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The 2023-2024 overview of developments in space security

EURODEFENSE SPACE OBSERVATORY

Under the cover of the media impact of events such as the Russian invasion of Ukraine and the more recent war in the Gaza Strip, we are witnessing a continuation of key trends that have been detailed in previous reports and in the Going Space White Paper produced by the Space Observatory. This report is divided into two sections. The first is economics, the second is security, since the latter derives from the former.

The Economic Trends

The space economy has continued growing. According to the Space Foundation, 90 countries operate in space. The value of the global space economy was $469 billion in 2021, with other analyses projecting it will increase to over $1.25 trillion in annual revenue by 2030[1]. Figure 1, from Bryce Aerospace, shows the size of the space economy in 2022, relying on a different method of measurement.

[1] Space Foundation Editorial Team, "Space Foundation Releases the Space Report 2022 Q2 Showing Growth of Global Space Economy," Space Foundation, July 27, 2022, https://www.spacefoundation.org/2022/07/27/the-space-report-2022-q2/; and "NSR's Global Space Economy Report Projects $1.25 Trillion in Revenue by 2030," Northern Sky Research, January 27, 2022, https://www.nsr.com/nsrs-0global-space-economy-report-projects-1-25-trillion-in-revenue-by-2030/.

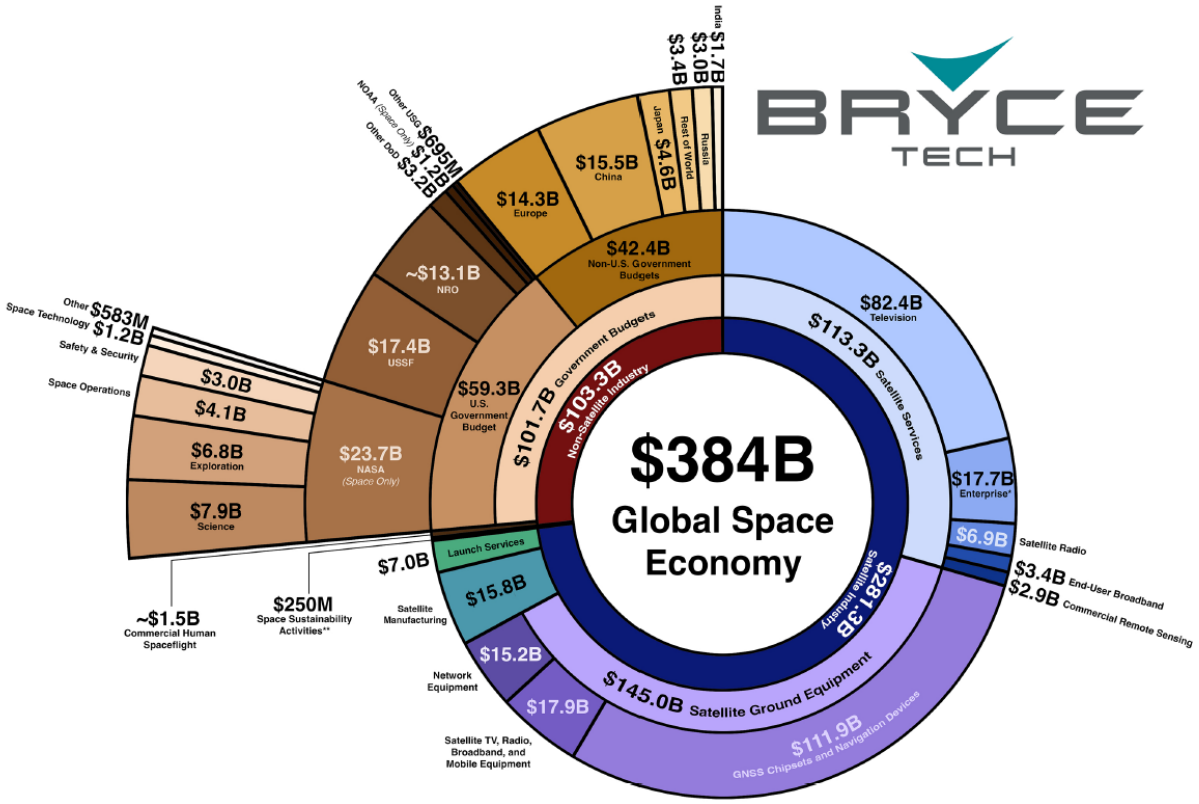


Figure 1. The size of the space economy in 2022 (source BryceTech Consultancy)

Figure 2 shows the acknowledged space launches in the year 2023. There were 221 launches delivering 2,938 spacecraft. 116 of the launches were by commercial companies launching commercial satellites, almost double the number for 2022, 21 were commercial launches of government-owned spacecraft and 84 launches were by government owned entities. Comparison with 2022 shows a strong rise in commercial launches, cementing US lead in this sector. U.S. operators dominate smallsats, accounting for three quarters f those launched since 2014. This defalcation hides two basic realities:

- Most of the commercial launches with most of the satellites were by the company SpaceX, operating under US flag;
- Most of the government launches were by China, or by states operating small launchers.

