependency-on-china.

752 GPS World; 29 February 2024; "Tough Times for Russian Navigation System"; gpsworld.com/tough-times-for-russian-navigation-system.

753 Middle East Political and Economic Institute; 30 May 2026; "Interactions among Major Countries in a Evolving Landscape: An Analysis of President Putin's 2026 State Visit to China"; mepei.com/interactions-among-major-countries-in-a-evolving-landscape-an-analysis-of-president-putins-2026-state-visit-to-china/.

754 Beijing Wangyi; 12 October 2022; "Russia has 'assurance,' and the Beidou and the GLONASS complement each other, GPS has opponent"; 163.com/dy/article/HJFOKMLG0552WNGD.html.

755 China Ministry of Foreign Affairs; 16 May 2024; "Machine Translation: Xi Jinping and Russian President Vladimir Putin jointly signed and issued a joint statement on deepening the China-Russia comprehensive strategic cooperative partnership in the new era"; mfa.gov.cn/zyxw/202405/t20240516_11305860.shtml.

756 Moscow Ekho Moskvyy Online; 9 July 2011; "Main Space Monitoring Center Chief on Mission, Training, Space Object Tracking"; echo.msk.ru/programs/voensovet/791306-echo.phtml.

757 Proceedings from the American Astronautical Society (AAS) Conference; 4 August 2011; "Simulating Space Surveillance Networks"; p. 9; agi.com/getmedia/8e3d8763-08c9-465d-a500-cba8b1300050/Simulating-Space-Surveillance-Networks.pdf.

758 SpaceWatch Global Online; June 2020; "Russia to develop space surveillance satellite to monitor space debris as part of Milky Way SSA network"; spacewatch.global/2020/06/russia-to-develop-space-surveillance-satellite-to-monitor-space-debris-as-part-of-milky-way-ssa-network.

759 RIA Novosti; 2 October 2023; "Roscosmos Spoke about the Milky Way Space Debris Monitoring System"; ria.ru/20231002/mu-sor-190003929.html.

760 Russian Academy of Sciences Institute of Astronomy; 12 January 2022; "Concept for the Creation of the 'Milky Way' System for the 2022-2025 Period and in the Future up to 2035"; inasan.ru/wp-content/uploads/2022/11/ntr7-2.pdf.

761 Roscosmos; 11 January 2022; "Aspos Okp Plans and Milky Way"; e-cis.info/news/569/97691.

762 Interfax; 23 January 2024; "India, China willing to join Russia's Milky Way space monitoring project - Roscosmos chief"; [interfax.com/newsroom/top-stories/98674/#:~:text=jan%2023%20\(in-](https://interfax.com/newsroom/top-stories/98674/#:~:text=jan%2023%20(in-)

terfax)%20%2d%20india,our%20chinese%20and%20indian%20 partners.

763 Interfax; 2 October 2023; “Milky Way space monitoring system to be global, envisages int’l cooperation – Roscosmos head”; interfax.ru/world/923770.

764 Space in Africa; 24 July 2023; “Russia deploys space debris monitoring facility to South Africa”; spaceinafrica.com/2023/07/24/russia-deploys-space-debris-monitoring-facility-to-south-africa.

765 Roscosmos; 12 January 2022; “Establishment of the system of information and analytical security of space activities in near-Earth space ‘Milky Way’ for the period 2022–2025 and in the future up to 2035”; inasan.ru/wp-content/uploads/2022/05/cont_1801_2022.pdf.

766 Research Gate; December 2023; “New status of the ISON project”; researchgate.net/publication/376800252.

767 Madrid Diario de Cuba; 23 June 2023; “Diario de Cuba: The Russian intelligence network that spies on the US from Cuba is exposed”; diariodecuba.com/cuba/1687546243_48050.html.

768 Izvestiya; 29 July 2019; “European Space Agency with the assistance of the Russian Federation published information about precise locations of American satellites”; iz.ru/902006/2019-07-23/eka-s-pomoshchii-rf-opublikovalo-dannye-o-tochnom-mestopolozhenii-sputnikov-ssha.

769 Interfax; 5 December 2018; “Peresvet combat laser can fight satellites – Russian Defense Ministry”; interfax.ru/russia/640821.

770 Russian Defense Policy Online; 30 May 2017; “Electronic Warfare Chief Interviewed”; russiandefpolicy.com/2017/05/30/electronic-warfare-chief-interviewed-2.

771 Moscow Vestnik Aviatsii i Kosmonavтики; 31 August 2011; “Electronic Warfare: Areas of Development”; pp. 22–25.

772 Lenta; 24 April 2013; “Russia Armed with Krasukha Complexes: Weapons”; lenta.ru/news/2013/04/24/krasuka.

773 Moscow Military Thought; 13 December 2013; “Russia: Improvements in the Electronic Warfare Weapons System.”

774 Russian Defense Policy Online; 30 May 2017; “Electronic Warfare Chief Interviewed”; russiandefpolicy.com/2017/05/30/electronic-warfare-chief-interviewed-2.

775 Military Industrial Complex; 15 August 2013; “Electronic warfare against potential threats”; vp.kname/news/94876_radioelektron-naya_borba_s_potencialnymi_ugrozami.html

776 Russian Defense Policy Online; 30 May 2017; “Electronic Warfare Chief Interviewed”; russiandefpolicy.com/2017/05/30/electronic-warfare-chief-interviewed-2.

777 Russian Defense Policy Online; 30 May 2017; “Electronic Warfare Chief Interviewed”; russiandefpolicy.com/2017/05/30/electronic-warfare-chief-interviewed-2.

778 Russian Ministry of Defense; 25 July 2021; “Within the framework of the international military-technical forum (IMTF) “ARMY-2021” specialists of electronic warfare (EW) of the combined-arms army of the Eastern Military District (VVO) in Primorye will present guests with modern jamming stations.”

779 BBC-Russian; 5 February 2015; “Ukraine Crisis: A proving Ground for New weapons”; bbc.com/russian/russia/2015/02/150206_russia_ukraine_new_weapons.

780 Izvestiya; 25 August 2016; “Defense Ministry to Jam GPS from Cell Towers”; iz.ru/news/628766.

781 Monavista; 27 July 2021; “Defense Blog: In The Sky Over The Rostov Region The Electronic Warfare Of The RF Armed Forces Attacked A NATO Military Satellite”; monavista.ru.

782 Naval News; 28 November 2023; “Russia’s Powerful Invisible Defenses Around Sevastopol Rendered Visible”; navalnews.com/naval-news/2023/11/Russias-Powerful-Invisible-Defenses-Around-Sevastopol-Rendered-Visible.

783 The Moscow Times; 5 May 2023; “Russia Expands GPS Signal Jamming to 15 Regions”; themoscowtimes.com/2023/05/05/russia-expands-gps-signal-jamming-to-15-regions-a81049.

784 Kyiv Post Online; 19 January 2024; “Recent GPS failures in Poland and Baltic States blamed on Russian Electronic Warfare Trials”; kyivpost.com/post/26945.

785 Kyiv Post Online; 19 January 2024; “Recent GPS failures in Poland and Baltic States blamed on Russian Electronic Warfare Trials”; kyivpost.com/post/26945.

786 Rossiyskaya Gazeta; 15 October 2022; “Satellite Communications Killers: What Is Known About the Tirada and Rudolph Complexes”; rg.ru/2022/10/15/ubijcy-sputnikovoj-sviasi-chto-izvestno-o-kompleksah-tirada-i-rudolf.html.

787 Naval News; 28 November 2023; “Russia’s Powerful Invisible Defenses Around Sevastopol Rendered Visible”; navalnews.com/naval-news/2023/11/Russias-Powerful-Invisible-Defenses-Around-Sevastopol-Rendered-Visible.

788 Monavista; 27 July 2021; “Defense Blog: In the Sky over the Rostov Region the Electronic Warfare of the RF Armed Forces Attacked a NATO Military Satellite”; monavista.ru.

