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IP IN OUTER SPACE: CHALLENGES RELATED TO OWNERSHIP OF INVENTIONS AND DATA ARISING FROM JOINT AND INTERNATIONAL SPACE MISSIONS

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I. ABSTRACT

The 21st century has witnessed an explosion of state and private actors in space with enormous possibilities for discovery and innovation. While on Earth, there are substantial systems of safeguarding intellectual property (IP), most IP systems are territorial, thus their applicability in outer space is a delicate subject. On a second, the emergence of greater international cooperation on missions also increases issues of joint ownership, and the joint launch, operation and maintenance of space assets between two or more states. This paper addresses the existing content of space law and its implications as it affects the protection of inventions made in space. It examines the unresolved issues of invention and data ownership in joint ventures such as the International Space Station, the Artemis Accords framework, and other international programs. It examines instruments such as the Outer Space Treaty (1967), the Liability Convention (1972), and the ISS Intergovernmental Agreement to determine their weaknesses when it comes to dealing with IP issues. The paper concludes that the existing regime is insufficient to deal with inventions made in space and suggests that existing treaties should be amended to specifically include space-made inventions.

II. KEYWORD

Outer Space Law, Intellectual Property Rights, Joint Space Missions, Data Ownership, Space Commercialization.

III. INTRODUCTION

Since the creation of space law, it has been an impressive development in learning and understanding the space environment. While space exploration activities were dominated by government entities, the private sector is now making strides in the same area, as communication industry in satellites, remote sensing, space

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manufacturing, direct broadcasting, space vehicle etc are commercially viable industries with the revolution in protecting and Intellectual Property Rights in outer space is a global issue.

Intellectual property rights are important for encouraging innovation and providing inventors and organizations recognition and rewards for their invention, but because intellectual property protection systems are territorial, based on the jurisdiction of a specific state, and outer space is global common of international law, not claimed by states. This basic distinction introduces an inherent conflict between the policy objectives of space law and intellectual property law.

As space exploration among international corporations grows, the rivalry increases. The International Space Station, joint missions such as NASA ESA Jaxa roscosmos projects, Artemis Accords, and partnerships such as chandrayaan (India) have blurred the traditional legal boundaries. These joint ventures encompass the participation of a number of national and private actors with the provision of technology and human expertise to accomplish the joint mission environment. Identifying ownership of an invention made abroad, sharing spacecraft, control over the data produced by a satellite orbiting the globe, all these are part of a legal world that we are just beginning to grapple with that is largely theoretical - and the need to resolve these caps is only now becoming clear.

Private companies like space X blue origin PC have stepped in and competition and commercial interest in space technology has grown. Development of satellite system, exploration vehicles for the interplay with the moon and even space mining projects have created material and valuable assets and data that leads to questions on ownership and licensing. Without proper legal direction, frequent disputes over inventions, access to common data and technology transfer can impede scientific advancement and international collaboration.

The development of intellectual property rights in space is necessary for the continued involvement of private citizens and for the ability to unlock the maximum commercial potential of space. Space law is comprised of international treaties, conventions, resolutions from the UN General Assembly and decisions of

international organizations. The United Nations Office for Outer Space Affairs (UNOOSA) has a key role in promoting cooperation among Nations for the peaceful exploration and use of outer space.

A. Research Objectives

1. To describe the applicability of existing international and national IP legislation on inventions in outer space.
2. Determining issues of ownership, access and IP enforcement of joint and multinational space missions.
3. To offer legal and policy model(s) for the compatibility of space law and intellectual property protection.

B. Research Questions

1. What do existing treaties and national laws say about the IP ownership in outer space?
2. What are the primary issues confronting ownership in joint missions?
3. How can international cooperation be organized in a way that strikes the right balance between innovation, business interests, and benefit-sharing?

C. Hypothesis

Current intellectual property regulations are insufficient for regulating ownership and protection of inventions in outer space, especially for the purpose of joint and international missions.

D. Methodology

This research is doctrinal legal, which is to analyze international treaties such as the outer space treaty (1967), liability convention (1972), moon agreement (1979), etc., intergovernmental agreements such as the ISS intergovernmental agreement, Artemis Accords, etc., national IP legislation. Secondary sources include scholarly articles, legal commentaries, as well as reports from organizations like WIPO and UNCOPUOS. A comparative analysis is used to outline gaps, conflicts and emerging challenges around IP and data ownership during multinational space missions.

