A Mad Dash to Orbit: The Regulatory Question of Satellite Mega-Constellations in Low Earth Orbit

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Abstract

The proliferation of satellite mega-constellations in Low Earth Orbit (LEO) has created significant regulatory challenges for existing international space law. Private operators, including Starlink, OneWeb and Amazon LEO, are deploying satellites at a scale and pace that existing legal frameworks were not designed to accommodate. This paper examines two interrelated consequences: the escalating accumulation of space debris in LEO and the absence of an effective Space Traffic Management (STM) regime. Drawing on an analysis of the Outer Space Treaty 1967 and its successor instruments, alongside a case study of the Swarm Technologies incident, the paper identifies structural deficiencies in the current regime, including its state-centric liability framework, fragmented national licensing systems, and non-binding debris mitigation guidelines. The paper argues that addressing these deficiencies requires coordinated international action on two fronts: the formal recognition of LEO as a global commons consistent with existing non-appropriation principles, and the establishment of a binding centralised STM regime alongside a liability system capable of extending direct regulatory accountability to private operators of satellite mega-constellations. It further contends that any such reform must integrate equity considerations to ensure that the long-term viability of LEO is preserved for future spacefaring nations.

1 Introduction

Aerospace America recently published an article about the rising instances of the National Aeronautics and Space Agency (NASA) purchasing hardware for its missions from independent third-party contractors.[1] Experts in this article called it an essential move to ensure the organisation can remain competitive in this 'Second Space Age' against rival geopolitical entities that have developed impressive space programs of their own.[2] The article also lays particular emphasis on the particulars of this Second Space Age, which has been characterised by an influx of private players backed by multi-billion dollar investments enabling a greater risk-taking appetite to produce cheaper, faster and more easily reusable alternatives to traditional payload delivery mechanisms into the planetary orbit.[3] Arguably, the most promising outcome of this age has been the development of low-latency telecommunication satellite constellations built by private companies that seek to occupy lower earth orbital shells.[4] As of 2026, 15,000 satellites operate in the planet's orbit, with the majority of these being satellites in Lower Earth Orbit (LEO), or at approximately under 2000 kilometres above terrestrial surface.[5] With thousands more satellites having achieved regulatory approval in coming years,[6] it raises natural questions about disruptions to existing legal orders that govern the deployment and use of objects in orbital space.

This paper examines the expansion of mega-constellations through the lens of two interrelated space law issues: the absence of an effective space traffic management (STM) regime and the escalating risks posed by space debris in Lower Earth Orbit. Herein, this paper argues that ensuring long-term space sustainability requires strengthened international cooperation and coordinated state action to more effectively regulate private space activities. This paper covers in brief, a background to Satellite Mega-constellations and existing Space Law. This is followed by a case study examination of the governance rules that plague this sector and how they are exacerbating issues with Space debris. Finally, the paper will posit two possible

[1] Jon Kelvey, 'In the Age of Commercial Space, Who Should Own the Hardware?' (*Aerospace America*, 2026) <https://aerospaceamerica.aiaa.org/departments/in-the-age-of-commercial-space-who-should-own-the-hardware/accessed> accessed 8 June 2026.
[2] Ibid.
[3] Ibid.
[4] Aslan Abashidze, Irina Chernykh and Maria Mednikova, 'Satellite Constellations: International Legal and Technical Aspects' (2022) 196 AA 176.
[5] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.
[6] Ibid.

regulatory responses: first, the formal recognition of Lower Earth Orbit as a global commons grounding reform in existing non-appropriation principles; and second, the institution of a binding space traffic management regime that extends direct accountability to private operators.

