THE INTELLECTUAL SPACE RACE: APPLYING TERRESTRIAL PATENT LAWS TO PRIVATE OUTER SPACE ACTIVITY

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I. INTRODUCTION

Human exploration beyond Earth has progressed dramatically since the Wright brothers' initial public airplane flight in 1908.[1] The commercial airliner and transportation industries that operate today do so under international laws and regulations that had not been contemplated beforehand, and that are still changing all the time.[2] The laws of the time were underinclusive of air transportation of people and goods. When efficient air travel became possible, the basic assumptions about how people move from place to place—jurisdiction to jurisdiction—were transformed, and the law has been catching up ever since.[3]

The same is now true for the private commercial outer space industry.[4] Basic assumptions about the legal landscape of outer space, have bent or been broken by widespread private activity that was not initially considered. At a broad level, it has been assumed that outer space should be governed by a free and open, research promoting, and international legal regime, much like what has been used for Antarctica.[5] As technology has now advanced enough to allow unending private activity in outer space, this assumption is now at odds with the strictly national and territorial laws that have long governed private commercial activity. These national laws can vary dramatically, which can fail to effectively protect activity in outer space that the laws weren't originally designed to consider.

The protection of intellectual property in outer space is one of the fields that is directly affected by a legal landscape that has failed to consider how private commercial activity in outer space actually applies to the present

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1. *See* Tom D. Crouch, *1908: The Year the Airplane Went Public*, AIR & SPACE MAGAZINE (Aug. 28, 2008), https://www.airspacemag.com/history-of-flight/1908-the-year-the-airplane-went-public-8791602/.

2. *See A Brief History of the FAA*, FAA, https://www.faa.gov/about/history/brief_history/ (last visited Dec. 14, 2017).

3. *See id.*

4. *See generally* GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 275-419 (1997) (discussing the law of private commercial activities in outer space and potential problems going forward).

5. *See* Elizabeth Howell, *Who Owns the Moon?*, SPACE.COM (Oct. 27, 2017), https://www.space.com/33440-space-law.html.

legal regime. I will address, herein, how governments use patent systems to bolster industries; why the United States has a strong interest in bolstering its own private outer space industry; and how the current American patent regime breaks down when applied to the private commercial activity of outer space. These points, together, create the foundation for arguing that the United States should expeditiously attempt to rework the patent system to give it greater effectiveness in outer space.

II. OVERVIEW OF PATENT RIGHTS ON EARTH AND THE UNITED STATES' INTEREST IN COMMERCIAL OUTER SPACE DEVELOPMENT

A. PATENT RIGHTS ON EARTH

Codified patent rights on Earth can be found as far back as the 15th Century, in the Venetian Act of March 19, 1474.[6] This marked the first instance where a legal structure was used to intrinsically incentivize the production of artistic expression and scientific innovation, instead of relying on direct patronage by sovereigns.[7] Over the following centuries patent laws continually became more widespread,[8] and were eventually embedded in the United States Constitution as the power for Congress "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."[9] This sentiment towards patent protection has become the global norm.[10] One hundred fifty-two countries have signed the Patent Cooperation Treaty (PCT), through the World Intellectual Property Organization (WIPO), which allows an applicant to use a single patent application to begin applying for patents in any PCT signatory countries.[11] Those same countries, plus twenty-four more, are also signatories of the Paris Convention, which expresses a general commitment to fairly administering patents in each respective country.[12]

Patent systems have been adopted and recognized so widely across differing countries because there is consensus that protecting inventions for some specified period is an effective means of encouraging innovation.[13] Strengthening a country's patent regime has been shown to increase ex ante

6. L. R. Bradford, *Inventing Patents: A Story of Legal and Technical Transfer*, 118 W. VA. L. REV. 267, 268 (2015).

7. *Id.*

8. MATTHEW FISHER, FUNDAMENTALS OF PATENT LAW 27 (2007).

9. U.S. CONST. art I, § 8, cl. 8.

10. *See* WIPO, *World Intellectual Property Indicators*, 23-72 (2015), http://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2015.pdf.

11. *The PCT Now Has 152 Contracting States*, WIPO, http://www.wipo.int/pct/en/pct_contracting_states.html (last visited Dec. 13, 2017). *See also PCT FAQs*, WIPO, http://www.wipo.int/pct/en/faqs/faqs.html (last visited Dec. 13, 2017).

12. *States Bound by the Paris Convention but not the PCT*, WIPO, http://www.wipo.int/pct/en/paris_non_pct.html (last visited Dec. 13, 2017); *Summary of the Paris Convention for the Protection of Industrial Property (1883)*, WIPO, http://www.wipo.int/treaties/en/ip/paris/summary_paris.html (last visited Dec. 13, 2017).

13. *See* David Kline, *Do Patents Truly Promote Innovation?*, IPWATCHDOG (Apr. 15, 2014), http://www.ipwatchdog.com/2014/04/15/do-patents-truly-promote-innovation/id=48768/.

innovation by offering valuable incentives for companies and inventors (hereinafter, "firms") to increase research and development.[14] Furthermore, the publication requirement[15] of our global patent regime has been shown to clearly increase ex post innovation by allowing information on the cutting edge of research and technology to spread efficiently to other firms.[16] "A 2006 study by French economists Francois Leveque and Yann Meniere found that 88 percent of U.S., European, and Japanese businesses *rely* upon the information disclosed in patents to keep up with technology advances and direct their own R&D efforts."[17]

The innovation benefits that come from a strong national patent regime are generally constrained to industries that stand to benefit from research and development, and industries that could not effectively rely on secrecy alone to protect their competitive advantage.[18] A study of two late-nineteenth century World's Fairs showed that "patent laws influence the direction of innovative activity."[19] Countries without patent regimes still innovated in some respects; the innovation was primarily in industries that could rely on secrecy to give value to inventors, such as "scientific instruments, food processing, and dye stuffs. . ."[20] These fields that could rely on secrecy, though, were quickly dwarfed in value during the twentieth century by industries that required patent protection such as manufacturing,[21] and in the twenty-first century by the portable computing industry.[22] Furthermore, complying with global patent standards may not be the right choice for developing countries that could benefit more by free riding on known, published information from other countries, than they could benefit by protecting it.[23] South Africa has made clear moves to use free riding on patents as a method to increase their own access to inexpensive drugs,[24] while China and Switzerland have each publicly opted to free ride in certain industries until their own country's is robust enough to warrant switching from free riding off of other countries to protecting their own industry's innovations.[25] The United States has not openly restricted patentable subject matter for free riding purposes, but has determined that some subject matter,

14. *Id.*

15. The publication requirement is the requirement that issued patents be published for the purpose of efficiently spreading the information contained within. *See General Information Concerning Patents*, UNITED STATES PATENT AND TRADEMARK OFFICE (Oct. 2015), https://www.uspto.gov/patents-getting-started/general-information-concerning-patents.

16. Kline, *supra* note 13.

17. *Id.*

18. *See id*.

19. Petra Moser, *How Do Patent Laws Influence Innovation?*, 95 AM. ECON. REV. 1214, 1231 (2005).

20. *Id*.

21. *See id*., 1232-33,

22. *See* Kline, *supra* note 13.

23. Moser, *supra* note 19, at 1233.

24. Joseph E. Stiglitz, Dean Baker & Arjun Jayadev, *Intellectual Property for the 21st-Century Economy*, STRAITS TIMES (Nov. 14, 2017), http://www.straitstimes.com/opinion/intellectual-property-for-the-21st-century-economy.

