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LEGAL AND JURISDICTIONAL CHALLENGES OF SPACE PATENTS

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Abstract:-

The commercialization of outer space inventions has caused an incompatibility between territoriality principle of patent law and the non-appropriation principle governing outer space. In recent days, space-based innovation has got increased significantly and as a result exposed significant absence in legal framework as to application of patent law beyond Earth. This paper examines and analyses the tension between the territorial scope of patent rights and the principle of non-appropriation in the context of outer space, which creates uncertainty in protecting space inventions and also analyses the limitations under the Indian Patents Act, 1970, and also addresses the key challenges faced such as jurisdiction issues, conflict of laws, patentability in microgravity, and enforcement difficulties and further the present paper highlights issues such as multi-jurisdictional infringement and regulatory loopholes, and the necessity for legal reforms to extend patent protection to space activities while ensuring conformity with international obligations.

Keywords: *Space Patents, Outer Space Treaty, Territorial Limitation, Non-Appropriation Principle, Indian Patents Act 1970, Jurisdictional Vacuum, Deemed Territoriality, Flags of Convenience, TRIPS Agreement, Kármán Line.*

Introduction:-

The term Space patents refer to intellectual property rights granted for inventions that are either developed, tested, or utilized in outer space, including technologies related to satellites, propulsion systems, microgravity research, and in-orbit manufacturing processes.[1238] As human activity expands beyond Earth, these inventions have gained substantial commercial and strategic importance. However, the legal protection of these inventions is challenging, as Traditional patent systems were designed for a world with clear borders.

The primary challenge arises due to the conflict between territorial aspects of patent law and the fundamental tenets of international space law and under the Outer Space Treaty, the outer space cannot be subjected to national appropriation, nor can any state assert sovereignty over it..[1239] At the same time, patent rights can only be enforced in the jurisdiction of the state where they were granted and this

[1238] WORLD INTELLECTUAL PROPERTY ORGANIZATION, INTELLECTUAL PROPERTY AND SPACE ACTIVITIES (2004), https://www.wipo.int/export/sites/www/patent-law/en/developments/pdf/ip_space.pdf [hereinafter WIPO Space Activities 2004].

[1239] Kopal V and United Nations, "TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES" (2008) <https://www.un.org/law/avl>, Art. II.

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creates a jurisdictional vacuum where inventions made or used in space may fall outside the effective reach of national legal systems. Although the Treaty allows states to have jurisdiction and control over registered space objects, but it doesn't explicitly extend patent enforcement to activities in space which leaves a lot of room for interpretation.

In the Indian context, this problem is made worse by the fact that the Patents Act, 1970, doesn't clearly express about inventions created or used outside national territory.[1240] As India develops its space capabilities and encourages private sector involvement, the lack of a clear legal framework makes it hard for innovators to protect their intellectual property. Enforcement challenges are especially bad because, infringing activities may occur in space, involve multiple jurisdictions, or be connected to foreign-registered space objects, making it difficult to apply traditional remedies.

These issues highlight the urgent need for legal reformation. India must consider extending patent jurisdiction to space activities through statutory provisions, adopting principles such as deemed territoriality for space objects under its registry, and strengthening mechanisms for cross-border enforcement[1241]. Harmonization with international obligations, along with the development of a dedicated legal framework for space activities, will be essential to ensure both the protection of innovation and compliance with global space law principles.

Territorial Limitations of Patent Law in Outer Space

The territorial limitation of patent law is its most fundamental feature and its most fundamental obstacle in the space context. A patent granted by any national authority is, by definition, a right that operates only within the territory of the granting state. Infringement of the patent requires an infringing act to occur within that territory. An act that occurs outside the territory — however commercially damaging to the patent holder — is beyond the jurisdiction of the patent-granting state's courts.[1242]

In outer space, the territorial limitation is absolute in the absence of specific legislative provision. A spacecraft 36,000 kilometres above the surface of the Earth in geostationary orbit is in no state's territory. An astronaut aboard the ISS is not on Indian territory, US territory, or Russian territory — she is on the territory of the state in whose module she is working, by virtue of the ISS IGA's deemed-territorial rule.[1243] Without equivalent deemed-territorial rules, Indian patent law has no reach in space.