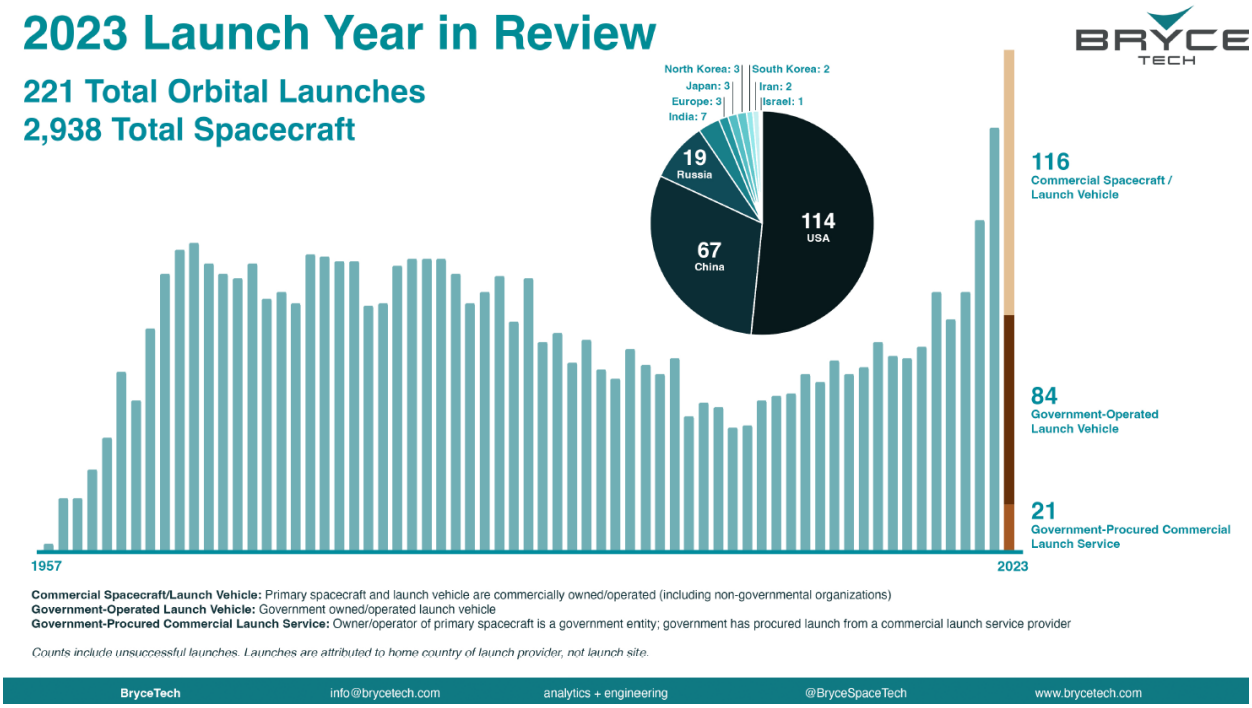


Figure 2. 2023 launches in review (source: BryceTech Consultancy)

The US accounted for 114 launches (27 more than in 2022), China for 67 (+3), Russia for 19 (-2), Europe for just 3 (-3), India for 7 (+1), Japan for 3 (+2), South Korea and Iran for 2 each (+1). The gradual fall in state launch capacity by the West has resulted in an overreliance on a small number of launch providers, and the predicted future yearly capacity of the SLS and Vega 6 systems are not systemic game-changers. SLS especially is estimated to only deliver one launch per year. This is a new dynamic, as it pits Western commercial space capacity against Chinese state-led capacity, where China is trying to achieve parity with the US and is investing the launch capacity to go towards 100 launches per year as part of a comprehensive spaceflight, including manned orbital presence.