2 A Primer to Satellite Mega-Constellations in Low Earth Orbit

A satellite refers to any object that orbits an object with a larger gravitational pull, akin to a moon with its planet for example.[7] Artificial satellites constitute man-made objects and are launched into orbit around the planet.[8] Depending on orbital distance, these satellites can perform a number of different functions. Since the first active communications satellite launch in 1962, satellites have increased in technical advancement and lowered in production expense and overall weight, allowing the deployment of large payloads of multiple hundreds of satellites in LEO at the same time.[9] A Satellite Constellation is a collection of multiple orbiting satellites that operate in a single controlled cluster. In a technical sense, these satellites are not just part of a single cluster, but also perform a similar function, further defined by an ability to perform autonomous navigation of cluster configurations.[10] Hence, a more encompassing definition would be 'a group of satellites that function together in such a way as to complement each other due to pre-selected orbital-frequency positions at which they are located and provide appropriate ground coverage for various specified purposes, for example, provision of communication, high speed broadband Internet, navigation or monitoring.'[11]

Satellite Mega-Constellations operate in clusters of many hundreds, sometimes thousands of individual satellites that work together to handle bandwidth requests from devices on earth (processed via strategically placed on-ground telemetry centres) in providing internet

[7] Avery Hurt, 'About 15,000 Satellites Are Circling Earth — And They're Disrupting the Sky' (*Discover*, 2026) <https://www.discovermagazine.com/about-15-000-satellites-are-circling-earth-and-they-re-disrupting-the-sky-48550> accessed 8 June 2026.
[8] Ibid.
[9] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.
[10] Aslan Abashidze, Irina Chernykh and Maria Mednikova, 'Satellite Constellations: International Legal and Technical Aspects' (2022) 196 AA 176.
[11] Ibid.

connectivity.[12] A number of prominent tech giants are involved in the creation, and deployment of their own directly competing constellations, the most prominent including the likes of Starlink, OneWeb and Amazon LEO.[13] Their design is necessitated to provide key improvements in service deployment.[14] Firstly, their relatively shorter distance to the surface greatly reduces the time needed to communicate with devices on the ground (i.e. communication latency) as compared to a more traditional satellite in Geo-Synchronous orbit.[15] This however, means that satellites operating in LEO have much quicker, roughly 20 minute orbit times around the planet, thus requiring a large number of individual units to maximize coverage of a sizable area of the planet at any given point.[16] Secondly, satellite mega constellations offer satellite connectivity to Earth areas that otherwise would have no feasible way of connecting fibre optic cables to their communities, allowing information dissemination and its tools to be accessible to some of the most remote underserved communities on Earth.[17] A recent example of the value of these satellites was the continued internet connection provided to Ukrainian civilians under Russian siege throughout their induced internet blackouts, which was made possible through Starlink's routers.[18] These satellites however, rest in an uneasy space in both regulation and the wider geo-orbital environment, as will be seen next.

3 A Primer to Space Law

Space Law, as a branch of Public International Law, exists to govern the use and appropriation of Outer Space, and elements of it thereof as a resource. The remit of this branch of law naturally encompasses a wide array of current spacefaring nations and is in the tricky spot of balancing their interests with those of future prospective nations with similar interests.[19] Developed in a desperate haste to provide legal grounding to the aftermath of the Soviet

[12] Devanshu Jha and others, 'Safeguarding the Final Frontier: Analyzing the Legal and Technical Challenges to Mega-Constellations' (2022) 9 JSSE 636.
[13] Aaron C Boley and Michael Byers, 'Satellite Mega-Constellations Create Risks in Low Earth Orbit, the Atmosphere and on Earth' (2021) 11 SR 10642.
[14] Sven Bilén, 'The next Frontier in Space Is Closer than You Think – Welcome to the World of Very Low Earth Orbit Satellites' (*The Conversation*, 16 December 2025) <https://theconversation.com/the-next-frontier-in-space-is-closer-than-you-think-welcome-to-the-world-of-very-low-earth-orbit-satellites-258252> accessed 8 June 2026.
[15] Ibid.
[16] Devanshu Jha and others, 'Safeguarding the Final Frontier: Analyzing the Legal and Technical Challenges to Mega-Constellations' (2022) 9 JSSE 636.
[17] Ibid.
[18] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.
[19] Frans von der Dunk, *Handbook of Space Law* (Edward Elgar Publishing 2015).