The practical consequence is stark. An Indian company that patents a novel satellite attitude-control system has, under current law, no remedy against a foreign company that copies the system and deploys it aboard a satellite registered in a jurisdiction where the Indian patent has no force. The copying occurs in space; the space is no-man's-land for patent purposes; and the foreign company's spacecraft is under the jurisdiction of its own registering state, not India.[1244]

Determination of Jurisdiction for Space-Based Inventions: "Made-in-Space" Patents

The concept of an invention "made in space" presents a novel jurisdictional challenge to patent law. When a scientist conducts an experiment on the ISS and conceives a novel pharmaceutical process based on the crystalline structure of a protein grown in microgravity, where was the invention "made"? The OST provides that the state of registry retains jurisdiction over the ISS module in which the experiment occurred — but without a domestic legislative act giving effect to that jurisdiction for patent purposes, the jurisdictional hook is purely formal.

[1240] Indian Patents Act, 1970,Section1(2)
[1241] International Space Station Intergovernmental Agreement (signed 29 January 1998) art 21(2).
[1242] Microsoft Corp. v. AT&T Corp., 550 U.S. 437 (2007).
[1243] ISS IGA, art. 21(2).
[1244] Quinn Emanuel, Low Orbit Patent Protection (Oct. 2023), https://www.quinnemanuel.com.

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The ISS IGA's Article 21(2) resolves this problem for ISS activities by providing that activities in a module will be considered to have taken place on the partner state's territory on whose registry the module is entered. The deemed-territorial rule attributes inventive locus to the state of the module, regardless of the nationality of the inventor. An American astronaut inventing in the Japanese Kibō module is deemed to have invented in Japan; a Japanese astronaut inventing in the US Destiny module is deemed to have invented in the United States.

For India, this framework offers a clear model. India does not participate in the ISS, but the Gaganyaan spacecraft will be under Indian jurisdiction pursuant to Article VIII of the OST. An invention made aboard Gaganyaan should, by statute, be deemed to have been made in India. The absence of such a provision leaves Indian Gaganauts' inventions in a legal void.

The Bristol-Myers Squibb experiment on the ISS illustrates the commercial stakes. BMS conducted experiments on monoclonal antibody crystallisation in the microgravity environment of the ISS, potentially generating patentable processes that could not be replicated on Earth. The company had to address the question of which patent law governed the resulting inventions — a question resolved by the ISS IGA but with no equivalent resolution for non-ISS activities.

Conflict of Laws: Determining the Applicable Law in Multi-National Missions

Multi-national space missions — including ISRO's collaborations with NASA (NISAR mission), ESA (Mars Express contributions), and JAXA — generate inventions that may involve contributors of multiple nationalities, equipment from multiple jurisdictions, and intellectual effort conducted across several national borders before any space activity begins. Determining which state's patent law governs the resulting inventions is a conflict-of-laws problem with no established resolution.

The traditional conflict-of-laws rule for IP disputes — the lex loci protectionis, the place of law where the protection is to be sought — is useless in space context because outer space is no place in the legal sense. The law of the inventor's nationality may apply, but in a multi-national team, the inventors may have different nationalities. The law of the sponsoring organisation may apply, but in a collaboration between ISRO and NASA, two national laws produce conflicting outcomes.

Contractual choice-of-law clauses provide the most practical resolution: the parties to a multinational space collaboration should agree in advance which law will govern IP ownership and enforcement disputes. But standard commercial contracts cannot override mandatory provisions of national patent law, and in any case, most NewSpace companies — particularly early-stage Indian start-ups — lack the sophisticated IP counsel needed to negotiate bespoke IP allocation agreements for multi-national space projects.[1245]

Patentability Hurdles: Novelty in Zero Gravity

The microgravity environment of space presents specific patentability challenges. Many space inventions depend on effects that exist only in microgravity — protein crystallisation patterns, fluid behaviour, materials synthesis outcomes — that cannot be replicated or anticipated from Earth-based prior art. These inventions are genuinely novel in the sense that no prior art in the patent databases anticipates them. However, the prior art generated by space experiments themselves — including the extensive published literature from ISS experiments by NASA, ESA, JAXA, and Roscosmos — may rapidly accumulate as a body of space-specific prior art that defeats later patent applications.[1246]

[1245] Morgan Lewis, Exploring the Legal Frontier of Space and Satellite Innovation (May 2025), https://www.morganlewis.com.

