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2024: A Pivotal Year for the Space Sector?

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Key Takeaways

- With ambitious programs and numerous technological developments, 2024 promises to be an important year for space exploration.
- The Moon will continue to be a focal point for the major space powers, with the first flight of astronauts around our satellite scheduled to take place next year.
- Europe is in a difficult situation because of its launcher crisis. But with the first launch of Ariane 6, it could regain its autonomy of access to space.
- Other launchers are due to make their first flights next year. Most are American and share common characteristics: using methane fuel and reusability.
- Satellite constellations could multiply by 2024, increasing the population in space. This has almost doubled in 5 years, fueling fears of cascading collisions if international regulations are not adopted soon.

Introduction

2024 could prove to be a pivotal year for space exploration. Technological innovations combined with ambitious programs promise to redefine the way we explore and utilize space. New launch solutions, sometimes described as revolutionary, are expected to make their maiden flights. Satellite constellations are also redefining the way space is being developed and utilized, potentially ushering in an era of hyperconnectivity, while creating a new set of challenges for the sustainable development of the outer space environment.

At the geopolitical level, since the start of the 21st century, space activity has increasingly revolved around two centers of power, the United States and China, whose rivalry is intensifying. The Moon stands out as a key focus for the major space powers over the coming years. In this dynamic context, Europe continues to lag behind, but Ariane 6's first launch and the deployment of the IRIS² constellation should help the Old Continent reclaim its status as a major space power in 2024.

Geopolitical trends

The Moon takes center stage

The technical and human achievements of the space sector are among the distinguishing attributes of great powers. The technological excellence required to build a space program confers a certain prestige to nations capable of developing one, just as it does to the companies which contribute to it. The world's major geopolitical powers showcase their advances in the space industry through major programs, foremost among them manned spaceflight. The lunar push of recent years has thus become a stage for the confrontation between the United States and China, the two centers of power of the 21st century.

The United States and China are pursuing parallel lunar programs. The United States leads the Artemis program, with the ambition of establishing a permanent base on the Moon. China, together with Russia, is leading the International Lunar Research Station (ILRS) program, which has similar objectives. Both projects are open to international partnerships. The announced timelines and objectives are similar enough to warrant calling this a new Moon race.[1] Artemis is currently running ahead of the Chinese program, both in terms of technical advances and partnerships.

A large number of activities are planned in the lunar region from 2024 onwards. With Artemis II, NASA hopes to send humans around the Moon for the first time since 1972.[2] The first two elements of the lunar space station (Gateway, LOP-G) should also be

1. M. Julienne and P. Wohrer, "Racing to the Moon: China's Lunar Exploration Program in Competition with the United States", *Reconnect China Policy Brief*, Reconnect China, 2023, available at: www.reconnect-china.ugent.be.
2. "Artemis II", NASA, available at: www.nasa.gov.

deployed. The first commercial missions to the Moon (Commercial Lunar Payload Services) are also scheduled: these will test the robotic technologies (landers, rovers) needed to establish a long-term human presence and develop commercial activity on our planet's satellite.[3] Finally, a test of Starship HLS, the first lander in the Artemis program, is still planned for 2024, despite delays to the Starship program (see below).[4] China's Quequiao 2 satellite, for its part, is scheduled[5] for launch into lunar orbit in early 2024. The Chang'e 6 mission is scheduled to bring back samples from the far side of the Moon later the same year.[6]

Though many of the missions scheduled for 2024 will almost certainly be delayed owing to overly optimistic planning, Artemis and the ILRS have emerged as the new framework programs around which many upcoming space missions will revolve, establishing the Moon as the favored destination of the coming years.

Even though 2024 would be an optimal year for a Mars mission – the launch window only opens every 26 months – the current lunar trend has been associated with a relative loss of enthusiasm for the Red Planet, now seen as a longer-term destination. Only a limited number of Mars science missions are planned for 2024, including one Japanese and one U.S. mission.[7]

A new dawn for Europe in space?

