PRIVATIZED SPACE EXPLORATION: HOW WILL INTELLECTUAL PROPERTY RIGHTS BE ENFORCED WHEN INFRINGEMENT OCCURS IN OUTER SPACE?

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I. INTRODUCTION

The "Overview Effect" - a term first coined by philosopher and space writer Frank White to describe the experiential moment when a person looks back on Earth from space and, in doing so, sees things that we all know, but don't experience: that the Earth is one system, we're all part of that system, and there is a certain unity and coherence to it all.[1] Unfortunately, the privilege of experiencing such an impressive moment remains only available to elite members of society who have the requisite financial and political support necessary to embark on a journey into the great wide open.[2] At the turn of the century, the world witnessed enormous leaps in technology, thereby vastly expanding the collective knowledge bank, and providing a window of opportunity for private and commercial actors to enter the space arena for the first time and launch the age of "space commercialization." It remains uncertain how space commercialization will change the human experience, but as hypothesized by Frank White, we can expect it to have a profound and significant impact on how we view our place in the universe.[3]

Before space commercialization and space tourism can become a reality, many important questions must be addressed regarding the application of terrestrial intellectual property laws, and to what extent additional agreements will need to be formed between participating nations in

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[1] OVERVIEW from Planetary Collective, http://www.realclearscience.com/blog/2013/02/the-overview-effect.html at 7min and 25sec of video (Frank White describing the "Overview Effect").
[2] Alexandra Wolfe, *Do You Have What It Takes to Go Into Space? (Probably)*, THE WALL STREET JOURNAL, http://www.wsj.com/articles/space-travel-for-all-1414179183.
[3] David M. Livingston, *Lunar Ethics and Space Commercialization*, SPACE FUTURE, http://www.spacefuture.com/archive/lunar_ethics_and_space_commercialization.shtml.

order to extend and honor those property rights beyond current territorial boundaries. Space technology remains one of the most advanced technical areas[4] and has been largely government owned because, due to the high cost, it was not worth the investment for the private or commercial sector.

With the recent realization of a profitable space race, space activities are expanding to the private and commercial sector. For example, as of the summer 2013, NASA granted contracts to SpaceX, Sierra Nevada Corporation, Blue Origin LLC, Boeing Company, and Orbital Sciences Corporation.[5] In addition, NASA signed its latest round of contracts with SpaceX, Orbital ATK, and Sierra Nevada to resupply the International Space Station (ISS)[6] with supplies through the year 2024.[7] The private space industry is so hot that investors, such as Google and Fidelity Investments, have committed an estimated $10 billion to it.[8] The pharmaceutical industry, one of the most profitable industries around today,[9] also has a great deal to benefit from the private space race since the testing of pharmaceuticals is vastly accelerated in the microgravity of space.[10] With this shift from public to private enterprises, the issue of intellectual property protection in the field of space activities is brought to the forefront of international negotiations

[4] Harsha Rohatgi, *Patents in the Field of Outer Space*, IIPRD BLOG – INTELLECTUAL PROPERTY DISCUSSIONS, https://iiprd.wordpress.com/2014/10/22/patents-in-the-field-of-outer-space/?utm_source=Mondaq&utm_medium=syndication&utm_campaign=View-Original.
[5] COMMENT: COMMERCIALIZING SPACE: INTELLECTUAL PROPERTY CONCERNS WITH SPACE ACT AGREEMENTS, 78 J. Air L. & Com. 651, 653 (2013).
[6] "The ISS is first and foremost a laboratory for research and technology demonstration." Michael Roberts, *Space-based Pharmaceutical Research and the 10X Innovation Solution*, AAPS BLOG IN CURRENT PERSPECTIVES, http://aapsblog.aaps.org/2014/11/13/space-based-pharmaceutical-research-and-the-10x-innovation-solution/.
[7] Loren Grush, *NASA picks SpaceX, Orbital, and Sierra Nevada to resupply the space station through 2024*, THE VERGE, http://www.theverge.com/2016/1/14/10772176/nasa-iss-resupply-contracts-sierra-nevada-spacex-orbital-atk-announced.
[8] Patrick J. Kiger, *Why the Next Few Years Will Be a Boom Time for the Private Space Race*, HOW STUFF WORKS, http://now.howstuffworks.com/2016/01/04/boom-time-private-space-race.
[9] Richard Anderson, *Pharmaceutical industry gets high on fat profits*, BBC NEWS, http://www.bbc.com/news/business-28212223.
[10] Roberts, *supra* note 6.

in an effort to harmonize laws that were never designed to operate in the vacuum of space.[11] An increasing number of those privatized activities are now being "operated under international cooperation schemes, which depend on a simple, uniform, and reliable international legal framework."[12]

Governments of the world have collaborated since the 1960s on an ideal approach to grant ownership rights to inventions or discoveries made in space. However, it has been unclear to what length those intellectual property rights (IPR) would be honored and where these claims would be adjudicated if, and when, infringement occurred. Regardless, courts around the world might one day be tasked with addressing patent infringement, not on any sovereign territory, but when the infringement occurs in the vastness of space.

Resolving how terrestrial patent laws apply to space activities, especially with the entrance of privatized space travel, requires global policy and ethical considerations. In general, the importance of protecting intellectual property was first recognized in the *Paris Convention for the Protection of Industrial Property* in 1883 and the *Berne Convention for the Protection of Literary and Artistic Works* in 1886.[13] The World Intellectual Property Organization (WIPO), the administer of both said treaties, reduced the importance of providing such protection into two main reasons: One is to give "statutory expression to the moral and economic rights of creators in their creations and to the rights of the public in accessing those creations," and second, "to promote creativity and the dissemination and application of its results, and to encourage fair trade, which would contribute to economic and social development."[14] In keeping with global

[11] Rohatgi, *supra* note 4.
[12] *Id.*
[13] World Intellectual Property Organization (WIPO), UNDERSTANDING INDUSTRIAL PROPERTY 4, http://www.wipo.int/edocs/pubdocs/en/intproperty/895/wipo_pub_895.pdf.
[14] *Id.* at 4.

policy, various solutions have been proposed and implemented to achieve the ultimate goal of incentivizing individuals to innovate and disclose those innovations such that the global breadth of knowledge continues to grow.[15] Without protection, however, inventors would not reap the full benefits of their inventions and would be either less willing to focus on research and development initiatives,[16] or more likely to keep their discoveries secret to avoid the risk of "slavish copying," the act of copying another's achievement with no intentions of deviating from the original work.[17] On the other hand, it can be ethically challenging to enact large-scale solutions that provide patent protection to inventors, but that do not result in a monopolistic hindrance to countries presently unable to participate in the space race. In addition, gauging the effectiveness of any single solution proves difficult when considering the many different situations that can arise, and the many different treatises and national laws that are involved.[18]

With these considerations in mind, the fundamental legal issues that this note purports to explore are fairly straightforward. 1) To what extent can patent owners assert their property rights when infringement occurs in outer space? 2) If it appears that the current scheme is inadequate, should governments of the world consider adopting a "space patent."[19] 3) If so, what

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[15] *See* World Intellectual Property Organization (WIPO), Frequently Asked Questions: Patents, http://www.wipo.int/patents/en/faq_patents.html (Q: Why are patents useful (to society, business, individuals, etc.)? A: Patents provide incentives to and protection for individuals by offering them recognition for their creativity and the possibility of material reward for their inventions. At the same time, the obligatory publication of patents and patent applications facilitates the mutually-beneficial spread of new knowledge and accelerates innovation activities by, for example, avoiding the necessity to "re-invent the wheel").