- 789 Interfax-AVN Online; 1 May 2015; "Russia has developed electronic warfare systems capable of 'hiding' Topol missiles' positioning areas from space reconnaissance"; militarynews.ru/story.asp?rid=1&nid=374975.
- 790 Defense Intelligence Agency; 28 June 2017; "Russia Military Power: Building a Military to Support Great Power Aspirations"; pp. 35-37, 41; dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Russia%20Military%20Power%20Report%202017.pdf.
- 791 The Irish Times; 19 May 2022; "Defunct Satellites are a hacker's paradise"; irishtimes.com/business/technology/defunct-satellites-are-a-hackers-paradise-1.4880920.
- 792 Izvestia; 24 December 2019; "Shoigu announced the deployment of Peresvet combat lasers has been completed"; iz.ru/957770/2019-12-24/shoigu-zaiavil-o-zavershenii-razvertyvaniia-boevykh-lazero-peresvet.
- 793 Interfax-AVN Online; 5 December 2018; "Peresvet combat laser can fight satellites – Russian Defense Ministry"; interfax.ru/russia/640821.
- 794 Nezavisimoye Voyennoye Obozreniye; 27 May 2021; "Star/Junk Wars: How to Blind the Enemy and Not Blind Yourself"; nvo.ng.ru/armament/2021-05-27/6_1142_wars.html.
- 795 Interfax; 28 December 2019; "Peresvet combat laser to be mounted on aircraft"; interfax.ru/russia/689740.
- 796 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 797 Redstar; 3 July 2020; "So that air supremacy remains ours"; redstar.ru/chtoby-gospodstvo-v-vozduhe-ostavalos-za-nami.
- 798 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 799 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 800 Baku Axar.az; 15 July 2022; "Russia is preparing a new weapon in the Caucasus mountain"; en.axar.az/news/world/660691.html.
- 801 The Conversation Blog; 7 August 2022; "Russia is reportedly building a laser that blinds satellites: Expert explains the technology"; theconversation.com/russians-reportedly-building-a-satellite-blinding-laser-an-expert-explains-the-technology-186890.
- 802 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 803 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 804 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 805 *Ordnance Knowledge*, No. 5; 1 May 2023; "Russian Kalina Anti-satellite Laser Weapon System"; pp. 42-47.
- 806 The Space Review; 5 July 2022; "Kalina – A Russian Ground-Based Laser to Dazzle Imaging Satellites"; thespacereview.com/article/4416/1.
- 807 *Ordnance Knowledge*, No. 5; 1 May 2023; "Russian Kalina Anti-satellite Laser Weapon System"; pp. 42-47.
- 808 Yezhenedelnik Zvezda; 29 September 2020; "How the military-industrial complex fulfills defense orders during the pandemic"; zvezdaweb.ru/news/2020922137-z8jnc.html.
- 809 Izvestiya; 19 April 2019; "Taking Aim at the Stars: What is Known About the New Anti-Satellite Weapons"; iz.ru/868986/aleksei-ramm/zvezdy-pod-pritcelom-cto-izvestno-o-novom-protivoputnikovom-oruzhii.
- 810 United States House Armed Services Committee; 21 April 2021; "United States Space Command Presentation to the Subcommittee on Strategic Forces, House Armed Services Committee, U.S. House of Representatives: Fiscal Year 2022 Priorities and Posture of the United States Space Command"; p. 6; docs.house.gov/meetings/AS/AS29/20210421/112467/HHRG-117-AS29-Wstate-DickinsonJ-20210421.pdf.
- 811 Moscow Gazeta; 28 July 2018; "Russia is creating a cutting-edge strategic weapon"; gazeta.ru/army/2018/07/28/11875339.shtml.
- 812 U.S. Space Command Public Affairs; 15 November 2021; "Russian direct-ascent anti-satellite missile test creates significant, long-lasting space debris"; spacecom.mil/news/article-display/article/2842957/russia-direct-ascent-anti-satellite-missile-creates-significant-long-last.
- 813 Moscow Gazeta; 19 June 2020; "Russia: Defense Industry Source Provides Delivery Schedule for S-500 Prometey, Nudol Systems"; gazeta.ru/army/2020/06/19/13123189.shtml.
- 814 The Space Review; 11 October 2021; "Aerostat: A Russian Long-Range Anti-Ballistic Missile System with Possible Counterspace Capabilities"; thespacereview.com/article/4262/1.

- 815 18th Space Defense Squadron; Space-Track.org; “Catalog”; space-track.org/catalog.
- 816 Popular Mechanics; 16 August 2018; “Is Russia’s Mysterious New Satellite a Space Weapon?”; popularmechanics.com/military/weapons/a22739471/is-russias-mysterious-new-satellite-a-space-weapon.
- 817 U.S. Department of State; 14 August 2018; “United States Remarks at the Conference on Disarmament as Delivered by Assistant Secretary of State for Arms Control, Verification, and Compliance”; geneva.usmission.gov/2018/08/14/remarks-by-assistant-secretary-yleem-d-s-poblete-at-the-conference-on-disarmament.
- 818 Interfax; 26 October 2017; “Russia Tests Military Satellite Capable of Approaching other Spacecraft – Newspaper”; militarynews.ru/story.asp?rid=1&nid=465067.
- 819 The Space Review; 27 April 2020; “Burevestnik: A Russian air-launched anti-satellite system”; thespacereview.com/article/3931/1.
- 820 U.S. Department of State; 14 August 2018; “United States Remarks at the Conference on Disarmament as Delivered by Assistant Secretary of State for Arms Control, Verification, and Compliance”; geneva.usmission.gov/2018/08/14/remarks-by-assistant-secretary-yleem-d-s-poblete-at-the-conference-on-disarmament.
- 821 Interfax; 26 October 2017; “Russia Tests Military Satellite Capable of Approaching other Spacecraft – Newspaper”; militarynews.ru/story.asp?rid=1&nid=465067.
- 822 Moscow RBK Online; 22 May 2024; “Why the US Accused Russia of Deploying Space Weapons”; rbc.ru/politics/22/05/2024/664d-fa289a79470ec44f28a4.
- 823 Time; 10 February 2020; “Exclusive: Strange Russian Spacecraft Following U.S. Spy Satellite”; time.com/5779315/russian-spacecraft-spy-satellite-space-force.
- 824 Interfax; 6 December 2019; “Russian military experts stage experiment in separating satellite from universal space platform”; interfax.ru/russia/686968.
- 825 Moscow RBK Online; 22 May 2024; “Why the US Accused Russia of Deploying Space Weapons”; rbc.ru/politics/22/05/2024/664d-fa289a79470ec44f28a4.
- 826 The Independent; 23 July 2020; “Russia accused of firing ‘weapon’ from satellite that could ‘threaten the peace of space’”; the-independent.com/news/world/russia-space-weapon-projectile-satellite-uk-us-a9635106.html.
- 827 The Sun – U.S. Edition; 16 February 2024; TSAR WARS: Is THIS the nuke Putin will launch into space amid fears Vlad’s planning to fire satellite-destroying ‘Cosmos 2543’; the-sun.com/news/10395955/putin-russia-nuclear-space-weapon-cosmos.
- 828 SatTrackCam Leiden; 2 August 2022; “Kosmos 2558, a Russian Inspector satellite targeting the US IMINT satellite USA 326?”; sattrackcam.blogspot.com/2022/08/kosmos-2558-russian-inspector-satellite.html.
- 829 Space.com; 18 August 2022; “Pentagon space chief condemns ‘irresponsible’ launch of Russian inspector satellite”; space.com/Russian-inspector-satellite-kosmos-2558-irresponsible-behavior.
- 830 Moscow RBK Online; 22 May 2024; “Why the US Accused Russia of Deploying Space Weapons”; rbc.ru/politics/22/05/2024/664d-fa289a79470ec44f28a4.
- 831 Ars Technica; 11 July 2025; “It’s hunting season in orbit as Russia’s killer satellites mystify skywatchers”; arstechnica.com/space/2025/07/its-hunting-season-in-orbit-as-russias-killer-satellites-mystify-skywatchers.
- 832 Breaking Defense; 30 May 2025; “Russia’s New Cosmos satellite orbiting near US sat, piques ASAT fears”; breakingdefense.com/2025/05/russias-new-cosmos-satellite-orbiting-near-us-sat-pires-asat-fears/.
- 833 Moscow Kommersant Online; 2 July 2025; “A spy is a godsend for an inspector”; www.kommersant.ru.
- 834 Office of Director of National Intelligence; 11 December 2020; “Support to U.S. Space Command Messaging”.
- 835 “The Space Review; 27 April 2020; “Burevestnik: a Russian air-launched anti-satellite system”; thespacereview.com/article/3931/1.”
- 836 NASA Space Flight; 29 April 2020; “Burevestnik– A New Russian ASAT”; p. 2; forum.nasaspaceflight.com/index.php?topic=45734.20.
- 837 Secure World Foundation; 13 July 2023; “Russian Direct Ascent Anti-Satellite Testing”; swfound.org/media/70369/swf-russia-da-asat-testing-may-2022.pdf.
- 838 NASA Space Flight; 29 April 2020; “Burevestnik – A New Russian ASAT”; p. 2; forum.nasaspaceflight.com/index.php?topic=45734.20.
- 839 Interfax-AVN; 17 September 2019; “Russia developing new inspector-satellite”; militarynews.ru/story.asp?rid=1&nid=517459&lang=ru.
- 840 United Nations Conference on Disarmament; 10 October 1967; “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies”; disarmament.un.org/t/treaties/t/outer_space.
- 841 White House Archives; 20 June 2024; “United States: On-the-Record Press Gaggle by White House National Security Communications Advisor John Kirby”; bidenwhitehouse.archives.gov/briefing-room/press-briefings/2024/06/20/on-the-re

cord-press-gaggle-by-white-house-national-security-communications-advisor-john-kirby-15.

842 U.S. Department of Defense and U.S. Department of Energy; 1977; "The Effects of Nuclear Weapons, Third Edition"; pp. 479, 487; govinfo.gov/content/pkg/govpub-d-purl-gpo106759.pdf.

843 Peel, Michael, Clive Cookson, and John Paul Rathbone. 25 February 2024. "How could nuclear weapons be used in space?"; ft.com/content/ea57d82c-e042-46d3-9989-ac1ef336766a.

844 U.S. Department of Defense and U.S. Department of Energy; 1977; "The Effects of Nuclear Weapons, Third Edition", pp. 518-519, 536, 538-539; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

845 Russian Ministry of Defense; 6 February 2022; "This is the first launch of the Soyuz-2 launch vehicle conducted in 2021 from the Plesetsk Cosmodrome"; z.mil.ru/spec_mil_oper/news/more.htm?id=12342072@egnews.

846 Wall Street Journal; 17 May 2024; "Moscow Puts Satellite in Space with Eye on Nuclear Weapon"; wsj.com/public/resources/documents/AyCGvmEaFnINTAINRiej-WSJNewsPaper-5-17-2024.pdf.

847 UN Digital Library; 2 December 2024; "Weapons of mass destruction in outer space resolution / adopted by the General Assembly; digitallibrary.un.org/record/4069200?ln=en.

848 Office of the Supreme Leader; 16 October 2006; "20-Year Vision of the Islamic Republic of Iran 1384-1404"; irandataportal.syr.edu/20-year-national-vision.

849 Tehran Times; 26 September 2018; "Space Tech-Domestic Industry Should be Connected – Minister"; tehrantimes.com/news/494004/Irans-space-prospect-Sending-humans-into-space.

850 Daily Mail Online; 16 Feb 2020; "Iran's beleaguered President Hassan Rouhani rules out resigning ahead of next week's general election - despite offering to step down twice since being elected"; dailymail.co.uk/news/article-8009917/irans-beleaguered-president-rouhani-rules-resigning.html.