Europe is currently experiencing an unprecedented crisis, a series of geopolitical and economic upheavals having undermined its industrial and institutional space organizations. This is especially apparent in the launch sector, which is struggling to cope with U.S. competition from Space X and increasing delays to the Ariane 6 program. The war in Ukraine also hit the sector hard, leading to the end of cooperation with Russia on Soyuz launches out of French Guiana. Finally, technical difficulties resulted in the recent failure of the new Vega C launcher, leaving Europe without an alternative solution to reach space. Caught between U.S. and Chinese initiatives, Europe does not yet seem to have found its own direction.[8]

3. The Moon's commercial exploitation encompasses a range of activities, some of which already exist (development of goods and services for the Artemis program), while others are more speculative (mining resources). For more details, see: C. Lavarde and V. Paoli-Gagin, (rapporteur), "Exploitation des ressources spatiales", *Rapport d'information*, No. 668, Sénat, June 2023, available at: www.senat.fr.

4. C. Bergin, "NASA Looking Forward to Next Starship Test, HLS Integration", *NasaSpaceflight*, May 16, 2023, available at: www.nasaspaceflight.com.

5. A. Jones, "China to Launch Queqiao-2 Moon Relay Satellite in Early 2024", *Space News*, 2023, available at: spacenews.com.

6. A. Jones, "China's Chang'e 6 Mission Will Collect Lunar Samples from the Far Side of the Moon by 2024", *Space.com*, 2021, available at: www.space.com.

7. "MMX", JAXA, 2023, available at: www.mmx.jaxa.jp.

8. P. Wohrer, "L'Europe spatiale prise dans une tenaille stratégique", *Politique étrangère*, vol. 88, n° 3, Ifri, 2023, p. 61-72, available at: www.ifri.org.

Yet Europe has many strengths, not least of which are a cutting-edge space industry and expertise in almost every critical sector of the space industry (apart from autonomous human spaceflight). The space sector also features a wealth of opportunities, not only in economic terms, but also scientifically and militarily.

2024 could therefore see Europe rectify some of its shortcomings in the space sector. Ariane 6's inaugural launch would bring to an end to Europe's inability to reach space. German company ISAR Aerospace is also planning its launcher's first flight out of Norway.[9] The first deployments and initial activation of the IRIS² constellation, designed to offer secure connectivity solutions,[10] are also planned for 2024. As part of the U.S. Artemis program, Europe will supply the service module for the Orion spacecraft, bringing astronauts into lunar orbit for the first time since 1972. Europe is also planning to launch the Space Rider prototype, a reusable unmanned mini-shuttle that will provide a platform for experimentation and testing new technologies. 2024 could thus mark a new beginning for Europe in space, with two new launchers, a new vehicle to explore space and develop its commercial potential, and new cooperative manned missions.

> Ariane 6's inaugural launch would bring an end to Europe's current inability to reach space

The war in Ukraine has demonstrated the importance of space in modern combat operations. Europe's support to Ukraine did not significantly involve its space capabilities, however, and the country quickly turned to American solutions for its space-based telecom and intelligence resources. This prompted the European Union (EU) to take action and publish a space strategy for security and defense in 2023. Departing from its role as a body concerned with civilian applications of space capabilities, the European Commission has now signaled its intention to more directly support the defense policies of its member states through the use of its satellite capabilities. Moreover, the EU is considering the introduction of a space law in 2024, and has proposed measures on space traffic management, satellite cybersecurity and the security of European space programs.[11]

For Europe's space sector to emerge from its current predicament, a number of political hurdles still need to be overcome. The member states of the European Space Agency or the EU have adopted national strategies that tend to undermine the European space project. Perspectives vary on the principle of autonomous access to space, on the best approach to cooperation on critical Earth observation and navigation technologies,

9d. K. Duffy, "German Startup to Launch Rockets from Norway in First for Europe", Bloomberg, 2023, available at: www.bloomberg.com.
10. "IRIS²: The New EU Secure Satellite Constellation", European Commission, 2023, available at: defence-industry-space.ec.europa.eu.
11. "Joint Communication to the European Parliament and the Council. European Union Space Strategy for Security and Defence", European Commission, 2023, available at: https://defence-industry-space.ec.europa.eu.

on satellite constellations, and on the highly political issue of European manned flight. Europe must succeed in establishing a common strategy to emerge from its current crisis and meet the challenges of international competition in the future.