[16] Rohatgi, *supra* note 4.

[17] Estelle Derclaye, The Legal Protection of Databases: A Comparative Analysis, pg. FN28 ("the cop[ied] product will be cheaper since the copier by definition always avoids the research and presentation costs.").

[18] *See generally*, Theodore U. Ro, *et al.*, *Patent Infringement in Outer Space in Light of 35 U.S.C. § 105: Following the White Rabbit Down the Rabbit LoopHole*, B.U.J.SCI.&TECH.L., http://www.bu.edu/law/central/jd/organizations/journals/scitech/volume172/documents/Kleiman_Web.pdf (describing various situations and laws in play with regards to extraterrestrial patent infringement).

[19] Yun Zhao, *Protection of Intellectual Property Rights in Outer Space IAC-06-E6.2.A.06*, 160 (2006), ("examining the issue of patent protection in outer space and proposing a viable regime for the protection of the so-called 'space patent'"); Bryan E. Erickson, *et al.*, Space Patents: Intellectual Property in Outer Space, Presented at the 8th Mars Society Convention,

would be the foundation for a space patent? In other words, would a space patent take into account ethical considerations by barring certain types of inventions from being patentable (e.g., inventions relating to protection of the human body in space)? 4) What would be the ideal vehicle for incorporating a space patent?

This note will serve the primary purpose of 1) discussing the current state of intellectual property protection for inventions made in outer space, 2) discussing the benefits, drawbacks and alternatives to these legal regimes, and 3) discussing the benefits and costs/drawbacks of having a space patent for providing patent owners protection of their inventions or discovers from infringers in outer space. Specifically, this note will provide an overview of the legal area of patent infringement in outer space, analyze possible solutions to the outer space infringement issue, look forward at how these solutions might be implicated in the future, and conclude with a final assessment of the issue.

II. OVERVIEW OF THE LEGAL AREA: PATENT INFRINGEMENT IN OUTER SPACE IN THE AGE OF COMMERCIAL SPACE TRAVEL

Parsing through the questions presented, inherently requires a basic understanding of both patent law and space law. Although "international patent law" and "international patents" do not exist, for purposes of this note, it is less important to understand the specific differences between each country's patent laws then it is to understand why intellectual property right (IPR) protection is granted in the first place.

A. Patent Law

https://docs.google.com/viewer?url=http%3A%2F%2Fwww.marshome.org%2Ffiles2%2FSPACE-PATENTS-MS2005.ppt.

In general, the patent system serves to incentivize the disclosure of the technical information of an invention in exchange for a limited period where the inventor may prohibit others from practicing the invention without permission from the patent holder. The requirements for receiving a patent vary widely across the globe, but generally protection is granted for an invention that is new, inventive (i.e., not obvious), useful, and falls into a category of subject matter that patent protection is extended.[20] Most nations set forth slightly different variations of the requirements for gaining patent protection, but ultimately will offer similar forms of protection if eligible (i.e., exclusive rights).[21] The exclusive rights vary by jurisdiction, such as, the ability to extend the typical patent term. For example, the exclusive rights for an invention covered by a U.S. patent provide protection to its owner for a period of twenty years from the date the patent application was filed with the ability to extend in circumstances where there is administrative delay in granting the patent.[22] Conversely, countries such as Denmark, France, and Germany allow the twenty year patent term to be extended by issuance of a supplementary protection certificate (SPC).[23]

In the United States, if there is a valid patent on an invention and you reproduce that invention without permission from the owner, you have committed infringement.[24] However, this is where the first point of contention crops up: the patent can only be enforced in a jurisdiction where the infringement occurred and only if a patent was granted in that

[20] *Protecting Intellectual Property Rights Abroad: Resources for U.S. Exporters*, EXPORT.GOV HELPING U.S. COMPANIES EXPORT, http://www.export.gov/regulation/eg_main_018818.asp.
[21] *Id.*
[22] *Patent protection and data and marketing exclusivity*, PRACTICAL LAW, http://us.practicallaw.com/2-517-4541 (providing a table summarizing patent protection in various jurisdictions).
[23] *Id.*
[24] DIY Space Exploration, *12 Things You Need to Know About Patents and DIY Space*, http://www.diyspaceexploration.com/12thingsaboutpatents/.

jurisdiction.[25] Therefore, a patent will not be enforceable in a country where an accused infringer lives, if a patent application was not filed in that country.[26] For example, if an inventor chooses to file for patent protection in the United States and China, then the inventor may only enforce that intellectual property right in those two countries.[27] If an alleged infringement action occurs in any other country, the inventor will have no other recourse by choosing to only file in another country.[28] The strategy involved with deciding which jurisdiction to file is often a complicated one and requires an understanding of, for example, the different markets in the different areas of the world, familiarity with different country's economies, and which countries have main ports of entry.[29]

In 1970, the International Patent Cooperation Treaty (PCT) was concluded as a response to the desire of patent owners to assert ownership rights in countries other than their own,[30] and since then, 148 countries have adopted and ratified the PCT.[31] The PCT provides a unified procedure for filing patent applications in any one of the contracting states and provided vast reform for the way in which patent owners choose which jurisdiction they wish to claim protection.[32] The patent application is still subject to the eligibility requirements of that particular jurisdiction, but with the PCT, a patentee can choose where they want to submit their

