

**PUBLIC SPACE, PRIVATE PATENTS:
UPDATING INTERNATIONAL SPACE LAW TO PROTECT
PATENTS IN OUTER SPACE**

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I. INTRODUCTION

“It looks like we’ve got us a dragon by the tail,” an astronaut announced on the International Space Station (“ISS”) at 9:56 AM Eastern Time on May 25, 2012.¹ On that day, with its Dragon vessel, SpaceX became the first commercial company to dock a spacecraft at the ISS.² Human activity in the final frontier is undergoing fundamental change

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1. Matt Williams, *SpaceX’s Billionaire Founder Elon Musk Calls Dragon Capsule Just the Beginning*, GUARDIAN (May 25, 2012, 5:02 PM), <https://www.theguardian.com/science/2012/may/25/spacex-founder-elon-musk-dragon> [https://perma.cc/52R3-NP5R].

2. *Id.*; Elizabeth Howell, *SpaceX’s Dragon: First Private Spacecraft to Reach the Space Station*, SPACE.COM (Mar. 14, 2019), <https://www.space.com/18852-spacex-dragon.html> [https://perma.cc/XSK6-EMAK].

as we enter an age of privatized and commercial space endeavors.³ In stark contrast to a time when space activities were conducted exclusively by government agencies, many private entities have entered the arena over the past decade.⁴ In fact, multiple private entities have already succeeded in launching low-orbit satellites and cargo into space, while a few inch closer toward civilian spaceflight and tourism.⁵ In turn, this has allowed government agencies to focus their time and resources on “deeper space exploration,” relying on private entities to reduce costs and execute less ambitious tasks.⁶ A key concern that has arisen from this rapidly changing environment is the protection of patents in space. This Note aims to assess, identify problems with, and present a solution to, the status of patent protection in the context of space activity by private entities.

Part II of this Note introduces the current international treaties that provide the framework for governing space activities. Current international space law and maritime law share similarities, including the “flags of convenience” problem, in which private entities selectively register themselves with the state with the most favorable laws.⁷ In space, this problem is exacerbated and perpetuated by the fact that a space object does not enter a destination port in the way that a ship does in maritime law.

Part III of this Note surveys the regulatory competition among states that seek to attract private entities conducting space activities and analyzes how national space legislation tracks the interests of such private entities. States may compete to provide the most favorable terms to private entities in a race to the bottom, aggravating the flags of convenience problem and creating externalities such as the degradation of patent protection across multiple jurisdictions.

Part IV of this Note presents a solution to the degradation of patent protection: the creation of a global patent jurisdiction to harmonize the various regulatory approaches to patents related to activities in space. This solution must overcome many challenges, but the international community has previously demonstrated support for multilateral treaties regulating the protection of intellectual property in space.

3. See Monica Grady, *Private Companies are Launching a New Space Race—Here’s What to Expect*, CONVERSATION (Oct. 3, 2017, 6:53 AM), <http://theconversation.com/private-companies-are-launching-a-new-space-race-heres-what-to-expect-80697> [<https://perma.cc/VF6C-N3DY>].

4. *Id.*

5. See, e.g., *id.*; *Your Trip to Space*, BLUE ORIGIN, <https://www.blueorigin.com/fly-with-us> [<https://perma.cc/UH2U-FK3N>]; *Dragon*, SPACEX, <https://www.spacex.com/dragon> [<https://perma.cc/QAN8-25HU>].

6. Doris Elin Salazar, *How Will Private Space Travel Transform NASA’s Next 60 Years?*, SPACE.COM (Oct. 12, 2018), <https://www.space.com/42113-nasa-future-private-space-flight.html> [<https://perma.cc/XRN8-R5UX>].