Economic and technological trends

New ways of access to space

The year 2024 should witness the maiden flights of numerous space launchers. A number of them are likely to have a significant impact: the first launch of Ariane 6 in Europe, as well as Starship, New Glenn, Vulcan and Neutron in the United States, are scheduled for late 2023 or 2024. Little information is available concerning China, although some companies have announced new reusable launchers for 2024, among them Space Pioneer with its Tianlong-3[12] and Galactic Energy and its Pallas-1. Next year could also mark the first successful launch of Japan's H3 launcher, following its failed maiden flight in 2023. India and Russia have no scheduled tests for new space launchers in 2024.

> 2024 will see the transition to a new generation of space launchers

For Europe, Ariane 6 will be the key to regaining autonomous access to space. This new launcher[13] is the successor to Ariane 5, whose last flight occurred in July 2023. It will also replace Soyuz, its flights having ceased following the outbreak of war in Ukraine in February 2022. Ariane 6's delays – the first flight was scheduled for 2020 – have severely impacted the European launch schedule. Some satellites initially scheduled for deployment on the European launcher[14] had to be launched by U.S. competitor Space X.[15]

Several U.S. launchers are scheduled to launch for the first time in late 2023 or early 2024. Vulcan is a new heavy-lift launch vehicle[16] built by United Launch Alliance (ULA). The successor to the Delta IV and Atlas V, it will specialize in government satellite launches, and in particular military satellites. Its engine is manufactured by Blue Origin, a company headed by Jeff Bezos (Amazon). Vulcan would enable American institutions to free themselves from their dependence on Russia, which produced the Atlas V's engines. With Space X's Falcon, the United States will have two

12. A. Jones, "Chinese Company Plans to Launch Rocket Comparable to Falcon 9 in 2024", *Space News*, 2023, available at: https://spacenews.com.
13. Capable of launching between 7 and 20 tons into low-Earth orbit, depending on its configuration (2 or 4 solid rocket boosters). See the Arianegroup website, available at: www.ariane.group.
14. "Arianespace and ESA Announce the Euclid Satellite's Launch Contract for Dark Energy Exploration", European Space Agency, 2020, available at: www.esa.int.
15. "Euclid Ready for Falcon 9", European Space Agency, 2023, available at: www.esa.int.
16. Capable of launching between 8 and 27 tons into low-Earth orbit, depending on its configuration (0 to 6 solid rocket boosters). See: www.ulalaunch.com.

American-made heavy-lift launchers at its disposal, ensuring resilient autonomous access to space. The first Vulcan launch is scheduled for December 2023.[17]

The company Rocket Lab is designing Neutron, a medium-lift launch vehicle[18] with a reusable first stage. Originally from New Zealand, now U.S.-based, Rocket Lab is one of NewSpace's success stories, its Electron rocket being one of very few small-lift launchers with proven reliability.[19]

Blue Origin has also announced that New Glenn,[20] an even more powerful launcher than Vulcan or Ariane 6, will have its first launch in 2024. It will carry the ESCAPADE mission to Mars.[21] Little information is available concerning its development, however.

Finally, Starship,[22] designed by Space X, has generated both considerable doubts and high expectations. This vehicle was designed to enable the colonization of Mars by humans. Despite this launcher's power, SpaceX announced that the cost per kilogram to orbit would be the lowest on the market, thanks in particular to the complete reuse of the rocket's two stages. Starship's first objective, for which it is already behind schedule, is to send humans to the Moon as part of the Artemis program. Despite extensive testing since 2018, Space X has yet to validate Starship's operational model, and suffered two notable failures in 2023. Its development is nevertheless moving quickly.