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[25] Protecting Intellectual Property Rights, *supra* note 20.
[26] *Id.*
[27] *Id.*
[28] *Id.*
[29] Donal O'Connell, *International or Foreign Patent Filing Strategies*, IPEG IN PATENT MANAGEMENT, http://www.ipeg.com/international-or-foreign-patent-filing-strategies/; Port of entry is a place where one may lawfully enter a country and may encompass an area that includes several border crossings, as well as some air and sea ports. https://en.wikipedia.org/wiki/Port_of_entry.
[30] Patent Cooperation Treaty, June 19, 1970, http://www.wipo.int/export/sites/www/pct/en/texts/pdf/pct.pdf.
[31] World Intellectual Property Organization (WIPO), *The PCT now has 148 Contracting States*, http://www.wipo.int/pct/en/pct_contracting_states.html.
[32] Michael A. Leonard II, *Patent Cooperation Treaty Overview*, FOUND PERSUASIVE, http://www.foundpersuasive.com/PCT_overview.aspx.

application by designating that country in the PCT application and by paying the applicable fees.[33]

The International Trade Commission (ITC) has recently become a popular venue where many foreign companies are sued for patent infringement in the United States.[34] The ITC, located in Washington D.C., has jurisdiction to grant exclusion orders, thereby excluding an infringing product from entering the United States, but does not have jurisdiction to award monetary damages.[35]

Along that same vein, the European Union member states saw an opportunity to make the filing of patents even easier by proposing a "unitary patent," which will protect inventions in 25 countries.[36] The European unitary patent will be a European patent granted by the European Patent Office (EPO) under the provisions of the European Patent Convention to which unitary effect is given at the patentee's request for enforcement in all contracting states.[37] Therefore, a patentee would only need to file a single unitary patent application with the EPO in order to receive protection in all states without having to enter into prosecution with each individual country's patent office.[38] In a separate but related proposal, the EU states are in the process of establishing a Unified Patent Court (UPC),[39] which will be a single patent court covering, with

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[33] *PCT Fees in US Dollars (effective 1 April 2016)*, UNITED STATES PATENT AND TRADEMARK OFFICE, http://www.uspto.gov/patents-getting-started/international-protection/patent-cooperation-treaty/pct-fees-us-dollars.
[34] Anthony J. Fitzpatrick, *Winning Patent Cases in a Challenging Legal Environment*, LITIGATION STRATEGIES FOR INTELLECTUAL PROPERTY CASES in INSIDE THE MINDS, http://www.duanemorris.com/articles/static/fitzpatrick_winning_patent_cases.pdf.
[35] *Id.*
[36] European Patent Office, *Unitary patent: Protecting inventions in 26 countries*, http://www.epo.org/news-issues/issues/unitary-patent.html.
[37] *Id.*
[38] *Id.*
[39] *Unified Patent Court*, WIKIPEDIA THE FREE ENCYCLOPEDIA, https://en.wikipedia.org/wiki/Unified_Patent_Court; Agreement on a Unified Patent Court, https://www.unified-patent-court.org/sites/default/files/upc-agreement.pdf.

the exception of Italy and Spain, 25 EU member states.[40] The UPC has yet to enter into force due to political frustrations in the negotiation process,[41] but is scheduled to start hearing cases in early 2017.[42] The UPC would serve as a central point for bringing patent infringement suits rather than having to litigate in each individual country where the patentee believes infringement has occurred.

The PCT and the unitary patent both attempt to move towards patent harmonization, which will greatly reduce the cost of obtaining a patent and subsequent litigation. Another example of patent harmonization is the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS),[43] an international agreement administered by the World Trade Organization (WTO), which sets down minimum standards for many forms of intellectual property (IP) regulations as applied to nationals of other WTO Members.[44]

B. Space Law

Unlike patent law, space law inherently invokes principles of international law and relies on international agreements in order to function. Most countries have international agreements/treaties in place between other countries with regards to what law should apply in outer space.[45] These treaties often concern various aspects of international policy including the non-appropriation of celestial bodies, establishing military bases in space, the testing of weapons

[40] European Patent Office, *supra* note 36.
[41] Joff Wild, *Should Spain join the UPC, the country's patent attorneys would have a great deal to lose*, IAM-MEDIA, http://www.iam-media.com/Blog/Detail.aspx?g=a8bd5eef-55c4-42fd-9fc7-d27ade40a996.
[42] James Nurton, *Some Practical Questions About the UPC*, MANAGING INTELLECTUAL PROPERTY, http://www.managingip.com/Blog/3520728/Some-practical-questions-about-the-UPC.html.
[43] Agreement on Trade-Related Aspects of Intellectual Property Rights, https://www.wto.org/english/docs_e/legal_e/27-trips.pdf.
[44] Adam Isaac Hasson, *Domestic Implementation of International Obligations: The Quest for World Patent Law Harmonization*, https://www.bc.edu/content/dam/files/schools/law/lawreviews/journals/bciclr/25_2/09_TXT.htm.
[45] United Nations Office for Outer Space Affairs, *Space Law Treaties and Principles*, http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html.

in space, and debris or collisions to name a few.[46] However, the number of treaties that concern both intellectual property and outer space activities are few and far between. For example, the Outer Space Treaty,[47] formally known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Moon and Other Celestial Bodies, is the treaty that forms the basis of international space law as we know today. The treaty was opened for signature in the USA, the UK, and the Soviet Union on January 27, 1967, and entered into force on October 10, 1967.[48] As of October 2015, 103 countries are parties to the treaty, while another 89 have signed, but have not completed ratification.[49] The Outer Space Treaty reflects man's inevitable expansion into space, "an endeavor for all mankind rather than a single nation seeking to prove technological dominance."[50] As such, the Outer Space Treaty was never meant to exclude any country that wished to participate in the endeavor.[51] It was meant to allow any country, regardless of their status, the opportunity to participate in the advancement of space exploration.[52]

Finally, the International Space Station Intergovernmental Agreement (the IGA)[53] is an international treaty signed on January 29, 1998 by the 15 governments involved in the Space

[46] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty), NTI, http://www.nti.org/treaties-and-regimes/treaty-principles-governing-activities-states-exploration-and-use-outer-space-including-moon-and-other-celestial-bodies-outer-space-treaty/.
[47] National Aeronautics and Space Administration, Outer Space Treaty of 1967, http://history.nasa.gov/1967treaty.html.
[48] Outer Space Treaty, *supra* note 46.
[49] *Id.*
[50] Amy Shira Teitel, *The Outer Space Treaty Promised Peace in Space*, DISCOVERY NEWS, http://news.discovery.com/space/history-of-space/the-outer-space-treaty-promised-peaceful-exploration-of-space-131010.htm.
[51] *Id.*
[52] *Id.*
[53] European Space Agency, *International Space Station Legal Framework* (2013), http://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/International_Space_Station_legal_framework.