Table 1 presents a comparison from March 2019 to May 2024 in terms number of active satellite systems according to the Union of Concerned Scientists' open-source satellite database. While over 7,500 satellites are in-orbit today, more than 24,500 satellites are anticipated to be launched in the next 8 years (2022–2031), over 70 percent of which will be commercial[2]. We can observe a massive increase in the number of satellites due to the large numbers of smallsat communication systems (under 600 kg) placed by SpaceX into orbit (average Starlink satellite mass, depending on generation, is around 150 kg), but also by other entities such as OneWeb or the various satellite imaging companies. By comparison to the previous UCS report, dated in the end of December 2022, the number of satellites has increased by almost 1,000, mostly accruing to the US. This may present a distorted view of actual state capabilities, since most of these systems provide commercial-grade services to customers (though Starlink has proved its usefulness in Ukraine) and the smaller number of satellites China has launched invariably contains much bulkier systems,

[2] "Satellite Demand to Quadruple over the Next Decade," Euroconsult, December 12, 2022, https://www.euroconsult-ec.com/press-release/satellite-demand-to-quadruple-over-the-next-decade/.

with significant additional mass for shielding, redundant systems, and secondary capabilities, making them more effective than cost-conscious and mission-optimized systems launched by private companies.

Table 1. Comparison of satellite numbers from 2019 to May 2024 (source: compiled by authors)

Satellite Facts ***(01.05.2024 compared to 31.03.2019)***			
Total number of operating satellites: 7,560/2,062			
United States: 5,184/901	Russia: 181/153	China: 628/299	Other: 1,572/709
LEO: 6,768/1,338	MEO: 143/125	Elliptical: 59/45	GEO: 590/554
Total number of US satellites: 5,184/901			
Civil: 30/38	Commercial: 4,741/523	Government: 167/164	Military: 246/176

Neither is the US lead in commercial space to be taken for granted, since China's 2016 white paper on space states the goal for "To build China into a space power in all respects"[3], and its 2021 white paper stresses the development of a private domestic space industry to lessen the reliance on imports from international markets and companies. This vision is why China lifted its ban in 2014 on private space sector companies[4], leading to a fast growing start-up sector, as will be seen further in this section.

Europe continues to fall behind on smallsats, which today represent the bulk of new space systems (figure 3).

[3] "Full Text of White Paper on China's Space Activities in 2016," State Council, People's Republic of China, December 28, 2016, http://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm

[4] Harrison et al. (2022). Space Threat Assessment Report 2022. Center for Strategic and International Studies, Washington, US, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/220404_Harrison_SpaceThreatAssessment2022.pdf?K4A9o_D9NmYG2Gv98PxNigLxS4oYpHRa

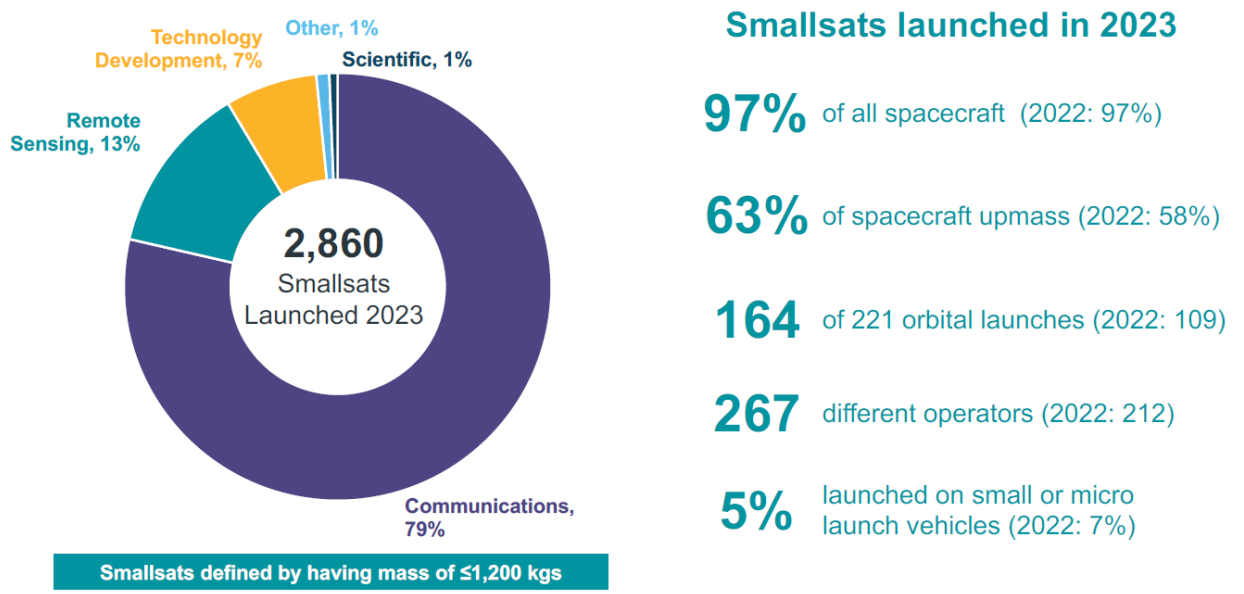
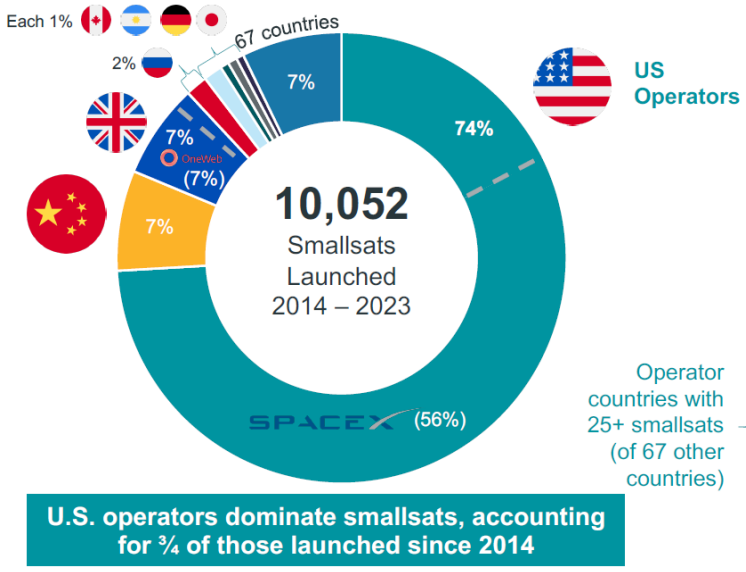