851 Mehr News Online; 3 February 2024; "Iran: President: Iran Stands Among World's Top 10 Countries in Space Technology"; en.mehrnews.com/news/211622/Iran-among-top-10-countries-leading-space-industry-Raeisi.

852 Press TV; 5 February 2024; "Islamic Revolution at 45: Iranian space industry's phenomenal feats despite odds"; presstv.ir/detail/2024/02/05/719520/islamic-revolution-45-iranian-space-industry-phenomenal-rise-despite-odds.

853 Tehran Times; 21 January 2024; "Iran's space prospect: Sending humans into space"; tehrantimes.com/news/494004/Irans-space-prospect-Sending-humans-into-space.

854 War on the Rocks; 20 December 2021; "Iranian President Raisi's Renewed Emphasis on Space Is Likely to Create New Tensions"; warontherocks.com/2021/12/Iranian-president-raisi-renewed-emphasis-on-space-is-likely-to-create-new-tensions.

855 Trend News Agency; 7 January 2023, "Iran takes 1st step for implementing 10-year space plan"; en.trend.az/iran/3692086.html.

856 Islamic Republic News Agency; 7 January 2023; "Iran Takes 1st Step for Implementing 10-Year Space Plan"; en.irna.ir/news/84991863/Iran-takes-1st-step-for-implementing-10-year-space-plan.

857 War on the Rocks; 20 December 2021; "Iranian President Raisi's Renewed Emphasis on Space Is Likely to Create New Tensions"; warontherocks.com/2021/12/Iranian-president-raisi-renewed-emphasis-on-space-is-likely-to-create-new-tensions.

858 Islamic Republic News Agency; 7 January 2023; "Iran Takes 1st Step for Implementing 10-Year Space Plan"; en.irna.ir/news/84991863/Iran-takes-1st-step-for-implementing-10-year-space-plan.

859 Islamic Republic News Agency; 7 January 2023, "Iran Takes 1st Step for Implementing 10-Year Space Plan," en.irna.ir/news/84991863/Iran-takes-1st-step-for-implementing-10-year-space-plan.

860 Tehran Times; 22 January 2023; "Operational Stage of Gen. Soleimani Satellite Project Launched"; tehrantimes.com/news/481145/Operational-stage-of-Gen-Soleimani-satellite-project-launched.

861 Tehran Times; 12 February 2024; "Iran plans satellite launches from domestic stations in two years: minister"; tehrantimes.com/news/494810/iran-plans-satellite-launches-from-domestic-stations-in-two-years.

862 Islamic Republic News Agency; 18 February 2024; "Iran to put domestic satellites into GEO in next 10 years: Minister"; en.irna.ir/news/85390276/Iran-to-put-domestic-satellites-into-GEO-in-next-10-years-Minister.

863 Press TV; 5 February 2024; "Islamic Revolution at 45: Iranian space industry's phenomenal feats despite odds"; presstv.ir/detail/2024/02/05/719520/islamic-revolution-45-iranian-space-industry-phenomenal-rise-despite-odds.

864 Tehran Times; 23 January 2024; "IRGC offers satellite launch services to neighboring nations"; tehrantimes.com/news/494091/IRGC-offers-satellite-launch-services-to-neighboring-nations.

865 War on the Rocks; 20 December 2021; "Iranian President Raisi's Renewed Emphasis on Space Is Likely to Create New Tensions"; warontherocks.com/2021/12/Iranian-president-raisi-renewed-emphasis-on-space-is-likely-to-create-new-tensions.

- 866 Trend News Agency; 7 January 2023; "Iran takes 1st step for implementing 10-year space plan"; en.trend.az/iran/3692086.html.
- 867 Asharq Al-Aawsat – English Online; 7 December 2024; "Iran Sends Capsule Capable of Carrying Animals Into Orbit"; english.aawsat.com/world/4713106-iran-sends-capsule-capable-carrying-animals-orbit.
- 868 Iran Press Online; 14 December 2022; "Kish Airshow Expo; Iran Displays Crewed Space Capsule"; iranpress.com/Kish-Airshow-Expo-Iran-Displays-Crewed-Space-Capsule.
- 869 Position Magazine; 2 June 2008; "Iran's Ambition in Space"; parviztarkihi.wordpress.com/features-2/irans-ambitions-in-space.
- 870 Iran Space Research Center; 18 June 2019; "IRSC About Us"; isrc.ac.ir/ماگش‌ت‌پ‌ج‌راب‌رد.
- 871 Mehr News Online; 17 August 2019; "ISRC to Deliver Home-grown Pars-1 Satellite in Dec"; en.mehrnews.com/news/149004/ISRC-to-deliver-homegrown-Pars-1-Satellite-in-dec.
- 872 Tehran Times 14 November 2018; "Iran to Involve Private Sector in Space Projects"; tehrantimes.com/news/429570/iran-to-involve-private-sector-in-space-projects.
- 873 Tabnak; 13 January 2019; "Glance at Long Row of Iranian Satellites Ready for Launch – Plus Details"; tabnak.ir/fa/news/869789/.
- 874 Tasnim News Agency; 14 October 2023; "Chabahar Space Center Offers Promising Opportunities for Space Launches in Region"; tasnimnews.com/en/news/2023/10/14/2971692/chabahar-space-center-offers-promising-opportunities-for-space-launches-in-region.
- 875 Press TV; 5 February 2024; "Islamic Revolution at 45: Iranian space industry's phenomenal feats despite odds"; presstv.ir/detail/2024/02/05/719520/islamic-revolution-45-iranian-space-industry-phenomenal-rise-despite-odds.
- 876 Gunter's Space Page; 12 March 2020; "Safir"; space.skyrocket.eu/doc_lau/safir.htm.
- 877 Tabnak; 13 January 2019; "Glance at Long Row of Iranian Satellites Ready for Launch – Plus Details"; tabnak.ir/fa/news/869789/.
- 878 Mashregh News; 23 March 2020; "What is Iran Pursuing in Space?"; mashreghnews.ir/news/1054898/.
- 879 Press TV; 5 February 2024; "Islamic Revolution at 45: Iranian space industry's phenomenal feats despite odds"; presstv.ir/detail/2024/02/05/719520/islamic-revolution-45-iranian-space-industry-phenomenal-rise-despite-odds.
- 880 Daily News Egypt; 2 February 2024; "Iran Makes Historic Triple Satellite Launch Using Domestic Technology"; dailynewsegyp.com/2024/02/02/iran-makes-historic-triple-satellite-launch-using-domestic-technology.
- 881 AP News; 28 January 2024; "Iran launches 3 satellites into space that are part of a Western-criticized program as tensions rise"; apnews.com/article/iran-satellite-launch-us-ballistic-missiles-israel-hamas-74bcd3eb7e48a31be4f52b8d86d24721.
- 882 IUS News; 2 February 2024; "Iran Reveals Number of Indigenous Satellites in Space"; iusnews.ir/en/news-details/495284/iran-reveals-number-of-indigenous-satellites-in-space.
- 883 Tasnim; 13 November 2023; "An Overview of Iran's Advanced Space Endeavors"; tasnimnews.com/en/news/2023/11/13/2987991/an-overview-of-iran-s-advanced-space-endeavors.
- 884 Rose al-Yusuf Online; 06 April 2025; "Iran begins disrupting US preparations for attack"; www.rosaelyoussef.com/1286284; www.rosaelyoussef.com/1286284.
- 885 Press TV Online; 08 December 2024; "Explainer: Why is launch of Simorgh and Fakhr-1 breakthrough for Iran's space industry?"; www.presstv.ir/Detail/2024/12/07/738646/explainer-why-is-the-launch-of-simorgh-and-fakhr-1-a-new-space-breakthrough.
- 886 Tasnim News; 28 March 2020; "Get Familiar with Iranian Satellite Launch Vehicles"; tasnimnews.com/fa/news/1399/01/09/2232058.
- 887 Space Rockets Blog; 8 May 2022; b14643.eu/spacerockets_1/Rest-of-World/qased-IRGC/Description/Frame.html.
- 888 NASA Spaceflight; 8 March 2022; "Iran Carries Out Military Launch with Qased Rocket and Noor-2 Satellite"; nasaspaceflight.com/2022/03/iran-military-qased-noor-2.
- 889 Tasnim; 13 November 2023; "An Overview of Iran's Advanced Space Endeavors"; tasnimnews.com/en/news/2023/11/13/2987991/an-overview-of-iran-s-advanced-space-endeavors.
- 890 Sputnik Online; 1 January 2024; "Iran's Khayyam Satellite Turns Nation Into Remote Sensing Heavyweight"; sputnikglobe.com/20240102/irans-khayyam-satellite-turns-nation-into-remote-sensing-heavyweight-1115948426.html.
- 891 Tasnim; 23 January 2024; "IRGC Ready to Launch Foreign Satellites"; tasnimnews.com/en/news/2024/01/23/3027664/irgc-ready-to-launch-foreign-satellites.
- 892 Tasnim; 23 January 2024; "IRGC Ready to Launch Foreign Satellites"; tasnimnews.com/en/news/2024/01/23/3027664/irgc-ready-to-launch-foreign-satellites.

893 TendersInfo – News; 10 February 2024; “United Kingdom: Iran’s Soraya satellite launch: E3 joint statement”; gov.uk/government/news/irans-soraya-satellite-launch-e3-joint-statement.

894 Xinhua; 22 April 2020; “Iran ‘successfully’ puts 1st military satellite in orbit”; xinhuanet.com/english/2020-04/22/c_138999480.htm.

895 Gunter’s Space Page; 12 March 2020; “Simorgh (Safir-2)”; space.skyrocket.eu/doc_lau/simorgh.htm.

896 Spaceflight Now; 22 April 2020; “Iran Places Military Satellite in Orbit”; spaceflightnow.com/2020/04/22/iran-places-military-satellite-in-orbit.