[1246]. Saikia & Deb, at 130 (Bristol-Myers Squibb ISS crystallography experiment, 2001).

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The Indian Patent Office's prior-art search processes are not currently adapted to systematically search the databases of NASA, ESA, and other space agencies for space-experiment results. An Indian inventor applying for a patent on a microgravity pharmaceutical process may not know — and the examiner may not find — that the same process was described in a NASA technical report from an ISS experiment conducted five years earlier. This is a prior-art search quality problem that requires institutional attention.

The inventive-step analysis also presents challenges in the space context. The "person skilled in the art" against whom inventive step is assessed must be defined for the specific space technology domain. Is the skilled person a satellite engineer? A microgravity materials scientist? A rocket propulsion specialist? The breadth of "space technology" as a technical domain means that the skilled person may need to be differently defined for different types of space invention, requiring specialist examiners at the Indian Patent Office.[1247]

Enforcement Challenges in Outer Space

Even where a court has jurisdiction over a space-patent infringement dispute, the enforcement of a patent judgment against a spacecraft in orbit presents practical obstacles with no terrestrial equivalent. Injunctions are meaningless against a spacecraft that cannot be reached; seizure orders cannot be executed on property that is orbiting at 28,000 kilometres per hour; and damages awards against operators based in multiple jurisdictions require complex international enforcement procedures.[1248]

The ground-station control doctrine provides the most practical enforcement avenue currently available. Under the doctrine developed in NTP, Inc. v. Research In Motion[1249] and earlier in Decca Ltd. v. United States,[1250] infringement may be deemed to occur where the beneficial use of a space-borne process is received — typically at the ground station or at the end-user terminal. If a competitor's satellite uses an Indian-patented communication protocol, and if the ground station controlling the satellite or the customers receiving its services are located in India, there may be a viable basis for an Indian infringement action.

This doctrine has not been adopted in Indian jurisprudence. The Patents Act contains no provision expressly applying the beneficial-use theory to space-patent infringement. Nor has any Indian court addressed the extraterritorial dimensions of patent infringement in the technology context. Codifying the ground-station control doctrine in the Patents Act — combined with the deemed-territorial provision proposed above — would provide Indian patent holders with a two-front enforcement architecture: rights in orbit (via the deemed-territorial rule) and rights on the ground (via the beneficial-use doctrine).[1251]

JURISDICTIONAL CHALLENGES IN SPACE PATENT ENFORCEMENT

The Territorial Principle vs. The Non-Appropriation Principle

The fundamental jurisdictional challenge in space patent enforcement derives from the collision between the territorial principle — the foundational axiom of patent law — and the non-appropriation principle — the foundational axiom of space law. Patent rights are territorial in nature: they are granted by sovereign states and can be enforced only within the boundary of the granting state. As enshrined under Article II of the Outer Space Treaty, the non-appropriation principle prohibits any state against claiming sovereignty over any celestial body or space. The logical consequence of these two tenets working hand in hand is that

[1247] ABA, The Space Maze: Navigating International Law and Protecting Patents in Low-Earth Orbit and Beyond, LANDSLIDE (Spring 2024).
[1248] IPWatchdog, Extraterrestrial Law: Protecting Patents in Outer Space and on Celestial Bodies (Aug. 20, 2023).
[1249] NTP, Inc. v. Research In Motion, Ltd., 418 F.3d 1282 (Fed. Cir. 2005).
[1250] Decca Ltd. v. United States, 544 F.2d 1070, 1074 (Ct. Cl. 1976).
[1251] Brook Kushman, Outer Space and Intellectual Property Law: A Dispatch from the Future (Apr. 2025), https://www.brookskushman.com.

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patent rights cannot, in the absence of specific legislative measures, extend to inventions that may have been created and utilized in outer space.

This jurisdictional vacuum is not merely theoretical. It creates concrete problems for inventors and patent holders whose technologies are used in outer space. Consider the following scenario: an Indian company develops a novel satellite propulsion system and obtains a patent for it from the Indian Patent Office. A foreign company subsequently launches a satellite using an identical propulsion system. The satellite is registered in a jurisdiction that has no extradition treaty or IP enforcement mechanism with India. Can the Indian patent holder enforce their rights against the foreign company for the use of their patented technology in orbit?