Station project. Article 21 of the IGA describes the various Intellectual Property provisions such as:

> [A]n invention made in or on any Space Station flight element by a person who is not its national or resident, a Partner State shall not apply its law concerning secrecy of inventions so as to prevent the filing of a patent application… in any other Partner State that provides for the protection of the secrecy of patent applications containing information that is classified or otherwise protected for national security purposes.[54]

The basic rule is that "each partner shall retain jurisdiction and control over the elements it registers and over personnel in or on the Space Station who are its nationals."[55] This means that the owners of the Space Station - the United States, Russia, the European Partner, Japan, and Canada - are legally responsible for the respective elements they provide. The European States are being treated as one homogenous entity, called the European Partner on the Space Station, but any of the European States may extend their respective national laws and regulations to the European elements, equipment, and personnel.[56] This extension of national jurisdiction determines what laws are applicable for activities occurring on a Partner's Space Station elements (e.g. European law in the European Columbus Laboratory). This legal regime recognizes the jurisdiction of the Partner State's courts and allows the application of national laws in such areas as criminal matters, liability issues, and protection of intellectual property

[54] Agreement Among the Government of Canada, Governments of the Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station [hereinafter the Intergovernmental Agreement], Article 21, ftp://ftp.hq.nasa.gov/pub/pao/reports/1998/IGA.html.
[55] *Id.* at Article 5.
[56] International Space Station Legal Framework, *supra* note 53.

rights.[57] Any conflicts of jurisdiction between the Partners may be resolved through the application of other rules and procedures already developed nationally and internationally.

Many countries recognized a need to enact their own statutes in an effort to protect their intellectual property in space. For example, in 1990 the U.S. enacted 35 U.S.C. §105,[58] pertaining to inventions in outer space. The United States Patent Act of 2003, now codified in 35 U.S.C. § 105, states that any invention made, used or sold in outer space on board a spacecraft that is under the jurisdiction or control of the United States is considered to be made, used or sold on U.S. territory, except where an international agreement has been concluded that states otherwise.[59] With this exception, United States patent law provides for itself to be superseded by an international treaty in space. In other words, that exception allows for the IGA to define what constitutes United States' territory for the purposes of the law as well as how patent rights will be assigned.[60]

Apart from the United States, several other countries have felt the need to enact its own space patent law including: Germany, who enacted law prior to the signing of IGA on the ISS to ensure that its patent law can be applied to inventions created on board a European Space Agency (ESA) registered module,[61] France,[62] and Russia,[63] although "the wording does not explicitly state that [] technology and equipment be produced in outer space, it does not rule out

[57] International Space Station Legal Framework, *supra* note 53.
[58] 35 U.S.C. § 105, Inventions in Outer Space, https://www.law.cornell.edu/uscode/text/35/105?qt-us_code_temp_noupdates=1#qt-us_code_temp_noupdates.
[59] European Space Agency, Patents and Space-Related Inventions, http://www.esa.int/About_Us/Law_at_ESA/Intellectual_Property_Rights/Patents_and_space-related_inventions.
[60] Kurt G. Hammerle & Theodore U. Ro, *The Extra-Territorial Reach of U.S. Patent Law on Space-Related Activities: Does the "International Shoe" Fit as We Reach for the Stars?*, 34 JOURNAL OF SPACE LAW 241, 266-67, http://www.spacelaw.olemiss.edu/jsl/pdfs/back-issues/jsl-34-2.pdf.
[61] Patents and Space-Related Inventions, *supra* note 59.
[62] Handbook of Space Law (edited by Frans von der Dunk) pg. 983 (2015).
[63] *Id.*, at 983.

such a possibility."[64] Italy has similar provisions in place as well.[65] For example, Article 16 of the Russian Law on Space Activities[66] provides protection of intellectual property resulting from development of space technology and equipment. Apart from these countries, the national patent laws of other countries do not contain provisions that would make national patent law applicable on board a spacecraft.[67] Regardless, for purposes of this note, the applicable treaties described herein supersede those national laws when infringement involving a plurality of countries occurs.

III. ANALYSIS

The issues identified thus far are ones in which historical practices are not entirely helpful. In other words, there are very few known infringement cases in outer space from an international perspective. However, this is primarily due to the fact that space activity has largely and solely been government owned.[68] Therefore, there has not been, until recent times, a risk of or an opportunity for infringement to occur. In the next ten years, governments of the world will need to agree on how they will adjudicate intellectual property infringement that occurs in space. This will require a wide range of collaboration and compromise by all who wish to offer an incentive for inventors and companies to invest in research and development as it pertains to space activity, and ultimately to incentivize them to apply for a patent.

Patents are valuable for many reasons and for many different groups of people. The first, and probably most obvious beneficiary of a patent, is the inventor who actually obtains a patent

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[64] Handbook of Space Law, *supra* note 62 at 983.
[65] Frans von der Dunk, *Space Law in the Age of the International Space Station* 148, 155, (2009), http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1005&context=spacelaw.
[66] Law of the Russian Federation on Space Activities, No. 5663-1, 20 August 1993, effective 6 October 1993.
[67] Patents and Space-Related Inventions, *supra* note 59.
[68] *See* COMMENT: FAILURE TO LAUNCH: WHY NASA'S UNCHECKED USE OF OTA POWER MAY ONE DAY DOOM THE AGENCY, 40 Dayton L. Rev. 131 ("While NASA was the only provider of space transportation for the United States for decades, that is no longer the case."); *See also* Bryan Parrish, Commercializing Space: Intellectual Property Concerns with Space Act Agreements, 78 J. AIR L. & COM. 651, 688 (2013) (discussing that private space companies will become less and less dependent on NASA).

because the patent then grants the patent owner exclusive rights to enjoin others from practicing the disclosed invention.[69] On the other hand, society benefits from the patent system since, in order to obtain a patent, one must provide enough detail in the disclosure to describe how to practice the invention. In other words, the patent must enable a person of ordinary skill in the art to recreate the patented invention without any undue experimentation or without having to contact the original inventor in order to recreate the invention.[70] The system is designed to disperse valuable information among the general public so that the information can be expounded upon since practicing the invention without permission from the patentee would constitute infringement. In addition, the system works because there is a reliable legal framework for which patent infringement cases can be litigated. Without a reliable framework, inventors are more likely to maintain their intellectual property and inventions as trade secrets instead of patenting, which in turn makes the collective knowledge bank all the poorer for not containing a patent describing the invention.