25. ERICH KAUFER, THE ECONOMICS OF THE PATENT SYSTEM 48 (2002).

such as nuclear weapon improvements, should not be patentable within its borders.[26]

B. THE UNITED STATES' INTEREST IN COMMERCIAL OUTER SPACE DEVELOPMENT

Outer space has been on the cutting edge of human experimentation and innovation since the launch of Sputnik, by the U.S.S.R., in 1957.[27] The United States responded to that move by passing the Space Act of 1958 and founding the National Aeronautics and Space Administration (NASA),[28] which is the government agency that has been funding and managing outer space related research and exploration for the Unites States ever since—now almost 60 years.[29] Space exploration across the globe was originally pursued by governments, and not the private sector, because certain governments saw value in outer space that far exceeded the research and development costs of getting there for the first time.[30] The value that the U.S. initially pursued, and the value that remains to be seized today, was military, technological, and economic prowess over the U.S.S.R.[31]

The government itself can reap direct value from the military benefits that come with advancing the cutting edge of outer space technologies.[32] Satellite based surveillance ("spy satellites") have been in use almost as long as humans have been experimenting with objects in outer space.[33] In response, countries have been jockeying for better adversarial position in outer space, and ways to interrupt or destroy other satellites in preparation for, or in response to, war.[34] The U.S.S.R. has tested "self-detonating spacecraft that could seek and destroy U.S. spy satellites by peppering them with shrapnel."[35] Weapons developed for use on Earth also increasingly use outer space as a means of deployment.[36] The intercontinental ballistic missile (ICBM) that North Korea tested on November 29, 2017, flew to 4475 km (2800 miles) above Earth's surface;[37] that is far further than the over one thousand satellites currently in low earth orbit, including the International

26. *General Information Concerning Patents*, UNITED STATES PATENT AND TRADEMARK OFFICE (Oct. 2015), https://www.uspto.gov/patents-getting-started/general-information-concerning-patents.

27. *Sputnik and the Dawn of the Space Age*, NASA, https://history.nasa.gov/sputnik/ (last updated Oct. 10, 2007).

28. *Id*.

29. *See generally NASA History*, NASA, https://www.nasa.gov/topics/history/index.html (last visited Dec. 13, 2017).

30. *See The Space Race*, HISTORY, http://www.history.com/topics/space-race (last visited Dec. 13, 2017).

31. *Id*.

32. *See* Lee Billings, *War in Space May Be Closer Than Ever*, SCIENTIFIC AMERICAN (Aug. 10, 2015), https://www.scientificamerican.com/article/war-in-space-may-be-closer-than-ever/.

33. *Id*.

34. *Id*.

35. *Id*.

36. *See* Mike Wall, *Missile Test-Launched by North Korea Was an ICBM*, SPACE.COM (July 5, 2017), https://www.space.com/37400-north-korea-intercontinental-ballistic-missile-test.html. *See generally* GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 94-177 (1997) (discussing the international treaties related to defense).

37. James Griffiths, *North Korea Missile Launch*, CNN (Nov. 29, 2017), http://www.cnn.com/2017/11/29/asia/north-korea-missile-test/index.html.

Space Station (ISS).[38] Beyond satellites, the United States has a military interest in being the first country capable of managing a moon base, and thereafter a Mars base, as governments and firms continue to move toward making humans an interplanetary species.[39] Similar to China building and inhabiting artificial islands in the South China Sea,[40] or Russia's effort to stake influence in the Arctic Circle as global warming takes hold,[41] the United States is in a military race to inhabit space so that they may be the ones to claim and leverage their rights to outer space, or its resources, when it becomes so necessary.

The technological value that outer space research and exploration provides is hard to predict, but very easy to see in retrospect.[42] NASA, and private space companies today, generally can't predict what they will discover or invent next, but because they are researching on the cutting edge of human knowledge, their discoveries are likely to be useful in industry on the surface of Earth as well.[43] To show this, NASA has published a report called Spinoff each year since 1976.[44] Each annual issue of Spinoff highlights approximately 50 different technologies that are being used in commercial activity which can be traced back to specific NASA missions and research.[45] The inaugural 1976 issue features technologies like flat wires for homes and electronics, ultrasonic imaging to reduce the risks of checking for breast cancer, and inductorless circuits used to dramatically improve two way radios for firefighters.[46] Likewise, the 2017 issue showcases mini heat pipes that help regulate heat in brain surgeries,[47] software to model and reduce the effects of sonic booms to allow faster air travel over land,[48] and fast-flow nanofiber filters that can purify water quickly during emergencies or in impoverished areas.[49] Aside from the uses that these technologies actually have for outer space exploration and utilization, these, and countless other inventions and innovations like them, are vital to keeping the United States at the forefront of emerging technologies.[50]

38. *UCS Satellite Database*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.Wh23pyOZOOE (last updated Nov. 7, 2017).

39. Sarah Fecht, *Six Reasons NASA Should Build a Research Base on the Moon*, NAT'L GEOGRAPHIC (Dec. 21, 2013), https://news.nationalgeographic.com/news/2013/12/131220-lunar-research-base-mars-mission-science/.

40. William Pesek, *Making Sense of the South China Sea Dispute*, FORBES (Aug. 22, 2017), https://www.forbes.com/sites/outofasia/2017/08/22/making-sense-of-the-south-china-sea-dispute/#6169da731c3b.

41. *The Arctic: Russia's Plan for the World's Newest Ocean*, VOX, https://www.vox.com/a/borders/the-arctic (last visited Dec. 13, 2017).

42. *See generally* Stephen J. Dubner, *Is Space Exploration Worth the Cost?*, FREAKONOMICS (Jan. 11, 2008) http://freakonomics.com/2008/01/11/is-space-exploration-worth-the-cost-a-freakonomics-quorum/ (compiling six leading space authorities' answers to the question "Is manned space exploration worth the cost? Why or why not?").

43. *See NASA Spinoff 2017*, NASA, https://spinoff.nasa.gov/Spinoff2017/index.html (last visited Dec. 13, 2017).

44. *Id*.

45. *Id*.

46. *Spinoff 1976*, NASA (1976), https://spinoff.nasa.gov/back_issues_archives/1976.pdf.

47. *Spinoff 2017*, NASA 38 (1976), https://spinoff.nasa.gov/Spinoff2017/pdf/Spinoff2017.pdf.

48. *Id*. at 56.

49. *Id*. at 80.

50. See *NASA Spinoff 2017*, *supra* note 43.

The economic benefits to the U.S. that can come from encouraging more outer space innovation are most easily realized in mining outer space commodities and harboring a private, outer space tech boom. There are over nineteen thousand known asteroids currently classified as near earth, or potentially hazardous.[51] Over one thousand of those asteroids have "diameters roughly one kilometer and larger."[52] As the cost of rocket launches and space missions decrease even further, the raw material that makes up these asteroids will become highly valuable for mining.[53] The website Asterank estimates the costs and rewards of mining specific asteroids by compiling the most up to date research papers on the size and composition of individual asteroids, as well as the decreasing costs of space missions.[54] Sorting these asteroids by most cost effective shows the asteroid Ryugu with an estimated mining profit of over thirty billion dollars. Sorting by most valuable produces over three hundred asteroids with an estimated profit of over one hundred trillion dollars—albeit further from Earth, making it a much longer-term space mission.[55] That monstrous economic benefit, although plausible, likely won't yield reward for many years and will require a large initial investment.[56]

In the meantime, the Unites States can reap the economic benefits of being "home" to the private commercial space industry boom, as they have with the ongoing technology and internet boom of Silicon Valley.[57] As this new industry develops, firms are finding creative ways to use outer space activity to increase their profits and productivity on Earth.[58] In fact, two United States firms, Genscape and Orbital Insights, are launching hundreds of small satellites, often smaller than a gallon of milk, that constantly photograph Earth and allow them to analyze real-time changes in order to gain valuable insight that can be sold to other firms.[59] For example, the firms each analyze photos of China for oil tanks, use the shadows that they cast to measure how much oil is currently being stored, and then sell that information to firms that bet on the commodities markets.[60] Beyond that, China had only made information about five hundred of the oil tanks public, and Orbital Insights was able to find over two thousand with the help of their satellites.[61] Innovations like these are likely to continue, and being the first

51. *Discovery Statistics*, JET PROPULSION LABORATORY, https://cneos.jpl.nasa.gov/stats/totals.html (last visited Dec. 13, 2017).

52. *Id*.

