INTERNATIONAL LAW AND ITS ROLE IN SATELLITE REGULATIONS

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ABSTRACT

Satellites have become indispensable to modern governance, security, communication, navigation, and economic development. Their growing significance, however, has intensified legal and regulatory challenges at the international level, particularly in light of increasing militarisation, commercialisation, and technological sophistication. This article critically examines the role of international law in regulating satellite activities, focusing on the adequacy of existing treaty frameworks and institutional mechanisms. It analyses the foundational principles of space law under the Outer Space Treaty, 1967, and evaluates subsequent legal instruments governing liability, registration, and spectrum management. The article further explores state responsibility for satellite operations, the challenges posed by dual-use and military satellites, and the regulatory implications of private actors and mega-constellations. Through a doctrinal and analytical approach, the study argues that while international law provides a basic normative structure for satellite regulation, it suffers from enforcement deficits, interpretative ambiguities, and institutional fragmentation. The article concludes by proposing the need for normative clarification and strengthened international coordination to ensure the sustainable, secure, and peaceful use of satellite technology.

Keywords: Satellite regulation, international space law, Outer Space Treaty, state responsibility, ITU, dual-use satellites

1. Introduction

Satellites occupy a central position in contemporary international relations. From telecommunications and navigation to disaster management, climate monitoring, and military operations, satellite systems underpin critical state and non-state functions. The exponential increase in satellite launches, coupled with technological advancements such as miniaturisation and reusable launch systems, has transformed outer space from a relatively exclusive domain into a congested and strategically contested environment. This transformation raises fundamental legal questions concerning regulation, responsibility, and the preservation of outer space for peaceful purposes.

International law plays a pivotal role in structuring the conduct of states and private actors in outer space. Unlike terrestrial domains, outer space is governed by a limited but influential set of multilateral treaties, supported by soft-law instruments and institutional practices. These legal norms were largely formulated during the Cold War, at a time when satellite activities were state-centric and technologically constrained. The contemporary satellite landscape, characterised by commercial mega constellations, dual-use technologies, and counter space capabilities, challenges the continued adequacy of this framework.

This article examines how international law regulates satellite activities and assesses whether existing legal instruments are capable of addressing modern regulatory demands. It argues that although international law establishes core principles governing satellite use, it lacks detailed regulatory precision and effective enforcement mechanisms. As a result, satellite regulation increasingly depends on national legislation and institutional coordination rather than binding international control.

2. Conceptual Foundations of Satellite Regulation

Satellites are artificial objects placed into orbit for specific functional purposes, including communication, navigation, earth observation, scientific research, and military support. Legally, satellites are categorised as “space objects,” a term broadly defined to include component parts and launch vehicles. This expansive definition ensures that satellite operations fall within the scope of international space law regardless of their functional character.

Satellite activities are inherently transboundary in nature. Signals transmitted from satellites

traverse national borders without regard to territorial sovereignty, while orbital paths intersect shared spatial environments. These characteristics necessitate international regulation to prevent harmful interference, manage scarce orbital resources, and allocate responsibility for damage. Consequently, satellite regulation represents a convergence of international law, technical coordination, and national regulatory control.

International law approaches satellite regulation through a principles-based framework rather than prescriptive rules. This approach reflects both technological uncertainty and political compromise. While flexibility allows adaptability, it also creates interpretative ambiguity, particularly when satellite activities intersect with national security concerns.

3. International Legal Framework Governing Satellite Activities

A. The Outer Space Treaty, 1967

The Outer Space Treaty (OST) constitutes the cornerstone of international space law and provides the foundational legal framework for satellite regulation. It establishes outer space as a domain beyond national appropriation and mandates that activities in space be carried out for the benefit and in the interests of all countries[1]. Although the Treaty does not explicitly regulate satellites, its principles apply to all space objects and activities.