The pressing issue is best illustrated by way of an example: A company receives a patent in their home country as well as in a few other countries for a new, highly-efficient solar cell. A company in a completely separate jurisdiction decides to copy and sell the device in a country where that company chose not to file. At this point in time, the patent holder has no recourse against the otherwise infringing company because they did not file for a patent in that specific country. Now assume the manufacturer chooses to sell the product to another company who plans on using the patented solar cells by fastening them to a satellite. As the infringing product

[69] 35 U.S.C. § 154(a) ("Every patent shall contain a short title of the invention and a grant to the patentee, his heirs or assigns, of the right to exclude others from making, using, offering for sale, or selling the invention…").
[70] 35 U.S.C. § 112(a); Minerals Separation Ltd. v. Hyde, 242 U.S. 261, 270 (1916).

orbits through space, it is not apparent from the Outer Space Treaty whether the patentee can assert his right and if so, where the lawsuit would take place.

A. Analogy to Maritime Law

The closest analogy to the present issue would be in the context of patent infringement with offshore drilling methods and exploration of the sea floor. In this context, the United Nations Convention of Law of the Sea of 1982[71] established a threshold distance from any given shoreline wherein the distance from the shoreline determines which country's law shall apply to the infringing action.[72] If infringement occurs within the first twelve nautical miles from a given shoreline, a coastal state is free to apply their laws.[73] The next twelve nautical miles allow for the coastal state to apply their laws only if the infringement began within the state's territory or is about to occur within the state's territory or territorial waters.[74] From twenty-four to two hundred nautical miles, known as the Exclusive Economic Zone (EEZ), the coastal nation has "sole exploitation rights over all natural resources."[75] That being said, the question of whether a patent can be infringed in this zone is less clear, and countries have dealt with this question in various ways. The United Kingdom has interpreted its own Patents Act as extending out into this area in limited fashion.[76] On the other hand, United States federal courts have declined to recognize United States patent rights within this zone.[77]

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[71] United Nations Convention on the Law of the Sea, http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.
[72] McDermott Will & Emergy, The Extent of Patent Coverage in Offshore Waters: A Comparison, http://www.lexology.com/library/detail.aspx?g=4fd8f8b9-b426-4307-abb2-6d8a24ee136c.
[73] *Id.*
[74] *Id.*
[75] *Id.*
[76] *Id.*
[77] *Id.* (*citing* WesternGeco v. Ion Geophysical Corp. et al., No. 4:09-cv1827, S.D. Tex. 2 March 2011 (stating that neither the high seas nor the EEZ of the United States can be considered US territories when determining the extent of coverage of US patent law)).

Although maritime law seems to be the closest in principle, it still proves difficult to compare patent infringement in space and patent infringement in international waters because the law is applied differently depending on the distance and the country you are nearest to. Unfortunately, having a distance metric would not be a feasible solution for infringement in space because the objects orbiting the earth are never a set distance from any given country. The distance metric becomes even less practical when taking into account the possibility of additive manufacturing (3D printing)[78] in space "establishing an on-demand machine shop in space, a critical enabling component for deep-space crewed missions and in-space manufacturing."[79] A potential infringer could simply print the patented product in space and the patent holder would have no recourse once again so long as the additive manufacturing or use did not occur in a part of the ISS registered to a country in which the patent has been granted. This example is merely for means of illustration since, although some countries have already ruled on 3D printing as it applies to patent law with varying results,[80] many countries have yet to rule on such a complicated topic.

B. Definition of Outer-Space

This alludes to the separate unresolved issue of defining outer space. As such, "no formally accepted legal definition or delimitation of outer space exists at this moment,"[81] although most international lawyers agree that "outer space generally begins at the lowest

[78] 3D printing refers to the process of making a three-dimensional object from a computer-aided design ("CAD") program file or scanning of a physical object through a 3D scanner.
[79] NASA, *3D Printing in Zero-G Technology Demonstration (3D Printing in Zero-G)*, http://www.nasa.gov/mission_pages/station/research/experiments/1115.html.
[80] *Compare* Hong Kong's Patent Ordinance (Cap. 514) where making a 3D replica of a patented article or using that article without permission of the patent owner may constitute patent infringement, *with* the United States patent law.
[81] Chukeat Noichim, *The Protection of Intellectual Property Rights in Outer Space of the EU and Thailand*, THAILAND LAW FORUM, http://www.thailawforum.com/articles/ipspacenoichim.html (proposing a suitable definition of outer space in terms of altitude).

altitude above sea level at which objects can orbit the Earth, approximately 100 km (60 mi).[82] Nevertheless, an international treaty defining where space begins, even if just in terms of distance from sea level, would be necessary in order to employ a system where patent protection can be granted for infringing space activity.

As a result of the way patent law evolved, international patents do not exist. Therefore, when inventors desire patent rights, and consequently global dissemination of valuable information, an inventor must apply for a patent in each individual country where he seeks protection. Furthermore, "[a] loophole in international space law . . . threatens to limit the patent system's ability to properly incentivize private investment in new space technologies."[83] As provided for in the IGA, national patent laws have been extended beyond national geography to apply to spacecraft or components according to which nation has jurisdiction or control over the spacecraft or component.

However, this means one nation's patent laws ends and another's begins from one component of the ISS to another.[84] This is a legal fiction especially when dealing with the European Space Agency (ESA) module on the ISS since the ESA is not a single jurisdiction and actually represents ten of its member states. This issue may be ameliorated if the EU passes their Unified Patent Court proposal.[85] The water potentially gets muddied with the introduction of commercial space stations such as the B330 Bigelow Commercial Space Station.[86]

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[82] Rohatgi, *supra* note 4.
[83] Matthew J. Kleiman, *Patent Rights and Flags of Convenience in Outer Space*, THE SPACE REVIEW, http://www.thespacereview.com/article/1772/1.
[84] Erickson, *supra* note 19.
[85] Anthony C. Tridico, *et al.*, *The Year It All Comes Together for the Unified Patent Court*, FINNEGAN ARTICLES (2015), http://www.finnegan.com/resources/articles/articlesdetail.aspx?news=2faa1876-014a-41e8-be87-a4107590e3b4.
[86] Bigelow Aerospace, *The First Private Space Habitat is Here*, http://bigelowaerospace.com/b330/ (the B330 is an expandable space habitat privately manufactured by Bigelow Aerospace).

A commercial space station, according to the IGA, will retain the jurisdiction of the country to which it is registered. This opens up the possibility of having a "flags of convenience" problem, which first became an issue in maritime law.[87] The flag of convenience problem is the practice of registering a ship in a sovereign state different from that of the actual owner.[88] Merchant ship owners used flags of convenience in order to reduce operating costs or avoid the regulations of the owner's country. A savvy space commercialization company could use this same practice in order to avoid liability. Allowing space companies to evade patents simply by using flags of convenience significantly undermines the value of issued patents.[89] This could have the adverse effect of having space companies resort to keeping their inventions as trade secrets rather than applying for a patent on the invention.

