

DEFINE OUR FUTURE



Artemis Accords 5th Anniversary, Launch
Setbacks, Focus on Resources, and Orbital
Governance

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23. IMPRESSUM

INTRODUCTION

On 13 October 2020, the United States established the Artemis Accords, a non-binding set of principles ‘...for the cooperation in the civil exploration and use of the Moon, Mars and comets for peaceful purposes.’ The Accords initial members included Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom and the United States. Five years later, the framework now boasts 57 State Parties, after Hungary signed up on 22 October 2025.

Firstly, the Accords are a true reflection of ‘soft law-making’ in the current age of rapid space economic growth and attempts to evolve space governance. Non-binding approaches are arguably now observed as a more effective way to gain a legal harmony among States, considering that the era of quick treaty-making of the 1960s and 70s is unlikely to see a resurgence. One example would be the UN Long-Term Sustainability guidelines, praised by UNOOSA Director, Aarti Holla-Maini, as the ‘treaty of our times’. Peter Martinez also stated that ‘...non-binding does not mean non-legal, in the sense that these...can be, and indeed, have been, adopted by a number of states into their own national regulatory frameworks, thereby giving them legally binding character...’

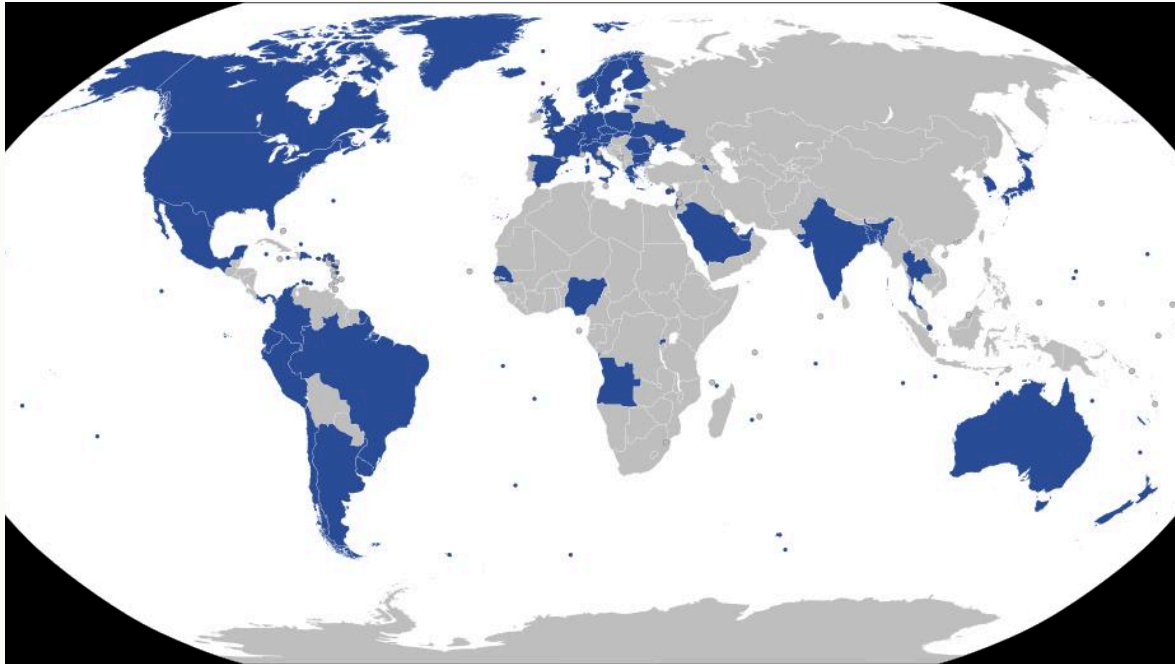
The Artemis Accords could indeed represent a high-level, US-led attempt to establish a ‘soft space treaty’ for the 21st century, thereby avoiding the often tedious and politically charged process of hard treaty-making. Yet despite gathering generous support, how far can the Artemis Accords go in implementing new universal norms of space activities?

Exploring Some Key Provisions of the Artemis Accords

Firstly, the Accords were presented as an effort to ‘...bring together nations through a common set of principles to guide civil space exploration, setting the stage for peaceful, responsible, and productive cooperation in space affairs’, according to the US Department of State. Importantly, they are grounded in the principles within the Outer Space Treaty and the other space treaties (but notably omits the Moon Agreement). This in itself has provided a viable starting point, in claiming to adhere to the OST, which is ratified by all leading space nations, with 116 States Parties to the OST in total.