Article I of the OST guarantees freedom of exploration and use of outer space, subject to international law. This freedom enables states to deploy and operate satellites without requiring international authorisation. At the same time, Article III requires compliance with international law, including the United Nations Charter, thereby linking satellite activities to broader principles of peaceful coexistence.

Article VI introduces the principle of state responsibility for national activities in outer space, whether conducted by governmental or non-governmental entities. This provision is particularly significant in the context of satellite regulation, as it obliges states to authorise and continually supervise private satellite operators.[2] However, the Treaty does not specify standards for such supervision, leaving regulatory discretion largely to national authorities.

[1] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. I, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205.
[2] Id. art. VI.

B. Liability and Registration Regimes

The Liability Convention, 1972, supplements the OST by establishing a liability regime for damage caused by space objects. It adopts a dual standard of liability: absolute liability for damage caused on the surface of the Earth and fault-based liability for damage occurring elsewhere in space.[3] While this framework theoretically applies to satellites, its practical utility is limited by evidentiary challenges and the absence of adjudicatory mechanisms.

Similarly, the Registration Convention, 1975, requires states to maintain national registries of space objects and furnish information to the United Nations.[4] Registration enhances transparency and facilitates the attribution of responsibility for satellite operations. Nonetheless, compliance remains uneven, and the Convention does not mandate disclosure of operational or functional details relevant to security or collision avoidance.

C. Role of the International Telecommunication Union

Satellite regulation extends beyond space treaties into the domain of international telecommunications law. The International Telecommunication Union (ITU) plays a crucial role in managing radiofrequency spectrum and orbital slots, both of which are essential for satellite operations.[5] Through its Radio Regulations, the ITU allocates frequencies and coordinates satellite networks to prevent harmful interference.

While the ITU framework is technically effective, it operates independently of space law treaties and focuses primarily on signal management rather than broader legal concerns such as sustainability or security. This institutional fragmentation underscores the challenges of achieving coherent international satellite regulation.

4. State Responsibility, Jurisdiction, and Control over Satellites

One of the most significant contributions of international space law to satellite regulation lies in the principle of state responsibility. Under the Outer Space Treaty, states bear international responsibility for all national activities in outer space, irrespective of whether such activities

[3] Convention on International Liability for Damage Caused by Space Objects arts. II–III, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187.
[4] Convention on Registration of Objects Launched into Outer Space arts. II–IV, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15
[5] International Telecommunication Union, Radio Regulations (2020).

are conducted by governmental agencies or private entities. This principle reflects the reality that satellites, once launched, operate in a domain beyond territorial jurisdiction and therefore require attribution to a terrestrial legal authority.[6]

Jurisdiction and control over satellites are primarily determined by the concept of the launching State, which includes states that launch, procure the launching of, or provide launch facilities for a space object. This broad formulation ensures that at least one state can be identified as responsible for a satellite at all times. In practice, however, the involvement of multiple states in satellite projects particularly in commercial and consortium based ventures has complicated the allocation of responsibility and liability.

While states retain jurisdiction and control over satellites registered under their authority, international law does not prescribe uniform standards for licensing, supervision, or operational oversight. As a result, national regulatory frameworks vary considerably in scope and rigor. Some states impose comprehensive licensing regimes covering orbital debris mitigation, cybersecurity, and spectrum coordination, while others adopt minimal regulatory controls to attract commercial operators. This regulatory asymmetry creates incentives for forum shopping and undermines the effectiveness of international satellite governance.

5. Military and Dual-Use Satellites: Legal and Security Challenges

Satellite regulation is further complicated by the inherently dual-use nature of space technology. Satellites designed for civilian purposes such as navigation, earth observation, and communication often perform critical military support functions. Navigation satellites facilitate precision-guided weaponry, communication satellites enable command and control systems, and reconnaissance satellites support intelligence gathering. International law does not prohibit such uses, provided they do not involve the placement of weapons of mass destruction in orbit.[7]

The Outer Space Treaty's emphasis on "peaceful purposes" has been interpreted predominantly as a prohibition on aggressive use rather than a ban on military activities per se. This interpretation allows extensive military reliance on satellite systems without formally violating

[6] Outer Space Treaty, supra note 1, art. VIII.
[7] Id. art. IV.

treaty obligations. While this approach preserves strategic stability, it also exposes a normative gap between the Treaty's aspirational language and operational realities.

