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India's Space Challenge: Updating Laws for In-Orbit Services and Debris Cleanup

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ABSTRACT

The Indian space sector is experiencing a commercialization and private participation shift from a government-monopolized space system, which requires legal innovations to address emerging challenges in in-orbit services (IOS) and space debris removal (SDR). The current legal framework of India based on policies and executive orders does not have sufficient provisions for licensing and liability and regulatory oversight in these modern domains despite its technological advancements. The paper identifies three main gaps in India's space law which include the nonexistence of statutory licensing for IOS and SDR operations, unclear liability rules and insufficient systems for protecting intellectual property and resolving disputes. The paper uses international best practices and guidelines to develop essential components for future Indian space legislation which includes activity-specific licensing procedures, mandatory insurance requirements, an independent regulatory authority and global space sustainability standards. The analysis shows that legal innovation must accompany technological progress to maintain India's leadership position in the complex and competitive outer space environment. Through proactive space law-making India can promote responsible commercial expansion while building international partnerships to establish its position in the emerging space governance framework.

Keywords: *In-Orbit Services (IOS), Space Debris Removal (SDR), Outer Space Treaty, Space Debris Mitigation Guidelines, Space Sustainability; Indian Space Law*

I. INTRODUCTION

The space industry now shifts from state-run space missions toward service-based operations with commercial growth. The development of space sustainability depends on In-orbit services (IOS) which provide satellite servicing and refuelling, repair and relocation and life extension of old satellites and orbital debris mitigation. The growing number of operational satellites because of mega-constellations such as SpaceX's Starlink, Amazon's Kuiper, and OneWeb has made satellite management in space essential for sustainability and commercial success.

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The satellite population in space reached 12,952 by 2025, with the top contributor United States, followed by Russia, China, Japan and India. The satellite-based communication and navigation and earth observation services require in-orbit services to be an essential part of the modern space infrastructure[2]. Through in-orbit services, operators can extend satellite lifespans while decreasing replacement expenses which leads to better space environment management. The combination of robotic arms, autonomous servicing vehicles and satellite docking modules has made IOS possible while keeping it economically sustainable. The developments in space technology force India and other emerging space nations to build corresponding legal frameworks for their space programs and transition from passive orbit cleaning to active debris mitigation procedures.

Definition and scope of space debris removal

Space debris represents human-made space objects that do not serve any operational function, including defunct satellites and spent rocket stages and collision-generated debris fragments. The space debris orbit Earth at speeds above 7 km/s and creates dangerous threats to operational satellites and crewed spacecraft. The European Space Agency reported in 2023 that Earth orbit contains more than 36,500 objects larger than 10 cm and one million between 1–10 cm as well as approximately 130 million pieces below 1 cm^3.

Space Debris Removal (SDR) involves intentional removal methods which utilize mechanical arms and nets, tethers and laser-based propulsion to capture and deorbit or relocate debris which protects orbital sustainability by reducing collision dangers. SDR creates multiple legal difficulties that stem from jurisdictional issues, ownership questions and liability responsibilities and state consent requirements when dealing with space debris located under foreign jurisdiction.

II. INTERNATIONAL LEGAL FRAMEWORK

During the Cold War period the international space law established its foundational instruments through the Outer Space Treaty (1967), the Rescue Agreement (1968), the Liability Convention (1972), and the Registration Convention (1976) and the least followed Moon Agreement with primary focus on state liability and peaceful space exploration and space object jurisdiction. The treaties create basic rules for liability and jurisdiction, yet they lack specific provisions regarding in-orbit services (IOS) and active debris removal (ADR).

[2] **B. Weeden & T. Chow,** Taking a Common-Pool Resources Approach to Space Sustainability: A Framework and Potential Policies, 28 *Space Policy* 166 (2012).
[3] European Space Agency, *Space Debris by the Numbers*, ESA Space Debris Office (2023), https://www.esa.int/Safety_Security/Space_Debris/.