C. Chinese Law

Space law in China, an increasingly strong competitor in the field, offers further insight into the problem since China has become more involved in the protection and enforcement of intellectual property rights in recent years. China only started working on protection of intellectual property rights in the last several years and now lags behind the United States and Europe when it comes to an effective management of space-related intellectual property.[90] China, while strengthening its cooperation with other states in the protection of intellectual property, has introduced the term "space patent" into its terminology. In addition, the European

[87] Kleiman, *supra* note 83.
[88] *Id.*
[89] *Id.* (describing the patent rights and flags of convenience in outer space).
[90] Yun Zhao, National Space Law in China, An Overview of the Current Situation and Outlook for the Future at pg. 200 (2015).

Space Agency identified five categories, which could be considered eligible for protection of a "space patent."[91]

In another example, the Outer Space Ordinance is the only law in Hong Kong, which specifically deals with outer space activities, but it does not touch on protection of intellectual property rights. Therefore, the Hong Kong Patent Ordinance ("Patent Ordinance") is worth exploring for an understanding of how Hong Kong handles intellectual property as a general matter. The Patent Ordinance provides that if a person is employed to carry out scientific experiments in outer space (normally on the ISS), an invention belongs to his employer unless certain narrow exceptions apply.[92]

As of March 2013, only nine countries of the roughly 195[93] independent countries of the world possessed the ability to launch an object into lower-Earth orbit: Russia, the United States, France, Japan, China, India, Israel, Iran, and North Korea.[94] Moreover, the ISS, a microgravity laboratory, has been continuously occupied since November 2000, but during that time, only fifteen countries have sent people to the ISS in order to carry out experiments that cannot be done on Earth.[95] The results and findings of such experiments often lead to profound discoveries of which should be fully available to those on Earth. However, the way in which these types of discoveries and inventions are shared with the population at large most often come by way of a patent application. In a patent application, an inventor discloses his or her discovery, in

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[91] Zhao, *supra* note 90 at 201.
[92] Patent Protection in Outer Space, with Particular Reference to the Patent Regime in Hong Kong, 14:2 Asia Pacific L Rev 161 (2006).
[93] U.S. Department of State, *Independent States in the World*, http://www.state.gov/s/inr/rls/4250.htm; World Atlas, *How Many Countries are in the World?*, http://www.worldatlas.com/nations.htm.
[94] Jonathan O'Callaghan, *How Many Countries Have Rockets Capable of Reaching Space?*, SPACE ANSWERS, http://www.spaceanswers.com/space-exploration/how-many-countries-have-rockets-capable-of-reaching-space/.
[95] NASA, International Space Station Experiment List, http://www.nasa.gov/mission_pages/station/research/experiments/experiments_by_name.html.

exchange for certain intellectual property rights in whichever country the patent application was filed.

NASA initially said that it would own both the patents and the data related to any research on the station, a major buzz-kill for companies interested in applied research. However, in 2012, NASA relinquished its claim on patents, but reserved the rights to research data. The move didn't prove effective at spurring more research.[96] Last year, NASA asked Congress to change the law governing space research to make clear that users of the laboratory retain full rights to the results of their research. "These revisions would help to alleviate commercial stakeholders' concerns over data rights, which in turn may increase commercial utilization of the ISS," the audit notes, but no bill has been introduced to make this change, and Congressional leaders have said it will not take up space legislation until next year.[97]

There are also several ethical and moral issues at play, which are important since the matter in which the government superpowers handle this nagging issue will affect the rest of the world no matter what the outcome. For example, if certain governments decide to agree on providing protection for infringement in space, and depending on the terms of that agreement, the "fear that space benefits would remain limited to a small number of advanced, industrialized countries" will become an unacceptable reality.[98] This view was clearly echoed by U Thant who, as Secretary-General of the United Nations, submitted to the 1968 Vienna Conference on the Exploration and Peaceful Uses of Outer Space a Memorandum in which he warned participants that "the space age was increasing the gap between the developed and the

[96] Tim Fernholz, *How Patent Law and the Dysfunctional US Congress is Killing Private Space Research*, QUARTZ (2014), http://qz.com/267996/how-patent-law-and-the-dysfunctional-us-congress-is-killing-private-space-research/.
[97] *Id.*
[98] Handbook of Space Law, *supra* note 62 at 9.

developing areas at an alarming rate."[99] For example, if the agreement entails providing protection for inventions used in space, space being "a province of all mankind" according to the Outer Space Treaty, but that agreement fails to provide information disclosure to all worldly nations, that would cut directly against the reason for having a space patent and treating space as a separate jurisdiction in the first place. With this in mind, the question should be, on the one hand, centered on how to best disseminate information that involves space travel, tourism, mining and other desirable space faring activities, and on the other, how to provide the inventor of that intellectual discovery a means for receiving a return on a certainly expensive endeavor as most countries provide with terrestrial intellectual property law.[100]

A case study of one of the most famous private space organizations of our time, SpaceX, may provide more clarification into some of the deeper issues. Elon Musk, the Chief Executive Officer (CEO) and Chief Technology Officer (CTO) of SpaceX, recently came forward to shed some light as to why his company avoids filing for patents altogether.[101] It would seem to make sense to protect intellectual property that involves building complicated things like spaceships and innovating new technologies daily, but in fact, not going the patent route makes complete sense when there is no regime available for enforcing those patents once infringement occurs in outer space.[102] Elon Musk stated that they "have essentially no patents in SpaceX," and that with the "primary long-term competition [being] in China," publishing patents "would be farcical, because the Chinese would just use them as a recipe book."[103] Instead, the company has chosen to keep most of their intellectual property as trade secrets, thereby disallowing other companies

[99] Handbook of Space Law, *supra* note 62 at 9.
[100] Michio Kaku, *The Cost of Space Exploration*, (stating how space travel remains just as expensive as it was fifty years ago) http://www.forbes.com/2009/07/16/apollo-moon-landing-anniversary-opinions-contributors-cost-money.html.
[101] Kim Bhasin, *ELON MUSK: 'If We Published Patents, It Would Be Farcical,'* BUSINESS INSIDER STRATEGY, http://www.businessinsider.com/elon-musk-patents-2012-11.
[102] *Id.*
[103] *Id.*

and inventors from, as some would say, being hoisted on the shoulders of a giant. Of course, an inventor could always reverse engineer the product that is only protected by a trade secret, but again this is a less than ideal solution to the problem.