Recent developments in counter-space capabilities including anti-satellite (ASAT) testing, electronic interference, and cyber operations targeting satellite systems highlight the limitations of existing legal frameworks. Although general international law principles such as necessity and proportionality may apply, there is no dedicated legal regime addressing hostile acts against satellites. The absence of clear legal thresholds increases the risk of escalation and miscalculation, particularly in times of armed conflict.

6. Commercialisation and the Role of Private Actors

The rapid commercialisation of satellite activities has fundamentally altered the regulatory landscape. Private entities now dominate satellite manufacturing, launch services, and operations, including large-scale satellite constellations providing global internet connectivity. This shift challenges the state-centric assumptions underlying international space law.

International law assigns responsibility to states, but effective regulation of private satellite operators depends on national legislation. States are required to authorise and continuously supervise non-governmental space activities, yet the scope of this obligation remains undefined.[8] In practice, regulatory oversight often prioritises economic competitiveness over long-term sustainability and security concerns.

Mega-constellations raise additional regulatory challenges due to their sheer scale and cumulative impact on orbital congestion and space debris. Existing legal instruments do not impose binding limits on the number of satellites deployed or mandate international coordination beyond technical spectrum management. Consequently, the regulation of large constellations remains fragmented, with significant implications for the long-term sustainability of orbital environments.

7. Emerging Challenges in Satellite Regulation

Satellite regulation must also respond to emerging technological and operational challenges. Space debris poses a growing threat to satellite operations, with collisions capable of generating

[8] Id. art. VI

cascading debris fields that render certain orbits unusable. Although non-binding guidelines on debris mitigation exist, there is no enforceable international obligation requiring compliance.

Cybersecurity risks further complicate satellite regulation. Satellites rely on ground-based infrastructure and software systems vulnerable to cyber intrusion, jamming, and spoofing. International law has yet to articulate clear rules governing cyber operations targeting satellites, leaving a regulatory gap that intersects both space law and cyber law.

Additionally, the increasing reliance on satellites for critical civilian infrastructure raises questions concerning due diligence and protection obligations. Disruptions to satellite services can have severe humanitarian and economic consequences, underscoring the need for stronger normative safeguards.

8. Critical Evaluation of the Existing Legal Regime

The existing international legal framework governing satellites is characterised by normative breadth but regulatory thinness. Foundational treaties establish essential principles but offer limited operational guidance. Institutional mechanisms such as the ITU address technical coordination effectively but operate in isolation from broader legal and security considerations.

Enforcement remains a persistent weakness. International space law relies heavily on voluntary compliance and diplomatic engagement rather than binding dispute resolution or sanctions. This reliance may have been sufficient during the early decades of space activity but is increasingly inadequate in a crowded and contested orbital environment.

Moreover, the absence of a specialised adjudicatory forum for space-related disputes limits the development of authoritative interpretations of treaty obligations. As a result, state practice, rather than legal principle, increasingly shapes the regulatory landscape.

9. Relationship Between Satellite Regulation and General International Law

Satellite regulation under international law does not operate in isolation. The space law treaties must be interpreted in conjunction with general principles of international law, including state responsibility, due diligence, and the obligation not to cause transboundary harm[9]. Although

[9] Corfu Channel (U.K. v. Alb.), Merits, 1949 I.C.J. 4, 22 (Apr. 9)

outer space is not subject to territorial sovereignty, satellite activities frequently produce effects within national jurisdictions through signal transmission, remote sensing, and navigation services.