The Accords then seek to implement the OST provisions, and it does so broadly throughout. Section 3 requests that Signatories ‘...affirm that cooperative activities...should be exclusively for peaceful purposes and in accordance with relevant international law.’ It also calls for

actors to ‘...register any relevant space object in accordance with the Registration Convention’, as well as enhancing the principle of ‘due regard’ within Article IX of the OST, and requests that Signatories also conduct activities ‘...with due consideration to the United Nations Guidelines for the Long-term Sustainability of Outer Space Activities adopted by the COPUOS’ (LTS Guidelines).



The Accords are then seemingly anchored in the OST, and furthermore, act as a mechanism to build upon and implement those principles. Another area where this is evident is in relation to resource activities, within Section 10. However, the Accords also present a bold step regarding definitions within the OST, namely Article II, which states that outer space ‘...is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.’ Section 10(2) of the Accords states that ‘...the extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty,’ while the US position is that ‘...removal (of resources) is permitted by Article I of the Treaty, which provides that outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States.’ (US delegation at the 2025 LSC COPUOS meeting).

Furthermore, the concept of ‘safety zones’ is introduced within Section 11, which applies the principle of ‘due regard’, and calls for the implementation of exclusion zones around active sites, such as on the Moon, in order to prevent harmful interference with other actors. However, the potential applications of ‘safety zones’ has presented a challenge. Walker A Smith has described that concerns exist regarding using them as ‘...de facto areas of national

appropriation...’, while during a US House discussion in December 2023, Michele Hanlon suggested that vehicles which land or crash into the lunar surface create a safety zone around them, and therefore reserve the mineral resources within it. Furthermore, Song Zhongping, a Chinese military and aerospace expert, has compared US aims on the Moon to enclosure movements in 18th-century Britain.

Nonetheless, the Accords present a framework for States to commit to principles which would enable and encourage resource activities, stating that ‘...the utilization of space resources can benefit humankind by providing critical support for safe and sustainable operations.’ Furthermore, in 2020, the US confirmed that ‘Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space...’ and that, in their view, outer space is not a ‘global commons’.

A harmonising approach, or geopolitical division? Artemis and Chinese global leadership

Though the Artemis Accords now boast 57 State Signatories, it is to be seen whether they can act as a truly global unifying framework on space governance. It would seem highly unlikely that adversaries of the US, namely China and Russia, would join any time soon, especially given only the terrestrial geopolitical and economic rivalries.

Additionally, the Accords represent an increasingly commercial focus on space exploration and utilisation, while Elle Rothermich argues that ‘Companies in the emerging commercial space industry have long called for this kind of framework, arguing that existing international space law is too ambiguous to allow for peaceful and stable development.’ President Trump’s second term has brought about more focus on the private sector, notably within the recent Executive Order, titled ‘Enabling Competition in the Commercial Space Industry’. Furthermore, acting NASA chief, Sean Duffy, has recently reopened competition for contracts to supply the crew lander for the Artemis-III mission, and called upon the private sector for proposals on the delivery of a nuclear reactor to the Moon by 2030, indicating yet more commercial leadership.

However, China, though home to its own thriving commercial space industry, provides an alternative form of leadership, one which is not necessarily driven by commercial aims, but rather based upon scientific exploration and international cooperation. Its Tiangong space station is open for international cooperation, while it has also invited international payloads onboard their Chang’e lunar missions, while Legarda writes that through this ‘science diplomacy...China positioned itself as a potential collaborator for European countries also seeking to build up their polar and space programs and capacities.’

China has also established its '555' plan for its International Lunar Research Station project, which aims to gather the support of 50 States, 500 research institutions, and 5000 researchers. Elizabeth Economy has also previously noted that, according to President Xi, China's Global Security Initiative advocates that countries should '...reject the Cold War mentality, oppose unilateralism, and say no to group politics and bloc confrontation.' This could then align with this alternate form of leadership in space, based on neutrality and science, offering a different path than Artemis.

However, Legarda also argues that, although China has a science-led approach to space, and indeed many aspects of research in the Arctic and the Deep Sea, these activities are '...are always accompanied by work to secure military advantages and develop new military capabilities it can deploy in case of conflict.' This then would indicate that Chinese leadership may also be based on local competition within an increasingly contested space domain. The Artemis bloc seems no different in its aims, as Sean Duffy recently said:

"When President Trump launched the Artemis Accords in his first term, he made sure American values would lead the way – bringing together a coalition of nations to set the rules of the road in space and ensure exploration remains peaceful. After five years, the coalition is stronger than ever. This is critical as we seek to beat China to the Moon, not just to leave footprints, but this time to stay."