53. Mark Sonter, *Asteroid Mining*, NAT'L SPACE SOC'Y (Feb. 2006), http://www.nss.org/settlement/asteroids/key.html.

54. ASTERANK, http://asterank.com (last visited, Dec. 13, 2017).

55. *Id*.

56. Sonter, *supra* note 53.

57. *See* Nick Wingfield, *The Silicon Valley of Space Start-Ups?*, N.Y. TIMES (July 29, 2016), https://www.nytimes.com/2016/08/02/science/seattle-space-flight-innovation-center.html.

58. *See* Jason Murdock, *How Satellite Surveillance is Helping to Predict Stock Prices*, NEWSWEEK (Mar. 2, 2017), www.newsweek.com/how-satellite-surveillance-helping-predict-stock-prices-skynet-562973.

59. *Id*; *SPACE 2: Wait, Why Are We Going*, *Planet Money*, NPR (Nov. 30, 2017) (downloaded using iTunes); *CubeSats Overview*, NASA, https://www.nasa.gov/mission_pages/cubesats/overview (last visited, Mar. 5, 2018).

60. Murdock, *supra* note 58; NPR, *supra* note 59.

61. Murdock, *supra* note 58.

firms to innovate in space is sure to be a lucrative business for the firms, and for the country where they are based.

C. THE UNITED STATES INTEREST IN STRENGTHENING OUTER SPACE PATENTS

Although space exploration began as a strictly government funded and directed venture, the privatization and commercialization of space activities has been slowly increasing ever since.[62] That slow growth was largely fueled by the increasing prevalence and usefulness of communication satellites across varying industries—from television, to GPS, to internet services—and the private companies needed to build and launch them.[63] The private space industry's growth has continued over the last decade as companies have made innovations in outer space technologies, and as the public interest in outer space has grown.[64] SpaceX has innovated to reduce the cost of launches by landing and reusing the boosters that initially launched the spacecraft off of the Earth's surface.[65] SpaceX, United Launch Alliance[66] (ULA), and Blue Origin are competing with one another and NASA to develop and operate "heavy" rockets, capable of launching much larger payloads deeper into outer space.[67] Virgin Galactic and Blue Origin have each developed different methods of providing short, tourist trips to outer space.[68]

These private companies, and many more on the cutting edge of outer space activities, are based in the United States.[69] The United States should want even more of the private space industry to be based at home, like the computer and technology revolution of the last fifty years, to maximize the benefits of its military, technological, and economic interests.[70] The United States should therefore ensure that intellectual property rights in outer space are well protected at home, as well as pressing for them to be well protected abroad to prevent free riding on the weak patent laws of other countries.

The current domestic and international patent landscape does not protect activities in space with much clarity or effectiveness.[71] In fact, many standard patent practices become impracticable when outer space is involved.[72] For example, it is unclear whether some patents that cover processes and methods to produce or use things without gravity pass the novelty

62. *See* EDYTHE WEEKS, OUTER SPACE DEVELOPMENT, INTERNATIONAL RELATIONS AND SPACE LAW: A METHOD FOR ELUCIDATING SEEDS 96 (2012).

63. SA'ID MOSTESHAR, RESEARCH AND INVENTION IN OUTER SPACE 59-60 (1995).

64. *See* Monica Grady, *Private Companies are Launching a New Space Race*, PHYS.ORG (Oct. 2, 2017), https://phys.org/news/2017-10-private-companies-space.html.

65. *Id*.

66. United Launch Alliance is jointly owned by Boeing and Lockheed Martin. *Id*.

67. Samantha Masunaga, *A New Generation of Giant Rockets is About to Blast Off*, L.A. TIMES (July 14, 2017), http://www.latimes.com/business/la-fi-heavy-lift-rockets-20170716-htmlstory.html.

68. Grady, *supra* note 64.

69. *See* Jennifer Alsever, *Space Startups are Booming in the Mojave Desert*, FORTUNE (Feb. 20, 2017), http://fortune.com/2017/02/20/space-startups-travel-satellites/.

70. *See id*.

71. *See* SA'ID MOSTESHAR, RESEARCH AND INVENTION IN OUTER SPACE 189 (1995).

72. *See* TOSAPORN LEEPUENGTHAM, THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES 99-100 (2017).

requirement for patents, as it is currently understood,[73] whether discovering new ways to send satellites into newly discovered orbits is patentable subject matter at all,[74] and whether infringement in outer space is enforceable infringement under the laws of any countries on Earth.[75] Most countries don't have any patent provisions that specifically address outer space, and although the United States does, it is a mere two sentences that simply have us assume that an object in space is actually "within" the country that it is registered to, and subject to that country's treaties.[76]

III. APPLYING TERRESTRIAL PATENT LAWS TO OUTER SPACE ACTIVITY

The international intellectual property regime came together before there was commercial air travel, let alone commercial outer space ventures.[77] Many issues have arisen in patent prosecution and in litigation as this new industry challenges our assumptions about how to approach the legal regime of this empty, unclaimed space.[78] Prosecution challenges include issues that may arise with applying current patentability laws to the outer space industry, as well as countries restricting outer space inventions from patentable subject matter. Litigation issues include those that make applying for intellectual property rights, or exercising them effectively, unreasonably difficult due to the nature of outer space activities and jurisdictional legal regimes. It is also important to individually address and distinguish the types of inventions that can arise in the commercial outer space industry. There are, first, patents for inventions that are initially invented for Earth that happen to also be useful in outer space; this would include a patent for a solar panel that works equivalently atop a house as it does on a satellite. Then, there are patents for inventions that can only be practiced in outer space or in a microgravity[79] environment; this includes the ISSpresso, an invention by Lavazza and the Italian Space Agency that allows espresso to be brewed in microgravity aboard the ISS, but is not more useful than any other coffee machine in use when on Earth.[80] Finally, there are patents for inventions that were made in space; as of now this is exclusively limited to inventions made by astronauts aboard the ISS, but it is very easy to imagine private space tourism companies making inventions aboard orbiting space vehicles to improve the customer experience, as well as inventions on other bodies such as the Moon, Mars, and asteroids as outer space habitation and utilization becomes reality.

73. *Id*. at 72-73.

74. *Id*. at 59-60.

75. *Id*. at 82.

76. 35 U.S.C. § 105 (2012); LEEPUENGTHAM, *supra* note 72, at 99-100.

77. *See Summary of the Paris Convention for the Protection of Industrial Property (1883)*, WIPO, http://www.wipo.int/treaties/en/ip/paris/summary_paris.html (last visited Dec. 13, 2017).

78. *See* LEEPUENGTHAM, *supra* note 72, at 56-57.

79. Microgravity is the apparent lack of gravity that is experienced in orbit around Earth. *What is Microgravity?*, NASA (March 30, 2010), https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-microgravity-k4.html.

80. *To Boldly Brew*, GUARDIAN (May 4, 2015), https://www.theguardian.com/world/2015/may/04/space-italy-coffee-astronaut-espresso-cristoforetti.

A. PROSECUTION CHALLENGES

The patent prosecution issues that arise when current patent laws are stretched into commercial outer space ventures largely revolve around which fields of space invention can be patented.[81] Space, like Antarctica, is currently under a legal regime based on International treaties, and not subject to the specific laws of any individual country.[82] Patent law, on the other hand, is strictly the opposite.[83] Patents must be applied for, and approved, in each individual country to obtain protection within its borders;[84] patent enforcement does not extend beyond the jurisdiction of any individual country;[85] and countries generally must assume that space objects are "within" the jurisdiction of the country that registered them for launch and that the actions these satellites make are actually actions made on Earth (for example, a satellite does not take an image of Earth, a controller somewhere on Earth took the photo with the satellite).[86] Assuming, by definition, that outer space objects and activities actually are within some terrestrial jurisdiction is a makeshift solution that is likely to fail as space activity continues to increase, as space activity becomes adversarial between countries, and as space colonization and mining brings up more complex property issues.[87]

The current international patent system, in general, recognizes that for something to be patentable, that thing must have novelty, an inventive step, and industrial application.[88] Novelty is the requirement that an invention be new and not currently a part of the state of the art.[89] Inventive step is the requirement that a person skilled in the art would not consider the innovation to be an obvious improvement over the state of the art.[90] Industrial application is the requirement that the invention have some practical use.[91] In simpler terms, an invention must be new, non-obvious, and useful in order to be patentable. Individual countries' laws can then make further distinctions about what is patentable beyond this baseline, such as restricting entire industries of invention from patentability.[92] What patentability issues arise, though, with the different classes of commercial outer space inventions and innovations?