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The Outer Space Treaty in Article VI states that states bear international responsibility for their national space activities which include those conducted by private entities while requiring continuous supervision. The Outer Space Treaty in Article VIII establishes that space objects launched by any state maintain their jurisdiction with the launching state which creates challenges for third-party servicing or removal operations[4]. The Liability Convention[5] imposes liability on the launching state for space object damages which creates legal ambiguities that might prevent ADR collaboration between entities.

Although, The UNCOPUOS Space Debris Mitigation Guidelines (2007) and Long-Term Sustainability Guidelines (2019) serve as non-binding instruments which provide best practices but they lack the power to enforce them. The current corpus juris spatialis (international legal system) fails to address the intricate technical and legal issues which private actors face when performing in-orbit services and debris removal because of its insufficient framework.

Space Debris Removal exceeds simple technical execution because it creates multiple legal problems regarding ownership, liability and consent due to Article VIII of the Outer Space Treaty which keeps space objects under launching state control even after they become non-functional.

A. Current global status of space debris management

The international legal framework for space debris management exists mainly through voluntary guidelines instead of enforceable international treaties. The Space Debris Mitigation Guidelines[6] issued by the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) in 2007 provide operational practices for normal operations and post-mission disposal. The Outer Space Treaty of 1967 serves as the base legal framework with its Article VIII maintaining states' authority over their space objects which makes third-party removal challenging as any third party has to find out the nationality of the debris then take authorization before its removal.

The United States together with Japan and members of the European Space Agency have initiated or funded Active Debris Removal (ADR) missions but legal uncertainties continue to block progress. The private space companies Astroscale and Northrop Grumman test

[4] 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 [hereinafter Outer Space Treaty].
[5] Convention on International Liability for Damage Caused by Space Objects art. II, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].
[6] U.N. Office for Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010), https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

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servicing technologies but their ability to expand operations remains limited because there is no established global framework for consent, liability and ownership rights.

India stands as a leading spacefaring nation but lacks specific legislation to regulate In-Orbit Services and Space Debris Removal operations. The regulatory framework of India relies mainly on ISRO policies, together with the Satellite Communication Policy and the draft Space Activities Bill that remains unimplemented. The growing commercial space activities of India, alongside its rising launch rate, necessitate the immediate development of legally sound international standards to manage orbital operations and space debris management.

B. UN space debris mitigation guidelines

The United Nations Space Debris Mitigation Guidelines which UNCOPUOS adopted in 2007, provide an internationally accepted set of standards to support responsible outer space conduct. The Scientific and Technical Subcommittee together with international experts from the Inter-Agency Space Debris Coordination Committee (IADC), developed these guidelines as non-binding soft law instruments. The guidelines have gained significant influence in the development of national and agency-level policies regarding orbital debris although they do not possess treaty law enforcement powers.

The seven essential principles that form the foundation of these guidelines include[7]:-

1. Normal space operations should not produce any space debris
2. Entities must try to minimize accidental explosions
3. Avoiding intentional destruction of space objects
4. Limit the Probability of in-orbit collisions
5. Avoid Long-Term Presence in Protected Regions/orbits
6. Ensuring post-mission disposal, such as deorbiting satellites or moving them to graveyard orbits at the end of their operational lives.
7. Prevent On-Orbit Collisions

The guidelines establish best practices to minimize long-term space debris threats particularly in busy low-Earth and geostationary orbits.

Despite their widespread approval the guidelines demonstrate significant constraints. The voluntary nature of these guidelines means that states choose whether to follow them since there exists no enforcement system or monitoring organization to verify its compliance. The guidelines lack specific provisions for Active Debris Removal (ADR) and In-Orbit Services

[7] *Id.*

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(IOS) and do not contain regulations for liability and licensing or international cooperation in debris remediation initiatives. States can choose to implement the guidelines at their discretion or not implement them at all because of inconsistent application which reduces their overall effectiveness.