Under current Indian law, the answer is almost certainly no. The Indian Patents Act, 1970 is territorially limited: it applies only to acts of making, using, selling, or importing the patented invention within India. The use of a patented propulsion system aboard a foreign-registered spacecraft in outer space does not constitute any of these acts within India, and therefore does not constitute infringement under Indian law. The Indian patent holder has no remedy against the foreign company's use of their invention in space.

This situation stands in stark contrast to the position under US law. Section 105 of Title 35 of the United States Code expressly extends US patent jurisdiction to inventions made, used, or sold in outer space on a spacecraft under the jurisdiction or control of the United States. This clause guarantees that the employment of an invention covered by an American patent onboard an American space vehicle qualifies as patent infringement in America irrespective of the place where the activity takes place..

The 'Flag of Convenience' issue in Space Law

The flags of convenience issue is one of the most significant challenge to an effective implementation of space patent enforcement. In maritime law, it is a recognized practice for registering ships in Nations with relatively lenient regulations— so-called 'open registries' such as Panama, Liberia, and the Marshall Islands — has long been recognised as a potential avenue for avoiding the more stringent labour conditions, safety measures, and environmental standards of the ship owner's home state. The same logic applies to space law with potentially even greater force.

According to Registration Convention, a state may register a space object irrespective of whether an object is owned or operated by an entity which has no substantive connection to that state. In this way a space operator seeking to escape the patent laws of a country with a solid intellectual property protection regime could, in theory, register their spacecraft in a state that has no domestic patent law applicable to space activities, or that has no bilateral IP enforcement arrangement with the state whose patents they wish to avoid. By doing so, this would effectively place their spacecraft beyond the reach of the patent holder's enforcement mechanisms.

The flags of convenience is further exacerbated by the fact that the Registration Convention does not set any minimum requirements for national space registry and does not demand that registering states have any connection to the space object being registered, and creates no mechanism for challenging the validity of the registration. The result is that, the registration of a space object in a convenient jurisdiction provides a relatively straightforward mechanism to evade Intellectual Property liability.

This problem affects India in a dual role as it is vulnerable to both the patent holder and a licensee of a patent. As India's space sector grows and Indian companies develop valuable patented technologies, the risk of foreign operators registering their spacecraft in lenient jurisdictions to avoid Indian patent law will increase. Likewise, Indian space operators could themselves be tempted to register their

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spacecraft in jurisdictions outside India to evade compliance with any intellectual property obligations that India may impose in future through a space activities law.

Addressing the solution to the flags of convenience issue requires the following strategies: legislative extension of patent jurisdiction to cover Indian-registered space objects, bilateral and multilateral agreements on IP enforcement in space, and international advocacy through WIPO and COPUOS for the formulation of minimum standards for space objects registration that include IP-related obligations.

Inventions Made in Outer Space: Where is the Locus?

A second major jurisdictional challenge is the question of where an invention is legally made when the physical act of invention takes place in outer space. Under most national patent laws — including India's Patents Act, 1970 — the relevant criterion for jurisdictional purposes is where the invention is made. In the terrestrial context, this is generally a straightforward factual question: the invention is made in the country where the inventive activity takes place.

In the space context, however, the question becomes enormously complex. An astronaut aboard the proposed Bharatiya Antariksh Station (BAS), developing a new process for manufacturing a pharmaceutical compound in microgravity, has made an invention in outer space — a domain over which India has no sovereign territory. Under the strict territorial principle, this invention would appear to have been made nowhere that is subject to Indian patent law. The inventor could not file a patent application in India, because the invention was not made in India. They could not rely on the OST to extend Indian jurisdiction to the BAS, because the OST does not itself create such an extension — it merely permits India to legislate for it.

The situation is further complicated by the international character of many space missions. When a team of Indian, American, Japanese, and German scientists collaboratively develop an invention aboard a multinational space station, each working on different components from modules registered with their respective states, the question of where the invention was made — and therefore which state's patent law applies — may be genuinely unanswerable under existing legal frameworks. The invention may have been made simultaneously in multiple 'territories,' giving rise to overlapping and potentially conflicting claims of patent ownership under the laws of multiple states.