81. *See* LEEPUENGTHAM, *supra* note 72, at 59.

82. GLENN H. REYNOLDS & ROBERT P. MERGES, OUTER SPACE: PROBLEMS OF LAW AND POLICY 25-27 (1997).

83. DR. I. H. PH. DIEDERIKS-VERSCHOOR & DR. V. KOPAL, AN INTRODUCTION TO SPACE LAW 112-13 (2008).

84. *Frequently Asked Questions: Patents*, WIPO, http://www.wipo.int/patents/en/faq_patents.html (last visited Dec. 13, 2017).

85. *Id*.

86. SA'ID MOSTESHAR, RESEARCH AND INVENTION IN OUTER SPACE 189-190 (1995).

87. *See* REYNOLDS, *supra* note 4, at 343-55.

88. TOSAPORN LEEPUENGTHAM, THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES 64 (2017).

89. *Id*. at 65.

90. *Id*. at 74.

91. *Id*. at 77.

92. *See id*. at 57-59.

1. Earthly Inventions Used in Outer Space

Inventions made on Earth that happen to be useful in outer space, such as the solar panel example used herein, are not likely to experience issues of novelty because they should meet the novelty requirement based on their terrestrial features and uses alone. If the build and mechanism of the solar panel is not currently a part of the state of art, and works the same in space as it does on Earth, then the solar panel should be considered novel all the same. A patent applicant should not fail novelty for the build and composition of this new solar panel, and any claims that are awarded for Earth should cause infringement, assuming there is jurisdiction, in outer space by those attempting to make, use, or sell the solar panels in outer space.[93] For an example this simple, the same should be true for the inventive step and industrial application. An invention's patentability does not change if the invention is used in outer space, because the invention itself is patentable without addressing outer space. As long as outer space activity could actually infringe on the claims in some way, there is no issue with attempting to exert their validity in outer space. This is particularly convenient because patents have a term of twenty years, which is more than enough time for there to be millions of currently patented inventions that could prove useful for outer space commercial activity at any point, and those patent holding firms may be able to use or license those patents for such future application.[94] The same is true for patented processes, where a patent is issued for an innovative method or process of producing or using something.[95] If the invented method of doing something does not require a different process when applied in outer space, then the patent obtained for Earth could be useful if the process finds a use in commercial outer space activity during the patent term. Process patents don't intrinsically cause issues with patentability because the only thing that changes is the location in which future infringement may be occurring, so none of our assumptions about what is patentable are broken, and only litigation concerns about where a country's patents give jurisdiction are implicated. This class of inventions is highly restrictive, and acts as a good baseline for the following two examples.

2. Inventions Only Made Effective in Outer Space

What, then, if the invented object or process for which we are applying can only be used in outer space activity? This category of invention begins with the example of ISSpresso, which brews espresso in microgravity environments,[96] but extends to include all physical objects and patentable processes that can only be reasonably used in outer space. One large class of

93. *See General Information Concerning Patents*, U.S. PAT. & TRADEMARK OFF. (Oct. 2015), https://www.uspto.gov/patents-getting-started/general-information-concerning-patents.

94. *See* Dennis Crouch, *How Many US Patents are In-Force?*, PATENTLYO (May 4, 2012) https://patentlyo.com/patent/2012/05/how-many-us-patents-are-in-force.html.

95. *Nonprovisional (Utility) Patent Application Filing Guide*, U.S. PAT. & TRADEMARK OFF. (Jan. 2014), https://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applications/nonprovisional-utility-patent.

96. *To Boldly Brew*, GUARDIAN (May 4, 2015), https://www.theguardian.com/world/2015/may/04/space-italy-coffee-astronaut-espresso-cristoforetti.

these inventions are those that are outer space specific solely because of their effectiveness in a microgravity environment. This includes the aforementioned ISSpresso, as well as a method for producing higher purity pharmaceutical products in microgravity environments and the build of a rocket thruster that would explode if fired from within the gravity and atmosphere of Earth.

This class of inventive activity for use in outer space is currently the most common, likely because earthly amenities adapted for the habitation of space are the low hanging fruit of commercial space utilization and exploration.[97] It is clear that some of these inventions can become valid patents, because in 2012 there were over eight hundred granted patents from the prior thirty years that use the term *microgravity*, and over five hundred applications from the prior decade.[98] These types of inventions raise the novelty issue of what amount of innovation must occur before earthly inventions can become separate space inventions (e.g., how much innovation has to go into the ISSpresso before it is patentable over the prior art of any terrestrial espresso machines)?[99]

The mere use of a known invention or process in space is unlikely to pass a novelty test, because the location of use, even in outer space, doesn't take away from whether or not the invention is documented in the state of the art—which is the primary requirement for novelty.[100] So where is the line drawn for these inventions? Coffee machines, pharmaceutical production, and rocket thrusters will each have very expansive bodies of prior art from each of their extensive developments on Earth. Adding microgravity to each of those innovations, though, gives the patent application an extra dimension through which they may be able to escape all of that prior art.[101] A single piece of prior art, for the purpose of novelty, must anticipate every part of the claim under review.[102] If the prior art mentions a coffee machine that uses gravity to make coffee, it will likely not destroy the ISSpresso's novelty because it explicitly requires a gravity environment and does not contemplate microgravity.[103] On the other end of the spectrum is prior art that clearly creates novelty issues because it specifically mentions effectiveness in microgravity.[104] The outcome for novelty becomes more questionable when it is unclear whether addition of microgravity is changing the invention.[105] Showing novelty is hardest for the ISSpresso example, because the outcome is the same cup of coffee that one could get on Earth, and so perhaps only the process used to make coffee in outer space can pass novelty. The process for producing pharmaceutical products of higher purity has a chance to pass

97. *See* Jessica Nimon, *Microgravity Research Coming of Age on the International Space Station*, NASA (Oct. 24, 2012), https://www.nasa.gov/mission_pages/station/research/news/microgravity_research.html.

98. *Id*.

99. *See* TOSAPORN LEEPUENGTHAM, THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES 65-73 (2017).

100. *See Id*.

101. *Id*. at 72.

102. *Id*. at 75.

103. *See id*. at 72-73.

104. *See id*.

105. *See id*.

novelty in this regard because it is an application for the process, which is relying on the presumptively new condition of microgravity to produce pharmaceutical products of superior purity than can be made without the addition of microgravity.[106] Similarly, the rocket thruster that only works in microgravity is most likely to be novel, even though rocket boosters have long been known, because of its specific reliance on microgravity to be effective at all.[107] Attempting to measure the importance that microgravity plays in these inventions will likely be a large source of uncertainty for patent prosecutors in findings of novelty.[108] Fundamental issues with novelty, though, will likely decrease as the state of art in commercial outer space ventures moves beyond the microgravity of low earth orbit, to the complex outer space inventions such as SpaceX's published plan for inhabiting and terraforming[109] Mars.[110] This plan involves processes for moving large numbers of people and cargo from Earth to another body or planet in a fleet, and with an innovative launch system that allows for reloading and refueling while the loaded rockets wait in low Earth orbit.[111] Inventions like these resolve patentability confusions because they no longer reside in the gray area between what is done on Earth, and what will be done in outer space—they are outer space specific.