Technological innovations

One feature the new U.S. launchers (Neutron, Vulcan, New Glenn, Starship) share is the use of methane as fuel. Europe is also developing this technology with the Prometheus engine, planned for the next generation of space launchers. Less powerful than kerosene and less efficient than liquid hydrogen, it was seldom used in space launchers in the past. This development is primarily intended to facilitate launcher reuse, since unlike kerosene, methane produces no soot and delivers greater thrust than liquid hydrogen.

Reuse has become an increasingly widespread operational strategy, with all of the launch vehicles mentioned above incorporating it to some extent. Starship was designed to be fully reusable, and New Glenn may be as well. Rocket Lab aims to recover the first stage and fairing of its Neutron launcher. The Vulcan and Ariane 6 launchers will not have a reuse strategy at the start of their operational life, but ULA is developing a solution

17. Statement by Tory Bruno, CEO of ULA, at the World Satellite Business Week in 2023.
18. Capable of launching approximately 13 tons into low-Earth orbit. See: www.rocketlabusa.com.
19. Despite a recent failure in September 2023, Electron remains the leader among small Western launch vehicles.
20. Capable of launching 45 tons into low-Earth orbit. See: www.blueorigin.com.
21. J. Foust, "ESCAPADE Confident in Planned 2024 New Glenn Launch", *Space News*, 2023, available at: https://spacenews.com.
22. Capable of launching between 100 and 150 tons into low-Earth orbit. See: www.spacex.com.

dubbed SMART Reuse, designed to recover the launcher's engine.[23] Arianegroup, which produces Ariane 6, announced in 2022 that it would develop a reusable upper stage named SUSIE.[24] It could be used on Ariane 6 and future European launch vehicles.

Another common objective for all these launchers is to facilitate the deployment of satellite constellations in low-Earth orbit. Ariane 6 features constellation deployment technologies, and signed the largest contract in Arianespace history with Amazon to deploy the Kuiper constellation. Starship was designed to be capable of carrying large numbers of Starlink satellites, and Rocket Lab describes Neutron as a "mega constellation launcher".[25] While efforts were once focused on optimizing geostationary launches, today there seems to be a general consensus in the launcher industry that constellations will drive markets in the future.[26]

Continued expansion of satellite constellations

Satellite constellations should keep growing in 2024. At present, only two have actually been deployed. Starlink, Space X's constellation, is by far the most advanced, with 4,812[27] satellites in orbit as of October 1, 2023. To put this figure into perspective, there are some 10,283 satellites in Earth orbit,[28] including some which are no longer operational.[29] Starlink therefore represents over 45% of all satellites in orbit, regardless of origin. The other operational constellation, OneWeb, is much more modest, with a fleet of 648 satellites.

Starlink constellation statistics

	Launches	Satellites deployed
2019	2	120
2020	14	833
2021	19	989
2022	34	1 722
2023	43	1 534
Total	**112**	**5 198**[30]

Source: information compiled by Jonathan Mc Dowell, available at: https://planet4589.org.

23. M. Ragab *et al.*, "Launch Vehicle Recovery and Reuse", American Institute of Aeronautics and Astronautics, 2015, available at: www.ulalaunch.com.
24. "Susie, The Reusable Space Transporter European Style", Arianegoup, 2022, available at: www.ariane.group.
25. "Mega Constellation Launcher", Rocketlabusa.com, available at: www.rocketlabusa.com.
26. "NGSO Constellations Continue to Gain Momentum, Satellite Connectivity & Video Market Expected to Double Over Next Decade", Euroconsult, 2023, available at: www.euroconsult-ec.com.
27. J. Mc Dowell, "Starlink Statistics", 2023, available at: https://planet4589.org.
28. "Online Index of Objects Launched into Outer Space", United Nations Office for Outer Space Affairs, 2023, available at: www.unoosa.org.
29. "Orbiting Now", a website that tracks satellites based on publicly available data, puts the number of operational satellites at 8,453 as of September 1, 2023, raising Starlink's share of the total to 55%. See: https://orbit.ing-now.com.
30. Of the 5,198 satellites launched, 4,812 were operational as of October 1, 2023.