IV. INTERNATIONAL LEGAL SYSTEM OF SPACE AND INTELLECTUAL PROPERTY

External space tasks are governed by a collection of Indian nationwide treaties, which are the basis for all activities in outer space but provide little direction on intellectual property possession.

A. Outer Space Treaty 1967

The basic conventions and rules regulating the actions of states in outer space including the moon and other celestial bodies were first laid down in 1967. Such equipment was intended to facilitate national exploration and research and ensure that such activities benefit all nations and to consider outer space as a resource to be used for the benefit of all humankind. This mutually beneficial approach extends to subsequent treaties.

The United Nations Outer Space Treaty (1967) regulates state sovereignty and jurisdiction over objects and human beings in space (Article 8), but it contains few guidelines for property rights or territorial control. Though it prohibits national appropriation of outer space by claims of sovereignty, it can be argued that its framework can be interpreted to include the protection of intellectual property and trademarks. These gaps have been addressed by several countries including Australia, Brazil, Canada, France, Nigeria, Russia, United Kingdom and the United States.

B. Major treaties and conventions:

1. The Rescue Agreement (1968)

- Extends the Outer Space Treaty by making states responsible for helping astronauts in distress and getting them home safely.
- Requires the return of space objects which touch down on territory of a State to the launching State while strengthening international cooperation and human rights.

2. Convention on Space Liability (1972)

- Sets up liability rules for space object related damage.
- States launching into space impose absolute liability on Earth and airspace damage and impose fault liability on damage in outer space.
- Ensures diplomatic and arbitral procedures for claims for accountability.

3. The Moon Agreement (1979)

- Also declares the moon and other celestial bodies to be the common heritage of mankind and freed from national appropriation.
- The Declaration sees exploration and exploitation of outer space resources for the benefit of mankind as a global venture under international law including the safeguarding of the environment and prevention of contamination of outer space.
- It has only been ratified by a limited number of countries, which has limited its impact on the broader field of space law.

4. The Convention on the Registration of Industrial Designs (1975)

- Requires states to report to UNOOSA (launching state, designation, launch date/location, orbital parameters, and function) on launched space objects.
- Improves transparency, accountability and object identification.

5. International Space Station Inter-Governmental Agreement (1998)

- Signed by 15 ISS participating governments.
- Expands national jurisdiction to ISS modules, thus essentially forming national enclaves on the ISS.
- Article 21 is mentioned to specifically include protection for IPs (patents, trade secrets, marking procedures, etc.); however, the jurisdiction is based on the location of the IP-related activity (flight element/module of a partner involved in the flight).

6. Artemis Accords (2020)

- The establishment of a set of principles and best practices for civil space exploration and use by civil space agencies that have signed the Declaration.
- This applies to operations on or around the moon, Mars, comets and asteroids, including subsurface operations and orbital operations.
- Implementation is done by mission planning and contracting between involved entities.

C. Space-related international instruments for IP:

1. **Paris Convention (1883):** which sets the standard for national treatment and priority claims between countries; this does not directly address inventions created in space.
2. **Patent Cooperation Treaty (1970):** Allows for the filing of multiple patents; application to space is based on the location of the invention within the jurisdiction of a contracting state.
3. **TRIPS Agreement (1994):** Provides for minimum standards for IP protection and enforcement for WTO members; does not apply to outer space but does cover commercialization of inventions made in outer space on Earth-based Earth.

V. INTERNATIONAL COMPARISON OF STRATEGIES

However, due to the scarcity of guidance on the ownership and jurisdiction of space-made inventions under international treaties, the regulation of IP in outer space is still based mostly on national legislation. Under Article 2 of the Registration Convention, the launching state maintains jurisdiction and control over registered space objects, which means that IP generated on board the space objects is the law of the state registering them that applies. As joint and private operations increase, national regimes also vary in accordance with legal traditions, technical capability, and economic objectives.

A. United States

US Pat. S 105 indicates that inventions "made, used, or sold" in outer space on a space-related object of U.S. jurisdiction are considered to be made within the territory of the United States, which extends U.S. patent law to U.S. registered spacecraft (e.g. NASA, SpaceX).