Ultimately, it appears that both China and the Artemis bloc approach space exploration as a means of advancing not only scientific progress but also national power and strategic influence. While each side frames its efforts in terms of cooperation and peaceful development, their underlying goals suggest that space is becoming an extension of geopolitical competition. In this sense, the pursuit of leadership beyond Earth increasingly reflects the broader dynamics of rivalry and ambition that shape international relations today.

NEWS ANALYSIS



A NEWS

OPINION | ANALYSIS

Launch Setbacks, the Pace of Artemis, and Lunar Resources for the Quantum Market

Illustration of Artemis stage separation (Image: ESA– D. Ducros)

Starship 11 Launch, Commercial Launch Delays, and Europe Pushes for Reusable First Stage

The acting head of NASA, Sean Duffy, has announced that the Artemis human landing system (HLS) will be opened up for competition. This comes on the back of delays from SpaceX, which is contracted to supply a HLS variant of Starship, to deliver crew to the lunar surface under the Artemis III mission, scheduled for 2027. The announcement has drawn fiery responses from Elon Musk on X (formerly Twitter), and it is to be seen which companies might be able to provide an alternative, with Blue Origin seen as the only likely competitor.

Nonetheless, given the rapid iteration techniques employed by SpaceX, it remains only reasonable to assume that Starship remains the frontrunner. In our previous report, we discussed the successful 10th demonstration launch of Starship on 26 August. This was swiftly followed by test launch 11, on 13 October. The launch saw the final flight of the current variant of Starship and booster, and according to the company, it met every major objective of the test, largely similar to test 10. SpaceX will now look to develop version 3 of Starship, which ‘...will be used for the first Starship orbital flights, operational payload missions, propellant transfer, and more...’ (SpaceX).

Furthermore, Starship V3 is designed to be fully reusable and able to carry 100 metric tons of payload into orbit, a feat which could see SpaceX once more disrupt the rapidly evolving space industry, theoretically at some point being able to deliver 1kg of payload into orbit for as little as \$10, according to an **AEI report**.

However, 2025 has not necessarily been a resounding success for all launch entities (so far). SpaceX has experienced a series of launch failures, including an explosion during a static fire test in June, while in late September, Firefly Aerospace also experienced an anomaly, which caused an explosion during first-stage testing of their Alpha rocket. This comes weeks after being given FAA approval to resume launches of its Alpha launch vehicle, after another failed launch incident in April this year.



Render of Dream Chaser (Image: Sierra Space)

Development of new space transportation systems is difficult and can take longer than what's originally planned

” **Dana Weigel, NASA**

Sierra Space (US) has been developing its reusable spaceplane, the Dream Chaser, since its first conception in 2004. It is designed to ferry cargo to orbital destinations, such as the ISS and future commercial stations, with a crew-rated version also in development, while the company is also partnered with Blue Origin in the Orbital Reef commercial space station project. However, Sierra had aimed to launch Dream Chaser on its inaugural flight in 2024, on the second ULA Vulcan launch, but with priority missions now on the schedule for Vulcan, Sierra has had to push the launch back to 2026.

Nonetheless, the launch sector remains vibrant and awaits numerous debut flights. Isar Aerospace (Germany) is prepping for the second launch of its Spectrum Rocket, and its first orbital launch attempt, after shipping the first stage to Andøya, Norway. This follows its first attempt in March, when the rocket cleared the launch tower, before losing control shortly after and crashing into the sea. UK-based company, Orbex, are also preparing for their debut launch, using its Prime rocket. The company carried out a successful simulated launch in

September, and is now aiming for 2026 for its debut demonstration. Prime will have a payload capacity of up to 200kg, while Spectrum is designed to carry up 1,000kg to low Earth orbit (LEO).

Taiwan is also striving to develop its sovereign launch capabilities. In March, Taiwan's National Science and Technology Council announced that Taiwan's first orbital launch site would be located in Pingtung County on the southeast coast of Taiwan, while the latest budget presented by the National Science and Technology Council (NSTC) in September has shown that the Taiwan Space Agency (TASA) is set to receive \$194 million for 2026. A key focus of this is to develop rocket technology capable of delivering 200kg into orbit. Further, Taiwan aims to complete a **preliminary design review** for a suborbital rocket in 2026.