Union's Sputnik 1 launch, Space Law was first etched in the Treaty on the Principles Governing the Activities of States in Outer Space, on the Moon and Other Celestial Bodies of 1967 (otherwise known as the Outer Space Treaty [OST] of 1967) based on basic fundamental tenets.[20] These are that 1) Space is a shared 'province for all mankind', 2) that space exploration between nations is to be a non-discriminatory affair and 3) that outer space is not to be appropriated by any one nation for its own purposes.[21] These tenets informed negotiations that brokered the creation of a set of five international declarations and five primary legislations drafted through consensus under the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS), which constitute the bulk of the frameworks that seek to regulate spacefaring activity.[22]

When it comes to the overarching law dictating the use of satellite Constellations, the OST 1967 first applies as an instructive document for nation states.[23] It lays primary emphasis on state actors as enablers of spacefaring activity and this approach is enshrined in three broad-based founding articles. Firstly, Art. VI decrees that nation states bear international responsibility for all state-led space activity.[24] Secondly, Art. VIII decrees that states will continue to retain sovereignty over any and all objects launched by them into space.[25] Finally, Art. VII crucially also declares that, should a space object near the Earth, moon or any other celestial bodies perform damage to anything else in its vicinity, that the 'state party' is to be held internationally liable for any and all object launches conducted by it and/or from its territory.[26] Foundational documents like this have been further expanded upon in bilateral and/or multiparty conventions that further dictate a complete full fault liability based system[27] constituting a 'soft law' regime for space exploration on an international level.[28] This soft law approach results in a mosaic patchwork of regulation, which nonetheless requires nation states

[20] Joanne Irene Gabrynowicz, 'Space Law: Its Cold War Origins and Challenges in the Era of Globalization', (2004) 37 SULR.
[21] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.
[22] Ibid.
[23] Frans G von der Dunk, 'National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation' in Frans G von der Dunk (ed), *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation, Studies in Space Law*, volume 6 (Martinus Nijhoff Publishers 2011).
[24] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 1967.
[25] Ibid.
[26] Ibid.
[27] Yun Zhao, 'International Regulatory Regime for MegaConstellations: A Path to Equitable Access to Outer Space' (2025) 50 ASL 591.
[28] PJ Blount, 'Renovating Space: The Future of International Space Law' (2011) 40 DJILP.

to exercise judgement when creating their own space law regimes as to how they wish to interpret any directives that they choose to be party to.[29] *Opinio Juris* across individual states can widely vary in what they consider to be adequate to the spirit of the OST.[30] Although some international bodies, such as the International Telecommunications Union (ITU), govern high level, equitable bandwidth allocation for Geo Stationary Orbits—herein too, there is a standing loophole as this body in particular does not handle allocation for Mega-Constellations that are privately managed.[31] States effectively deciding how they regulate themselves and which activities they wish to be held liable for, unsurprisingly creates governance gaps across mixed systems of spacefaring especially when dealing with private actors, as was most recently demonstrated in the case of Swarm Technologies.

4 Spacefaring and Space Law- The Swarm Technologies case

March of 2018, Silicon-valley startup Swarm Technologies was accused of conducting the first ever unauthorized launch of transmission satellites into orbit by the US Federal Communications Commission (FCC), the body legislating and granting authority to conduct all telecommunications satellite activity in the US. Swarm had been rejected for a license application from the FCC for its SpaceBEE satellites on account of their minuscule sizes and the issues this presented in tracking them in LEO.[32] Following this, the four satellites were launched by an independent broker named Spaceflight via an Indian state-owned launch company named Antrix using their indigenously built PSLV rockets. When this was discovered, space agencies used to actioning solely state-led launches driven by stricter government bureaucracy were blindsided by a company that found loopholes to exploit, in what reportage has since claimed is emblematic of a typical silicon-valley startup's 'seek