A legally binding multilateral instrument or broader space sustainability framework with verification systems should be used to enhance the guidelines' effectiveness. The space environment requires better provisions for data sharing along with clearer commercial actor obligations and mega-constellation deployment coordination. The guidelines require expansion to include in-orbit servicing operations, refuelling procedures and Active Debris Removal protocols to maintain their usefulness in upcoming years.

C. UN long-term sustainability guidelines

The increasing complexity of outer space activities because of commercial mega-constellations and active debris removal with in-orbit servicing has led to the international community developing new norms, guidelines and soft-law instruments that go beyond the traditional space treaty framework. The new legal trends aim to protect space sustainability while reducing risks and promoting cooperative actions between state and non-state actors.

The core UN space treaties from the 1970s remain unaltered but the international community has achieved substantial progress through non-binding instruments and multilateral discussions. The UNCOPUOS adopted the LTS Guidelines as a landmark initiative for Long-Term Sustainability of Outer Space Activities in 2019[8]. The 21 voluntary guidelines serve to promote outer space sustainability through measures that promote transparency, coordination, debris mitigation and capacity-building. The Space Debris Mitigation Guidelines receive expansion through new provisions which address SSA (space situational awareness) and data sharing and responsible conduct by private entities.

The International Telecommunication Union (ITU)[9] has developed improved coordination methods to handle orbital slots and radio frequencies because of mega-constellation deployments. The regulatory changes create an impact on space debris management and orbital congestion issues.

The United States along with other nations has established national policies that generate

[8] U.N. Office for Outer Space Affairs, *Guidelines for the Long-Term Sustainability of Outer Space Activities* (2019), https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability-of-outer-space-activities.html (last visited July 8, 2025).

[9] International Telecommunication Union, *Radio Regulations* (2020), https://www.itu.int/pub/R-REG-RR (last visited July 8, 2025).

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international effects. The U.S. Space Policy Directive-3 (2018) establishes national standards for space situational awareness (SSA) and space traffic management (STM) while promoting worldwide space traffic management standards. Japan along with Luxembourg and the UAE, have passed domestic laws which authorize commercial space operations, including orbital activities.

D. Proposed international regulations or guidelines

The world lacks any enforceable international agreement that controls ADR or IOS operations. The UNCOPUOS together with the Hague International Space Resources Governance Working Group, has received proposals for establishing new legal frameworks. The Hague Building Blocks for the Development of an International Framework on Space Resource Activities (2019) propose that space resource extraction and servicing missions should operate under a cooperative non-sovereign legal framework[10].

The UNCOPUOS Working Group on Space Traffic Management (2021–2023) has moved forward with multilateral STM regime discussions, yet geopolitical tensions and technological disparities prevent consensus from forming[11].

E. Evaluation of their potential impact on India's space activities

The rising status of India as a space power will face both favourable and unfavourable effects from these developing norms. The implementation of Long-Term Sustainability Guidelines together with Space Traffic Management frameworks enables India to gain international recognition as a responsible space actor while gaining access to collaborative data networks for collision avoidance and orbital safety. The lack of domestic legislation that matches evolving standards creates challenges for India to take part in and shape rule-making processes effectively.

The growing commercial space sector of India needs legal certainty to follow international best practices regarding servicing, active debris removal and space sustainability. India should create future-oriented national legislation that enforces these norms through enforceable regulatory frameworks to achieve maximum benefits while reducing legal exposure.

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[10] Hague International Space Resources Governance Working Group, *Building Blocks for the Development of an International Framework on Space Resource Activities* (Nov. 2019), https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/bb-thissidelines.pdf (last visited July 8, 2025).

[11] White House, *Space Policy Directive-3: National Space Traffic Management Policy* (June 18, 2018), https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/ (last visited July 8, 2025).