Spaceflight reusability has, though, undoubtedly been one of the key disruptive forces in the space industry over the last decade, demonstrated by SpaceX and its Falcon-9. They accounted for the vast majority of US space launches in 2024, and have already matched their launch record for 2025 (133 so far). The democratisation of space and the lowering of launch costs have given SpaceX and the US a means of dominating an increasingly congested LEO, which in turn is driving competition (a subject we touch upon in this month's Legal Review). The European Space Agency (ESA) and Italy's rocket developer, Avio, signed an agreement at the International Astronautical Congress (IAC) in September, on a €40 million contract to develop a reusable first stage. ESA is also developing 'Space Ryder', a reusable spaceplane, while Arianespace (France) is developing 'Susie', a reusable upper stage.

Artemis-II Brought Forward, Blue to Deliver VIPER, Honda Lunar Power Project and Artemis Lunar Wifi

Sean Duffy's decision to reopen competition for the Artemis III HLS vehicle may indicate a continued push by the US administration to return astronauts to the Moon, and succeed in the increasingly geopolitically-charged 'race' to establish a sustained presence there. The acting administrator has made decisive steps towards this aim, even during his very short tenure at the agency.

Duffy already announced that NASA is aiming to build a nuclear reactor on the Moon by 2030, and in August referred to similar joint plans between Russia and China, and voiced fears that they may establish a 'keep out zone' on the Moon. Despite this being in contravention of Article II of the Outer Space Treaty (which prohibits appropriation of outer space), such a zone, or a 'safety zone', around an active nuclear reactor could actually be compliant with the US-led governance framework, the Artemis Accords. The Accords call for the use of a 'safety zone' where '...nominal operations of a relevant activity or an anomalous event could reasonably cause harmful interference.'

Competition then appears to be intensifying, with China seeming on course to deliver taikonauts to the Moon by 2030, following a test firing of their Long March-10 rocket in August, and a simulated flight of its 'Lanyue' lunar landing vehicle. Russia is planning to launch its Luna-26 mission, now in 2028, which is to search for suitable landing sites. This will be followed by Luna-27A and Luna-27B, which will fly to the south and north lunar poles. Luna-28 is then planned as a lunar sample return mission.

NASA have now revealed that they will bring forward their Artemis-II mission by several months, now scheduled for February 2026. The mission is to transport crew around the Moon, on the same trajectory as Artemis-I, on a 10-day mission, further than any human has travelled into space.

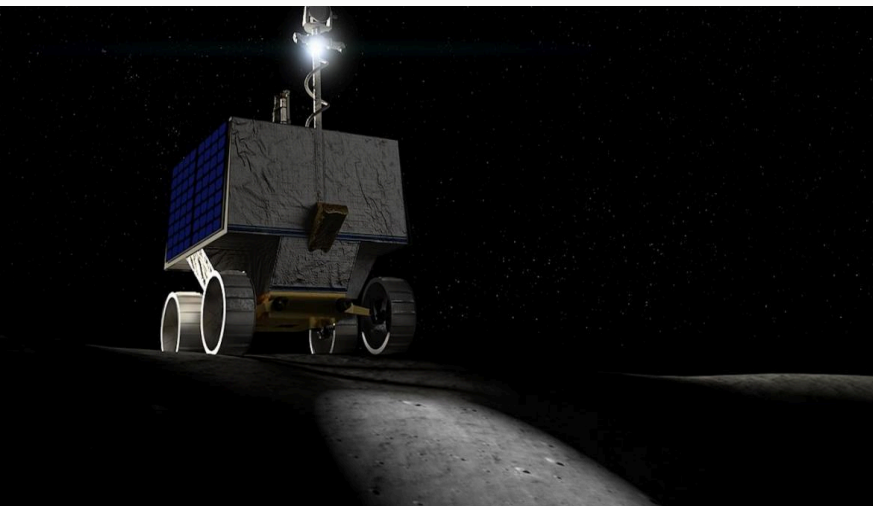


Illustration of VIPER (Image: NASA)

NASA is committed to studying and exploring the Moon, including learning more about water on the lunar surface

” **NASA**

These missions are critical steps in the aim to expand humanity's footprint into outer space, for scientific discovery, to establish a launchpad to Mars and beyond, and to utilise the benefits of space. Moreover, these aims continue to be supported by commercial technology and innovation. A prime example of this is the case of NASA's VIPER (Volatiles Investigating Polar Exploration Rover) lunar rover, which was halted in July 2024 due to cost overruns. NASA then called for partnership proposals from industry on the project. In a confusing to-and-fro from the agency, the call for proposals was then cancelled in May 2025. However, on 19 September, NASA announced that it had awarded Blue Origin a 'CLPS (Commercial Lunar Payload Services) task order with an option to deliver a rover to the Moon's South Pole region', with a total potential value of \$190 million (NASA). It is now expected that Blue will deliver the rover to the lunar south pole in 2027.