The ISS IGA partially addresses this problem by providing that for IP purposes, activities in a flight element are deemed to have taken place in the jurisdiction of the state responsible for that element. However, in the case of inventions that emerge from collaborative work across multiple modules, the IGA provides for the application of the first-to-file principle: the partner state in whose element the invention is deemed to have been completed will be the state whose law governs. For more complicated collaborative inventions, according to IGA there will be bilateral negotiations between the affected partner states. This solution can be easily made within the structured framework of the ISS, but would not be easily adapted into a less organised and commercially driven environment of the emerging commercial space station economy.

Multi-Jurisdiction Infringement in Space Operations

In terms of Patent infringement in the context of space it frequently involves activities that span multiple jurisdictions, creating challenges not only for the identification of the applicable law but also for the practical enforcement of patent rights. As a general practice within commercial space operations the following process takes place: the invention is made in one country; the patent is filed in a second country; the satellite incorporating a new patented technology is manufactured in a third country; the satellite launch is from a

fourth country; the satellite operating in orbit, registered in a fifth country; and the satellite offers services to users in a sixth country.

Each of these steps could potentially constitute a relevant act under patent law — making, selling, using, or importing the patented invention — and each step occurs in a different jurisdiction with its own patent law and enforcement mechanisms. The patent holder who seeks to enforce their rights against a competitor who has replicated their patented satellite technology in this multi-jurisdictional scenario faces an almost insuperable enforcement challenge: they would need to bring separate infringement actions in each relevant jurisdiction, applying different national laws, navigating different procedural systems, and potentially obtaining inconsistent outcomes.

India's position in this landscape is doubly vulnerable. As a country that is increasingly both a consumer and a producer of space technology, Indian companies face the dual risk of being infringed in overseas jurisdictions (where they may lack the resources or legal expertise to enforce their patents) and of infringing foreign patents in their domestic and space-based operations (creating exposure to infringement actions in multiple overseas jurisdictions).

The Kármán Line and Patent Jurisdiction

The Kármán Line — the internationally recognised boundary between Earth's atmosphere and outer space, set at an altitude of 100 kilometres above mean sea level — has potential significance for the question of where the territorial jurisdiction of national patent laws ends and the jurisdictional vacuum of outer space begins. If a spacecraft carrying a patented technology ascends through the 100 km altitude, does the use of the patented technology cease to be subject to the patent laws of the launching state at the moment the spacecraft crosses the Kármán Line?

In strict doctrinal terms, the answer would appear to be yes: once a spacecraft crosses the Kármán Line, it enters outer space — a domain that is not the sovereign territory of any state and over which no state's territorial patent jurisdiction extends, absent a specific legislative extension such as Section 105 of the US Code. In practice, however, such a rigid interpretation would lead to absurd results: a company that manufactures a satellite in India, incorporating a patented Indian technology, and launches it into orbit would effectively become free of Indian patent liability for the use of that technology from the moment of launch. This cannot have been the legislative intent of the Patents Act, 1970, which was enacted in 1970 — before India had any significant independent space launch capability.

The more appropriate interpretation, supported by the general principle of purposive construction and the teleological approach to statutory interpretation that Indian courts have adopted in the IP context, would be that the Patents Act, 1970 does not extend to outer space but that the act of manufacturing a satellite in India for use in space constitutes infringement of the relevant Indian patent at the point of manufacture. The act of using the patent in space — which would not constitute infringement in India — remains an enforcement gap that can only be definitively closed by legislative action.

Conclusion:-

Therefore, this Paper analyses and points out the existing framework of patent law and its limitations to address inventions created or used in outer space and the core conflict between the principle of territorial nature of patent rights and the non-appropriation principle under international space law, resulting in a jurisdictional gap that affects ownership, protection, and enforcement of space-related inventions. In India, this gap is further widened by the absence of explicit provisions under the Patents Act, 1970 and the lack of a dedicated legal regime governing space inventions.

The above analysis infers that issues such as determination of jurisdiction, conflict of laws in multinational missions, patentability in microgravity environments, and enforcement of rights in orbit remain unresolved under present legal regime and further comparative study indicate that deemed territoriality and space-specific legislative extensions offer workable solutions and further to address these challenges, India requires targeted legal reforms, including statutory recognition of space-based inventions, extension of patent jurisdiction to Indian-registered space objects, and development of a comprehensive space activities legislation to ensure clarity, certainty, and effective protection of space based innovation.

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