Moreover, the U.S. Commercial Space Launch Competitiveness Act (2015) acknowledges the private rights of space resources that are mined by U.S. entities.

Under NASA regulations (14 C.F.R. Part 1245) the contractors may retain the ownership of the invention while NASA acquires a nonexclusive, royalty-free license for the use of the invention for governmental purposes.

Taken together, these measures advance U.S. IP jurisprudence into space and promote private development.

B. European Union/ESA

Article XIII of the ESA (1975) gives the originating contractor/member state IP rights of ESA activities and ESA continues to hold a license for internal use.

ESA's 2012 IP Policy ensures that inventions by contractors are protected and can be licensed for industrial exploitation and technology transfer.

Large multi-state projects (e.g. Galileo) deal with IP/data by means of special intergovernmental agreements which set the conditions for distribution and commercialization.

The ISS IGA (1998) specifies that activities carried out in a registered module of a partner state are subject to the rules of that state's regime and therefore this model is clearly exploitive and fragmented within the member national patent regimes.

C. India

As a result, India's outer space intellectual property legislation is in its developing phase. The patent act 1970 is only applicable in national territories and does not extend to inventions that are made in outer space. Keeping this limitation in mind, the draft space activities bill 2017 proposes the licensing regime for private entities

and that the intellectual property created abroad and the Indian created registered space object shall vest with the central government subject to licensing norms. But although the bill is still in the process of being enacted, it is a step towards establishing a comprehensive framework covering issues of ownership, liability and benefit sharing. The Indian Space Research organization has a policy for technology transfer and innovation which is soliciting private industries to innovate and opting for either joint ownership or licensing agreement that will ensure the space derived technologies are benefiting the common good. India's approach can thus be described as public led with evolving balance between the governmental control and increasing private participation.

D. Japan

Japan: The hybrid regime of public control and private enterprises Public Patent Act 1959 Patents within Japan Space Launch Act 2008 Extends Japanese jurisdiction to register space vehicles JAXA Intellectual Property Policy (2020) Inventions made on a JAXA project jointly owned by contractors and JAXA (JAXA has royalty-free rights for research and government use) This two ownership model promotes technology diffusion and collaboration in a manner consistent with Japan's general penchant for innovation in the form of public private partnerships. Thus, the Japanese system provides a balanced model of space IPR regulation, which allows for both industrial use and public benefit.

E. IPR and its issues in space

Because IP rights are territorial in nature, the jurisdiction of a state is necessary to guarantee the protection of such rights. This poses problems for IP to be applied to space activities. For protection purposes, activities can be classified as:

- Commercial operations in outer space, including on the moon and other celestial bodies.
- Operations performed on a space vehicle or space object.
- Outer space activities but conducted in the territorial jurisdiction of a state.

Some of the above activities may be subject to domestic IP laws for the state or by multilateral treaties. A shared international legal system is particularly needed for activities which take place outside any state's jurisdiction.

Sovereignty, liability, intellectual property and jurisdiction issues arise from the increasingly common participation of the states and private sector in the development of common space missions, thus giving rise to the issues of ownership in the international space way.

1. **Jurisdiction vs. Ownership:** Outer space treaty Article 8 makes a distinction between registry state and actual ownership as the state from which an object is launched retains jurisdiction and control of said object, but ownership could be with another state (often a private manufacturer/commercial entity), this is a problem when registry state can control and use object versus owners right to use invention / technologies.
2. **Lack of agreed upon framework:** the international legal framework for space resources/ownership is not globally harmonized, and States and other interested parties will need to deal with divergent national laws and regulatory requirements. Therefore, this made it difficult to bring com into operation and share the benefit of joint missions.
3. **Intellectual property rights issue:** territoriality of IPR regime, and therefore, lack of clarity in the joint missions about the applicable law, the right to enforce, and the dispute resolution in case the inventions are made jointly or across jurisdictions.
4. **Resource and cost-sharing:** Sharing use, benefit and cost of developed and deployed technologies, infrastructure has traditionally been a thorny issue; the ISS experience showed that resources allocation had to be negotiated, and this established a principle of "keep what you bring", but this leaves shade use areas open.
5. **Difficulty in implementation and attribution of liability:** While an agreement may be reached over ownership and rights of exploitation of outer space

resources, it is difficult to enforce such an agreement, since outer space is unique. In the case of violations of intellectual property, it may be difficult to identify infringement, gather evidence and enforce remedies. Additionally, when there are shared ownership and use of assets and activities that cause an accident or injury, liability becomes a contentious issue.