897 Financial Tribune; 4 February 2020; “Islamic Republic Working on Two Small Satellite Launch Vehicles”; financialtribune.com/articles/sci-tech/102021/islamic-republic-working-on-two-satellite-launch-vehicles.

898 Seradata Ltd (Space Equipment Research & Analysis); 22 April 2020; “Iran launches new Qased rocket type with Noor military sat aboard”; seradata.com/iran-launches-new-qased-rocket-type-with-noor-military-sat-aboard.

899 The Verge; 22 April 2020; “Iran claims it has successfully launched a military satellite”; theverge.com/2020/4/22/21230847/iran-military-satellite-rocket-launch-islamic-revolutionary-guard-corps.

900 Seradata Ltd (Space Equipment Research & Analysis); 22 April 2020; “Iran launches new Qased rocket type with Noor military sat aboard”; seradata.com/iran-launches-new-qased-rocket-type-with-noor-military-sat-aboard.

901 Tehran Times; 18 May 2024; “IRGC To Launch Ghaem 105 Satellite”; tehrantimes.com/news/498676/IRGC-to-launch-Ghaem-105-satellite-carrier.

902 Tasnim; 23 January 2024; “IRGC Ready to Launch Foreign Satellites”; tasnimnews.com/en/news/2024/01/23/3027664/irgc-ready-to-launch-foreign-satellites.

903 Iran Military Forum; 15 February 2020; “Qaem solid propellant space launcher”; iran-military.com/index.php?threads/qaem-solid-propellant-space-launcher.1537.

904 Center for Strategic and International Studies; 20 March 2020; “Space Threat Assessment 2020”; p. 30; aerospace.csis.org/sta2020.

905 Jane’s Intelligence Review; 14 April 2011; “Republic space – Iran’s satellite programme accelerates”;

906 World Politics Review; 29 September 2016; “Don’t Count Iran’s Nascent Space Capabilities Out”; www.worldpoliticsreview.com/

[trend-lines/20067/don-t-count-iran-s-nascent-space-capabilities-out](https://www.worldpoliticsreview.com/trend-lines/20067/don-t-count-iran-s-nascent-space-capabilities-out).

907 Kayhan News Online; 10 March 2025; “Salmas and Chenaran ground stations to be operational next year”; <https://kayhan.ir/200CAW>

908 Mashregh News; 13 January 2025; “Zafar 2 and Paya satellites to be launched early next year with foreign launcher”; www.mashregh-news.ir

909 Mashregh News; 30 March 2020; “Report Examines Range of Satellite Carrier Rockets, Progress on New Designs, Bases”; www.mashreghnews.ir

910 Arms Control Wonk; 13 February 2026; “A Chabahar Check-In”; armscontrolwonk.com/archive/1221442/a-chabahar-check-in/.

911 Khabar Online; 16 September 2024; “Important news of the high-ranking commander of the IRGC regarding space programs in the future / Hajizadeh’s quote from Pezeshkian about space activities”; khabaronline.ir

912 Tasnim; 23 January 2024; “IRGC Ready to Launch Foreign Satellites”; tasnimnews.com/en/news/2024/01/23/3027664/irgc-ready-to-launch-foreign-satellites.

913 TendersInfo – News; 10 February 2024; “United Kingdom: Iran’s Soraya satellite launch: E3 joint statement”; gov.uk/government/news/irans-soraya-satellite-launch-e3-joint-statement.

914 Center for Strategic and International Studies; April 2024; “Space Threat Assessment 2024”; csis-website-prod.s3.amazonaws.com/s3fs-public/2024-04/240417_swope_space_threat_0.pdf?versionid=ddej0ekynf5w7pofmjvhvgjkxevetx3o0.

915 The New Arab; 11 March 2024; “Why Middle East space geopolitics are back in the spotlight”; newarab.com/analysis/why-middle-east-space-geopolitics-are-back-spotlight.

916 The Jerusalem Post; 5 March 2024; “Islamic Republic claims new satellite launch from Russia”; jpost.com/middle-east/iran-news/article-789588.

917 Sputnik Online; 1 January 2024; “Iran’s Khayyam Satellite Turns Nation into Remote Sensing Heavyweight”; sputnikglobe.com/20240102/irans-khayyam-satellite-turns-nation-into-remote-sensing-heavyweight-1115948426.html.

918 Sputnik Online; 1 January 2024; “Iran’s Khayyam Satellite Turns Nation into Remote Sensing Heavyweight”; sputnikglobe.com/20240102/irans-khayyam-satellite-turns-nation-into-remote-sensing-heavyweight-1115948426.html.

919 Sputnik Online; 1 January 2024; “Iran’s Khayyam Satellite Turns Nation into Remote Sensing Heavyweight”; sputnikglobe.com/

com/20240102/irans-khayyam-satellite-turns-nation-into-remote-sensing-heavyweight-1115948426.html.

920 Sputnik Online; 1 January 2024; "Iran's Khayyam Satellite Turns Nation into Remote Sensing Heavyweight"; sputnikglobe.com/20240102/irans-khayyam-satellite-turns-nation-into-remote-sensing-heavyweight-1115948426.html.

921 TASS; 25 August 2015; "Russia to create satellite for remote sensing of the Earth for Iran"; tass.ru/kosmos/2210115.

922 VNIIEM; 25 August 2015; "Agreement on Establishing a DZZ SC for the Iranian Republic"; vniiem.ru/ru/index.php?option=com_content&view=article&id=718:2015-08-26-04-14-18&catid=36:2008-03-09-13-50-48&Itemid=50.

923 TASS; 5 October 2023; "Iran plans talks with Russia to build new satellite – report"; tass.com/science/1684837.

924 Russian Space Web; 29 February 2024; "Soyuz Launches a Weather Satellite and 18 Hitchhikers"; russianspaceweb.com/meteor-m2-4.html.

925 Kyiv Independent; 16 January 2024; "ISW: Russia, Iran Preparing to Sign Treaty to Develop Military-Technological Cooperation"; kyivindependent.com/isw-russia-iran-preparing-to-sign-treaty-to-develop-military-technological-cooperation.

926 TASS; 28 November 2023; "Iran Ready to Boost Space Cooperation with Russia, Embassy Official Says"; tass.com/science/1713107.

927 Financial Tribune; 18 September 2017; "Iran Plans to Join 2 APSCO Projects"; financialtribune.com/articles/economy-sci-tech/72519/iran-plans-to-join-2-apsco-projects.

928 Asia-Pacific Space Cooperation Organization; 27 March 2019; "Introduction to APSCO: Convention History"; apSCO.int/sitesearchOne.asp?ID=76.

929 Tehran Times; 23 June 2018; "Iranian Space Agency Seeks Further Co-op With APSCO"; tehrantimes.com/news/424664/iranian-space-agency-seeks-further-co-op-with-apsco.

930 Wall Street Journal; 6 June 2024; "Iran Taps China for Fuel for Ballistic Missiles"; wsj.com/world/iran-orders-material-from-china-for-hundreds-of-ballistic-missiles-1e874701.

931 New York Times; 31 October 2023; "In Cyberattacks, Iran Shows Signs of Improved Hacking Capabilities"; nytimes.com/2023/10/31/world/middleeast/iran-israel-cyberattacks.html.

932 Tasnim; 31 August 2018; "DM: Iran to Give Crushing Response to Enemies Space Threats"; tasnimnews.com/fa/news/1397/06/09/1816755/

933 Radio Farda Online; 14 July 2018; "Iran's Jamming of Foreign TV Signals Harmful to People's Health"; en.radiofarda.com/amp/iran-satellite-jamming-health/29364815.html.

934 Tasnim; 26 September 2018; "Iran Unveils New Achievements in Drone Industry"; tasnimnews.com/fa/news/1397/07/04/1837768/

935 Center for Strategic and International Studies; 20 March 2020; "Space Threat Assessment 2020"; pp. 32-33; aerospace.csis.org/sta2020.

936 SpaceWatch.Global; 3 September 2016; "Iran and APSCO to create a space situational awareness network"; spacewatch.global/2016/09/iran-apsco-create-space-situational-awareness-network.

937 Radio Farda Online; 14 July 2018; "Iran's Jamming of Foreign TV Signals Harmful To People's Health"; en.radiofarda.com/amp/iran-satellite-jamming-health/29364815.html.

938 Tasnim; 26 September 2018; "Iran Unveils New Achievements in Drone Industry"; tasnimnews.com/fa/news/1397/07/04/1837768/.

939 Center for Strategic and International Studies; 20 March 2020; "Space Threat Assessment 2020"; pp. 32-33; aerospace.csis.org/sta2020.

940 Iran Electronics Industries; 12 January 2011; "L-Band Jammer, LBJ-50 & LBJ-200"; ieimil.ir/products/l-band-jammer-lbj-50-lbj-200.

941 Iran Electronics Industries; 12 January 2011; "GPS Jammer (GPSJ-10)"; ieimil.ir/products/gps-jammer-gpsj-10.

942 Iran Electronics Industries; 12 January 2011; "GPS Jammer (GPSJ-25)"; ieimil.ir/products/gps-jammer-gpsj-25.

943 Iran Electronics Industries; 12 January 2011; "GPS Jammer (GPSJ-40)"; ieimil.ir/products/gps-jammer-gpsj-40.

944 Iran Electronics Industries; 12 January 2011; "GPS Jammer (GPSJ-50)"; ieimil.ir/products/gps-jammer-gpsj-50.

945 Rose al-Yusuf Online; 06 April 2025; "Iran begins disrupting US preparations for attack"; www.rosaelyoussef.com/1286284

946 Airspace Review; 7 April 2025; "Facing US threats, Iran deploys mobile electronic warfare systems in Persian Gulf and Strait of Hormuz"; www.airspace-review.com/2025/04/07/hadapi-an-caman-as-iran-kerahkan-sistem-peperangan-elektronik-bergerak-di-teluk-persia-dan-selat-hormuz.