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III. INDIA'S CURRENT LEGAL FRAMEWORK

The Indian space program initiated its operations in 1962 through the Indian National Committee for Space Research (INCOSPAR) under the Department of Atomic Energy which became the Indian Space Research Organisation (ISRO) in 1969 under the Department of Space. The early space program of India followed the lead of visionary scientist Dr. Vikram Sarabhai who steered the space efforts toward developing space technology for national development primarily in agriculture, meteorology and communication.[12]

A. Overview of India's current space capabilities and infrastructure

The Indian space industry operates through both public facilities and private space capabilities. ISRO operates multiple launch vehicles, including the Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV), and the LVM3 (formerly GSLV Mk III), enabling independent access to space for a range of payload sizes and orbits. The country operates multiple research facilities, ground stations and production sites which are spread throughout Bengaluru, Thiruvananthapuram and Sriharikota and other Indian cities[13].

The country operates its satellite fleet through systems INSAT, GSAT, IRNSS (NavIC), and Cartosat, which deliver communication services together with earth observation and meteorological capabilities and navigation systems. India has launched more than 400 satellites since 2024, while many of these spacecraft continue to operate in both low Earth orbit and geostationary orbit. The policy change toward space venture commercialization and private sector participation in space ventures became evident through the creation of IN-SPACe (Indian National Space Promotion and Authorization Center) and the NewSpace India Limited (NSIL).

India faces challenges in space debris management alongside in-orbit services because the country does not have an adequate legal and regulatory structure for these developing space sectors which need national and international coordination.

B. Challenges faced by India in space debris management and in-orbit services

Although the Indian space sector demonstrates strong technological capabilities it lacks sufficient legal structures to address both space debris management and in-orbit services

[12] Maulik Sharma, *Critical Analysis of India's Space Law and Policy Framework*, in *Designing Competitive Space Laws and Policies for Commercialisation of Space Sector in India* (Ph.D. dissertation, Shobhit University, 2025) (unpublished).
[13] Indian Space Research Organisation, *Launch Vehicles*, https://www.isro.gov.in/Launch_Vehicles.html (last visited July 6, 2025).

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(IOS). ISRO follows international standards yet the Indian Space Activities Bill remains pending which produces legal confusion about liability regulations and licensing requirements and third-party service provisions. The country performs passive debris mitigation techniques through graveyard orbit disposal but it maintains no active debris removal (ADR) missions even though other space actors such as the U.S., Japan and the European Union operate these types of missions. ISRO maintains indigenous space situational awareness (SSA) capabilities through its NETRA program and the Directorate of Space Situational Awareness and Management (DSSAM) yet it continues to depend on international data for real-time monitoring and collision warnings[14]. Foreign entities or private organizations need state permission under Article VIII of the Outer Space Treaty to modify Indian space objects although India does not have established rules to approve such orbital maintenance activities. The UNCOPUOS Space Debris Mitigation Guidelines receive Indian support through soft law instruments yet the country plays a minor role in establishing binding international rules for space debris removal and in-orbit services.

The space law framework of India exists as multiple scattered sectoral policies and executive notifications alongside administrative control from the Department of Space (DoS) and the Indian Space Research Organisation (ISRO). The current legal instruments that have directed India's space program since the 1960s fail to address the intricate legal aspects of in-orbit services (IOS) and space debris mitigation because they remain outdated and inadequate.

C. Existing space-related legislation

1. Satellite Communication Policy, 2000

The Satellite Communication Policy (SATCOM Policy) of 2000[15] served to control satellite communication development while enabling restricted private involvement in India. The policy establishes satellite capacity for national requirements will be fulfilled by Indian satellites and outlines leasing terms for transponders and broadcasting from satellites. The policy fails to provide specific guidelines about satellite servicing rules and orbital responsibility as well as disposal requirements that are crucial for both debris management and IOS practices. At the time of policy creation private space activities remained rare thus the policy does not accommodate current commercial space requirements.