An approach to ameliorating these concerns might be to incorporate an International Space Patent in the PCT or propose a new Space Patent Treaty wherein an inventor could file for protection in outer space and enforce those rights if infringement were to occur in outer space. It is important to distinguish between intellectual property law here and other types of law (e.g., criminal law, citizenship) since there are many different legal regimes involved. It is also important to note that an International Space Patent would be different from an International Patent since some see an International Patent as "bad news for developing countries and their citizens."[104] An International Patent would, presumably, grant protection to an inventor in any country of the world no matter where he files. An International Space Patent, on the other hand, would just be responsible for granting protection for infringement occurring in outer space.

This International Space Patent would come by way of an international treaty. All member countries would need to agree on a number of issues including 1) where would claims be adjudicated; 2) who would share the cost of examination, adjudication, and maintenance; 3) what would the requirements for a "space patent" be; 4) what would the monopoly period look like; 5) how would case law be applied and what constitutes legally binding authority; and 6) how would personal jurisdiction be determined? These are all legal determinations that will need to be addressed in an international space and intellectual property law treaty before a sensible solution can be reached.

[104] GRAIN, *One Global Patent System? WIPO's Substantive Patent Law Treaty*, 2003, https://www.grain.org/article/entries/109-one-global-patent-system-wipo-s-substantive-patent-law-treaty.

The question of jurisdiction is not as straightforward as one might think. For example, in 1969, an atheist activist sued the National Aeronautics and Space Administration (NASA) after astronauts on board the Apollo 8 spacecraft read quotes from the sectarian Christian Bible while in outer space for violating the first amendment anti-establishment clause.[105] The district court ruled in favor of the government and the plaintiffs appealed.[106] Ultimately, the United States Supreme Court granted the governments motion to dismiss and dismissed the appeal for lack of jurisdiction even though the alleged first amendment violation occurred on a United States owned aircraft.[107] Now, this example is only meant to highlight the complexities of determining jurisdiction when an activity occurs in space. However, as described earlier, the use of international treaties and the enactment of various national laws have gone a long way toward answering the question of whether a terrestrial country's judicial system has jurisdiction over those activities occurring in space.

The trickier question is when one country attempts to establish jurisdiction over inventors from another country when they have not purposefully availed themselves of that country's legal system. The way in which the patent system currently operates would not, and should not, allow a foreign court to establish jurisdiction over a person who has not purposefully availed himself of that jurisdiction. In other words, if a U.S. inventor files for a Chinese and U.S. patent and then suspects someone in China of infringing that patent, a fair legal system would not be able to order that Chinese suspect into its own jurisdiction for an infringement action occurring in China. Ultimately, it would be up to a Chinese court to make that determination of 1) whether the Chinese patent is valid and 2) how enforcement proceedings should take place.

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[105] O'Hair v. Paine, 312 F.Supp. 434 (1969).
[106] *Id.*
[107] O'Hair v. Paine, 397 U.S. 531 (1970).

Since the "notion of jurisdiction finds its origins in the concept of territory, the principle of sovereign equality, and non-interference with the domestic affairs of states," nations will have to use new and innovative legal regimes in order to exert legal controls over people in space.[108] The concept of a space visa has been proposed in papers where it would serve as a way to create an internationally uniform jurisdictional regime,[109] wherein spaceports would be treated as border regions, much as airports are treated today.[110]

The only reasonable alternative is to have each individual partnering country adjudicate its own cases just as is done with terrestrial patent infringement suits. It would require many resources to first build the system, employ patent examiners[111] and judges, as well as faith in each partnering countries legal system in order to make feasible such an international space and intellectual property law regime. This should not be difficult since that is how international patent disputes are handled already.

A primary concern with the formation of this regime would be the costs involved with paying examiners, judges, maintaining databases, etc. It would be important to consider these costs and what the likelihood would be of someone finding an infringement action worth prosecuting for infringement of a patented article in space. The patented article would have to be fairly expensive to procure since (1) the cost of obtaining and thereafter maintaining a patent is fairly high, and (2) the cost of enforcing a patent via litigation is often times even higher, especially internationally.

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[108] P.J. Blount Jr., Jurisdiction in Outer Space: Challenges of Private Individuals in Space, 33 Journal of Space Law 299 (2007) http://www.researchgate.net/publication/228227432_Jurisdiction_in_Outer_Space_Challenges_of_Private_Individuals_in_Space.

[109] *Id.*

[110] *Id.*

[111] During patent prosecution, patent examiners review granted patent applications and reject patents that they believe should not have been granted in the first place.

In order to address the moral consideration presented previously, it is important to strike a balance between incentivizing innovators while avoiding unfair disadvantages to underdeveloped societies of the world. This could be done by only allowing patent protection for discoveries deemed non-essential to a country's development. For example, this could be modeled after the TRIPS agreement which provides for members to bar the patenting of inventions in order to "protect ordre (sic) public or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law."[112] For example, patents relating to new methods of growing fruits, vegetables, and meats in space could enter the public domain so that when new nations enter space, they can grow their own food without having to pay countries royalties every time a plant is grown in space or fearing an infringement action being brought against them for growing food in space. Although, a trade-related agreement may not be the best example, it could serve as an invaluable starting point.

IV. IMPLICATIONS

Despite there being a need for protecting intellectual property in outer space, the world could benefit immensely from having a common space patent that, once filed, provided a means for enforcing this property right in court. Depending on how the system were to be developed, a space patent could have the advantage of promoting uniformity in an area of law where international requirements for receiving and enforcing a patent vary widely. The proponents of a space patent could potentially agree on a set of requirements necessary to receiving protection in space by reconciling the variations that currently exist between countries that have a patent system. As it is right now, most countries grant exclusive patent rights to inventors for a limited

[112] https://www.wto.org/english/docs_e/legal_e/27-trips.pdf, Section 5, Article 27, 319, at pg. 331.

period of time in exchange for detailed public disclosure of an invention. The snag occurs when reviewing the differing requirements for receiving a patent from country to country. A space patent could further the global patent law harmonization movement by setting forth a uniform body of requirements and enforcement provisions.[113] This would have the added effect of encouraging cooperation on a global level wherein participating countries would be obliged to come to an agreement on, for example, what types of inventions are eligible for a patent.

The purpose of a patent system is to create incentives for companies to invest in new technologies, but as mentioned before, those patents only apply in the geographical territory of the nation or nations that have issued the patent. Since space lies outside the jurisdiction of any nation, certain technologies that are particularly useful in space and space exploration are consequently excluded from the investment incentives of any patent system.