947 Drummond, Michael; 8 June 2026; "Everyone is doing it: The dark art of GPS jamming in the Iran war"; news.sky.com/story/everyone-is-doing-it-the-dark-art-of-gps-jamming-in-the-iran-war-13542156.

948 Irregular Warfare Center; 4 May 2026; "Operation Epic Fury/Roaring Lion is an IW Showcase"; irregularwarfarecenter.org/wp-content/uploads/1-07_Operation-Epic-Fury-Roaring-Lion.pdf

949 Mashregh News; 22 March 2025; "Achievements of the IRGC Ground Force in 1403: From ballistic missiles to various types of drones"; www.mashreghnews.ir;

950 Fars News Agency; 13 February 2025; "Focusing on the development of defense technologies, increasing the accuracy of weapons, military self-sufficiency, and future research are the most important drivers that can bring the country's military industries to higher levels of deterrence and defense power"; farsnews.ir/kamran_shirazi/1739433118513898807.

951 Office of the Secretary of Defense; 5 January 2016; "Report to Congress: Military and Security Developments Involving the Democratic People's Republic of Korea 2015"; pp. 4, 10, 13, 19; hsdl.org/?view&did=790165.

952 Center for Strategic and International Studies; 20 March 2020; "Space Threat Assessment 2020"; pp. 35-36; aerospace.csis.org/sta2020.

953 Newsweek; 30 October 2017; "Star Wars: North Korea Unveils Five-Year-Plan to Conquer Space"; newsweek.com/star-wars-north-koreas-unveils-5-year-plan-conquer-space-695896.

954 Defense Intelligence Ballistic Missile Analysis Committee and the National Air and Space Intelligence Center; June 2017; "Ballistic and Cruise Missile Threat 2017"; p. 27; nasic.af.mil/Portals/19/images/Fact%20Sheet%20Images/2017%20Ballistic%20and%20Cruise%20Missile%20Threat_Final_small.pdf.

955 38 North; 12 September 2012; "North Korea's Satellite Program"; 38north.org/2012/09/nhansen091212.

956 Nautilus Institute for Security and Sustainability; 21 October 2021; "APLN Space Engagement and Cooperation with the Democratic People's Republic of Korea – Is it Feasible"; pp. 7, 9, 10, 11; nautilus.org/napsnet/napsnet-special-reports/space-engagement-and-cooperation-with-the-dprk.

957 38 North; 21 April 2023; "North Korea's Space Agency at Ten"; pp. 1-3; 38north.org/2023/04/north-koreas-space-agency-at-ten.

958 Agence France Presse (Yahoo News Reprint); 2 February 2016; "N. Korea confirms Imminent Satellite Launch"; news.yahoo.com/n-korea-issues-shipping-warning-satellite-launch-imo-152605329.html.

959 North Korea News; 11 October 2021; "North Korea boasts of 'full-scale' work towards space capabilities"; www.nknews.org/2021/10/north-korea-boasts-of-full-scale-work-towards-new-space-capabilities.

960 NK News; 22 November 2023; "North Korea Says It Successfully Placed Military Spy Satellite into Orbit"; pp. 1, 3; nknews.org/2023/11/north-korea-says-it-successfully-placed-military-spy-satellite-into-orbit.

961 VOA News Online; 29 November 2023; "North Korea: Leader Kim Views Photos Captured by New Reconnaissance Satellite"; p. 1; voanews.com/a/north-korea-s-kim-inspects-spy-satellite-photos-of-target-regions-/7369408.html.

962 Yonhap News Agency; 3 December 2023; "N. Korea's spy satellite operation office begins mission: state media"; en.yna.co.kr/view/AEN20231203000500315.

963 Reuters; 8 October 2016; "Images show activity at North Korea satellite launch site: report"; yahoo.com/news/images-show-activity-north-korea-satellite-launch-report-195718806.html.

964 Center for Strategic and International Studies; 17 December 2019; "December 2019 Update: Tonghae Satellite Launching Ground"; beyondparallel.csis.org/december-2019-update-tonghae-satellite-launching-ground.

965 IISS and CENESS; 14 July 2021; "DPRK Strategic Capabilities and Security on the Korean Peninsula: Looking Ahead"; www.iiss.org/research-paper/2021/07/dprk-strategic-capabilities-security-korean-peninsula/

966 38 North; 7 June 2023; "First Flight of North Korea's Chollima-1 SLV Fails but More Launches and More New SLVs are Likely"; pp. 1, 4; 38north.org/2023/06/first-flight-of-north-koreas-chollima-1-slv-fails-but-more-launches-and-more-new-slvs-are-likely.

967 NK News; 22 November 2023; "North Korea Says It Successfully Placed Military Spy Satellite into Orbit"; pp. 1, 3; nknews.org/2023/11/north-korea-says-it-successfully-placed-military-spy-satellite-into-orbit.

968 Fresh News Asia; 3 January 2024; "Report on 9th Enlarged Plenum of 8th WPK Central Committee"; m.en.freshnewsasia.com/index.php/en/localnews/44185-2024-01-03-03-18-17.html.

969 Associated Press; 27 May 2024; "North Korean Rocket Carrying its 2nd Spy Satellite Explodes Shortly After Launch"; apnews.com/article/north-korea-missile-japan-28efd0f15318594fdcf5ec8f-416c196b.

970 38 North; 21 April 2023; "North Korea's Space Agency at Ten"; pp. 1-3; 38north.org/2023/04/north-koreas-space-agency-at-ten.

971 Seoul DailyNK; 20 October 2023; "South Korean NGO: N. Korea completes reorganization of National Aerospace Technology Administration"; dailynk.com/english/north-korea-completes-reorganization-National-Aerospace-Technology-Administration.

- 972 Seoul DailyNK; 20 October 2023; “South Korean NGO: N. Korea completes reorganization of National Aerospace Technology Administration”; dailynk.com/english/north-korea-completes-reorganization-National-Aerospace-Technology-Administration.
- 973 38 North; 21 April 2023; “North Korea’s Space Agency at Ten”; pp. 1-3; 38north.org/2023/04/north-koreas-space-agency-at-ten.
- 974 Center for Strategic and International Studies; 14 April 2023; “Space Threat Assessment 2023”; aerospace.csis.org/wp-content/uploads/2023/04/230414_Bingen_SpaceThreatAssessment_2023_UPDATED-min.pdf.
- 975 Yonhap News Agency; 14 September 2017; Chronology of North Korea’s missile, rocket launches; en.yna.co.kr/view/aen20240527004500315.
- 976 Yonhap News Agency; 21 November 2023; “Yonhap: Chronology Of North Korea’s Space Vehicle Launches”; en.yna.co.kr/view/aen20240527004500315.
- 977 War on the Rocks; 13 November 2023; “Is Military Space-Based Jamming Normal? Some Worry It Is”; warontherocks.com/2023/11/is-military-space-based-jamming-normal-some-worry-it-is.
- 978 North Korea Tech; 17 November 2012; “Report: DPRK Jams South Korean Satellite Comms”; northkoreatech.org/2012/11/17/report-dprk-jams-south-korean-satellite-comms.
- 979 United Press International; 31 March 2016; “North Korea Jamming GPS Signals in South; Can Affect Planes, Cellphones”; upi.com/Top_News/World-News/2016/03/31/North-Korea-jamming-GPS-signals-in-South-can-affect-planes-cellphones/2551459443059.
- 980 Secure World Foundation; April 2024; “Global Counterspace Capabilities – An Open Source Assessment”; swfound.org/media/207826/swf_global_counterspace_capabilities_2024.pdf.
- 981 Security Affairs Blog; 19 November 2020; “Nation-state Actors from Russia, China, Iran, and North Korea Target Canada”; securityaffairs.co/wordpress/111182/cyber-warfare-2/canada-nation-state-actors.html.
- 982 U.S. Department of Health and Human Services; 25 March 2021; “North Korean Cyber Activity”; hhs.gov/sites/default/files/north-korean-cyber-activity.pdf.
- 983 Zero Day Net; 30 July 2020; “US defense and aerospace sectors targeted in new wave of North Korean attacks”; zdnet.com/article/us-defense-and-aerospace-sectors-targeted-in-new-wave-of-north-korean-attacks.
- 984 NK News; 19 June 2020; “North Korean hackers targeted aerospace, defense companies via LinkedIn: experts”; nknews.org/2020/06/north-korean-hackers-targeted-aerospace-defense-companies-via-linkedin-experts.
- 985 Center for Strategic and International Studies; 20 March 2020; “Space Threat Assessment 2020”; p. 38; aerospace.csis.org/sta2020.
- 986 Nautilus Institute for Security and Sustainability; 21 October 2021; “APLN Space Engagement and Cooperation with the Democratic People’s Republic of Korea – Is it Feasible”; pp. 7, 9, 10, 11; nautilus.org/napsnet/napsnet-special-reports/space-engagement-and-cooperation-with-the-dprk.
- 987 Nautilus Institute for Security and Sustainability; 21 October 2021; “APLN Space Engagement and Cooperation with the Democratic People’s Republic of Korea – Is it Feasible”; pp. 7, 9, 10, 11; nautilus.org/napsnet/napsnet-special-reports/space-engagement-and-cooperation-with-the-dprk.
- 988 Barron’s Online; 2 December 2023; “North Korea Threatens to Destroy U.S. Spy Satellites”; barrons.com/news/north-korea-threatens-to-destroy-us-spy-satellites-88bc7c63.
- 989 Associated Press; 20 November 2024; “North Korea Launches A Rocket In What May Be Its Third Attempt To Put A Spy satellite Into Orbit”; p. 2; apnews.com/article/north-korea-spy-satellite-japan-5e16266707e0e4034eca022fde44ffa7.
- 990 Yonhap News Agency; 19 June 2024; “Yonhap: Putin, N. Korea’s Kim Start Summit Talks Amid Concerns Over Deepening Military Cooperation”; en.yna.co.kr/view/AEN20240619001800315.
- 991 China Aerospace Studies Institute; 2 October 2022; “China’s Space Narrative”; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 992 China Academy of Space Technology; 7 March 2018; “Strong Space Power: ‘Our journey is the Sea of Stars’”; cast.cn/3g/show.asp?m=1&d=6281.
- 993 Xinhua; 19 October 2017; “Fu Yifei: China Became a Space Power in 2020, More than 200 Orbiting Spacecraft, Annual Launch 30 Times”; xinhuanet.com/politics/2017-10/19/c_1121823300.htm.
- 994 Xinhua; 27 June 2019; “CASC: To Strive to Push China to Forward Ranks of Strong Space Powers by 2030”; xinhuanet.com/science/2019-06/27/c_138177326.htm.
- 995 IEEE; 23 November 2021; “Cost Estimation Model For Mega Constellation Deployment Missions”; ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9625940.
- 996 China Aerospace Studies Institute; 2 October 2022; “China’s Space Narrative”; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 997 China Academy of Space Technology; 7 March 2018; “Strong Space Power: ‘Our journey is the Sea of Stars’”; cast.cn/3g/show.asp?m=1&d=6281.