[14] Indian Space Research Organisation, Space Situational Awareness (2023), https://www.isro.gov.in/SSA.html (last visited July 8, 2025).

[15] Department of Space, *Satellite Communication Policy, 2000* (2000), https://www.isro.gov.in/media_isro/pdf/SATCOM_policy.pdf (last visited July 8, 2025).

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2. Remote Sensing Data Policy, 2011

The Remote Sensing Data Policy (RSDP), 2011[16], manages satellite remote sensing data acquisition and dissemination activities. It maintains national security needs against supporting civilian data accessibility. The policy states that all data acquired through Indian remote sensing satellites needs to be processed and disseminated by the National Remote Sensing Centre (NRSC) under ISRO. The RSDP does not provide answers to legal questions regarding satellite servicing or space traffic management or debris avoidance protocols for data collection operations. The policy's centralized control structure creates obstacles for commercial development of serviceable satellite architectures as well as responsive systems.

3. Other Relevant Policies and Developments

The Government of India has worked to liberalize its space sector through various initiatives during the past few years. The 2020 revision to Foreign Direct Investment (FDI) Policy in the Space Sector enables 100% FDI for satellite establishment and operation through government approvals. The Indian National Space Promotion and Authorization Centre (IN-SPACe) stands as a key institutional innovation to enhance private industry involvement in space programs. These measures function without a comprehensive law to define liability structures or licensing requirements or authorization frameworks for ADR and in-orbit refueling operations.

There exists no domestic legal framework that brings India's obligations from international treaties such as the Outer Space Treaty (1967) and the Liability Convention (1972) into national law. The current legal system faces limitations in enforceability while private operators experience poor regulatory predictability.

D. Indian Regulatory Bodies and Their Roles

The Indian government drives space activities through regulatory initiatives while multiple agencies perform overlapping responsibilities and informal activities. The Indian space sector has started accepting private entities but the lack of both a unified regulatory framework and a space regulatory authority creates confusion and reduces accountability and flexibility in the existing structure.

1. Indian Space Research Organisation (ISRO)

ISRO functions as India's leading space agency which carries out scientific research while

[16] Indian Space Research Organisation, *Remote Sensing Data Policy (RSDP), 2011*, https://www.isro.gov.in/media_isro/pdf/RSDP_2011.pdf (last visited July 8, 2025).

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developing technology and operating satellites and functions as the de facto regulatory body[17]. The Department of Space (DoS) allows ISRO to establish internal policies for satellite launch authorization and spectrum coordination together with orbital data sharing and mission authorization. The lack of legal recognition for ISRO's regulatory function creates a conflict of interest because it operates as both a space agency and regulatory body especially during the growth of private sector space activities. The organization's dual function as operator and regulator might create barriers to fair competition and reduce private innovation and decrease transparency during decision-making processes.

2. Department of Space (DoS)

The Department of Space functions as an administrative body under the Prime Minister's Office to oversee India's space program and create policy guidelines for the Satellite Communication Policy as well as the Remote Sensing Data Policy and the Space Activities Bill. The Department of Space performs essential duties in space governance yet it lacks a legal basis to enforce regulations or resolve conflicts regarding private companies, particularly in new areas like in-orbit servicing and active debris removal.

3. IN-SPACe (Indian National Space Promotion and Authorization Center)

IN-SPACe started operations in 2020 as an independent body under DoS to enable authorization for space sector participation by private companies. The agency functions as a single authorization point for private satellite missions and spectrum utilization and satellite-based services to separate regulatory responsibilities from ISRO operational duties. The reforming agency IN-SPACe operates under executive authority yet lacks the power to impose penalties or settle liability disputes which national regulatory bodies normally handle. The agency's responsibility for managing long-term operations including in-orbit servicing and debris removal remains undefined.

4. Other Involved Agencies

Other agencies with intersecting responsibilities include:

- The Ministry of Defence controls national security matters related to space.
- TRAI and WPC operate under the Ministry of Defence to regulate satellite spectrum distribution.