[29] Frans G von der Dunk, 'National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation' in Frans G von der Dunk (ed), *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation, Studies in Space Law*, volume 6 (Martinus Nijhoff Publishers 2011).
[30] Ibid.
[31] Christopher D Johnson, 'The Legal Status of MegaLEO Constellations and Concerns About Appropriation of Large Swaths of Earth Orbit' in Joseph N. Pelton and Scott Madry (eds.), *Handbook of Small Satellites* (Springer 2020).
[32] Tim Fernholz, 'The US Government Said No. Swarm Technologies Launched Its Satellites Anyway' (*Quartz*, 20 March 2018) <https://qz.com/1230354/swarm-technologies-how-the-silicon-valley-start-up-launched-satellites-without-government-permission> accessed 8 June 2026.

forgiveness, not permission' style of working. [33] The primary issue stemmed from the fact that the FCC could only grant satellite clearance and not launch clearance, which was handled by the Federal Aviation Administration (FAA), and their independent launch clearance was considered sufficient by Spaceflight which failed to conduct further due diligence about the FCC license before engaging with Antrix- who further absolved themselves of any responsibility to confirm the veracity of any launch licenses.[34]

The Swarm case illuminates a fundamental issue of existing Space Law, that much like most other international law, it is rendered toothless due to an emphasis on non-interference and upholding of national sovereignty as a guiding principle.[35] In the absence of any binding legislation governing mega constellations, it is individual state bodies like the FCC that become primary filters to determine legitimate and illegitimate space ventures- this hinges spacefaring as a whole largely upon the sensibilities of individual states and their governance practices. This expectedly results in geopolitical faultlines acting as an enabler for regulatory loopholes, with incidents like the Swarm case hinting towards an emerging economy of states willing to conduct launches from foreign companies for cheaper and with fewer checks.[36] However, even when these satellites meet criteria, national bodies have a prior use history of awarding their licenses on a first come first served basis, with evidence of inadequate regard given to the health and long term viability of other countries' space programs or missions to access and traverse the orbital shells these satellites occupy.[37] This also manifests in the form of major liability gaps, also seen within the Swarm case where the only meaningful liability allotted was a menial $900K settlement fine with the FCC, and a requirement for greater scrutiny in their future launches.[38] Individual countries engaging in self-policed spacefaring have a free hand in dictating their own launch patterns and how they are regulated. Beyond liability gaps, this decentralization forms an existential threat to spacefaring as a whole, namely through the impact this activity has on increasing the number of space debris pieces in LEO.

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[33] Ibid.
[34] Aslan Abashidze, Irina Chernykh and Maria Mednikova, 'Satellite Constellations: International Legal and Technical Aspects' (2022) 196 AA 176.
[35] Yun Zhao, 'International Regulatory Regime for MegaConstellations: A Path to Equitable Access to Outer Space' (2025) 50 ASL 591.
[36] Aaron C Boley and Michael Byers, 'Satellite Mega-Constellations Create Risks in Low Earth Orbit, the Atmosphere and on Earth' (2021) 11 SR 10642.
[37] Ibid.
[38] fcc.gov, 'FCC Reaches $900,000 Settlement for Unauthorized Satellite Launch', (*Federal Communications Commission*, 20 December 2018) <https://www.fcc.gov/document/fcc-reaches-900000-settlement-unauthorized-satellite-launch> accessed 8 June 2026.