- 998 China Daily Online; 30 August 2018; “CASC Clarifies Building a Strong Space Power with a Roadmap”; chinadaily.com.cn/interface/toutiaonew/53002523/2018-08-30/cd_36846561.html.
- 999 Xinhua; 19 October 2017; “Fu Yifei: China Became a Space Power in 2020, More than 200 Orbiting Spacecraft, Annual Launch 30 Times”; xinhuanet.com/politics/2017-10/19/c_1121823300.htm.
- 1000 Xinhua; 27 June 2019; “CASC: To Strive to Push China to Forward Ranks of Strong Space Powers by 2030”; xinhuanet.com/science/2019-06/27/c_138177326.htm.
- 1001 China Aerospace Studies Institute; 2 October 2022; “China’s Space Narrative”, p. 16; airuniversity.af.edu/casi/display/article/2369900/chinas-space-narrative.
- 1002 Xinhua; 27 January 2024; “China’s Kuaizhou Reusable Rocket Completes VTOL Test”; english.news.cn/20240127/bc1a5c65c09a-429ea218f4d4179d021d/c.html#:~:text=beijing%2c%20jan.%2027%20(xinhua)%20%2d%20a%20test,and%20industry%20corporation%20limited%2c%20used%20a%20liquid.
- 1003 TASS; 27 March 2024; “Construction of the Site for the Reusable Amur-LNG Rocket Can Begin in 2026”; tass.ru/interviews/20357351.
- 1004 Space News; 6 October 2021; “Japanese carmaker Honda developing reusable rocket for LEO satellites”; spacenews.com/japanese-carmaker-honda-developing-reusable-rocket-for-leo-satellites.
- 1005 Space.com; 6 October 2023; “Spanish Company PLD Space Launches Rocket For 1st Time”; space.com/pld-space-first-launch-miura-1-rocket.
- 1006 Interfax; 3 October 2023; “The Korona and Amur-SPG reusable rocket projects have attracted interest from foreign partners – head of Roscosmos”; interfax-russia.ru/rossiya-i-mir/proekty-mnogorazovyyh-raket-korona-i-amur-spg-vyzvali-interes-u-inostrannyh-partnerov-glava-roskosmosa.
- 1007 Interfax; 28 January 2025; “Russia’s Roscosmos set to develop Amur-SPG reusable rocket by 2030”; interfax.com/newsroom/top-stories/109417.
- 1008 Interfax; 28 January 2025; “Russia’s Roscosmos set to develop Amur-SPG reusable rocket by 2030”; interfax.com/newsroom/top-stories/109417.
- 1009 Izvestiya Online; 26 April 2024; “A variant of reusable use of Angara launch vehicles has been proposed: General Designer of the V.M. Myasishchev Salyut Design Bureau Sergey Kuznetsov on the development of the new Russian heavy rocket and its modifications”; iz.ru/1687603/andrei-korshunov/predlozhen-variant-mnogorazovogo-ispolzovaniia-raket-nositelei-angara.
- 1010 Interfax; 3 October 2023; “The Korona and Amur-SPG reusable rocket projects have attracted interest from foreign partners – head of Roscosmos”; interfax-russia.ru/rossiya-i-mir/proekty-mnogorazovyyh-raket-korona-i-amur-spg-vyzvali-interes-u-inostrannyh-partnerov-glava-roskosmosa.
- 1011 Interfax; 30 June 2020; “Angara rocket may get reusable stages – Roscosmos (Part 2)”; interfax.com/newsroom/top-stories/69173.
- 1012 Space Daily; 15 December 2023; “China’s Shenlong space plane embarks on another secretive mission in space”; spacedaily.com/reports/Chinas_Shenlong_space_plane_embarks_on_another_secretive_mission_in_space_999.html.
- 1013 China Daily Online; 14 December 2023; “China Sends Reusable Experimental Spacecraft into Orbit”; chinadaily.com.cn/a/202312/14/WS657b14a4a31040ac301a7d8f.html.
- 1014 China Aerospace Science and Technology Corporation; 25 August 2022; “My Country’s Suborbital Vehicle Reusable Flight Test a Complete Success”; mp.weixin.qq.com/s/ngOK_mUFar4hb-ZFqVW6-g.
- 1015 Space News; 6 November 2023; “LeoLabs data shows on-orbit maneuvers by Russian satellites”; spacenews.com/leolabs-datta-shows-on-orbit-maneuvers-by-russian-satellites.
- 1016 Breaking Defense Online; 12 December 2023; “LeoLabs: Russia, China time suspicious space activity for some US holidays”; breakingdefense.com/2023/12/leolabs-russia-china-time-suspicious-space-activity-for-some-us-holidays.
- 1017 X post; 8 February 2023; “ATTN: Our *Preliminary* Analysis of the Cosmos 2499 Fragmentation Event (using LeoLabs LeoRisk) Points toward a Low Intensity Explosion with Moderate Confidence”; x.com/LeoLabs_Space/status/1623387025725353985.
- 1018 China Daily Online; 14 December 2023; “China Sends Reusable Experimental Spacecraft into Orbit”; chinadaily.com.cn/a/202312/14/WS657b14a4a31040ac301a7d8f.html.
- 1019 Space News; 6 September 2024; China’s secretive reusable spaceplane lands after 267 days in orbit; spacenews.com/chinas-secretive-reusable-spaceplane-lands-after-267-days-in-orbit.
- 1020 NBC News Online; 10 June 2005; “Russia ready to take lead on space station”; nbcnews.com/id/wbna8148275.
- 1021 Buran-Energia Blog; 7 Jul 2010; “Roscosmos will not revive Buran”; buran-energia.com/blog/2010/07/07/roscomos-will-not-revive-buran.
- 1022 TASS; 29 May 2019; “Russian Space Tourism Firm to Send Dummy for First Flight in Returnable Capsule”; tass.com/science/1060575.

1023 Kyodo News; 1 September 2018; “Japanese Startup aims for Commercial Space Travel in 2023”; english.kyodonews.net/news/2018/09/8203d9fff78c-japanese-startup-aims-for-commercial-space-travel-in-2023.html.

1024 Space Daily; 9 June 2024; “Virgin Galactic Completes Final Spaceflight Before Two-Year Pause”; spacedaily.com/reports/Virgin_Galactic_completes_final_spaceflight_before_two-year_pause_999.html.

1025 Moscow Kommersant Online; 23 January 2024; “Russia will create a spaceplane for flights to the national orbital station”; kommersant.ru/doc/6465952.

1026 Center for Strategic and International Studies; 21 May 2024; “Space, Speed, and Sovereignty: Hypersonic Tensions in the Southern Hemisphere”; pp. 1-7; csis.org/analysis/space-speed-and-sovereignty-hypersonic-tensions-southern-hemisphere.

1027 Bulletin of Atomic Scientists; 13 June 2023; “Orbital hypersonic delivery systems threaten strategic stability”; pp. 1-4; thebulletin.org/2023/06/orbital-hypersonic-delivery-systems-threaten-strategic-stability.

1028 Bulletin of Atomic Scientists; 13 June 2023; “Orbital hypersonic delivery systems threaten strategic stability”; pp. 1-4; thebulletin.org/2023/06/orbital-hypersonic-delivery-systems-threaten-strategic-stability.

1029 IEEE; 22 December 2023; “Tendencies and Challenges of Artificial Intelligence Development and Implementation”; 12th International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS); ieeexplore.ieee.org/document/10348800.

1030 Center for Naval Analyses; 21 May 2021; “Artificial Intelligence and Autonomy in Russia”; cna.org/reports/2021/05/Artificial-Intelligence-and-Autonomy-in-Russia.pdf.

1031 China Military Online; 30 January 2016; “The dawn of intelligent military revolution is emerging”; 81.cn/jskj/2016-01/28/content_6871858.htm.

1032 Changsha Guofang Keji; 11 February 2021; “The Application of Artificial Intelligence in the Process of US Military Kill Chain.”

1033 Krasnaya Zvezda Online; 24 June 2019; “Artificial Intelligence Means Both Risks and Opportunities”; redstar.ru/iskusstvennyj-intellekt-eto-i-riski-i-vozmozhnosti/?attempt=1.

1034 Center for Naval Analyses; 15 January 2021; “Artificial Intelligence In Russia”; cna.org/reports/2021/05/Artificial-Intelligence-and-Autonomy-in-Russia.pdf.

1035 Changsha Guofang Keji; 11 February 2021; “The Application of Artificial Intelligence in the Process of US Military Kill Chain.”

1036 China Military Online; 30 January 2016; “The dawn of intelligent military revolution is emerging”; 81.cn/jskj/2016-01/28/content_6871858.htm.

1037 Changsha Guofang Keji; 11 February 2021; “The Application of Artificial Intelligence in the Process of US Military Kill Chain.”