The principle of **due diligence**, recognised by international courts and tribunals, imposes an obligation on states to prevent activities within their jurisdiction from causing harm to other states.[2] Applied to satellite operations, this principle suggests that states must take reasonable measures to avoid harmful interference, orbital congestion, and the creation of space debris.[10] However, international space law does not expressly codify due diligence standards, resulting in uncertainty regarding the scope of state obligations.

The interaction between satellite operations and **international humanitarian law** is similarly underdeveloped. Dual-use satellites supporting both civilian and military functions raise complex questions relating to distinction, proportionality, and lawful targeting during armed conflict, particularly in the absence of a dedicated legal regime governing hostilities in outer space.[11]

10. Jurisdictional Complexities in Transnational Satellite Operations

Jurisdiction over satellites is primarily determined through registration and the concept of the launching State under international space law.[12] This approach ensures continuity of jurisdiction and control but does not fully account for the multinational character of modern satellite operations. Satellites are often designed, manufactured, launched, owned, and operated by entities across multiple states, complicating responsibility attribution.

Hosted payload arrangements exemplify these jurisdictional ambiguities. In such cases, payloads operated by one state or private actor are placed aboard satellites registered by another state, without clear guidance on the allocation of responsibility for harmful acts or interference.[13] The absence of express treaty provisions governing hosted payloads leaves these issues to bilateral agreements and ad hoc practices.

[10] Trail Smelter (U.S. v. Can.), 3 R.I.A.A. 1905, 1965 (1941)
[11] Bin Cheng, International Responsibility and Liability for Space Activities, 20 *Air & Space L.* 297, 300–03 (1995).
[12] Michael N. Schmitt ed., Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations 274–79 (2017).
[13] Michael N. Schmitt ed., Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations 274–79 (2017).

Emerging activities such as satellite servicing, in-orbit refuelling, and active debris removal further strain existing jurisdictional concepts. These operations involve physical interaction with foreign space objects, raising unresolved questions concerning consent, liability, and interference with jurisdiction and control.[14]

11. Spectrum Allocation, Orbital Slots, and Equity Concerns

Satellite regulation is inseparable from access to radiofrequency spectrum and orbital positions, both of which are limited natural resources. The allocation of these resources is governed by the International Telecommunication Union (ITU), which applies coordination mechanisms designed to prevent harmful interference.[15]

From an international law perspective, concerns arise regarding **equitable access**, particularly for developing countries. Although international space law emphasises the use of outer space for the benefit of all countries, this principle has limited practical effect in spectrum and orbital allocation.[16] States with advanced technological and financial capabilities are better positioned to secure early filings and deploy satellite networks.

The deployment of mega-constellations intensifies these concerns, as large commercial operators can occupy substantial portions of low Earth orbit and associated spectrum bands, potentially constraining future access by other states and operators.[17]

12. Environmental Protection and Sustainability of Orbital Environments

Environmental protection has become a critical dimension of satellite regulation. Space debris generated by satellite collisions, fragmentation events, and abandoned spacecraft poses a serious threat to the long-term sustainability of orbital environments.[18] Despite the seriousness of the problem, international law relies primarily on non-binding debris mitigation guidelines rather than enforceable obligations.[12]

The absence of binding environmental standards weakens incentives for preventive conduct, as liability under international law is generally triggered only after damage occurs.[13] This

[14] Outer Space Treaty art. VIII, Jan. 27, 1967, 610 U.N.T.S. 205.
[15] Ricky J. Lee, Law and Regulation of Commercial Space Activities 161–65 (2012)
[16] U.N. COPUOS, Rep. of the Legal Subcomm., U.N. Doc. A/AC.105/1203 (2019).
[17] International Telecommunication Union Constitution art. 44.
[18] Ram S. Jakhu, Equitable Access to the Geostationary Orbit, 29 *Annals Air & Space L.* 1 (2004)

reactive approach contrasts sharply with developments in international environmental law and undermines the sustainable use of outer space.