Figure 3. Smallsat launches in 2023 by type plus key statistics (source: BryceTech Consultancy)

The US is in the clear lead, with China in second place and the UK following on the basis of the OneWeb system

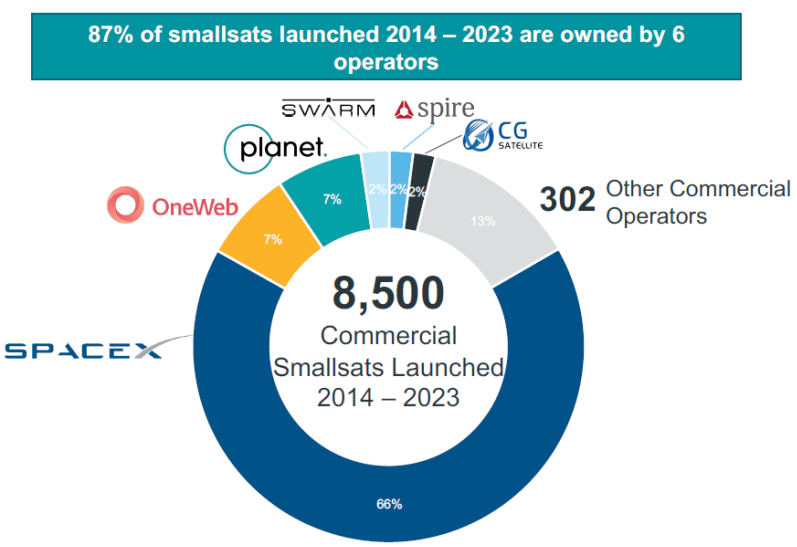


Operator countries with 25+ smallsats (of 67 other countries)

Operator Country	# of Smallsats
USA	7,420 (5,652 Starlink)
China	719
UK	679 (636 OneWeb)
Russia	159
Japan	135
Canada	66
Germany	62
Argentina	54
Italy	49
France	47
Spain	47
India	45
Finland	38
South Korea	37
Israel	33
Australia	32
Netherlands	31

Figure 4. Smallsats by origin, 2014-2023 (source: BryceTech Consultancy)

The concentration of smallsats among just 6 operators (actually 2-3) is also not to Europe's advantage, given its lack of presence among these (with the exception of the UK's OneWeb). The EU sits even worse.



Operators with >15 smallsats

Operator	# of Smallsats
Satellogic	44
ICEYE	30
Kepler	23
Guodian Gaoke	21
Astrocast	20
Spacety	19
BlackSky	18
HawkEye 360	18
Xioyong Microelectronics Park	18
ORBCOMM	17
Fossa Systems	17
BlackSky Global	16
Kleos Space	16
Abla Orbital	15

Figure 5. Smallsats by operator, 2014-2023 (source: BryceTech Consultancy)

Government purchases of smallsats for various purposes have been a strong tool for the US, China and Russia to develop space capabilities. Europe has not done so. Right now, BryceTech's open-source list of government smallsat users lists only two entities from Europe, ESA and the DLR from Germany, compared to 6 for US, 4 for China, 2 for Russia and 1 each for India and Japan. This translates into weakness also in the launch market