5 Space Debris

The first known object to break up in orbital space was a Thor-Ablestar rocket in 1961 that sent more than 200 catalogued ship fragments hurtling into LEO.[39] Subsequent spacefaring activity has driven this number of fragments in orbit up by an order of magnitude. This mass of orbiting material in upper atmospheric space is referred to as space debris. Debris itself can range in two types—constituting tracked pieces and stray, individual pieces of junk that were discarded from previous missions or collisions. As of 2026, the European Space Agency estimates that approximately 40,000 objects are tracked in orbital space, with 11,000 being active payloads. However, they further estimate a vast swathe of nearly 1.2 million individual objects larger than 1 centimetre, capable of causing irrevocable damage to satellites and human missions alongside some 50,000 objects larger than 10 cm, that can collide with other objects with the force of a large bomb.[40] The large influx of satellite units in Mega-Constellations from national and private players operating in the Ka and Ku communication frequency bands risk overcrowding Lower Earth Orbit.[41]

Satellite Mega-constellations themselves have inherent problems in their makeup that make them prone to producing debris. Their vast cluster sizes that ensure multiple fail safes, protecting against a single satellite becoming inoperable, comes at the cost of manoeuvrability.[42] Additionally, they are built for shorter lifespans, meaning more of these satellites will be made redundant quicker than traditional satellites. Add to this the fact that tracking objects in orbital shells (as shown by Swarm's SpaceBEE CubeSats) is not precise and generally work on probabilistic predictions, and the risk of collisions increases by orders of magnitude even if one or a few satellites in a Mega cluster encounter a stray piece of debris or lose functionality altogether.[43] Amazon for instance estimated that a loss in collision manoeuvring capabilities in one in ten satellites of its proposed cluster will increase the chances

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[39] aerospace.org, 'A Brief History of Space Debris' (*Aerospace Corporation*, 2 November 2022) <https://aerospace.org/article/brief-history-space-debris> accessed 8 June 2026.

[40] European Space Agency, *ESA Space Environment Report 2025* (2025) <https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2025> accessed 8 June 2026.

[41] Nikita Bhakare, 'The Need for Evolving Legal Framework for Regulation of Space Debris Caused by Satellite Constellations' (2021) 8 ESA Space Debris Office.

[42] Christopher D Johnson, 'The Legal Status of MegaLEO Constellations and Concerns About Appropriation of Large Swaths of Earth Orbit' in Joseph N. Pelton and Scott Madry (eds.), *Handbook of Small Satellites* (Springer 2020).

[43] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.

of one of these satellites colliding with an object of 10 centimetres or larger by at least twelve percent.[44] Even in best case scenarios, collision avoidance manoeuvres are expensive and time intensive affairs that require at least hours, if not days of notice.[45] Experts estimate that a third of all debris in space today is the result of just two past collisions.[46] A scenario where multiple such collisions occur simultaneously risks starting a chain reaction. This doomsday scenario for spacefaring was first proposed by Dr Donald J Kessler and has been eponymously dubbed the 'Kessler Syndrome' wherein, a cascading series of collisions in orbital space ejects so much debris that it renders our orbit hostile to any space flight for multiple generations.[47]

6 Where do we go from here? The Legal Answers

The phenomenon which describes multiple actors performing in self-interest, leading to the unviability of a shared resource is known in political science as 'the tragedy of the commons'. Historical examples of this include the common atmospheric aerosol dumping that led to the depletion of the ozone layer.[48] It took universal ratification from individual national parties to the Montreal Protocol of 1987 to begin the process of successfully banning the emission of hydrocarbons and naturally restoring the ozone. Similarly, the international legal regime has a defining role to play in ensuring the long-term sustainability of space faring for future generations. This involves a combined effort that first works towards establishing a framework universally recognising the LEO as a 'global commons', in line with non-appropriation principles in Art. II of the OST.[49] Following this, extensive technological safeguards must be instituted on units being sent into space alongside a robust legal mechanism that holds them accountable. The ESA predicts that despite increasing adherence of debris-mitigation protocols and charters drafted by individual space agencies as well as UNCOPUOS, more debris is being