This is just one of the latest examples of the private sector increasingly supporting the long-term aims of US-led space exploration, and an overall commercialisation of the lunar

economy. Solstar Space, a US startup, has also announced how they will support NASA lunar exploration, through providing **wifi access points (LWIFI-AP)**. According to the CEO, Brian Barnett, wifi will be essential on the Moon, just as it ‘...revolutionised life on Earth.’ Issued under NASA CLPS, they received a Phase I Small Business Innovation Research (SBIR) award, valued at \$150,000.

Lastly, Honda has once more demonstrated how the automotive sector is playing a key role in the new lunar economy, through a new partnership with Astrobotic (US). Their joint feasibility study is to ‘...explore how the Honda regenerative fuel cell (RFC) system can be integrated with Astrobotic’s Vertical Solar Array Technology (VSAT) and LunaGrid service to provide continuous power, even during prolonged periods of darkness on the Moon.’ LunaGrid is Astrobotic’s lunar power solution programme, which envisages using tethered rovers to deliver power wirelessly for customers on the lunar surface. The Honda RFC solution would then be able to store solar energy as hydrogen during the lunar day, which could then be converted into electricity during the long lunar nights.

Project Oasis Lunar Prospecting, Helium-3 for Quantum Market, and a Growing Focus on Resources

Similarly, as discussed in our previous report, there is currently a spike in activity in relation to space and lunar resource utilisation and retrieval. Last month our report highlighted an agreement between lunar mining company, Magna Petra, and NASA, to deliver a NASA-developed Mass Spectrometer Observing Lunar Operations (MSOLO) instrument to the lunar surface. This will be sent with iSpace’s Mission 3, and is set to search for data on helium-3 and other volatiles. Interlune are also set to send a spectrometer on Astrolab’s FLIP rover, which will be launched with Astrobotic’s Griffin lander, as early as late 2025, and will also aim to identify quantities of helium-3.

On 30 September, Blue Origin announced ‘Project Oasis’, a ‘...multi-phase initiative to identify key lunar resources from orbit, assess them on the ground, and harness them in situ.’ Blue will work with partners in Luxembourg, a State which has established its own space mining legislation, with the project aimed at creating a detailed, high-resolution map of lunar resources, such as water, helium-3, radionuclides, rare earth elements and precious metals. This first stage will be ‘Oasis-1’, and will be ‘further enabled through Blue Alchemist’, Blue Origin’s technology used to heat and utilise lunar regolith for the construction of solar cells and cables, among other applications.

The retrieval of helium-3 remains a key focus. As it has been widely discussed in previous reports, the isotope is believed to be in abundance on the Moon, and its scarcity on Earth gives it a current market value of \$20 million p/kg, according to Interlune CEO, Rob Meyerson.

While it is often linked to providing clean fuel for nuclear fusion reactors on Earth, its use is also vital for quantum computing, for cryogenic cooling systems. On 16 September, Interlune signed an agreement with Finland's Bluefors, a world-leading company developing these systems. Interlune are to deliver up to 10,000 litres of helium-3 to Bluefors annually between 2028 and 2037. The deal is **estimated to be worth \$300 million**.

Interlune are some steps away from harvesting and retrieving helium-3, but deals are nonetheless already being signed in order to deliver it terrestrially, while prospecting missions may take place as soon as this year. What remains, though, is a thorough legal framework to govern resource activities. While a **draft proposal** has been presented at the United Nations Committee on Peaceful Uses of Outer Space (COPUOS), titled the 'draft set of recommended principles for space resource activities', it is anticipated that the final version may not be presented until 2027. Meanwhile, recent developments suggest that resource activities, in the backdrop of increasing geopolitical rivalries, are developing quickly.