7. See *infra* Part II.

II. OVERVIEW OF INTERNATIONAL SPACE LAW

International space law currently consists of a collection of international treaties and principles that govern various aspects of outer space investigation, exploration, and other activities.⁸ Five international treaties, collectively referred to as the Five United Nations Treaties on Outer Space (“the UN Treaties”), exist to ensure that “the activities carried out in outer space and whatever benefits might be accrued from outer space [are] devoted to enhancing the well-being of all countries and humankind, with an emphasis on promoting international cooperation.”⁹ The UN Treaties entered into force between 1967 and 1984, when space exploration was led by government agencies.¹⁰ The treaties were meant to address the behavior of major space powers against the backdrop of the Cold War and the Space Race and to focus on issues such as allocating responsibility for damages and rescue operations.¹¹ As a result, the UN Treaties do not speak directly to the preservation of patents in space.¹² Nonetheless, as explored below, two of the UN Treaties are still particularly relevant as we consider the privatization of outer space activities: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the “Outer Space

8. See, e.g., *Space Law Treaties and Principles*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html> [<https://perma.cc/95RF-JSVJ>].

9. *Id.* The UN Treaties are: (1) the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the “Outer Space Treaty,” entered into force on October 10, 1967 and currently ratified or accepted by 107 states and organizations); (2) the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the “Rescue Agreement,” entered into force on December 3, 1968 and currently ratified or accepted by 96 states and organizations); (3) the Convention on International Liability for Damage Caused by Space Objects (the “Liability Convention,” entered into force on September 1, 1972 and currently ratified or accepted by 95 states and organizations); (4) the Convention on Registration of Objects Launched into Outer Space (the “Registration Convention,” entered into force on September 15, 1976 and currently ratified or accepted by 67 states and organizations); and (5) the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the “Moon Agreement,” entered into force on July 11, 1984 and currently ratified or accepted by 18 states and organizations). Comm. on the Peaceful Uses of Outer Space, Status of International Agreements Relating to Activities in Outer Space, U.N. Doc. A/AC.105/C.2/2018/CRP.3 (2018) [hereinafter Status of International Agreements].

10. *Space Law Treaties and Principles*, *supra* note 8; see, e.g., Cheryl L. Mansfield, *Kennedy Space Center: Historical Timeline*, NASA (June 29, 2012), <https://www.nasa.gov/centers/kennedy/about/history/timeline/60s-decade.html> [<https://perma.cc/W7VC-MYWU>]; Mike Wall, *Happy Birthday, NASA! At 60, Agency Continues to Inspire*, SPACE.COM (Oct. 1, 2018), <https://www.space.com/41977-nasa-60-year-anniversary-unifying-force.html> [<https://perma.cc/8SZN-HRLT>].

11. See William C. Pannell, *Pirate Battles in Outer Space: Preventing Patent Infringement on the 8th Sea*, 46 U. MEM. L. REV. 733, 743 (2016); *Space Law Treaties and Principles*, *supra* note 8.

12. See Pannell, *supra* note 11, at 743–44.

Treaty”) and the Convention on Registration of Objects Launched into Outer Space (the “Registration Convention”).¹³

A. The Outer Space Treaty, the Registration Convention, and Their Implications for Patents in Space

The Outer Space Treaty was the first international space treaty, and 107 states have consented to be bound by it since it was entered into force on October 10, 1967.¹⁴ The Outer Space Treaty lays down two fundamental principles of international space law.¹⁵ First, the Outer Space Treaty extends the general application of international law into space.¹⁶ Second, the Outer Space Treaty sets out the concept of “non-appropriation,” which reserves outer space and celestial bodies as free for exploration and use by all states and prohibits any nation from claiming territory or resources.¹⁷ Furthermore, the Outer Space Treaty declares that a state is responsible for damage arising from acts that are directly attributable to that state, as well as for damage indirectly attributable through the acts of those in an official capacity or private entities under the supervision of that state.¹⁸ In turn, a state’s responsibility for supervision arises when it registers a space object with the Secretary-General of the United Nations: the Outer Space Treaty places a space object under the jurisdiction, control, and responsibility of the state that registers it.¹⁹ While the UN Treaties do not comprehensively define what constitutes a space object, the Registration Convention explains that “the term ‘space object’ includes component parts of a space object as well as its launch vehicle and parts thereof.”²⁰ The ambiguity presented by this term is outside the scope of this Note, which will assume that a space object encompasses the parts and launch vehicle of objects launched from Earth into outer space.