[44] Mark Harris, 'Amazon Reports Collision Risk for Mega-Constellation of Kuiper Internet Satellites', *IEEE Spectrum* (16 October 2019) <https://spectrum.ieee.org/amazon-reports-collision-risk-for-its-megaconstellation-of-kuiper-internet-satellites> accessed 27 March 2026.
[45] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.
[46] Mark Harris, 'Amazon Reports Collision Risk for Mega-Constellation of Kuiper Internet Satellites' (*IEEE Spectrum*, 16 October 2019) <https://spectrum.ieee.org/amazon-reports-collision-risk-for-its-megaconstellation-of-kuiper-internet-satellites>accessed 8 June 2026.
[47] Nikita Bhakare, 'The Need for Evolving Legal Framework for Regulation of Space Debris Caused by Satellite Constellations' (2021) 8 ESA Space Debris Office.
[48] Garrett Hardin, 'Tragedy of the Commons' (*Econlib*, 5 February 2018) <https://www.econlib.org/library/Enc/TragedyoftheCommons.html> accessed 8 June 2026.
[49] Pauline Pic, Philippe Evoy and Jean-Frédéric Morin, 'Outer Space as a Global Commons: An Empirical Study of Space Arrangements' (2023) 17 IJC 288.

added to orbits than is being disposed of via atmospheric re-entry.[50] While the current levels of unaccountable space debris have suffered unsuccessful attempts to be limited, the natural course of action is to greatly regulate future spaceflight to ensure minimal new debris is added to the list. This makes it incumbent on international coalitions like the Inter-Agency Debris Coordination Committee [IADC] to push for its member nations to adopt robust collision detection technologies as part of their licensing requirements and crucially, mandate a more stringent de-orbiting requirement for individual operators beyond the 25 year cycle prescribed to date.[51] This timeframe remains woefully short in case of satellite Mega-constellations, whose units remain in orbit for an average of 5 to 7 years, and therefore must be deorbited quicker.[52] These actions constitute a broader action towards instituting a binding, centralized system of Space Traffic Management (STM).[53]

In 2021, China issued formal notice to UNCOPUOS regarding two instances of its space station Tianhe having to engage in collision mitigation procedures to avoid Starlink satellites who came within 3 kilometres of it.[54] The ESA further estimates that at the current rate of debris injection, such procedures will become impossible to conduct without the aid of machine learning systems.[55] This stems from the lack of an international body, and recognised standards towards monitoring and regulating the assignment of orbital shells to spacefaring parties.[56] Multiple proposals exist to take cognizance of the issue and gain inspiration from existing international agreements relating to sea faring in international waters, such as the International Regulations for Preventing Collisions at Sea, 1977 and the U.N. Convention on the Law of the Seas (UNCLOS) 1982 to begin deployment on a three step centralization effort which must

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[50] European Space Agency, *ESA Space Environment Report 2025* (2025) <https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2025> accessed 8 June 2026.

[51] Aaron C Boley and Michael Byers, 'Satellite Mega-Constellations Create Risks in Low Earth Orbit, the Atmosphere and on Earth' (2021) 11 SR 10642.

[52] The FCC's recent adoption of a 5-year deorbiting directive for Satellite Mega-Constellation provides a promising step towards this. See Federal Communications Commission, 'FCC Adopts New "5-Year Rule" for Deorbiting Satellites' (*Federal Communications Commission*, 30 September 2022) <https://www.fcc.gov/document/fcc-adopts-new-5-year-rule-deorbiting-satellites-0> accessed 8 June 2026.

[53] Steven E Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 EILR.

[54] Mike Wall, 'China's Tianhe Space Station Module Dodged SpaceX Starlink Satellites Twice This Year' (*Space*, 30 December 2021) <https://www.space.com/china-tianhe-space-station-maneuvers-spacex-starlink> accessed 8 June 2026.

[55] European Space Agency, *ESA Space Environment Report 2025* (2025) <https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2025> accessed 8 June 2026.