[17] Indian Space Research Organisation, *About ISRO*, https://www.isro.gov.in/About.html (last visited July 8, 2025).

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- The Ministry of External Affairs manages international treaty obligations together with space diplomacy.

The lack of a central legal authority responsible for coordination among various agencies produces regulatory uncertainty while creating operational inefficiencies.

E. The evaluation assesses how well the current regulatory system functions

The regulatory framework of India lacks a unified legal foundation and operates through institutional divisions that are controlled by executive bodies and policy-based systems. A space regulatory authority that operates independently from operational entities like ISRO remains non-existent leading to overlapping responsibilities and delayed approval processes and weak enforcement. The commercial transition of India's space economy demands a new regulatory system that establishes transparency and accountability and legal strength for managing complex activities including IOS, ADR, space traffic management and private sector participation.

IV. IDENTIFICATION OF LEGAL GAPS AND THE NEED FOR INNOVATION IN INDIA

India needs to move away from its government-run space program to develop a commercial space economy and its current legal and regulatory architecture fails to handle complex high-risk activities such as in-orbit services (IOS) and space debris removal (SDR). There is an urgent need to create a forward-looking legal framework that satisfies both international commitments and technological requirements. India faces an immediate legal problem because the current outdated or incomplete legal instruments cannot keep pace with the expanding space operations.

Key legal gaps include the absence of:

- The current legislation does not contain a legal framework to govern in-orbit servicing and debris removal.
- Licensing norms for ADR (Active Debris Removal) or servicing missions involving foreign or commercial actors.
- The liability framework does not cover damages that occur in IOS or debris removal operations.
- The procedures to share data, track and work together for debris mitigation do not exist.

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- The space traffic management and servicing authorization need dedicated Institutional oversight.

India needs to introduce new legal frameworks to stay competitive and meet emerging global standards. The country should enact domestic laws that adopt international best practices and promote public-private partnerships for IOS and develop swift dispute resolution procedures and environmental legal standards for space sustainability.

The Indian space law should include traditional regulatory elements with risk-sharing and insurance and technological neutrality features to facilitate adaptable growth in emerging orbital segments including satellite life-extension and autonomous debris mitigation under a comprehensive national space legislation.

A. Licensing and regulatory framework

The current legislation of India does not include specific regulations to authorize IOS or space debris remediation activities. The proposed Space Activities Bill, 2017, presents a simple licensing structure for commercial space activities yet fails to provide detailed and specific regulations for:

- Foreign satellites servicing
- Orbital operations must be carried out by autonomous systems
- Active debris capture and on-orbit refuelling activities[18]

A future-ready licensing system requires activity-specific licenses for in-orbit services that include inspection, repair, refuelling, relocation and deorbiting with defined eligibility requirements and application processes and liability coverage for each activity. Licensing should apply to foreign private businesses that collaborate with Indian firms to determine state responsibility according to Article VI of the Outer Space Treaty[19].

B. Suggested regulatory oversight mechanisms

India does not have a self-contained, independent space regulatory authority. The regulatory authority of ISRO, the Department of Space (DoS) and IN-SPACe perform fragmented responsibilities. The establishment of a statutory body called the National Space Regulatory Authority (NSRA) with legislative support represents the necessary step for India to improve governance. The regulatory authority should have the power to:

[18] Department of Space, *Draft Space Activities Bill, 2017* (Nov. 21, 2017), https://prsindia.org/files/bills_acts/bills_parliament/1970/Draft%20Space%20Activities%20Bill%202017.pdf (last visited July 8, 2025).
[19] Outer Space Treaty, *supra* note 3.

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- Issue licenses,
- Set technical and safety standards,
- Monitor compliance,
- Enforce penalties, and
- Coordinate with international space traffic management bodies.