The meteoric rise in the number of objects in orbit, which is now exponential, is entirely attributable to Starlink. Other constellations are scheduled for deployment: Amazon's Kuiper, the EU's IRIS² and China's Guowang constellation should all have their first launches next year. This should create new space traffic management challenges, as certain orbits grow increasingly congested.

Other trends worth tracking

Space programs of small and middle powers

New space technologies, such as small satellites, and the decreasing costs of launches have made it possible for many countries to develop space programs, an unthinkable prospect just a few years ago. This has given the United Arab Emirates (UAE), New Zealand, Argentina, Brazil and South Africa, among others, the opportunity to develop their own space programs.

Small and middle powers are now able to develop their space programs

This trend should continue in 2024. Launches are now planned for satellites designed and manufactured in Australia, the UAE, New Zealand, Djibouti, Hungary, Singapore, Pakistan, Slovakia, Portugal, Brazil and Argentina. Small satellites allow these countries to develop their expertise in the space sector, and even launch some operational missions. Most of these satellites still rely on launchers from established space powers (United States, China, Europe) to reach space, however.

Direct-to-cell satellites

Cell phone manufacturers are increasingly advertising smartphones capable of connecting directly to satellites. This capability has already been introduced on certain Apple[31] and Huawei[32] devices. For now, the technology is limited to emergency SMS and text messages, but some analysts predict that it will be rolled out more widely, until true worldwide connectivity is available.[33] Several companies are interested in this new market, including U.S. operators Space X, Lynk Global, AST SpaceMobile and Spain's Sateliot. Operators SES, Iridium, Intelsat and Inmarsat have also expressed interest in this new market.

Satellite-based quantum key distribution

The technology of satellite-based Quantum Key Distribution (QKD) has been the subject of research for several years now. In 2016, China was the first to launch a satellite, Mozi

31. Apple press release on emergency SOS via satellite, 2022, available at: www.apple.com.
32. K. Chua, "How Satellite Calling Works on the Huawei Mate 60 Pro", *Tech360*, 2023, available at: www.tech360.tv.
33. R. Jewett, "How Big Is the Satellite Industry's Direct-to-Device Opportunity?", *Via Satellite*, 2023, available at: www.satellitetoday.com.

(or Micius), capable of performing this type of encryption. This technology allows for extremely secure communications, as it can detect any attempt at interception by a third party, while ensuring that intercepted signals are indecipherable.[34] At present, satellite communications seem better suited to QKD implementation than ground-based methods like fiber optics.

European company SES has announced plans to launch Eagle-1, Europe's first QKD satellite, in 2024.[35] This satellite will be used to test technologies needed for the future European IRIS² constellation. Singaporean start-up SpeQtral also hopes to launch a QKD satellite in 2024, following the success of its experimental satellite in 2019.[36]

Militarization of space

Starlink's role in the war in Ukraine has demonstrated the importance of space-based tools for the armed forces. The militarization of space is advancing with the emergence of increasingly capable spatial solutions. The US Space Force has requested a larger budget than NASA for 2024 ($30 billion[37] compared to $27.2 billion[38]). Budgets have not yet been settled, but space military capabilities seem to be high on the agenda. The militarization of space, and even its weaponization, can be seen as a consequence of ongoing international tensions between the United States, China and Russia. This trend will extend well beyond 2024.

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37. S. Erwin, "Space Force General: 'No Pushback' from Congress on 2024 Budget Priorities", *Space News*, 2023, available at: https://spacenews.com.
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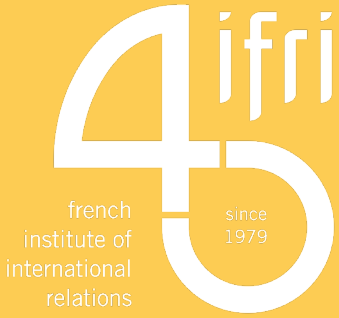

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