The Registration Convention entered into force on September 15, 1976, giving effect to the registration requirement of the Outer Space Treaty.²¹ In relevant part, the Registration Convention requires that the

13. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty]; Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

14. Status of International Agreements, *supra* note 9.

15. See Dimitri Linden, *The Impact of National Space Legislation on Private Space Undertakings: Regulatory Competition vs. Harmonization*, 8 J. SCI. POL’Y & GOVERNANCE 1, 2 (2016).

16. *Id.*; Outer Space Treaty, *supra* note 13, art. I.

17. Pannell, *supra* note 11, at 744; Outer Space Treaty, *supra* note 13, art. II.

18. Linden, *supra* note 15, at 2–3; Outer Space Treaty, *supra* note 13, arts. VI–VII.

19. Outer Space Treaty, *supra* note 13, art. VIII.

20. Registration Convention, *supra* note 13, art. I(b).

21. Status of International Agreements, *supra* note 9; Registration Convention, *supra* note 13, at 2.

“launching state” of a space object register that object.²² A launching state is defined as a “[s]tate which launches or procures the launching of a space object” or a “[s]tate from whose territory or facility a space object is launched.”²³ Where multiple states fall into the definition of a launching state, the Registration Convention directs those states to jointly determine one state to register the space object.²⁴ Putting the pieces together in the context of private ventures, then, a space object launched by private means must also be registered with one state, which exercises jurisdiction and control over that space object.²⁵

In effect, the Outer Space Treaty and the Registration Convention work together to extend the jurisdictional reach of a state to space objects registered by that state, even if those objects are located in outer space. The laws of a state apply within its jurisdiction. Therefore, the implication of the Outer Space Treaty and the Registration Convention is that a state’s laws, including intellectual property laws, apply to a space object registered by that state as if the object were on Earth and within the state’s territorial bounds.

The precise application of a state’s laws in outer space depends on the surrounding legal context. For example, the United States Patent Act provides certain protections within the United States, its territories, and possessions.²⁶ Courts generally interpret the Patent Act to be limited to territorial boundaries in the absence of explicit extraterritorial expansion by Congress.²⁷ In any case, it became clear that the Patent Act could apply in outer space when Congress enacted the “Inventions in Outer Space” provision of the Patent Act in 1989.²⁸ In relevant part, this provision states:

Any invention made, used or sold in outer space on a space object or component thereof under the jurisdiction or control of the United States shall be considered to be made, used or sold within the United States for the purposes of [patent laws], except with respect to any space object or component thereof that is . . . carried on the registry of a foreign state in accordance

22. Registration Convention, *supra* note 13, art. II(1).

23. *Id.* art. I(a).

24. *Id.* art. II(2).

25. *See* Outer Space Treaty, *supra* note 13, arts. VI–VII; Linden, *supra* note 15, at 3.

26. *See* 35 U.S.C. § 100(c) (2018).

27. *See, e.g.,* Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 531 (1972) (“Our patent system makes no claim to extraterritorial effect; ‘these acts of Congress do not, and were not intended to, operate beyond the limits of the United States’”) (citing *Brown v. Duchesne*, 60 U.S. (19 How.) 183, 195 (1856)).

28. 35 U.S.C. § 105 (2018).

with the Convention on Registration of Objects Launched into Outer Space.²⁹

In summary, this provision explicitly extended the patent laws of the United States to any space object registered by the United States (and therefore under its jurisdiction), and excluded space objects registered by other states from its jurisdiction. This is in line with the Outer Space Treaty and the Registration Convention, as this Note explains above.

B. The Flags of Convenience Problem in Outer Space

A foreign registration exception to the application of patent laws to space objects raises the possibility of private entities selectively registering with states that provide the most favorable conditions with regard to patent liabilities.³⁰ Because patent laws and protections are territorial, one must acquire a patent in every state jurisdiction in which one seeks protection.³¹ For the same reason, a potential patent infringer in one jurisdiction can avoid liability in outer space simply by registering its infringing space object with a state where the patent holder has failed to acquire a patent. For example, even if the patent holder were protected under the patent laws of the United States, such registration with a foreign state would trigger an exception to the application of United States patent laws in outer space.³²

This is a variation of a problem frequently referred to in maritime law as the “flags of convenience.”³³ The context of maritime law is very similar to that of international space law in that both bodies of law pertain to physical areas where no single country has jurisdiction. As a result, the two bodies of law share key characteristics. For example, a ship in international waters must be registered with a single state and is under the exclusive jurisdiction of that state.³⁴ The flags of convenience problem arises when ship operators register with whichever state offers the most favorable conditions with regard to taxes, costs, liability, or other relevant concerns, regardless of where those operators conduct business or where their businesses are incorporated.³⁵ Numerous cases

29. *Id.* § 105(a).