13. Data Governance, Privacy, and Sovereignty Concerns

Earth observation satellites generate vast quantities of data capable of revealing sensitive information about states, infrastructure, and individuals. International space law recognises the freedom of observation from outer space, but it does not regulate the collection, processing, or dissemination of satellite data.[19]

The unrestricted availability of high-resolution satellite data raises concerns relating to informational sovereignty, national security, and individual privacy.[20] As satellite data increasingly informs governance, disaster response, and commercial decision-making, the absence of international standards on data responsibility represents a growing regulatory gap.[21]

14. Institutional Fragmentation and the Limits of Soft Law

Satellite regulation is characterised by institutional fragmentation. UN COPUOS addresses legal and policy issues, while the ITU focuses on technical coordination, and national authorities oversee licensing and enforcement[22]. Soft-law instruments play an important role in addressing regulatory gaps, but their voluntary nature limits their effectiveness in situations involving conflicting state interests.[23]

Without binding dispute settlement mechanisms or enforcement procedures, compliance with satellite-related norms remains largely dependent on good faith and political will, reducing legal certainty and predictability.

15. Future Directions for International Satellite Regulation

The future development of satellite regulation is likely to depend on incremental legal reform rather than comprehensive treaty revision. Proposals such as confidence-building measures,

[19] ITU Radio Regulations (2020)
[20] U.N. COPUOS, Space Debris Mitigation Guidelines, U.N. Doc. A/62/20 (2007).
[21] Inter-Agency Space Debris Coordination Committee, IADC Guidelines (2009).
[22] Convention on International Liability for Damage Caused by Space Objects arts. II–III, 1972.
[23] Outer Space Treaty art. I.

transparency mechanisms, and sector-specific agreements offer pragmatic pathways for strengthening governance.[24]

Clarifying existing treaty obligations, enhancing institutional cooperation, and promoting sustainability-oriented norms are essential to ensuring that satellite activities continue to serve collective interests rather than strategic rivalry.[25]

16. Liability for Satellite Accidents and Collisions

Liability arising from satellite accidents and in-orbit collisions represents one of the most underdeveloped areas of international space law. While the Liability Convention establishes a framework for compensation, its application to modern satellite operations remains uncertain[26]. In particular, the distinction between absolute liability for damage caused on Earth and fault-based liability for damage occurring in outer space creates evidentiary and procedural challenges in collision scenarios.[27]

Satellite collisions often involve complex technical factors, including orbital mechanics, tracking inaccuracies, and shared responsibility between operators. Establishing fault in such circumstances is difficult, especially in the absence of mandatory transparency obligations or independent investigative mechanisms.[28] As a result, no collision dispute has yet been formally adjudicated under the Liability Convention, raising questions about its practical effectiveness.

The increasing density of satellites in low Earth orbit heightens the risk of cascading collision events, commonly referred to as the Kessler Syndrome.[29] Despite the systemic nature of this risk, international law continues to approach liability on a case-by-case basis, offering little in terms of collective risk management or preventive accountability.

17. Dispute Resolution Mechanisms in Satellite-Related Conflicts

International space law lacks a dedicated dispute resolution mechanism for satellite-related

[24] Stephen Gorove, Observations of Earth from Space and International Law, 4 *Annals Air & Space L.* 343 (1979).
[25] Frans G. von der Dunk, Remote Sensing and International Law, 28 *Air & Space L.* 3 (2003).
[26] Irmgard Marboe, Soft Law in Outer Space (2012).
[27] Kai-Uwe Schrogl et al. eds., *Handbook of Space Security* (2019).
[28] Daniel Porras, Developing an ASAT Test Ban (UNIDIR 2019).
[29] Convention on International Liability for Damage Caused by Space Objects arts. II–III, Mar. 29, 1972, 961 U.N.T.S. 187.

conflicts. Although disputes may theoretically be resolved through diplomatic channels, arbitration, or the International Court of Justice, states have shown reluctance to invoke these mechanisms in practice.[30] This reluctance stems partly from strategic sensitivities and partly from the technical complexity of satellite disputes.