Table 2. Smallsats by government operator in 2023 (source: BryceTech Consultancy)

Type	Largest Government Operators Open-Source Data	Country	# of Smallsats Launched
Civil	National Aeronautics and Astronautics and Space Administration	USA	51
	Chinese Academy of Aerospace Navigation Technology	China	30
	Indian Space Research Organisation (ISRO)	India	24
	Japan Aerospace Exploration Agency (JAXA)	Japan	16
	Los Alamos National Laboratory (LANL)	USA	13
	Roscosmos	Russia	13
	Chinese Academy of Sciences	China	11
	Jet Propulsion Laboratory (JPL)	USA	10
	European Space Agency (ESA)	Multinational	9
	Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	Germany	8
	China National Space Administration (CNSA)	China	8
National Security	People's Liberation Army	China	129
	Russia MoD/Aerospace Forces	Russia	31
	Space Development Agency (SDA)	USA	22
	Defense Advanced Research Projects Agency (DARPA)	USA	20
	United States Air Force	USA	16

As detailed in the Going Space White Paper produced by the Eurodefense Space Observatory, Europe has key security interests in space that can only be achieved through full spectrum public and private development in space. It is not enough for Europe to bootstrap key services through targeted government spending in order for it to achieve true strategic autonomy. The Earth Observation, PNT and secure communications capabilities are necessary, but not sufficient to

ensure European security and competitiveness in the long-run. The text box below quotes the report on priorities for Europe.

We can derive key priorities for Europe in terms of space both from the European documents of reference which have been published, the recent evolutions in European space governance and the realities of the evolving space environment:

- Accessible, affordable and sustainable access to space services for European citizens and businesses as a precondition of continuity, resilience, growth and innovation;
- Europe must maintain itself as a leader in innovation and production the aerospace field and must reduce the existing gap with regards to new technologies, such as reusability;
- European strategic autonomy in space – Europe must build, maintain and protect a full spectrum of space capabilities so that it will not be reliant on those of other powers. The next project in this regard is the secure government communications satellite system, GOVSATCOM;
- Europe must achieve resilience to risks, vulnerabilities and threats deriving from its increasing reliance on space systems, both at the level of its militaries, and at the level of society and economy;
- Europe must create the toolbox with which to pursue its interests in a free and peaceful access to space, through a combination of multilateral agreements on rules of conduct, sectoral diplomacy and the development of instruments of deterrence against attacks on its space systems;
- The European Armed Forces must have safe and secure access to space services in order to maintain their qualitative edge in an environment beset by cyber and electronic warfare threats;
- Europe must emulate other actors in developing fair and sustainable comprehensive space partnerships with third countries, whose development will rely on space and which might otherwise become unduly beholden to European systemic rivals;
- Overall, Europe must integrate space into its toolbox for internal and external governance in all fields, from environmental and economic, to the security one.

Security issues

Over the past year and a half, there has been regular testing and use of reversible non-destructive capabilities against satellite systems, which can enable adversaries to make pinpoint and temporary degradations of space capabilities to enable operations or to cover for them. There was also a destructive test that created a debris field, jeopardizing safe operations and indicating that the space domain is becoming more contested as we lurch towards the first ever offensive operations in space.

China and Russia are developing and integrating space capabilities that will afford them the same advantages the US and its allies currently enjoy. They are also developing a robust spectrum of offensive capabilities to deny their adversaries access to space, both to military, state and commercial users.

The Russia-Ukraine war is "the first commercial space war," and it has highlighted areas where the use of commercial space capabilities has advanced ahead of policy, strategy, and concepts of operations. Commercial space capabilities are making a significant contribution to the Ukrainian fighting capacity and providing options that Ukraine did not have organically. Therefore, commercial space has become "a great equalizer, allowing Ukrainian forces to have the necessary intelligence, surveillance, and reconnaissance and command and control to better understand Russian force disposition, communicate and stay connected globally, and strike with precision". It is thus no surprise that we have also witnessed escalation in attempts to deny access to commercial capabilities, so far through cyber-attacks and through jamming, though political declarations from Russia have also hinted at willingness to use kinetic strikes and other destructive means, which would imply a new phase of space operations.