1038 Modern Defense Technology; 2023; “Applications of Artificial Intelligence in Space Equipment”; pp. 33-42.

1039 *National Defense Technology Journal*, Vol. 41, No. 2; April 2020; “Application of Artificial Intelligence in Space Defense”; pp. 5-9.

1040 *Journal of Astronautics*; 2023; “An Intelligent Guidance Algorithm for GEO Space Debris Removal Mission”; 719-723.

1041 Military Digest Magazine; 6 October 2023; “The ‘Achilles’ Heel’ of Algorithmic Warfare”; pp. 38-41.

1042 PLA Daily: Military Forum; 15 March 2022; “Battlefield entropy increase from the perspective of ‘OODA’”; 81.cn/jfjbmap/content/2022-03/15/content_311328.htm.

1043 Changsha Guofang Keji; 11 February 2021; “The Application of Artificial Intelligence in the Process of US Military Kill Chain.”

1044 Federal Communications Commission; November 2019; “U.S. Government Orbital Debris Mitigation Standard Practice”; orbital-debris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf.

1045 Inter-Agency Space Debris Coordination Committee (IADC); September 2007; “IADC Space Debris Mitigation Guidelines”; orbit-aldebris.jsc.nasa.gov/library/iadc_mitigation_guidelines_rev_1_sep07.pdf.

1046 National Aeronautics and Space Administration; 27 January 2021; “NASA’s Efforts to Mitigate the Risks Posed by Orbital Debris”; oig.nasa.gov/docs/ig-21-011.pdf.

1047 European Space Operations Centre (ESOC); 29 September 2020; “ESA’s Annual Space Environment Report”; pp. 68-71; sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf.

1048 18th Space Control Squadron; “Box Score”; space-track.org.

1049 AIAA; 30 December 2019; “Spacecraft Collision Avoidance Using Aerodynamic Drag”; arc.aiaa.org/doi/10.2514/1.g004518.

1050 18th Space Defense Squadron; “Catalog”; space-track.org/catalog.

1051 *The Journal of Space Safety Engineering*, Vol. 104; International Association for the Advancement of Space Safety (IAASS) Space Safety Conference, Los Angeles, CA; May 2019; “The Global Risk

Continuum (GRC”); researchgate.net/publication/339287399_The_global_risk_continuum_GRC.

1052 *The Journal of Space Safety Engineering*, Vol. 104; International Association for the Advancement of Space Safety (IAASS) Space Safety Conference, Los Angeles, CA; May 2019; “The Global Risk Continuum (GRC”); researchgate.net/publication/339287399_The_global_risk_continuum_GRC.

1053 18th Space Defense Squadron; “Catalog”; space-track.org/catalog.

1054 18th Space Control Squadron; “Box Score”; space-track.org/boxscore.

1055 18th Space Defense Squadron; “Catalog”; space-track.org/catalog.

1056 NASA Orbital Debris Program Office; “FAQ”; orbitaldebris.jsc.nasa.gov/faq/#.

1057 Jonathan’s Space Report; 25 June 2024; “Launches”; planet4589.org/space/stats/launches.html.

1058 Space News; 23 February 2023; “The Coming Chinese Megaconstellation Revolution”; spacenews.com/the-coming-chinese-megaconstellation-revolution.

1059 Space News; 29 December 2023; “First Satellite for Chinese G60 Megaconstellation Rolls Off Assembly Line”; spacenews.com/first-satellite-for-chinese-g60-megaconstellation-rolls-off-assembly-line.

1060 Space News; 30 June 2023; “China’s Changugang Satellite demonstrates space-to-ground laser links”; spacenews.com/chinas-changguang-satellite-demonstrates-space-to-ground-laser-links.

1061 Business Insider; 4 December 2021; “Russia pushes the International Space Station away from ‘90s US rocket debris — the 2nd space-junk scare this week”; businessinsider.com/international-space-station-swerves-to-avoid-rocket-debris-2021-12.

1062 NASA Orbital Debris Program Office; *Orbital Debris Quarterly News*, Vol. 28, number 1, p.2; Feb 2024; ISS Maneuvers to Avoid Potential November 2023 Collision; orbitaldebris.jsc.nasa.gov/quarterly-news/pdfs/ODQNV28i1.pdf.

1063 *Orbital Debris Quarterly News*, Vol. 29, No. 2; May 2025; “ISS Maneuvers Twice to Avoid Debris.”

1064 International Academy of Astronautics (IAA); May 2019; “A Handbook for Post-Mission Disposal of Satellites Less Than 100 kg”; unisec-global.org/pdf/UNCOPUOS_June19_2019_A_Handbook_for_Post-Mission_Disposal_of_Satellites.pdf.

1065 Federal Communications Commission; November 2019; “U.S. Government Orbital Debris Mitigation Standard Practice”; orbital-debris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf.

1066 18th Space Control Squadron; “Box Score”; space-track.org/boxscore.

1067 International Astronautical Congress; 25 September 2017; “Preliminary Analysis of Two Years of the Massive Collision Monitoring Activity”; ntrs.nasa.gov/api/citations/20170008541/downloads/20170008541.pdf.

1068 Zhejiang Online; 24 July 2023; “Lower Than Starlink, Seize the Commanding Heights of Space Value”; zjnews.zjol.com.cn/zjnews/20230724_26008274.shtml.

1069 Space News; 30 March 2023; “Chinese defense contractor to begin launching VLEO satellites”; spacenews.com/chinese-defense-contractor-to-begin-launching-vleo-satellites.

1070 Space News; 30 March 2023; “Chinese defense contractor to begin launching VLEO satellites”; spacenews.com/chinese-defense-contractor-to-begin-launching-vleo-satellites.

1071 Tianjin Economic-Technological Development Zone; 20 February 2025; “Renewing the industrial culture and pursuing the dream of the starry sky”; teda.gov.cn/contents/26/79641.html.

1072 China Daily Online; 24 April 2024; “Launch To Pave Way For Remote Sensing Network”; chinadaily.com.cn/a/202404/24/WS-66286bc0a31082fc043c3b0a.html.

1073 Global Times; 12 July 2023; “State Owned Aerospace Giant to Build 300 Satellite Constellation at Very Low Earth Orbit by 2030 for Better, More Economic Remote Sensing Services”; globaltimes.cn/page/202307/1294211.shtml.

1074 White House; 18 April 2022; “FACT SHEET: Vice President Harris Advances National Security Norms in Space”; whitehouse.gov/briefing-room/statements-releases/2022/04/18/fact-sheet-vice-president-harris-advances-national-security-norms-in-space.

1075 Payload Space; 14 September 2023; “Kim Jong Un and Putin Meet at Spaceport, Discuss Rockets and Satellites”; payloadspace.com/kim-jong-un-and-putin-meet-at-spaceport-discuss-rockets-and-satellites.

1076 Reuters; 26 October 2023; “Partner Nations on China’s Lunar Research Station Programme”; www.reuters.com/science/partner-nations/-chinas-lunar-research-station-programme-2023-10-26.

1077 Spire online; 23 October 2024; “The Hidden Risks of Satellite phones: From lifeline to liability”; spire.com/blog/space-recon.

naissance/the-hidden-risks-of-satellite-phones-from-lifelines to liability.

1078 NOAA; 30 September 2025; “GOES-R: Fire Detection and Characterization”; https://www.goes-r.gov/education/docs/fs_fire.pdf.

1079 NOAA; 30 September 2025; “Search and Rescue Satellites: SAR-SAT”; sarsat.noaa.gov/search-and-rescue-satellites.”

1080 Joint Chiefs of Staff; 26 October 2020; Joint Publication 3-14: “Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.

1081 Office of the Director of National Intelligence; 5 February 2024; “Annual Threat Assessment of the U.S. Intelligence Community”; dni.gov/index.php/newsroom/reports-publications/reports-publications-2024/3787-2024-annual-threat-assessment-of-the-u-s-intelligence-community;

1082 Secure World Foundation; April 2023; “Global Counterspace Capabilities, An Open Source Assessment”; swfound.org/media/207567/swf_global_counterspace_capabilities_2023_v2.pdf.

1083 War on the Rocks; 20 December 2021; “Iranian President Raisi’s Renewed Emphasis on Space Is Likely to Create New Tensions”; warontherocks.com/2021/12/iranian-president-raisis-renewed-emphasis-on-space-is-likely-to-create-new-tensions.

1084 Trend News Agency; 7 January 2023, “Iran takes 1st step for implementing 10-year space plan”; en.trend.az/iran/3692086.html.

1085 Fresh News Asia; 3 January 2024; “Report on 9th Enlarged Plenum of 8th WPK Central Committee”; m.en.freshnewsasia.com/index.php/en/localnews/44185-2024-01-03-03-18-17.html.

1086 Associated Press; 27 May 2024; “North Korean Rocket Carrying its 2nd Spy Satellite Explodes Shortly After Launch”; apnews.com/article/north-korea-missile-japan-28efd0f15318594fdcf5ec8f-416c196b.

1087 Center for Strategic and International Studies; 20 March 2020; “Space Threat Assessment 2020”; pp. 32-33; aerospace.csis.org/sta2020

1088 War on the Rocks; 13 November 2023; “Is Military Space-Based Jamming Normal? Some Worry It Is”; warontherocks.com/2023/11/is-military-space-based-jamming-normal-some-worry-it-is.

1089 North Korea Tech; 17 November 2012; “Report: DPRK Jams South Korean Satellite Comms”; northkoreatech.org/2012/11/17/report-dprk-jams-south-korean-satellite-comms.

1090 United Press International; 31 March 2016; “North Korea Jamming GPS Signals in South; Can Affect Planes, Cellphones”; upi.com/Top_News/World-News/2016/03/31/North-Korea-jamming-GPS-signals-in-South-can-affect-planes-cellphones/2551459443059.