30. See Pannell, *supra* note 11, at 749–50.

31. See, e.g., *Patents*, WORLD INTELLECTUAL PROP. ORG., <https://www.wipo.int/patents/en> [<https://perma.cc/SCX8-P76R>].

32. 35 U.S.C. § 105(a).

33. Pannell, *supra* note 11, at 741–42.

34. Convention on the High Seas art. 6(1), Apr. 29, 1958, 13 U.S.T. 2312, 450 U.N.T.S. 11 (“Ships shall sail under the flag of one State only and . . . shall be subject to its exclusive jurisdiction on the high seas.”).

35. Pannell, *supra* note 11, at 741.

demonstrate that certain states with very little regulation and oversight allow crimes to occur under their flags of convenience.³⁶

While the flags of convenience problem can exist in both international waters and outer space, there is a crucial difference between the two contexts: ships in international waters have destination ports that serve as an additional layer of regulation,³⁷ while space objects do not. For example, if a ship carries cargo which infringes a United States patent, then it will not be able to unload that cargo at any port within the United States.³⁸ However, a space object registered with a foreign state is permanently removed from the jurisdiction of the United States, regardless of whether the space object's use of a certain technology would otherwise meet the test for patent infringement under United States patent laws.³⁹

Courts in the United States have confronted this issue before, outside of the context of admiralty and international space law. In *NTP Inc. v. Research in Motion, Ltd.*,⁴⁰ a patent case concerning email "push" technology, the Federal Circuit held that patent infringement occurred in the United States because the beneficial use of the infringement was within its territorial bounds, although a key component of the infringing system was in Canada.⁴¹ Similarly, it is not difficult to imagine that a satellite may be registered and launched in a foreign state but provide beneficial services, such as television signals, to people in the United States. Nonetheless, the foreign registration exception would prevent United States jurisdiction in such a case, and therefore protection under its patent laws.⁴² Because a space object does not need to enter the destination of its services, unlike the cargo of a ship which must enter the destination port to fulfill its commercial purpose, the flags of convenience problem is exacerbated. This in turn may perpetuate outer space patent infringement, requiring a rethinking of patent law, like in the case of *NTP Inc.*

III. NATIONAL SPACE LAWS AND REGULATORY COMPETITION

To understand the ramifications of the flags of convenience problem in outer space, it is important to consider the factors relevant to

36. See, e.g., Michael Richardson, *Crimes Under Flags of Convenience*, YALEGLOBAL ONLINE (May 19, 2003), <https://yaleglobal.yale.edu/content/crimes-under-flags-convenience> [<https://perma.cc/CR37-K733>] (discussing North Korean freighter that was smuggling "15 scud missiles, conventional warheads and rocket propellant" while registered in Cambodia).

37. Pannell, *supra* note 11, at 742–43.

38. 19 U.S.C. § 1337(a)(1)(B) (2018).

39. 35 U.S.C. § 105(a) (2018); see *supra* Section II.A.

40. 418 F.3d 1282 (Fed. Cir. 2005), *abrogated on other grounds by* *Zoltek Corp. v. United States*, 672 F.3d 1309, 1323 (Fed. Cir. 2012).

41. *Id.* at 1315–17.

42. 35 U.S.C. § 105(a); see *supra* Section II.A.

private entities in seeking a convenient flag to bear, as well as the variety in those factors different states provide in their regulatory frameworks. Indeed, the flags of convenience problem can only exist in the context of states providing different conditions for private entities seeking to operate in space, and in turn, those private entities having the freedom to choose with which state to register.⁴³ In this Part, I examine national space laws that track the considerations of states and private entities, the competition among regulatory frameworks of different states, and the resulting neglect of patent protection in outer space.