Figure 6. 2024 global assessment of ASAT capabilities (source: Samson, 2024)[5]

Counter-space capabilities in Europe

France is the most vocal European country in stating its plans for counterspace weapons development and fielding.
In April 2023, the Ministry of the Armed Forces of France released its 2024–2030 Military Programming Law, which includes plans for orbital counterspace capabilities.
These include a project for "lasers in orbit" called FLAMHE and a ground-based laser counterspace system called BLOOMLASE, both of which aim to be operational by the end of the decade.
An article published by the ministry in October 2023 mentions plans for a GEO-based active defense constellation. YODA, a demonstrator satellite for the constellation, is planned to be launched in 2025

Key highlights in military and space capabilities from 2023:

- The Ariane 5's last flight occurred on July 5, 2023, creating a gap in European heavy-lift capability until the planned first launch of the Ariane 6 in mid-2024. France is the only EU country to have launched a defense payload in 2023, a military communications satellite;

[5] Samson, V. (2024). Space Sustainability: An Overview. Secure World Foundation, Presentation for SAIS' SA.502.183.01.SP24, "Space Security", April 15, 2024, https://swfound.org/media/207851/vsamson_space-sustainability_sais_-april-15-2024.pdf

- In March 2023, Israel launched a new SAR satellite on its Shavit-2 rocket, joining a family of on-orbit reconnaissance satellites;
- Israel has deployed electronic warfare capabilities that have interfered with satellite services as part of its war on HAMAS. In mid-October 2023, as it began military operations in Gaza, Israel said it was restricting GPS use in active combat areas and warned the public to expect glitches in
- location-based applications that use GPS. Israel also acknowledged the use of GPS spoofing, observed to originate in northern Israel, stating that it was a required defensive measure, likely to confuse guided missiles, drones, and rockets used by Hezbollah;
- Israel's Iron Beam energy system might be used for ASAT missions;
- Of note was Israel's November 2023 use of its Arrow missile defense system to intercept a medium-range ballistic missile (MRBM) fired by Houthi rebels from Yemen. While the intercept was reported at an altitude of about 100 km, MRBMs can reach an altitude of over 300 km at their peak, solidly within very low Earth orbit (VLEO), making the Israeli Arrow system and similar missile defense systems capable of being ASAT weapons;
- In June 2023, Japan released a Space Security Initiative, serving as the country's first space security policy. The initiative will be based on three basic policies: expanding the use of space for national security, ensuring the safe and sustainable use of space, and creating a positive cycle of space security and space industrial development. The January 2023 U.S.-Japan Security Consultative Committee meeting between Japanese and U.S. foreign and defense ministers led to the joint statement that "attacks to, from, or within space . . . in certain circumstances, could lead to the invocation of Article V of the Japan-U.S. Security Treaty," which commits that the United States would defend Japan if any of its territory was attacked by a third party;
- At the end of 2022, South Korea's defense ministry announced a new military space strategy to build and organize space capabilities. Space budgets have increased by 20% and South Korea is working on the KPS – Korean Positioning System, that would enable it to be less reliant on GPS. Defense is the third pillar of the new space budget, while the second pillar is the dual use KSLV-3 rockets;
- Noteworthy achievements in 2023 include the successful first launch of South Korea's KSLV-2 (Nuri) rocket in May 2023 and the launch of South Korea's first spy satellite from the U.S. Vandenberg Space Force Base in November 2023. South Korea's space agency, the Korea AeroSpace Administration (KASA), was launched in May 2024 and will lead aerospace research and space missions, such as Moon and Mars exploration projects. KASA will also facilitate the domestic aerospace industry, including "plans to foster more than 2,000 space-related companies and create about 500,000 new jobs." This is in addition to the already established Korean Aerospace Research Institute (KARI), which will focus on technology R&D in support of KASA, which will now lead "space industry and space security."
- Given strong South Korean defense industry development, it is likely that the space military component will also be targeted for development;
- The United Kingdom established its Space Command as well as its first National Space Strategy in 2021. In 2023, the United Kingdom released two space plans: the National Space Strategy in Action and the Science and Technology Framework. These set the framework for a March 2024 document, the Space Industrial Plan. Together, the three plans outline UK space strategy until 2030 and a roadmap for delivering 22 national space

capability goals by the end of the decade. UK Space Command confirmed that its ongoing priorities were operationalizing its activities, including the Ministry of Defence's SKYNET military communication satellite program. The United Kingdom is also focused on international cooperation and joined the United States and Australia for the DARC network of space-tracking radars (a joint space domain awareness program to provide advanced monitoring of satellites in GEO). In 2023, the UK government announced that it would fund £10 billion ($12.7 billion) over the next decade to meet the goals outlined in the National Space Strategy;