1091 U.S. Space Force; 8 April 2024; “Accelerating the Purposeful Pursuit of Hybrid Space Architectures”; U.S. Space Force Commercial Space Strategy, pp. 2-6, 12-14; spaceforce.mil/Portals/2/Documents/Space%20Policy_USSF_Commercial_Sapce_Strategy.pdf.

1092 Center for Naval Analyses; 21 May 2021; “Artificial Intelligence and Autonomy In Russia”; cna.org/reports/2021/05/Artificial-Intelligence-and-Autonomy-in-Russia.pdf.

1093 China Military Online; 28 January 2016; “JFJB: Liberation Army Daily Dawn peeps in intellectualized military revolution”; www.81.cn/jskj/2016-01/28/content_6871858.htm.

1094 *National Defense Technology Journal*, Vol. 41, No. 2; April 2020; “Application of Artificial Intelligence in Space Defense”, pp. 5-9.”

1095 Federal Communications Commission; November 2019; “U.S. Government Orbital Debris Mitigation Standard Practice”; orbital-debris.jsc.nasa.gov/library/usg_orbital_debris_mitigation_standard_practices_november_2019.pdf.

1096 Inter-Agency Space Debris Coordination Committee (IADC); September 2007; “IADC Space Debris Mitigation Guidelines”; orbital-debris.jsc.nasa.gov/library/iadc_mitigation_guidelines_rev_1_sep07.pdf.

1097 National Aeronautics and Space Administration; 27 January 2021; “NASA’s Efforts to Mitigate the Risks Posed by Orbital Debris”; oig.nasa.gov/docs/ig-21-011.pdf.

1098 European Space Operations Centre (ESOC); 27 May 2021; “ESA’s Annual Space Environment Report”; pp. 68-71; sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf.

1099 18th Space Control Squadron; “Box Score”; space-track.org/boxscore.

1100 Center for Strategic and International Studies; April 2024; “Space Threat Assessment 2024”; csis-website-prod.s3.amazonaws.com/s3fs-public/2024-04/240417_swope_space_threat_0.pdf?versionid=ddej0ekynf5w7pofmjvhvgjkxevetx3o0.

1101 Sellers, Jerry Jon; *Understanding Space: An Introduction to Astronautics*; 2015, 4th Edition; pp. 614-617, 623-624.

1102 Center for Strategic and International Studies; 25 July 2022; “The Private Sector’s Assessment of U.S. Space Policy and Law”; aerospace.csis.org/wp-content/uploads/2022/07/AGoessler_The_Private_Sectors_Assessment_of_U.S.-Space-Policy_and_Law.pdf.

1103 NASA.gov; 25 May 2021; “What is Remote Sensing?”; pp. 1-3; earthdata.nasa.gov/learn/backgrounder/remote-sensing.

1104 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-4.

- 1105 Sellers, Jerry Jon; *Understanding Space: An Introduction to Astro-nautics*; 2015, 4th Edition; pp. 6, 59-60.
- 1106 Space News; 21 April 2021; “China is developing plans for a 13,000-satellite megaconstellation”; spacenews.com/china-is-developing-plans-for-a-13000-satellite-communications-mega-constellation.
- 1107 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. II-3.
- 1108 Congressional Research Service; 11 June 2021; “Precision Guided Munitions: Background and Issues for Congress”; congress.gov/crs_external_products/R/PDF/R45996/R45996.9.pdf.
- 1109 GPS.GOV; 5 November 2019; “Timing”; gps.gov/applications/timing.
- 1110 Air Command and Staff College; 1 August 2017; “The Post GPS-Only Era: Positioning, Navigation, and Timing (PNT) in 21st Century Warfare”; apps.dtic.mil/sti/pdfs/ad1054619.pdf.
- 1111 Quasi-Zenith Satellite System; 2021; “Overview of the Quasi-Zenith Satellite System”; qzss.go.jp/en/overview/services/sv01_what.html.
- 1112 Indian Space Research Organization; 2021; “Indian Regional Navigation Satellite System (IRNSS): NavIC”; isro.gov.in/irnss-programme.
- 1113 European Global Navigation Satellite Systems Agency; 17 February 2021; “Galileo is the European global satellite-based navigation system”; gsa.europa.eu/european-gnss/galileo/galileo-european-global-satellite-based-navigation-system.
- 1114 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. II-8.
- 1115 Space News; 14 November 2019; “Air Force: SSA is no more; it’s ‘Space Domain Awareness’”; spacenews.com/air-force-ssa-is-no-more-its-space-domain-awareness.
- 1116 Aerospace Corporation; 1 May 2018; “Getting in Your Space: Learning from Past Rendezvous and Proximity Operations”; pp. 3-4, 6, 8, 10; csp.aerospace.org/sites/default/files/2021-08/GettingInYourSpace.pdf.
- 1117 Aerospace Corporation; 1 May 2018; “Getting in Your Space: Learning from Past Rendezvous and Proximity Operations”; pp. 3-4, 6, 8, 10; csp.aerospace.org/sites/default/files/2021-08/GettingInYourSpace.pdf.
- 1118 Center for Strategic and International Studies; April 2024; “Space Threat Assessment 2024”; csis.org/analysis/space-threat-assessment-2024.
- 1119 National Bureau of Asian Research; 1 September 2024; “Mapping China’s Strategic Space”; nbr.org/publication/mapping-chinas-strategic-space.
- 1120 Joint Chiefs of Staff; February 2025; “DoD Dictionary of Military and Associated Terms”; p. 71.
- 1121 Joint Chiefs of Staff; February 2025; “DoD Dictionary of Military and Associated Terms”; p. 60.
- 1122 Joint Chiefs of Staff; February 2025; “DoD Dictionary of Military and Associated Terms”; p. 71.
- 1123 Joint Chiefs of Staff; 22 May 2020; “Joint Publication 3-85: Joint Electromagnetic Spectrum Operations”; p. I-4.
- 1124 War on the Rocks; 13 November 2023; “Is Military Space-Based Jamming Normal? Some Worry It Is”; warontherocks.com/2023/11/is-military-space-based-jamming-normal-some-worry-it-is.
- 1125 ADS-B Exchange; “GPSJAM”; gpsjam.org.
- 1126 PLA National Defense University; September 2020; “The Science of Military Strategy (2020)”; pp. 236-240; airuniversity.af.edu/CASI/Display/Article/2913216/in-their-own-words-2020-science-of-military-strategy/7.
- 1127 Politico; 11 August 2023; “For the First Time, U.S. Government Lets Hackers into Satellite in Space”; politico.com/news/2023/08/11/def-con-hackers-space-force-00110919.
- 1128 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; pp. I-3, II-16.
- 1129 *Harvard National Security Journal*, Vol. 474, No. 6 (June 2015); June 2015; “Rethinking Warfare: The Ambiguity of Cyber Attacks”; harvardnsj.org/wp-content/uploads/2015/06/Chayes.pdf.
- 1130 Lawfare; 28 January 2024; “The United States Needs a New Way to Think about Cyber”; lawfaremedia.org/article/the-united-states-needs-a-new-way-to-think-about-cyber.
- 1131 Aerospace Corporation; 10 February 2023; “Space Attack Research & Tactic Analysis”; sparta.aerospace.org.
- 1132 Joint Chiefs of Staff; 22 May 2020; “Joint Publication 3-85: Joint Electromagnetic Spectrum Operations”; p. I-4.
- 1133 Joint Chiefs of Staff; February 2025; “DoD Dictionary of Military and Associated Terms”; p. 55.
- 1134 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.
- 1135 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.

1136 Office of the Director of National Intelligence; 6 February 2023; “Annual Threat Assessment of the U.S. Intelligence Community”; dni.gov/index.php/newsroom/reports-publications/reports-publications-2023/3676-2023-annual-threat-assessment-of-the-u-s-intelligence-community.

1137 Office of the Director of National Intelligence; 5 February 2024; “Annual Threat Assessment of the U.S. Intelligence Community”; dni.gov/index.php/newsroom/reports-publications/reports-publications-2024/3787-2024-annual-threat-assessment-of-the-u-s-intelligence-community.

1138 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.

1139 Freeman Air and Space Institute; 28 May 2024; “Russian military space-related capabilities: The vital deterrence role of counterspace weapons (Part I)”; kcl.ac.uk/warstudies/assets/paper-22-rod-thornton-and-marina-miron-russian-military-space-related.pdf.

1140 Joint Chiefs of Staff; 26 October 2020; “Joint Publication 3-14: Space Operations (10 April 2018, Incorporating Change 1)”; p. I-13.

1141 Financial Times Online; 25 February 2024; “How could nuclear weapons be used in space”; ft.com/content/ea57d82c-e042-46d3-9989-ac1ef336766a.

1142 Financial Times Online; 25 February 2024; “How could nuclear weapons be used in space”; ft.com/content/ea57d82c-e042-46d3-9989-ac1ef336766a.

1143 U.S. Department of Defense and U.S. Department of Energy; 1977; “The Effects of Nuclear Weapons, Third Edition”, pp. 520-527; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

1144 U.S. Department of Defense and U.S. Department of Energy; 1977; “The Effects of Nuclear Weapons”; chapters 1, 3, 9; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

1145 U.S. Department of Defense and U.S. Department of Energy; 1977; “The Effects of Nuclear Weapons”; 3rd Edition; p. 519; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

1146 U.S. Department of Defense and U.S. Department of Energy; 1977; “The Effects of Nuclear Weapons”; 3rd Edition; p. 536; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

1147 U.S. Department of Defense and U.S. Department of Energy; 1977; “The Effects of Nuclear Weapons”; 3rd Edition; pp. 518-520, 536-539; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

1148 U.S. Department of Defense and U.S. Department of Energy; 1977; “The Effects of Nuclear Weapons”; 3rd Edition; chapters 1, 3, 9; govinfo.gov/content/pkg/govpub-d-purl-gpo106759/pdf/govpub-d-purl-gpo106759.pdf.