SPACE LAW REVIEW



SPACE LAW & POLICY

SUSTAINABLE & PEACEFUL USES OF OUTER SPACE

Discussing the challenges, threats and opportunities to international space law and governance, arising out of evolving international relations, geopolitical dynamics and more

Key terms: Key terms: Outer Space Treaty; Registration Convention; Liability Convention; ITU Constitution; Radio Regulations; Dual-Use; Megaconstellations; Cyber-Resilience; LEO;

Competition, Militarisation and Equity - Analysing Some Key Challenges to Orbital Governance

Peter Martinez, the executive director of the Secure World Foundation, described space as becoming increasingly congested, contaminated and contested,¹ and while these words were published in 2023, they are yet more applicable today. As of October 2025, there are 13,976 objects in different orbits,² while in 2024 there were almost 3000 objects launched into space, compared to just 237 in 2015.³ Increasing value and sovereignty being placed on space, by both State and non-governmental entities, is seemingly placing strain on the existing legal and governmental structures in place to maintain pace, security and sustainability.

This is seen in the use of Earth orbit as a domain of defence, emphasised since the beginning of the Ukraine conflict in 2022, and the divisive use of Starlink in battlefield operations. Furthermore, orbit, particularly low Earth orbit (LEO), is becoming rapidly populated by satellite megaconstellations, while more diverse uses of space are being explored. Additionally, increasing congestion of orbit places more strain on the space environment and the concept of equitable sharing of space for all States.

This brief article aims to analyse what governance mechanisms are in place to govern the use of Earth orbit, and to understand what urgencies need addressing, in light of recent and pressing developments in the orbit domain. While this research does not aim to discuss the deeper dynamics of current geopolitical conflicts and international relations, it will briefly introduce some of these concepts in order to provide context.

An Increasingly Valued Domain of Defence - Can Space be Maintained for Peace?

Since the Trump administration returned to office, European nations have been forced to reconsider their own defensive strategies, in the wake of pressure from the US. In February, US Defence Secretary, Pete Hsgeth, said that Europe would need to provide the 'overwhelming share' of military aid to Ukraine in future,⁴ while a leaked message within the 'Signalgate' scandal in March detailed US frustration with Europe, with the Vice President saying that he hates '...bailing out Europe again.'⁵ This apparent threat of US military 'isolationism' has led to a wave of European rearmament strategies. The UK announced it would increase defence spending to 3% (from 2.5%) in the next parliament,⁶ while France has committed to double military spending by 2027.⁷

Similarly, the German government announced that lawmakers voted to back plans to unlock \$547bn for defence and infrastructure development.⁸ This commitment has more recently pronounced the urgency surrounding the development of space assets for defence, with the German Defence Minister announcing on 25 September that \$41bn would be allocated over the next five years for space security and cybersecurity.⁹ While Trumpian isolationism may have been one defining factor in this decision-making, the Minister also noted that 'Russia and China have in recent years rapidly expanded their capabilities for conducting warfare in space,'¹⁰ a view also shared by other European neighbours.

On 10 September, the Commander of UK Space Command, Major General Paul Tedman, said that the UK must be able to control space and defend its assets in space, adding that 'Over the past year, China has conducted close-proximity operations, deployed dual-use inspector satellites, and integrated kinetic, directed-energy, AI, and cyber tools into a formidable counterspace arsenal.'¹¹ Furthermore, in an interview with the BBC, Tedman also discussed the current threat posed by Russian satellites 'stalking' UK space assets, claiming that 'They've got payloads on board that can see our satellites and are trying to collect information from them.'¹²

Head of the European Space Agency (ESA), Josef Aschbacher, has also warned that the UK and EU are unprepared for the new reality of growing threats from space,¹³ and argued that

satellites providing services for civil applications could also be used for defence. This somewhat reflects the use of Starlink Ukraine, a commercial broadband connectivity constellation which has been pivotal in the Ukrainian military machine. An article from the Harvard Kennedy School reinforces this, stating that ‘Starlink has undoubtedly played an important role in basic communications and strategic field operations in the wake of the war. From a technical standpoint, low orbit constellations have proven to be reliable, dynamic, and resilient.’¹⁴

However, a notable increase in defence activity in the space domain requires critical awareness of what governance structures are in place to regulate such activity, specifically in relation to maintaining space for peaceful uses, and the role of non-military assets in the defence segment. An instinctive place to begin is, of course, with the international space treaties. The Outer Space Treaty (OST)¹⁵ does provide some clear and direct provisions regarding the militarisation of outer space, and while it has gained some criticism for being somewhat outdated for the modern age,¹⁶ the OST was written during the heightened tensions of the Cold War, and as described by Von der Dunk and Tronchetti, the OST makes a prominent effort to ‘...minimise the risk of nuclear war using space...’, as well as demilitarising the Moon and building transparency and confidence building measures (TCMBs).¹⁷