The inventive step requirement yields a similar result for patent applicants looking to protect inventions made that are specifically effective in outer space.[112] This requirement raises the bar to exclude inventions that are considered obvious, based on the state of the art.[113] Notably, this judgment is not made based on any single piece of prior art that anticipates the invention, but instead it is made as a subjective ruling on what a person skilled in the art would consider obvious based on the current state of the art as a whole.[114] So the ISSpresso is now subjected to the largely untested bar of whether it would have been obvious for a person skilled in the art to use pneumatics and hydraulics in the way that they did to make coffee without gravity.[115] Similarly, would it have been obvious to a person skilled in the art of pharmaceutical manufacture that a microgravity environment would increase purity, and would it be obvious to a rocket engineer that if their thruster design fails to work when tested on Earth, that it should be attempted in outer space? These questions, again, fall on the undefined test of whether the product's application of the outer space environment is an obvious one.[116]

106. *Id*.

107. *See id*.

108. *See id*.

109. Terraforming is the process of making another body more Earth-like, presumably to be livable for humans. Matt Williams, *The Definitive Guide to Terraforming*, UNIVERSE TODAY (Feb. 23, 2016), https://www.universetoday.com/127311/guide-to-terraforming/.

110. Matthew Hart, *Elon Musk Reveals Plans for Interplanetary Transport System*, NERDIST (Sep. 27, 2016), https://nerdist.com/elon-musk-reveals-plans-for-interplanetary-transport-system/.

111. *Id*.

112. *See* LEEPUENGTHAM, *supra* note 72, at 74-77.

113. *Id*. at 74.

114. *Id*.

115. *See* Valerio Di Tana & Joshua Hall, *ISSpresso Development and Operations*, 2 J. OF SPACE SAFETY ENGINEERING 1 (June 2015), http://www.argotec.it/argotec//docs/Journal_SpaceSafety Engineering_150721.pdf.

116. LEEPUENGTHAM, *supra* note 72, at 76-77.

Perhaps the test will be more simple to apply in situations such as pharmaceutical production, where different atmospheric conditions are more likely to have been simulated or conjectured by scientists on Earth.[117] However, for most fields of inventive activity, where changing atmospheric conditions or dealing with outer space is not the norm, determining what is obvious over the state of the art will surely only become less predictable.[118] In the case of the ISSpresso, there are likely coffee machine engineers that may consider a zero gravity application to be quite far beyond the state of the art for coffee machines, while an astronautical engineer may consider it to be an obvious arrangement to reduce the machine's reliance on gravity.[119] Similar issues are likely to arise whenever a field that isn't astronautics is crossed with an application in outer space.[120]

The final primary hurdle of patentability, then, is the industrial application.[121] Generally, this is interpreted to mean that a patent examiner must be able to "foresee a practical use of the invention."[122] This causes another potential patentability issue with inventions for use in outer space.[123] "If an invention is still at only a high-level theoretical stage, then it would be premature to file a patent application."[124] This is unlikely to cause issue for the ISSpresso, the process of producing pharmaceutical products, and the rocket booster because they are each inventions that can be used almost immediately in outer space activity, and the industrial application requirement is applied liberally.[125] That liberal application, though, may not extend indefinitely.[126] SpaceX's concept for terraforming and colonizing Mars, for example, may be considered to be at a high-level theoretical stage due to the amount of technology that must still be developed and refined to even make such an attempt. These two extremes are easy to predict, but prosecutors will need to slowly try, and fail, to receive claims in order to gain an understanding of where examiners actually think the industrial application line falls for outer space inventions.[127]

Furthermore, the industrial application requirement presents a small source of uncertainty for patent applicants because it could be the case that some national legislatures determine industrial application to mean some industrial application within its territory.[128] This seems to be a minor potential issue, as we wouldn't expect a landlocked country to outright deny patent claims for oceanography tools based on industrial application alone.[129]

117. Jessica Nimon, *Microgravity Research Coming of Age on the International Space Station*, NASA (Oct. 24, 2012), https://www.nasa.gov/mission_pages/station/research/news/microgravity_research.html.

118. *See* LEEPUENGTHAM, *supra* note 72, at 76-77.

119. *See id*.

120. *See id*.

121. *See id*. at 77-80.

122. *Id*. at 77.

123. *See id*.

124. *Id*. at 77.

125. *Id*.

126. *See id*.

127. *Id*.

128. *Id*. at 78.

129. *See id*. at 78-79.

Also, this interpretation would be counter to the intent of the industrial application requirement, which has no appreciable nexus to territoriality.[130] In the United States, it seems, this issue does not arise.[131] This is embodied by a patent granted by the United States Patent and Trademark Office (USPTO) for a cup that, on Earth is just an oddly shaped cup, but in microgravity is the first cup that is useable in any respect.[132]

3. Inventions Made in Outer Space

Inventions made in outer space are the final class of commercial outer space inventions that may cause potential issues with patentability based on the application of current intellectual property laws. Inventions made in outer space are limited to where humans are physically active in space. At the moment, this is exclusively aboard the ISS.[133] In the past, there has been human activity aboard space shuttles and on the moon, and in the future, we can expect more human activity in these places, as well as on Mars and in deep space.[134] If private companies are to make these expensive leaps beyond Earth, they are likely going to also want to be able to patent whatever inventions their employees and crew may devise along the way.[135] Fortunately, patentability of inventions made in outer space only incurs minor issues.[136]

Inventions made in outer space have the potential to cause issues of novelty, in that they may accidentally disclose the invention into the state of the art before the patent is applied for, thereby destroying their own novelty.[137] Countries evaluate a pending patent application against the state of the art as it was on a priority date of the application.[138] In most jurisdictions, the priority date is the date that the initial patent application was filed, and novelty is measured against the state of the art upon said filing.[139] The state of the art is defined and interpreted across jurisdictions to include inventions that are used in practice, or disclosed to the public, where "the public" is interpreted very broadly.[140] This currently causes an issue because all of the experimentation and invention being done in outer space is done by a group of astronauts from different countries aboard the very confined space of the ISS.[141] If an experiment is done by the United States astronauts and the result is plainly obvious upon execution of the experiment, then it is likely that astronauts from other countries will either see or hear

130. *See id*.
131. *Id*.
132. *Id*. at 79; U.S. Patent No. 8,074,827.
133. *See* David Hitt, *What is the International Space Station*, NASA, https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-iss-k4.html (last updated Nov. 9, 2017).
134. *See id*.
135. See *Who Owns Patent Rights? Employer or Inventor?*, NOLO, https://www.nolo.com/legal-encyclopedia/who-owns-patent-rights-employer-inventor.html (last visited, Dec. 13, 2017).
136. *See* TOSAPORN LEEPUENGTHAM, THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES 65-73 (2017).
137. *See id*.
138. *Id*. at 66.
139. *Id*.
140. *See id*. at 66-70.
141. *Id*. at 69.

about the results.[142] This disclosure would take place before any patent applications could possibly be filed, and could destroy the novelty of the invention if the information is spread in any way by the other astronauts.[143] Aboard the ISS this issue is handled by contract, where all of the astronauts and scientists that do work aboard the ISS are bound by international agreement to keep all development confidential, although this is yet to be enforced by a court.[144] It is easy to imagine that some of the first private commercial space activity involving humans in outer space will also be aboard a very confined shuttle or base, and that it may be in partnership with multiple private firms due to the extreme complexity and expense of such ventures. In this scenario, the partnered firms would have financial incentive to learn and develop the inventions that their partners make, and they would not have the backing of a national government like the astronauts of the ISS. If such confidentiality agreements were held by a jurisdiction's courts to be ineffective for the purpose of proving novelty, any leaked information could still destroy patentability, a loss which could only be remedied by the terms of said contract.[145]

The United States uses a unique grace period in identifying an application's priority date, where the applicant can have practiced and disclosed the invention for up to one year before the application date.[146] This legislative implementation essentially removes the novelty issue that outer space brings up, but only when filing for a United States patent.[147] To obtain patent protection in any other country, the issue still lingers, which is why few firms utilize this grace period.[148]

Inventive step and industrial application pose no additional problems for inventions made in outer space, although they do overlap with some previously discussed challenges, because they are subject to the same judgment as any other inventions made for outer space, without respect to having been invented in outer space itself.[149]

B. LITIGATION CHALLENGES

Once the private commercial outer space industry has overcome the prosecutory hurdles to obtaining, licensing, and using patents in outer space activity, there is still a wall of practical hurdles to enforcing and being successfully compensated for the infringement of their outer space patents.[150] The three primary hurdles to exercising granted outer space patents are found

142. *See id*. at 69-70.
143. *See id*.
144. *Id*. at 71.
145. *See id*. at 70-72.
146. *Id*. at 66-67.
147. *Id*.
148. *Id*.
149. *See id*. at 74-80.
150. *See id*. at 82-87. *See generally* Derek M. Abeyta, Note, *Privatized Space Exploration: How Will Intellectual Property Rights Be Enforced When Infringement Occurs in Outer Space?*, 60 Ariz. L. J. of Emerging Tech. 1, 60 (2017).

when attempting to detect infringement of patents,[151] finding a valid jurisdiction within which to remedy such infringement,[152] and overcoming the hurdles of actually proving infringement and damages in court.