The Liability Convention provides for the establishment of Claims Commissions, but this mechanism has never been utilised.[31] The absence of precedent has resulted in legal uncertainty regarding procedural rules, evidentiary standards, and the enforceability of outcomes. Consequently, satellite disputes are often managed informally or through political negotiation rather than legal adjudication.

Several scholars have proposed the creation of a specialised international space tribunal or arbitration framework capable of addressing satellite-related disputes[32]. Such a body could develop consistent jurisprudence, enhance legal certainty, and reduce reliance on unilateral measures. However, political resistance and concerns over sovereignty continue to impede institutional reform.

18. Role of National Space Legislation in Satellite Regulation

In the absence of detailed international regulation, national space legislation has emerged as a primary mechanism for governing satellite activities. States implement licensing regimes that regulate satellite launches, operations, and end-of-life disposal.[33] These domestic frameworks vary significantly in scope, reflecting divergent policy priorities and regulatory philosophies.

Some states adopt stringent regulatory standards, incorporating debris mitigation, cybersecurity requirements, and insurance obligations. Others maintain minimal oversight to attract investment and reduce compliance costs. This disparity undermines the harmonisation of satellite regulation and creates uneven levels of protection against transboundary harm.[34]

Although national legislation plays a crucial role in implementing international obligations, excessive reliance on domestic regulation risks fragmenting the global satellite governance

[30] Bin Cheng, Studies in International Space Law 311–15 (1997).
[31] Frans G. von der Dunk, Liability Versus Responsibility in Space Law, 34 *Air & Space L.* 91, 98–102 (2009).
[32] Donald J. Kessler & Burton G. Cour-Palais, Collision Frequency of Artificial Satellites, 83 *J. Geophysical Res.*2637 (1978).
[33] Stephen Gorove, Dispute Settlement in Space Law, 11 *Annals Air & Space L.* 1, 5–9 (1986)
[34] Liability Convention art. XIV.

regime. Without greater international coordination, national approaches may prioritise competitiveness over sustainability and security.

19. Satellite Regulation and the Principle of Common Interest of Humankind

The principle that outer space shall be used for the benefit and in the interests of all countries forms a normative foundation of international space law.[35] In the context of satellite regulation, this principle raises important questions regarding access, participation, and distribution of benefits.

Satellite services such as navigation, meteorology, and disaster monitoring provide global public goods. However, access to these benefits is uneven, with developing states often dependent on foreign-owned satellite systems.[31] International law has yet to articulate enforceable obligations to ensure equitable benefit-sharing or capacity building in satellite governance.

The increasing commercialisation of satellite services further complicates the application of common interest principles. Market-driven allocation of orbital and spectrum resources risks marginalising states lacking technological or financial capacity. Addressing this imbalance requires renewed attention to the distributive dimensions of satellite regulation within international law.[32]

20. Satellites, Armed Conflict, and the Risk of Escalation

The integration of satellites into military operations has transformed the nature of armed conflict. Satellites enable real-time intelligence, surveillance, reconnaissance, and precision targeting, making them strategically significant assets.[33] As a result, satellites are increasingly viewed as potential military objectives.

International humanitarian law applies to armed conflict in outer space by virtue of its general applicability, but its concrete application to satellite systems remains contested.[36] Questions persist regarding the lawful targeting of dual-use satellites, proportionality assessments, and the protection of civilian services reliant on satellite infrastructure.

[35] Steven Freeland & Ram S. Jakhu, *The Need for a Space Tribunal*, 7 *Space Pol'y* 1, 6–10 (2012).
[36] Ram S. Jakhu, National Space Legislation, 6 *J. Space L.* 37, 41–45 (2011).