The regulatory body must maintain its independence from ISRO to prevent conflicts of interest and establish equal market opportunities for private companies.

C. Measures to ensure compliance with international standards

India maintains membership in essential space treaties yet it has not implemented essential international legal standards within its national legislation. The current licensing system needs to be implemented:

- The UNCOPUOS Space Debris Mitigation Guidelines[20] and
- The Long-Term Sustainability Guidelines (LTS)[21],
- The regulations of the ITU regarding frequency allocation and orbital coordination and Bilateral or multilateral partnerships have established provisions for space situational awareness (SSA) and collision avoidance.

Aditionally, all operators must present the following documentation during the licensing process.

- The end-of-life disposal plans and
- Risk assessments for debris generation,
- Data-sharing protocols for orbital position and maneuvers.

Such requirements will enable India to achieve global standards in space governance and improve its position in international space governance frameworks.

D. Liability and Insurance Regimes

The 1972 Convention on International Liability for Damage Caused by Space Objects [22]requires launching states to pay all damages that occur on Earth and aircraft while fault-based liability applies to damages in space. India lacks specific national legislation that incorporates these international obligations. The undefined and ambiguous nature of liability

[20] Space Debris Mitigation Guidelines, *supra* note 5.
[21] Long Term Sustainability Guidelines, *supra* note 7.
[22] The Liability Convention, *supra* note 3.

distribution exists between state and non-state actors.

A contemporary Indian legal framework needs to include the following features:

- The framework should identify main and secondary responsibilities between state-run space activities and those conducted by private organizations.
- The framework needs to establish clear liability definitions for damage occurring on Earth or in outer space.
- The framework should establish joint and several liability rules for instances of joint launches and collaborative space missions.
- The state needs private operators to obtain indemnification agreements as part of their legal framework.

The legal certainty and public resource protection and global best practice alignment of Indian law would be guaranteed by these provisions.

E. Suggestions for mandatory insurance requirements

A major space law risk management tool depends on insurance requirements which become compulsory. The draft Space Activities Bill, 2017, of India states that space activity licensees must obtain insurance coverage together with third-party claim indemnification for the central government. The legal framework does not specify any details about coverage restrictions and insurance requirements together with risk assessment methods.

A detailed regulatory framework should include:

- All commercial space operators need to acquire **third-party liability insurance** (TPLI) as a requirement.
- The framework must define **minimum insurance coverage** levels based on both mission profiles and risk assessment categories.
- Every spacecraft or service mission must have insurance that covers both failure events and losses.

The framework allows state-sponsored missions to use self-insurance under regulatory oversight. The implemented provisions enable new participants to obtain low-cost insurance coverage by shifting responsibility for accident costs to responsible parties.

F. Mechanisms for dispute resolution and compensation

India currently does not possess an established system to resolve space-related disputes or

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award compensation. The current legal system requires parties affected by space-related incidents such as collisions and interference or debris damage to pursue redress either through diplomatic means or general court procedures.

India must establish:

- A national tribunal or specialized bench operated by a space law authority serves to resolve space-related disputes.
- The framework should establish arbitration and mediation processes which serve as substitute to court litigation.
- Private contracts need to include jurisdiction and choice-of-law provisions which must follow international standards.

India should back the creation of international procedures to handle cross-border damage claims through backing an international compensation fund or joining a global registry for liability incidents.

The success of a modern market-driven space sector depends on liability and insurance principles. India's space actors including private players stay exposed to risks because the legal definitions remain unclear and risk allocation and financial protection instruments are absent. A sound liability-insurance framework that follows international standards will guarantee operational safety and attract investors while enabling India to meet its treaty commitments.