- Although Tehran saw previous setbacks with its Simorgh SLV, it most recently conducted two successful space launches in January 2024—one via a Simorgh SLV and another with a Qaem 100 rocket—that placed four separate satellites into orbit. In September 2023, Iran launched its third military satellite, Noor-3, which is believed to perform Earth remote sensing, like its two predecessor Noor satellites.178 Iran also launched a biocapsule in December 2023 that may be part of Tehran's ambitions for a domestic human spaceflight capability. Raisi has recognized space as a "power-creating" industry, with Iran aiming to achieve "first place in the region" for its space capabilities. Iranian officials have alluded to a "space club" of technologically capable nations, which Iran aims to join. In addition, advancements related to Iran's space program also advance Iran's policy goals around missile development, as SLVs and ICBMs use similar technologies. In 2023, Iran outlined space goals in a 10-year strategic plan created by the Supreme Space Council. In response to the 10-year plan, Raisi underscored the importance of investing in domestic space capabilities, including space launch, and completing the goal of placing an Iranian communications satellite in GEO. Another goal is the development and launch of at least eight new satellites, plus a telecommunication constellation of 10 small satellites named the General Soleimani Satellite System. Furthermore, Iran aims to send a human into space in the next five years. Due to Russia's procurement of Iranian missiles and drones for use in Ukraine and sanctions that have disrupted Russian space launch sales to the West, Iran is now one of Russia's few remaining space customers and has used that to its advantage in negotiations with Moscow. In 2022, Russia built and launched Iran's Khayyam Earth observation satellite. In October 2023, Iran announced plans to seek additional aid from Russia on a new Khayyam-2 satellite. It also plans to discuss developing with Russia a remote-sensing satellite, a small GEO satellite, and a telecommunications satellite. Furthermore, in September 2023, universities in Iran and Russia agreed to jointly develop a research spacecraft in the next two years.
- Iran's civilian aerospace centers work closely with the Ministry of Defense and Armed Forces Logistics (MODAFL), for instance on Iran's liquid-fueled ballistic missile program. The Islamic Revolutionary Guard Corps (IRGC) Aerospace Force also conducts space launches. Over the last several years, the IRGC has become more active in space and expanded its efforts at the Shahroud missile test site, one of two main Iranian spaceports, including in the construction and launching of the Noor satellites.
- While significantly behind the United States and China in the number of rockets launched in 2023, India had more launches than Europe and Japan combined. Over the next few years, India plans to become the fourth nation capable of sending astronauts into space. India is also strengthening its international space cooperation, signing the U.S.-led Artemis Accords in June 2023 and partnering with Japan on another lunar mission. India is also placing greater emphasis on using its growing space capabilities for military purposes -

India has plans to launch and operate over 100 military satellites in the next seven to eight years. India released Indian Space Policy 2023, the nation's first official space policy, which outlines the peaceful, prosperous, and sustainable use of space by government and non-government entities. It complements India's ongoing Mission DefSpace initiative that challenges private companies to produce space and other defense equipment domestically. In November 2023, Prime Minister Narendra Modi also unveiled Space Vision 2047, outlining India's long-term goals for space, including launching humans into space, establishing a space station, and building a lunar base. Currently, India has about 60 active satellites performing communications, remote-sensing, and positioning, timing, and navigation functions. Three of those satellites are dedicated to providing military communications. In April 2024, SpaceX plans to launch a new Indian SAR satellite with 0.5-meter resolution, which will reportedly be used to monitor the Indian-Chinese border.

- 2023 saw North Korea's first successful space launch since 2016, with the launch of the Malligyong-1 military reconnaissance satellite on the first successful launch of the solid-fueled Chŏllima-1. It also completed significant upgrades to the Sohae satellite launching station. Additionally, North Korea strengthened its cooperation with Russia in various areas, including space technology. North Korea also tested a solid-fuel ICBM in 2023, which could be used for space launch, potentially providing North Korea the ability to build rockets that can launch heavier satellites or place satellites in higher orbits. In December 2023, state media reported on 2024 plans to launch three more reconnaissance satellites. In March 2024, North Korea attempted to jam GPS signals during South Korean military exercises, the first reported use of GPS jamming by North Korea in eight years;
- A Russian attempt to land on the Moon failed in August 2023, with Luna-25 crashing into the lunar surface. Three Russian spacecraft supporting the ISS suffered coolant leaks in the last year. However, Russia successfully launched several civilian and military satellites. Additionally, Russia picked up new foreign launch customers, including the United Arab Emirates (UAE) and Malaysia, despite U.S. and European sanctions. Arguably, the biggest revelation since the last report involves allegations that Russia is developing a nuclear-capable ASAT weapon that the United States says would violate the 1967 Outer Space Treaty. Such a weapon, in either case, would be an effective way to threaten large numbers of satellites—such as proliferated satellite constellations—which the United States and others are deploying as a means to build greater resiliency against space threats.
- In addition to developing new ASAT capabilities, Russia maintains ASAT systems, last testing such a system in 2021. Russia launched a second Luch/Olymp inspector satellite in March 2023, which, like the original Luch/Olymp satellite, is making stops near Western satellites in GEO. Since launch, the second Luch/Olymp has parked near a U.S. Wideband Global SATCOM satellite and Eutelsat satellites. The first Luch/Olymp remained near Western commercial communications satellites for most of the last year;
- In November 2023, the Russian satellite Cosmos 2570 released a daughter satellite that then released its own daughter satellite. All three satellites then performed close approach activities around each other. The same month, a presumed-defunct Russian remote-sensing satellite, Resurs-P3, came to life and approached another Russian satellite, Cosmos 2562, for an unknown purpose. This activity suggests a need to reassess satellites that are no longer operational, as they may be acting as sleeper cells in space. Russian satellites with a record of unfriendly behaviors can pose hazards even after the end of their missions. Between 2013 and 2014, two Russian satellites, Cosmos 2491 and Cosmos 2499, were