[56] Christopher D Johnson, 'The Legal Status of MegaLEO Constellations and Concerns About Appropriation of Large Swaths of Earth Orbit' in Joseph N. Pelton and Scott Madry (eds.), *Handbook of Small Satellites* (Springer 2020).

perform three basic functions—a) establishing agreed upon standards of behaviour in collision avoidance; b) SOPs for greater sharing of space situational awareness information; and c) an expanded market for conjunction assessment and alerting services.[57]

On a legislation level, the OST is widely considered inadequate and will require further interpretation from UNCOPUOS regarding the remit of Art. IX with the aim of combining traditionalist understandings of mutual assistance to include the relationships between Space Agencies, Mega-constellation operators and their actions in preventing undue contamination of orbital space.[58] Further cases and arbitration will have to contend with the definition of the 'launching state' as prescribed within 1972 Convention on International Liability for Damage Caused by Space Objects and the 1976 Convention on Registration of Objects Launched into Outer Space, and which backwardly recognise only nation states as actionable entities of Spacefaring.[59] Their recognition of direct liability for private players engaging in Space Activities, whilst necessary, will enshrine an additional independent space faring authority capable of competing with countries for orbital space, and it is imperative that this is integrated alongside the OST's Non-Appropriation principles.[60] More material liabilities may be in order too, including novel ideas surrounding a tax levied on operators for every satellite that is put into orbit (an 'Orbit Tax') with the aim of driving efficiency in cluster planning and management.[61] Despite its overall cost on operators, proponents estimate that establishing effective space traffic management systems to prevent functionally irreversible damage to the planet's orbital space is far outweighed by the value they will produce in the long term. Presenting a business case, estimates place an orbital commons with basic regulation to drive up initial value estimates of the satellite market from $600bn by 2040, to $3tn.[62]

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[57] Ruth Stilwell, *Space Situational Awareness: Key Issues in an Evolving Landscape* Hearing Before the Subcommittee on Space and Aeronautics of the Committee on Science, Space & Technology (February 2020) <https://www.congress.gov/116/chrg/CHRG-116hhrg39617/CHRG-116hhrg39617.pdf> accessed 8 June 2026.
[58] Ibid.
[59] Aslan Abashidze, Irina Chernykh and Maria Mednikova, 'Satellite Constellations: International Legal and Technical Aspects' (2022) 196 AA 176.
[60] Frans G von der Dunk, 'National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation' in Frans G von der Dunk (ed), *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation, Studies in Space Law*, volume 6 (Martinus Nijhoff Publishers 2011).
[61] Sky News, '"Orbit Tax" Proposed to Tackle Growing Problem of Space Junk' *Sky News* (26 May 2020) <https://news.sky.com/story/orbit-tax-proposed-to-tackle-growing-problem-of-spacejunk-11994748> accessed 8 June 2026.
[62] Ibid.

7 Conclusion

The rapid proliferation of satellite mega-constellations in LEO represents one of the defining regulatory and sustainability challenges of the Second Space Age. As this paper has demonstrated, the existing framework of international space law—rooted in the Outer Space Treaty of 1967 and supplemented by fragmented national licensing regimes—was designed for an era of state-led, infrequent space activity and is increasingly inadequate for governing modern private-enterprise led space activity. Addressing this requires action on two fronts: the formal recognition of LEO as a global commons grounded in the OST's non-appropriation principles, ensuring equitable access for future spacefaring nations; and the institution of a binding STM regime extending direct accountability to private operators through reformed liability frameworks and mechanisms such as the Orbit Tax.

Beyond this, the institution of space as a shared global common resource will ensure its living viability for coming generations of researchers, artists, explorers and entrepreneurs. By the time the Tragedy of the Commons has struck in other sectors, the social cost has been enormous, with policy and the biosphere still catching up to its effects today. Space, as the final frontier, presents the latest and perhaps the ultimate example of a shared resource with immense growth potential for our increasingly technocratic species and its continued preservation demands immediate, proactive steps. We embarked on a mission with mega-constellations to bring information and power to those who have none. Every generation deserves a chance to do the same.