G. Intellectual property rights in space

India needs to protect intellectual property rights (IPR) in its space commercialization initiatives because it now targets advanced space operations like in-orbit servicing (IOS) and space debris removal (SDR). Strong intellectual property rights frameworks support innovation and facilitate technology transfer and international partnerships. The current legal system of India does not contain specific regulations for protecting intellectual property rights during space activities. The legal framework for IPR protection in space activities should be established by the following structure:

The Outer Space Treaty (1967) along with the Patent Cooperation Treaty (PCT) serve as the main treaties that indirectly govern intellectual property rights in outer space. According to Article VIII of the Outer Space Treaty launching states maintain authority over their space objects and personnel which includes jurisdiction over IPR matters. The Outer Space Treaty fails to establish procedures for IPR management when multiple countries work together or

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when inventions emerge on space stations and satellites or during in-orbit servicing operations.

The Indian government supports the PCT while maintaining its own Patents Act 1970 yet there exists no clear regulation regarding:

- The patentability of inventions created in space particularly those produced through international collaborations remains unclear.
- Foreign-registered spacecraft that operate in the space zone of India must identify which jurisdiction has authority.
- Enforcement procedures for IPR violations that occur in orbital space need clarification.

A space specific IPR framework should define ownership rights together with jurisdictional and enforcement standards for inventions created through orbital operations and autonomous technologies and debris removal systems.

V. CONCLUSION AND SUGGESTIONS

India currently faces a crucial moment regarding its space sector progress. The complexity of technology-based space operations including in-orbit servicing (IOS) and space debris removal (SDR) reveals significant gaps in the current legal and regulatory system. The absence of a complete enforceable space law in India threatens to limit its ability to maintain leadership in the rapidly commercializing outer space sector.

This research has uncovered vital deficiencies within India's legal structure regarding the elements of in-orbit service and space debris management and licensing procedures and regulatory control mechanisms and liability provisions and insurance policies and intellectual property protection. The current space economy requires updated policies starting from the SATCOM Policy (2000) and Remote Sensing Data Policy (2011) and the non-passed Space Activities Bill (2017) to meet evolving industry needs. The absence of a statutory space regulator along with an unclear liability framework creates uncertainty for private operators who operate in space.

The implementation of a comprehensive space law by India needs to follow international best practices as seen in UNCOPUOS guidelines and ESA IP policies. A future space law needs to establish principles of transparency and accountability and sustainability and international compliance to enable innovation by establishing clear licensing frameworks and insurance regulations and IPR protections and technology transfer policies which NSIL executes.

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The future governance and industrial position of India in outer space requires a forward-thinking legal framework. Legal advancement plays a decisive role in determining the nation's capability to lead responsibly in the new space era because it balances domestic interests with international responsibilities and commercial development.

The new space law structure needs to incorporate essential elements which will address both current space exploration and utilization challenges and future opportunities. The law must contain precise definitions for space-related terms together with established guidelines for responsible space resource utilization and specific rules for space debris mitigation. The law should create an international framework for space activities cooperation and specify methods for dispute resolution along with jurisdictional rules for space-related matters.

International regulations for in-orbit services together with debris removal represent essential elements for maintaining safe and sustainable space activities. These regulations need to define liability standards while creating standard procedures for debris removal operations and specifying requirements for satellite owner consent. International cooperation and information sharing systems must be created to enable joint space debris management efforts and in-orbit servicing missions.

VI. RECOMMENDATIONS AND FUTURE PROSPECTS

A complete space law for India must establish rules about licensing processes alongside liability standards and insurance requirements and intellectual property rights protection to handle the current regulatory gap. A dedicated independent space regulatory authority should be established to guarantee transparency and compliance and gain private sector confidence.

The responsible development of space requires mandatory third-party insurance and efficient dispute resolution tools and international debris mitigation standard compliance. Clear IPR rules together with public–private collaboration initiatives will enhance India’s capabilities in this developing industry.

India should engage actively in worldwide forums while establishing space traffic coordination agreements with other countries and supporting sustainable green space technology development. With its future-ready legal structure India can take leadership positions in satellite launches and establish worldwide guidelines for responsible and creative space operations.

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