The preamble to the OST firstly recognises the ‘...use of space for peaceful purposes’, while Article III requests that States shall carry out activities ‘...in the interest of maintaining international peace and security and promoting international co-operation and understanding.’¹⁸ Furthermore, Article IV directly prohibits ‘...any objects carrying nuclear weapons or any other kinds of weapons of mass destruction...’ in outer space, and Article VI places responsibility on States for the activities of non-governmental entities, such as private actors. States are also required to register space objects, a provision laid out in Article VIII, and later expanded upon with the Registration Convention in 1974 (the ‘Convention’).¹⁹ Article IV of the Convention requires that States provide details of a mission to the United Nations, such as launch date, orbital parameters, and general function of the space object.²⁰

It would seem then that suitable provisions are in place to prevent the weaponisation of Earth orbit, as well as maintain the transparency of activities. However, according to Tronchetti, the OST does not strictly forbid ‘...other kinds of weapons, such as anti-satellite weapons, or the transit of anti-ballistic missiles and rockets through space...’²¹ This would then seemingly allow for the placement of types of space-based weapons, such as the interceptor and tracking technologies proposed as part of Donald Trump’s ‘Golden Dome’ defence shield.²²

Also, Kinetic anti-satellite (ASAT) testing has already taken place by leading space nations, the most recent by carried out by Russia on 15 November 2021 on one of their own satellites in LEO, which subsequently created 1500 pieces of debris.²³ Efforts have been made at UN-

level to address the use of ASAT technology and the threats they pose, such as a 2022 General Assembly (GA) Resolution, which calls upon States ‘...to commit not to conduct destructive direct-ascent anti-satellite missile tests.’²⁴ However, GA Resolutions of course remain non-binding, and this also does not address the increasing threat of non-kinetic and cyber attacks on space objects, such as those voiced by Major General Paul Tedman.

Furthermore, while the Registration Convention may provide some transparency in relation to the activities and nature of space objects, ambiguity remains surrounding the technologies which would be interpreted as ‘dual use’, those which may have a peacetime application, such as vehicle which could use on-orbit servicing technologies to deorbit debris or refuel satellites, but could also be used to intercept and capture enemy satellites. This then questions what objects could become legitimate military targets in warfare, especially the rapidly growing number of commercial vehicles. Von der Dunk and Tronchetti write that ‘Due to the fact that the majority of commercial satellites have dual-use capacity and often have military clients, the determination of a legitimate military target in space is highly complicated.’²⁵ A case in point would be the use of Starlink in Ukraine. While its primary service is to provide global connectivity, its use to provide battlefield support has also brought about a reaction from Russia, which claims that Starlink satellites could become legitimate military targets.²⁶

International humanitarian law via the Geneva and Hague systems provides rules on armed conflict relating to human security and methods of conducting hostilities, respectively.²⁷ However, as a rapidly growing domain with a still young and evolving set of rules and governance, detailed research could be applied here, regarding the jus in bello rules for outer space.²⁸

Diversifying Applications, and a Rush to Secure a Contested Earth Orbit

Secondly, this article will explore the recent developments regarding diversifying applications and services from Earth orbit, and the legal quandary of equity and appropriation. The rapid acceleration of development in Earth orbit has undoubtedly brought about significant benefits for people and planet, such as global broadband connectivity and seamless navigation. Downstream space services are also playing an increasingly vital role in sustainable development, providing essential climate data, water monitoring, and assisting in disaster response, among others. Furthermore, the United Nations Office for Outer Space Affairs details how space can contribute to achieving each of the 17 Sustainable Development Goals (SDGs) outlined in the 2030 Agenda.²⁹

Earth orbit could also be a solution for answering increasing global energy demands. For example, Jeff Bezos has proposed building orbital data centres to power Artificial Intelligence (AI).³⁰ The plan would involve launching gigawatt orbital platforms within the next 10-20 years, which would be exposed to unlimited solar energy. US company, Starcloud, is also exploring orbital data centres, aiming to launch its Starcloud-1 mission later this year, deploying a 1-kilowatt solar array, and according to the company, it will ‘...deliver one hundred times the computational throughput of previous spaceborne systems.’³¹ In-space manufacturing (ISM) also aims to provide benefits utilising the space environment. UK-based company, Space Forge, are aiming to use the microgravity of space to develop delicate semiconductor materials, and in September signed an MoU with United Semiconductors (US) to ‘...accelerate the development of commercially viable in-space semiconductor manufacturing.’³² Varda Space (US) have already pioneered commercial ISM, successfully carrying out the in-orbit production of pharmaceutical products in 2024.³³