1. Detecting Infringement in Outer Space Activities

Detecting that your patents are being infringed can be a very challenging task on Earth, let alone if your competitor is launching their infringing product into orbit or beyond.[153] This is of particular importance because if a firm does not identify a potential case of infringement with enough certainty to plead a case, then the patents essentially have failed to protect them from that infringement. With conventional, earthly infringement, patent holding firms often rely on public information to identify potential infringers of their patents.[154] In some fields this is much harder than others. For example, it can be very challenging to identify potential infringement of many software patents without the ability to analyze the source code of the potentially infringing program. Similarly, some patented methods of producing a product will make it hard to detect potential infringers without access to the production plant in question. These challenges are far reaching in today's world; shorter product life cycles have led to faster infringement and product turnover with less time to identify infringement and react, and technologies like 3D printing open up the ability to share infringing products as easily as digital music.[155] Detecting patent infringement is so critical to the efficacy of patents that firms have been issued patents on novel ways to detect infringement of intellectual property.[156]

With outer space patents, the conventional practices similarly fall apart.[157] On Earth, a firm may be able to purchase or inspect a product and attempt to reverse engineer its composition or manufacturing process.[158] This can hardly be done when the potentially infringing firm has sent that product, with all of its directly infringing materials, devices, and software into outer space, usually to never return back to Earth.[159] Furthermore, while the processes used to launch the satellite into outer space may be visible to a viewer of the launch, the processes used to make the satellite and its components will be free of any public inspection by patent holders. Patent holding firms may never know exactly what a potentially infringing company is doing with their satellites, because they cannot rely on marketing and sales campaigns,[160] which are currently out of the ordinary for firms involved in commercial outer space activity. Satellites that orbit Earth and provide some type of information back down to their respective terrestrial

151. Lisa Williams, *Extraterrestrial Patent Infringement*, SPACENEWS (Dec. 2, 2015), http://spacenews.com/op-ed-extraterrestrial-patent-infringement/.

152. *See* LEEPUENGTHAM, *supra* note 72, at 82-87.

153. *See* Williams, *supra* note 151.

154. *See id*.

155. *See* David Hricik, *Will Patenting Make As Much Sense in the New Regime of Weakened Patent Rights and Shorter Product Life Cycles?*, 20 Vand. J. Ent. & Tech. L. 457, 504-505 (2017).

156. *See* U.S. Patent No. 7,792,832; US Patent No. 7,797,249.

157. *Id*.

158. *See id*.

159. *Id*.

160. *Id*.

firms will likely be a small cog in whatever service is actually being provided to the public by said firm. This makes the infringing satellite akin to a manufacturing method on Earth whose secrets cannot be unveiled by merely inspecting the product or service that the method ultimately provides the public. The prospect of detecting infringement are even worse when the directly infringing space object is not an orbiting satellite, and instead is speeding away from Earth with no plans to ever return.[161]

This is not to say that detecting infringement becomes impossible. There are other ways to detect infringement than those already discussed, including serendipity,[162] and sometimes infringing firms may do so openly, either unknowingly or strategically. That said, as the hypothetical outer space scenario gets more complex—such as how should a firm detect infringement via a 3D printer aboard a space vehicle—the viability of the current patent regime becomes less secure.

2. Finding a Jurisdiction Within Which to Litigate

So if a firm does somehow discover that their patent is being infringed in outer space activities, how can they go about enforcing their patent rights? Even on Earth, a firm that has some evidence of infringement still needs to overcome a lot of hurdles to determine in which jurisdiction they may bring a suit for the best chance of adequate recovery. Immediately, the patent enforcing firms are limited to the jurisdictions in which they originally filed for, subsequently pursued, and ultimately received a patent. Now limited to those jurisdictions, the patent enforcing firm must consider a litany of other factors, such as where the alleged infringing firm operates, acts, and extends influence; where the alleged infringement takes place; and which of the possible jurisdictions would be able, willing, or likely to provide the patent holding firm's preferred remedy.

The challenge of finding a jurisdiction within which a firm can enforce their patent rights for outer space activities comes largely from the joining of an international and borderless space law regime with a territorial patent law regime.[163] The expanse of outer space is governed by international treaties, most notably the Outer Space Treaty of 1967, which explicitly states that "Outer space, including the moon and other celestial bodies shall be free for exploration and use by all States . . . in accordance with international law . . . . There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage

161. *Online Index of Objects Launched into Outer Space*, UNITED NATIONS, http://www.unoosa.org/oosa/osoindex/search-ng.jspx (last visited, Mar. 5, 2018) (filter list by objects not in orbit).

162. *See* Mark Warburton, *How Do Lawyers At Organisations Like IBM Or Microsoft Detect Possible Patent Infringement Situations?*, ACACIA LAW, https://acacialaw.com/how-do-lawyers-at-organisations-like-ibm-or-microsoft-detect-possible-patent-infringement-situations/ (last visited, Mar. 5, 2018).

163. Derek M. Abeyta, Note, *Privatized Space Exploration: How Will Intellectual Property Rights Be Enforced When Infringement Occurs in Outer Space?*, 60 Ariz. L. J. of Emerging Tech. 1, 60, 89 (2017); *see* TOSAPORN LEEPUENGTHAM, THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES 82-87 (2017).

international cooperation in such investigation."[164] This is directly at odds with territorial patent laws that protect intellectual property within each country's physical jurisdiction and no further.[165]

In order to even attempt to find relief, we must attempt to apply our primarily terrestrial patent laws to these outer space activities.[166] When objects are launched into outer space, they must be registered to a country, pursuant to the Outer Space Treaty of 1967.[167] The outer space object is then considered to be within and under the control of that countries jurisdiction throughout its entire time in space, and upon potential return to Earth.[168] This immediately seems to limit any potential recovery to the country with which the infringing object is registered. A firm may then sue another within that jurisdiction for patent infringement, and it will be up to the country of register to determine whether or not they should apply their patent laws to the outer space activity.[169] This could allow companies to race to the bottom and register their infringing spacecraft with countries that have declined to extend protection to outer space, although this may not come to fruition because the countries themselves are generally considered liable for their registered space objects.[170] When a similar jurisdictional issue arose with patent infringement at sea in a country's Exclusive Economic Zone,[171] the United Kingdom determined that its Patents Act should extend out to sea "in a limited fashion."[172] The United States Supreme Court took a different approach with their own patent act when they ruled, in *Deepsouth Packing Co. v. Laitram Corp.*,[173] that "US patent law had no extraterritorial effect and was not intended to apply to activities taking place beyond the territorial limit of the United States."[174] The same could happen country to country with outer space infringement, as their respective courts attempt to determine the reach of their patent laws, and to balance them against the principles of the Outer Space Agreement. The United States legislature took a preemptive step by enacting the Patents in Space Act, which ensures that in the United States, infringement on any space object registered to the United States is

164. Williams, *supra* note 151 (quoting Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. 8, Jan. 27, 1967, 18 U.S.T. 2410).