The absence of clear legal norms governing hostile acts against satellites increases the risk of escalation and miscalculation. Destructive anti-satellite operations can generate debris with long-term consequences, affecting third states and civilian infrastructure.[37] Strengthening legal constraints on military actions involving satellites is therefore essential to maintaining stability in outer space.

21. Recommendations and the Way Forward

To enhance the effectiveness of satellite regulation, several measures merit consideration. First, there is a need for normative clarification of existing treaty principles, particularly regarding peaceful use, due diligence, and responsibility for private actors. Interpretative declarations or supplementary agreements could address these issues without reopening foundational treaties.

Second, international coordination should be strengthened through enhanced institutional cooperation between bodies such as UN COPUOS and the ITU. Integrating technical regulation with legal oversight would promote coherence and reduce fragmentation.

Third, confidence-building measures and transparency initiatives should be expanded to mitigate security risks associated with military and dual-use satellites. Such measures could reduce mistrust and promote stability without requiring immediate legally binding commitments.

Conclusion

Satellite technology has become an indispensable component of contemporary global infrastructure, supporting communication, navigation, security, environmental monitoring, and humanitarian operations. As satellite activities expand in scale and complexity, the role of international law in regulating their deployment and use assumes increasing importance. This article has demonstrated that while international law provides a foundational normative framework for satellite regulation, it remains ill-equipped to respond comprehensively to the legal challenges posed by modern technological, commercial, and security developments.

The Outer Space Treaty and its related instruments establish core principles governing satellite activities, including freedom of use, non-appropriation, state responsibility, and liability for

[37] Ricky J. Lee, Regulatory Competition in Space Activities, 44 *Air & Space L.* 55, 61–65 (2019).

damage. These principles continue to shape state behaviour and provide a degree of legal stability. However, their broadly framed and technology-neutral nature has resulted in significant interpretative ambiguity. Contemporary satellite operations particularly those involving dual-use technologies, private actors, mega-constellations, and counter-space capabilities operate at the margins of these treaty norms, exposing regulatory gaps that international law has yet to address effectively.

The analysis further reveals that satellite regulation has become increasingly fragmented across multiple legal and institutional domains. While the International Telecommunication Union plays a critical role in managing spectrum and orbital resources, its technical mandate operates largely disconnected from broader concerns of sustainability, security, and equitable access. Similarly, the growing reliance on national space legislation, though necessary for implementation, risks producing uneven regulatory standards and competitive distortions that undermine collective governance objectives. In the absence of binding international enforcement mechanisms or specialised dispute resolution forums, compliance with satellite-related norms continues to depend heavily on state practice and political will.

Environmental sustainability and security emerge as particularly pressing concerns. The accumulation of space debris, the vulnerability of satellites to cyber interference, and the integration of satellites into military operations pose systemic risks not only to individual states but to the shared orbital environment as a whole. The current legal regime, which emphasises post-damage liability rather than preventive obligations, offers limited tools for managing these collective risks. Without stronger normative commitments and coordinated oversight, the long-term viability of key orbital regions may be jeopardised.

This article argues that strengthening the role of international law in satellite regulation does not require wholesale treaty revision but rather a process of incremental legal development. Clarifying existing treaty principles, enhancing transparency and confidence-building measures, integrating sustainability considerations into regulatory practice, and improving institutional coordination represent pragmatic avenues for reform. Above all, satellite regulation must be guided by a renewed commitment to the common interest of humankind, ensuring that outer space remains accessible, secure, and sustainable for present and future generations.

In conclusion, international law remains central to the governance of satellite activities, but its

effectiveness depends on its capacity to evolve alongside technological and geopolitical change. As satellites continue to shape global connectivity and security, the challenge for international law lies in transforming foundational principles into operational norms capable of managing an increasingly crowded and contested orbital environment.