An additional benefit to those countries that would want to participate is that those countries would all receive access to the filed space patent application, which contains valuable information including how the invention works. There are only so many countries that are currently engaged in space research on the ISS, so a space enforceable patent could provide an incentive for companies to disclose the fruits of their research to countries that are not yet capable of launching objects into space. Information disseminated by way of a space patent application would provide the patent owner with rights to exclude reproduction of the invention without permission. However, it would give all participating countries the opportunity to learn of the various ways in which space exploration is being done and invest in research on their own in order to receive their own space patents. This alone could be a huge economic driver since, once patent rights are secured, an inventor can license the technology to others who are willing

[113] WIPO, *Patent Law Harmonization*, http://www.wipo.int/patent-law/en/patent_law_harmonization.htm (describing the history of patent law harmonization).

to pay for the technology. As it is right now, most of the patents related to space exploration are only owned by countries currently involved in space exploration. This has the inevitable effect of leaving underdeveloped countries behind, which is not healthy to the advancement or diffusion of knowledge… the only guardian of true liberty.[114]

With these potential advantages laid out, examining the drawbacks and potential pitfalls in this type of system is necessary in assessing the feasibility of such an option. The potential drawbacks would be in ensuring investment does not stop. Entities innovate in order to get a financial return on their investment. How would they be compensated for their investments? What will incentivize developing countries to participate and not simply sit idle as other nations pour money in? One possible incentive could be the prospect of space tourism,[115] mining asteroids, settling Mars, etc. Countries have already begun competing over space resources by staking claims in extraterrestrial bodies even though the IGA prohibits this from a legal standpoint.[116] It might also be imperative to have programs in place that bring qualifying members (e.g., scientists, engineers) from any country regardless of their status.

It could prove difficult determining what the requirements would be for getting a space patent. In other words, would those requirements be more like those in the U.S. or in other countries? For example, while the laws of most countries follow the spirit of an absolute novelty system, the United States, Japan, China, Taiwan, Republic of Korea, Russia, Australia, and various countries in Europe provide various exceptions to the standard.[117] This would require a

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[114] Quote by James Madison: "The advancement and diffusion of knowledge is the only guardian of true liberty."
[115] Chris Taylor, *Space Travel is Dangerous. There Will Be No Tourists*, http://mashable.com/2014/10/31/space-tourism-danger/#Mw726INUU8qt; Leonard David, *Will Commercial Space Travel Blast Off in 2014?*, http://www.space.com/24249-commercial-space-travel-blasts-off-2014.html.
[116] National Space Law in China, *supra* note 90 at 262.
[117] Kevin J. Zilka and Dominic M. Kotab, Patent Novelty Requirements of the World and Strategic Foreign Patent Procurement Practices, http://zilkakotab.com/pdf/publication1.pdf.

concerted effort by all parties involved to reach an agreement on what the requirements for a patent would be.

Another hurdle would be in handling matters of national security. For example, export controls apply to all exports and re-exports, including deemed exports, which are disclosures, releases or discussions related to EAR or ITAR controlled technology/information/technical data inside the United States with foreign nationals.[118] Thus, disclosure of export controlled technical data/information/technology to a foreign person with whom you are collaborating on a patentable invention may first require you or your employer to obtain an export license.[119] Export control laws (ECLs) represent a comprehensive set of federal regulations that control and restrict the release of critical technologies, technical data, software code, equipment, chemical and biological materials, and other materials, information, and services to foreign nationals or foreign countries for reasons of foreign policy and national security.[120] Export of any item or technology on the U.S. Munitions List,[121] which includes all military vehicles (land, air, and sea); spacecraft (including nonmilitary); and military and space electronics, requires specific authorization from the Department of State.[122] While most patent applications are not related to technologies/information subject to ITAR or EAR controls, all originally filed U.S. patent applications are subject to the USPTO's foreign filing license program. Under the foreign filing license program, patent applications are not authorized to be filed in a foreign country until six months from the filing of the application in the U.S., unless authorized by the commissioner of

[118] Law 360, *When IP Falls Under The Export Control Regime*, http://www.law360.com/articles/511440/when-ip-falls-under-the-export-control-regime.
[119] *Id.*
[120] *Id.*
[121] The United States Munitions List (USML) is a list of articles, services, and related technology designated as defense- and space-related by the United States federal government. 22 U.S.C. 2778, 2794(7).
[122] *Export Controls and Regulatory Agencies*, SMITHSONIAN ASTROPHYSICAL OBSERVATORY, https://www.cfa.harvard.edu/spp/ec/eccontrls.html.

patents.[123] Because most space technologies are subject to export controls, it is the responsibility of companies that might export technology to be aware of the steps necessary to ensure that their operations are lawful.

This issue is difficult to reconcile and will need some additional thought. The United States has an "effective and complicated export control structure; however, different voices have come out concerning the adverse effect of the export control measures on exports."[124] For example, it has been noted that the United States cannot "engage in technology denial without suffering significant costs to its prosperity and national security."[125] The issuance of a space patent, where sensitive information would then be available to participating nations, would need to take into account the various needs present in order to foster an effective system.[126]

Without a universal system in place for protecting intellectual property in space, private companies are unlikely to invest inordinate amounts of money to research and development technology to be used in space knowing that a potential infringer could circumvent and evade suit in any number of the ways as described herein. In the end, a space patent could ameliorate these concerns and provide investors with the incentive to continue investing and developing for the benefit of all mankind. It would incentivize private companies to file for patent protection which is the ultimate goal of the patent system. In other words, the more companies are willing to teach the world how it is they arrived at their discovery, the more companies will be required to push the envelope further in order to avoid infringement. In addition, a space patent could

[123] 35 U.S.C. § 184, Filing of Application in Foreign Country, https://www.law.cornell.edu/uscode/text/35/184.
[124] National Space Law in China, *supra* note 90, at 178 (*citing* Mitchel B. Wallerstein, "Losing Controls: How U.S. Export Restrictions Jeopardize National Security and Harm Competitiveness," Foreign Affairs 88 (2009):18) (describing export controls over space products).
[125] *Id.* at 178.
[126] *Id.*

serve as a model for an international patent on Earth since, as mentioned before, an international patent does not currently exist.

V. CONCLUSION

As described in this note, the issue is to what extent patent laws apply to infringement in space in the age of private and commercial space travel. The issue is underscored by the fact that patents rights are normally confined to terrestrial bounds and have not been easily applied outside of earth-bound territories as evidenced by the inconsistent ways in which these laws have been applied to infringement suits in international waters. Since private industries have entered the realm of space exploration, governments of the world need to create a uniform patent system for space where it is clear to what extent property rights will be administered in the event of infringement.[127] Lastly, the issue of export control is an essential topic to explore in more depth but is outside the scope of this note. With the proper system in place, the dream of commercial space tourism could finally be realized, when "suddenly we look back on ourselves and it seems to imply a new kind of self-awareness," and the sky is no longer the limit for the human mind.

[127] Kleiman, *supra* note 83.