165. Williams, *supra* note 151.

166. *See id*.

167. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. 8, Jan. 27, 1967, 18 U.S.T. 2410.

168. *Id*.

169. *See* Derek M. Abeyta, Note, *Privatized Space Exploration: How Will Intellectual Property Rights Be Enforced When Infringement Occurs in Outer Space?*, 60 Ariz. L. J. of Emerging Tech. 1, 60, 74-75 (2017).

170. *See* Gerry Oberst, *Satellite Sales and International Liability*, VIA SATELLITE (May 1, 2012), http://www.satellitetoday.com/telecom/2012/05/01/satellite-sales-and-international-liability/.

171. A country's Exclusive Economic Zone is the area from twenty-four nautical miles to two hundred nautical miles off of a country's coastline, where they have exclusive control over the ocean resources therein. Khushboo Sheth, *What is an Exclusive Economic Zone (EEZ)?*, WORLDATLAS, https://www.worldatlas.com/articles/what-is-an-exclusive-economic-zone-eez.html (last updated April 25, 2017).

172. Abeyta, *supra* note 150, at 74.

173. Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518 (1972).

174. TOSAPORN LEEPUENGTHAM, THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS IN OUTER SPACE ACTIVITIES 84-85 (2017).

enforceable in the United States.[175] However, few countries have enacted any similar outer space specific patent legislation.[176] The result is a shaky footing for enforcing patent laws. Firms that are hoping to reap the benefits of their patents must wade through this uncertainty and gamble their resources in an attempt to find clarity in these laws. On the other end, infringers can ride freely into this new frontier hoping to evade liability by exploiting unclear laws and the unwillingness of courts to extend jurisdictional patent laws into outer space activity where there is no clear legislative guidance.

Even though the United States has enacted a specific law ensuring that patent holding firms will be able to "follow the flag" back to the U.S. in their infringement suits, there is little clarity as to whether a firm will be able to recover if the infringing object is registered to a country without similar laws, or in which a patent was not obtained.[177] There is a small chance that there may be jurisdiction for a United States patent infringement lawsuit if the company that developed, built, or launched the infringing object is based in the United States, did substantial development work in the United States, or even launched the object from United States territory.[178] That will be an increasingly smaller carve out as other countries rapidly catch up to the United States' public and private outer space ventures, lowering the odds that infringers have any nexus to the United States.[179] In fact, even if a handful of major space-faring countries were to follow suit with similar laws, the landscape would still be wide open for intentional infringers to evade actions that yield jurisdiction in those countries specifically.

3. Overcoming the Hurdles of Litigation

If a patent holding firm is able to pin an infringer to a jurisdiction in which it holds a patent, then they will still need to prove infringement even though the infringing object itself is in outer space, and they will still have to clear the temporary presence defense embedded in the Paris Convention.[180]

Proving infringement in a courtroom involves many similar challenges to those that come from detecting infringement in the first place. First, whichever jurisdiction the firm ultimately had to bring the patent infringement suit in would need to have discovery laws that allow the infringee to obtain the documents and information necessary to make their case. If the suit couldn't be brought in the United States, the patent holding firm is already at a distinct disadvantage because, as a general rule, other countries do not have discovery laws that reach as deeply as those of the U.S.[181] Of course, even if the discovery laws themselves are satisfactory to

175. 35 U.S.C. § 105 (2012).

176. *See* LEEPUENGTHAM, *supra* note 72, at 83-84.

177. *See id*. at 82-88.

178. *See id*. at 85-86.

179. *See* Derek M. Abeyta, Note, *Privatized Space Exploration: How Will Intellectual Property Rights Be Enforced When Infringement Occurs in Outer Space?*, 60 Ariz. L. J. of Emerging Tech. 1, 60, 77-84 (2017).

180. *See* LEEPUENGTHAM, *supra* note 72, at 89-91.

181. *See* Stephan N. Subrin, *Discovery in Global Perspective: Are We Nuts?*, 52 DEPAUL L. REV. 299 (2002).

get to the information that the infringee needs, there still needs to be something to discover. The object itself may be in space, so inspection fails once again. Though one would hope that this hurdle would be an easy one to clear, as there should be enough documentation, tests, and prototypes of every stage of the building and launch processes to address the objects and process themselves. The challenge that remains is the potential inability to know what the physical objects in outer space are being used for—best illustrated by the hypothetical manned spacecraft that orbits Earth with a 3D printer on board.

The temporary presence defense is found in the Paris Convention but is further embodied in the statutes of many countries, and acts to ensure that infringement from the construction or operation of ships, aircraft, or land vehicles, when they temporarily or accidentally enter another jurisdiction, is not enforceable.[182] Some countries have interpreted their implementation of this principle to not extend to outer space activity, while the United States in particular has determined that their temporary presence exception does extend to outer space activity.[183] This position is the natural result of extending the laws for ships and aircraft to spacecraft,[184] however it fails to make sense for outer space, where a satellite can operate indefinitely—providing information and services to any country, day and night, while only temporarily passing over the country or only having temporary ties to the country for something such as assembly or launch. Furthermore, the United States is only one party, of 177, to the Paris Convention.[185] Other countries may make the decision to extend the temporary presence defense to outer space, some may do so even without restriction, but perhaps some will draw a line in the sand to make clear that outer space provides enough potential and uniqueness to require special treatment. Until these decisions are made, the uncertainty remains problematic for the patent holder.

IV. POLICY ANALYSIS

What is the United States—or the World—to do about the immense challenge of removing uncertainty from the current patent regime for outer space activity. On one hand, the legislature could draft proactive legislation that lays out a new patent regime for outer space activities, although it may be hard to gain traction in the legislative body because this approach is trying to fix major future problems that haven't yet reared their head. Additionally, that legislation has to work alongside the international landscape as previously described herein. Perhaps instead, the executive branch could navigate towards new international treaties or regulation to clear up the problems. Unfortunately, they are likely to push up against the many countries that benefit from loosely managing patent rights in certain fields—not to mention the political capital that would need to be leveraged to unilaterally push such a feat. All this considered, there are three main paths

182. LEEPUENGTHAM, *supra* note 72, at 89.

183. *Id*. at 90.

184. *Id*.

185. *Contracting Parties, Paris Convention*, WIPO, http://www.wipo.int/treaties/en/ShowResults.jsp?lang=en&treaty_id=2 (last visited, Mar. 5, 2018).

to the future of patent rights in outer space activity; I will refer to them as passive adaptation, global offensive, and strong arming.

A. PASSIVE ADAPTATION

Passive adaptation is the idea that the United States could just leave the global patent regime as it is, making only the changes necessary to keep up with issues as they arise. The courts will have to make hard interpretation decisions when they try to apply our terrestrial patent laws, or the poorly adapted space ones, to situations that weren't contemplated by the drafters of those laws. When those interpretation decisions aren't satisfactory to the legislature, perhaps they will pass legislation that corrects and updates the laws for those particular situations. But, the path of passive adaptation rules out a grand-scale overhaul of the laws for outer space activities by definition. There is some reason to believe that passive adaptation will work. Our eighteenth century constitution's clauses are still regularly interpreted to handle technology that was in no way considered by the drafters,[186] all without a major overhaul.[187] The same can be said for laws written ten, twenty, and fifty years ago.[188]

Unfortunately, just because passive adaptation works in some fields, it is unlikely to yield the best results for the United States and its commercial space industry. The hurdles to effectively utilizing patent protection in the outer space industry are so substantial that they are disincentivizing the industry from utilizing patents at all.[189] Elon Musk, the founder and CEO of SpaceX, has openly chosen to rely on trade secrets and to forego keeping patents for SpaceX's innovations.[190] This decision is considered prudent because the disclosure requirement of the patent system would soon publish their inventions for China, or any other country or firm, to copy, likely without affording any protection in China or the United States.[191] Industries have always had the option of relying on trade secrets where they feel that it may be a better alternative to patent rights. In fact, commercial space companies such as SpaceX may be better off making that decision under the current system because they are operating in a field where secrecy is, more or less, inherent. Many of the problems that firms face to enforce patent rights for outer space activities are because of that inherent secrecy. So the

186. *See* Transcript of Oral Argument, Carpenter v. United States, No. 16-402 (U.S. argued Nov. 29, 2017) (deciding whether the warrantless seizure and search of historical cellphone records revealing the location and movements of a cellphone user over the course of 127 days is permitted by the Fourth Amendment).