All these reasons point towards an Earth orbit becoming more competitive and contested, particularly as more nations aim to establish sovereign and independent access to space. For example, Russia is aiming to develop its own answer to Starlink, named ‘Rassvet’, with Russian company, Bureau 1440, due to launch 292 satellites by the end of the decade.³⁴ There is also the much larger megaconstellation development to consider, the largest being Starlink, numbering 8,475 satellites in LEO as of 25 September 2025.³⁵ Amazon’s Kuiper constellation is due to consist of over 3,200 satellites,³⁶ while China is establishing at least three megaconstellations; ‘Thousand Sails’ is set to be 14,000+ satellites,³⁷ ‘Guowang’ is set to be nearly 13,000,³⁸ while Hongqing Technologies is planning a 10,000+ constellation named ‘Honghu-3’.³⁹

There could then be reasonable evidence to suggest that space, moreover spectrum frequencies and orbital slots, are becoming increasingly valued and monopolised. Firstly, according to Newman and Napier, the deployment of very large constellations questions the notions within Article II of the OST, writing that ‘...it is not known whether one space actor (authorised by one State) launching tens of thousands of satellites to form a larger mega constellation would be appropriation by means of occupation.’⁴⁰ Article II states that outer space is ‘...is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.’⁴¹ Opinion and interpretations are likely to diverge regarding concepts of appropriation of orbital resources, especially considering that megconstellations are not registered as one single entity, but rather each satellite is registered as an individual space object.⁴²

However, it could be argued that the ‘monopolisation’ (or ‘long-term occupation’) of orbital planes may be in contravention of the International Telecommunications Union (ITU) Constitution.⁴³ Article 44 of the Constitution reads:

“...Member States shall bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically...so that countries or groups of countries may have equitable access to those orbits and frequencies...”⁴⁴

While this principle could be applied to prevent any form of appropriation of orbital planes and maintain outer space as a benefit for all States, there remain certain stumbling blocks to this argument. The use of orbital radio frequencies is assigned and licensed by the ITU, and through national regulators, while the OST, along with the subsequent Registration Convention, requests that States register all space objects nationally, and also with the United Nations. Upon accessing the UN registry, as of 21 October 2025, it is clear to see that, for example, the world’s largest constellation, Starlink, *is* being publicly registered.⁴⁵ Furthermore, Article 11.44 of the ITU Radio Regulations prevents the reservation of an orbital frequency assignment unless it is brought into use within seven years,⁴⁶ and given the pace of competition and increasing annual global launch cadence, it seems unlikely that leading megaconstellation operators would fall foul of this provision in the near future.

It then seems that while the principles of free and equitable access to the benefits of space are laid out in international law, there may still be room to ensure that all States, including new and developing space nations, can benefit from them too, during an age of increasing competition.

Conclusion

Earth orbit is becoming more congested and contested, driven not least by growing global competition, namely through superpower and commercial expansion. A report from the Commercial Space Federation has warned that China could overtake the US as the leading space power within five to ten years, claiming that it is experiencing its ‘...Apollo, ISS, and commercial space eras all at once...’⁴⁷ Moreover, a new age of geopolitics and economic rivalry, arguably catalysed since the start of the second Trump administration, has given further rise to States aiming to invest in the use of space for defence, to secure space assets and improve the resilience of satellite infrastructure.

International law and governance may still be lacking in regard to preventing the weaponisation of outer space, and while the OST serves primarily to prevent the placement of nuclear weapons (and other WMDs) in outer space, there remains little in terms of preventing the use of kinetic and non-kinetic satellite attacks. Furthermore, there also appears a necessity to address the role of dual-use assets in times of conflict, to understand their role in warfare, and what international laws would apply.

Lastly, downstream space technologies are generating an expanding array of opportunities, yet these may be increasingly constrained, particularly for smaller nations, by the de facto appropriation of orbital slots and frequency allocations. Further research in this area could examine how existing provisions of international law might be refined or expanded to mitigate the monopolisation of Earth orbit, for instance through an enhanced regulatory role for the International Telecommunication Union (ITU) with respect to Low Earth Orbit. Such research should also account for prevailing geopolitical dynamics and the progressively contaminated state of the orbital environment, assessing how these factors may shape the evolution of future binding or non-binding legal frameworks.



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22 October 2025

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ANASDA GmbH Monthly Space Report September 2025

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ISSN 3052-217X