observed conducting very close approaches with other Russian satellites, possibly testing orbital weapons technologies. Although observers concluded that their missions probably ended around 2017, Cosmos 2491 made news in 2020 when its propulsion tank unexpectedly exploded. In 2023, Cosmos 2499 also suddenly exploded, with observers speculating that the explosion was caused by the same propulsion tank issue that affected its sister satellite. The explosion created a cloud of debris that will likely remain in orbit for decades, if not centuries. With these Luch/Olymp and Cosmos satellites, Russia could be testing and validating tactics, capabilities, and operational procedures that it could use to enable future orbital counterspace weapons. Russia is probably assessing what kinds of space activities it can perform without escalating conflict with the US.

Increasingly, we are also experiencing spectrum congestion in space, with many related space activities risking frequency fratricide (unintentional jamming) or opening themselves up to jamming operations[6].

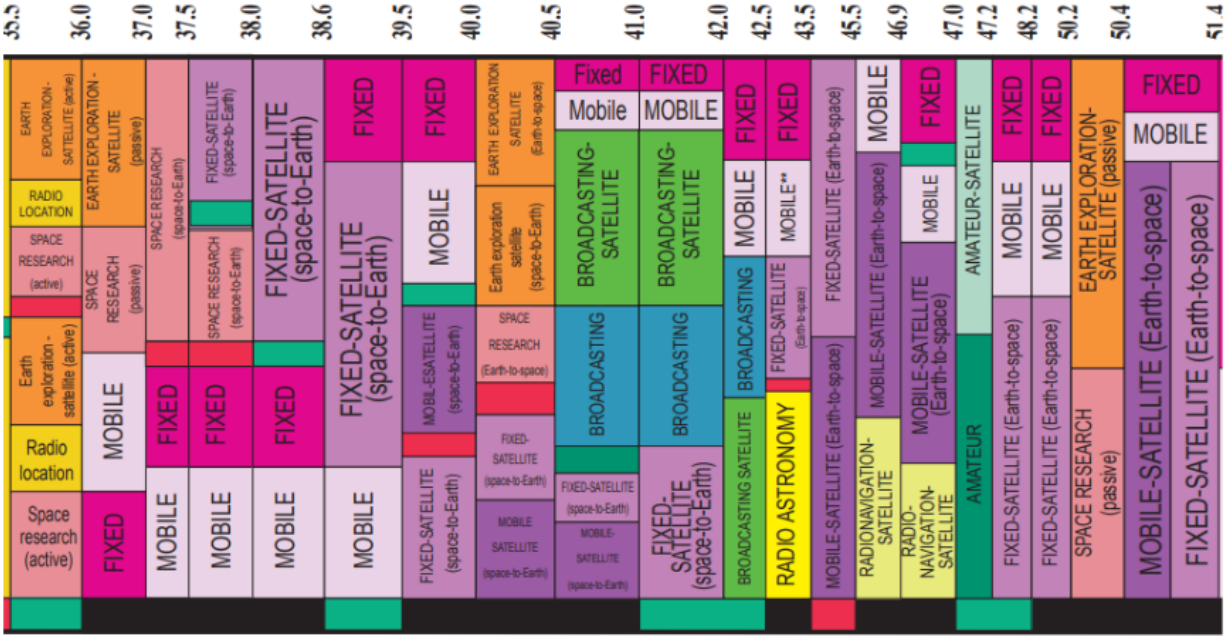


Figure 7. Frequency crowding in space (source: Samson 2024)

[6] Samson, V. (2024). Space Sustainability: An Overview. Secure World Foundation, Presentation for SAIS' SA.502.183.01.SP24, "Space Security", April 15, 2024, https://swfound.org/media/207851/vsamson_space-sustainability_sais_-april-15-2024.pdf