187. *See generally Timeline of Constitutions*, COMP. CONSTS. PROJECT, http://comparative constitutionsproject.org/chronology/ (last visited, Mar. 6, 2018) (showing that the U.S. amends or overhauls its Constitution much less than Canada or the nations of Western Europe).

188. *See* Transcript of Oral Argument, United States v. Microsoft, No. 17-2 (U.S. argued Feb. 27, 2018) (deciding whether a United States provider of email services must comply with a probable-cause-based warrant issued under 18 U.S.C. § 2703 by making disclosure in the United States of electronic communications within that provider's control, even if the provider has decided to store that material abroad).

189. *See* Kim Bhasin, *Elon Musk Explains Why SpaceX Doesn't Patent Anything*, BUS. INSIDER (Nov. 9 2012), http://www.businessinsider.com/elon-musk-patents-2012-11.

190. *Id.*

191. *Id*.

move to trade secrets allows the firm to put up a shield in lieu of the sword that the industry's secrecy removed. The United States should not allow passive adaptation to push more firms away from patents and toward trade secrets because the major interest in the commercial outer space industry relies on the disclosure requirement of patents to quickly push the cutting edge of commercial space technologies. If each United States based firm is running an "every man for themselves" trade secret operation, then the bar moves more slowly for each of them, allowing other countries and firms that operate under secrecy to keep up or surpass United States based technologies.

B. GLOBAL OFFENSIVE

The global offensive approach is best understood as one where the United States and the international community come together to create a new patent regime specifically for outer space activity. There are some major benefits to such an approach. From the top level, this would solve the major problem of trying to reconcile territorial patent laws with the international law regime of outer space. In theory, a unified and international space patent regime should gel with the international space law regime. These proposals involve creating a special "space patent"—with its own international patent application, standards, and review board—as well as an international tribunal in which to litigate disputes over the enforcement of said space patents.

The space patent proposed would have an international scope, but without the depth of merely making our current territorial patents international.[192] "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."[193] This would have to come into effect by means of international treaty, and the administrative systems that come with it would likely have to be managed and funded by the signatory countries. This is unlikely to be much of a hurdle because the USPTO is already solely fee-funded, and effectively turns a profit for the United States.[194]

Beyond cost, the signatory countries will have to agree to the specifics of the system's nuances.[195] "All member countries would need to agree on a number of issues including 1) where would claims be adjudicated; . . . 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?"[196] These issues, some of which have been previously discussed herein, are not to be taken lightly. For an international space patent

192. *See* Derek M. Abeyta, Note, *Privatized Space Exploration: How Will Intellectual Property Rights Be Enforced When Infringement Occurs in Outer Space?*, 60 Ariz. L. J. of Emerging Tech. 1, 60, 81-82 (2017).

193. *Id*. at 81.

194. *See* Dennis Crouch, *Federal Budget Cuts = USPTO Budget Cuts?*, PATENTLYO (Apr. 12, 2011) https://patentlyo.com/patent/2011/04/federal-budget-cuts-uspto-budget-cuts.html.

195. *See* Abeyta, *supra* note 72, at 81.

196. *Id.*

regime, many countries would need to agree on the answers to these problems, and, at this point, it isn't clear that even any individual country has an idea of how the problems should be addressed. Furthermore, if a country was not a signatory to the treaty, then all of the previously discussed issues could still exist in that country, unless the international space patent regime found some way to limit the disclosure requirement to only benefit signatory countries. An example of this would be if space patents weren't published publicly, but could be requested by companies, via a signatory country. This would allow the signatory country to use contract to reap the benefits of the patent system, while potentially limiting the ability for non-signatory countries to free-ride on the system.

This system, like passive adaptation, is also very good for the individual space faring firms. Along the same vein, though, this system doesn't necessarily give firms any incentive to be United States based; likewise, it doesn't necessarily exercise the United States' interest in the commercial space industry to a meaningful extent over other countries. Without the United States' interest being promoted, there isn't anything motivating the political branches to make such a massive international political move. This is the major folly of global offensive. It is highly unlikely that such a broad international system could be agreed upon in any reasonable period of time, and that low likelihood makes the chances near zero that the United States should be a part of the push towards that idealistic, international future for outer space and space patents.

C. STRONG ARMING

The United States should exercise its advantage and reap the benefits that will come from a strong commercial outer space industry by leading the rest of the countries into a patent regime that is prepared to handle current outer space activities, and the future activities that follow naturally from such development. Essentially, instead of allowing the industry to develop around current law, and instead of proactively attacking international law, the United States should proactively attack the United States outer space patent law regime to incentivize firms to be United States based, while also incentivizing other space faring countries to follow.

Prosecution issues can largely be solved with clear legislation that expands the statutory definitions of novelty, inventive step, and industrial application to ensure that the USPTO award patents for satisfactory outer space inventions. The issues in patent litigation will likely need to be tackled by the United States passing laws that ensure that patent holders will have more options for exerting jurisdiction over their accused infringers, such as for providing services to the United States or its citizens, or by holding countries politically accountable for intentionally undermining the commercial space industry by free riding. This is not particularly far fetched. The United States has used its legislation, courts, and influence in the past to allow jurisdiction where it would be historically unexpected.[197] Notably, the Alien Tort Statute allowed plaintiffs to obtain civil justice over their foreign

197. *See Enemy of Mankind*, *More Perfect*, WNYC STUDIOS (Oct. 23, 2017) (downloaded using iTunes).

counterparts for international crimes or crimes in violation of United States treaties.[198]

Of course, free riding another country's outer space patents is hardly equivalent to international crimes like torture. Under a similar model of proactive action, though, the United States can use its influence to ensure that United States commercial space firms can find relief in United States courts against those abroad that exploit the complexities that come with acting in outer space. Such legislation and enforcement will likely be looked down upon by other countries, as with the Alien Tort Statute, for essentially forcing United States law on the rest of the world.[199] Surely the United States will not be able to pursue such a plan without spending some international political capital, though the benefit of this approach is that it likely requires much less than a Global Offensive, while being more effective than Passive Adaptation. There are downfalls that are not fully remedied, such requiring tenuous litigation to attempt to keep other firms from exploiting the publication requirement, and perhaps part of that is restricting publishing for some short period for United States space patents. The overarching benefit, though, is that the United States approaches these issues head on, with intent to incentivize commercial space investment on United States soil, and thereby encourages innovation in the United States while forcing other countries to follow suit if they want any of the space faring firms to inject value into their country. This essentially strong arms the international legislative race to the bottom into a race to the top, favoring more protection and more patents.

V. CONCLUSION

The widespread issues of exerting patent rights in outer space are unlikely to be remedied all at once. The challenges affect individual countries differently, and they affect private firms differently still. The United States has tangible interests in ensuring that its private commercial space industry continues to take off, because outer space remains a frontier of military and economic development on its own, as well as with respect to leveraging interests on Earth. The United States has taken a small step down the road of promoting patents for outer space firms, but there is still a long way to go. The legislature should address these issues head on, and place stock in the future of the industry, before other countries beat them to it. If they use the two arm approach of incentivizing private investment with strong outer space patents and incentivizing international compliance by strong arming United States law to its bounds, then they are likely to succeed in fostering yet another military and technology windfall within its borders.

198. *Id*. *See* 28 U.S.C. § 1350 (2012); Filartiga v. Pena-Irala, 577 F. Supp. 860 (E.D.N.Y. 1984).
199. *See Enemy of Mankind*, *supra* note 197.