VI. CASE STUDIES

A. Stanford versus Roche 2011

In this instance, the research project was supported by the US government at Stanford University and Roche was a scientist who developed a method for measuring HIV virus. To some degree, the question of who owned the patent created conflict between Stanford and Roche. Scientists entered into an agreement with Stanford for assigning inventions. They have separate assignments and are mentioned right to Roche and the invention was developed under funded research collaboration, the legal question or issue here is who the rightful owner of the invention and does the federal funding automatically vest rights with the university, the court here held that the inventor owns the patent initially and assignment must be explicit. Cooperation in joint or multinational missions financed by one organization does not of itself give that organization ownership (unless specifically granted).

B. ISS intellectual property allocation issue IGA

In this case, the IGA between NASA and ESA Russia Japan and Canada applies to IP generated outside the ISS. each party retains title over IP generated within its flight element or by its nationals. inventions by joint teams are subject to partner agreements and national IP law, the territorial allocation principle will apply, and the invention is put to the nationality of the modules. The involved party, bilateral without joint experiment will be applied. The case offers a practical model for intellectual property ownership of multinational Space Research.

VII. CONCLUSION

In conclusion, the current architecture of international space law, which provides a solid structure for safety, cooperation, registration, and liability, only addresses the

issues of space-related inventions' IP ownership and jurisdiction in a limited manner. However, there are gaps - these include issues of shared ownership, cross-jurisdictional research and development, and data rights as shared resources - in the rapidly growing number of multinational missions and private sector engagement. The existing multilateral agreements governing space activities could be improved through targeted treaty amendments and greater harmonization via intergovernmental agreements and national legislation to maximize the protection of space-crafted inventions while fostering cooperation and commercial development.

The discovery and use of outer space have spurred a period of unprecedented scientific and technological innovation, redefining the frontiers of human creativity. However these innovations develop, they do so in a legal vacuum where the lack of a coherent IP regime is a major threat to collaboration, transparency and equitable benefit sharing: the tension between proprietary technology and the principle of outer space as the "province of all mankind" is a fundamental legal and ethical challenge.

To solve the problem, the international community needs to balance the space launch treaties such as the OST and the Moon Treaty with today's IP regimes that balance innovation and inclusivity: a global legal regime establishing ownership rights over inventions made in space, resolving jurisdictional questions related to multi-national missions, and avoiding the monopolization of space-generated knowledge and resources. Such harmonization would not only ensure reasonable recognition and protection to inventors but will also ensure collective scientific advancement, transparency and mutual access to technologies derived from space.

Ultimately, outer space must be viewed as a global common, and the pursuit of knowledge must be viewed as a common endeavour of humanity in order to foster an international legal regime that ensures that outer space remains a place of peace and cooperation where innovation can flourish without the shadow of greed and self-interest.

VIII. RECOMMENDATIONS

1. Create a dedicated Space IP regime that could be supported by an International Space IP treaty that would harmonize the various terrestrial IP agreements, with respect to clarity of rights, jurisdiction, enforcement and benefit sharing mechanism for the space-based innovations.
2. Establish an international authority possibly to fall under the United Nations Office for Outer Space Affairs (UNOOSA), or the World Intellectual Property Organization (WIPO), to manage international issues relating to space intellectual property rights, settle disputes, and coordinate activities of state and private actors in space.
3. Clear rules for the distribution of intellectual property rights among the international partners in joint space mission projects are introduced to ensure transparency and fairness of ownership of inventions and technology developed jointly.
4. Encourage policies or platforms for sharing certain space technologies under licensing or open innovation model to promote broader access issues while respecting core rights in winter while balancing innovation incentives with fair sharing.
5. Space intellectual property regime should include the benefit sharing principle to ensure that benefits or advantage generated by space inventions are used to contribute to the international development rules, poverty reduction or scientific capacity development in less developed country
6. Harmonize existing national intellectual property legislation to provide uniform rule that applies to inventions created or used in space and which covers the problems caused by the extra-territorial nature of outer space activities.

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