A. National Space Laws Balancing the Considerations of States and Private Entities

To ensure compliance with the responsibilities outlined by the UN Treaties, such as supervision and compensation for damages, many states have enacted national space laws that regulate space-related activities that occur under their auspices.⁴⁴ Naturally, national space laws touch on a wide range of areas, including registration, safety, insurance and indemnification, environmental protection, and enforcement by the relevant state.⁴⁵ While such national space laws diverge widely with regard to their treatment of each area, they generally seek to balance the responsibilities and potential liabilities of the private entity and the state.⁴⁶ Broadly, a state seeks to achieve two goals: first, ensuring that private entities registered with that state do not expose the state to ex-

43. See *supra* Section II.B.

44. See, e.g., 51 U.S.C. § 50906 (2012 & Supp. III 2015) (discussing regulations for acquiring experimental permits for space activity); 14 C.F.R. §§ 400.1–1310.20 (2019) (laying out regulations for commercial space transportation activities conducted within the United States or by United States citizens); Loi 2008-518 du 3 juin 2008 relative aux opérations spatiales [Law No. 2008-518 of June 3, 2008 Relating to Space Operations], JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE [J.O.] [OFFICIAL GAZETTE OF FRANCE], June 4, 2008, p. 9169 [hereinafter Law No. 2008-518 of June 3, 2008 Relating to Space Operations]; Décret 2009-643 du 9 juin 2009 relatif aux autorisations délivrées en application de la loi 2008-518 du 3 juin 2008 relative aux opérations spatiales [Decree No. 2009-643 of June 9, 2009 on Authorizations Issued Under Law No. 2008-518 of June 3, 2008 Relating to Space Operations], JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE [J.O.] [OFFICIAL GAZETTE OF FRANCE], June 10, 2009, p. 9406 (governing insurance requirements for space activity in France); *Space Activities Act 1998* (Cth) ss 47–48, 69(4) (Austl.); *Space Activities Regulations 2001* (Cth) regs 7.01, 7.02 (Austl.) (governing insurance requirements for space activity in Australia); *Outer Space Act 1986*, c. 38, §§ 4–5 (UK) (governing insurance requirements for space activity in United Kingdom). This Note will focus on the United States with regard to national space legislation, but will compare specific examples of national legislation in other countries where relevant.

45. See Paul Stephen Dempsey, *National Laws Governing Commercial Space Activities: Legislation, Regulation, & Enforcement*, 36 NW. J. INT'L L. & BUS. 1, 42 (2016).

46. See Linden, *supra* note 15, at 3.

cessive international liability under the UN Treaties, and second, incentivizing private entities to register with that state.⁴⁷ These two goals are often in tension, as they call for strict and lax regulations, respectively.

One clear example of such tension and balancing can be seen in the area of insurance and indemnification. Pursuant to the Outer Space Treaty and the Registration Convention, a state is liable for any damage arising from space objects registered with that state.⁴⁸ Accordingly, as a precondition to registration, many states require private entities to commit to some level of liability insurance and indemnification for such damages arising out of their own space activities.⁴⁹ As a preliminary matter, articulation of the maximum liability a private entity may face for future damages provides clarity and strong incentives for a private entity to register with a particular state.⁵⁰ States generally require private entities to acquire insurance coverage as well as indemnify the state for international liability beyond a predetermined amount.⁵¹

To illustrate, the United States may require a private entity registering there to obtain insurance up to the “maximum liability insurance available on the world market at a reasonable cost,” not to exceed USD 500 million for injuries to third parties or USD 100 million for claims by the United States government.⁵² The United States government covers any liability beyond this required insurance coverage, but only up to USD 1.5 billion beyond the insured amount.⁵³ Similarly, Australia requires private entities to acquire insurance in an amount that is the lower of AUD 750 million and the maximum probable loss, and the government covers additional liability up to AUD 3 billion.⁵⁴ In France, insurance of EUR 50 to 70 million is required, and the government absorbs all incremental liability.⁵⁵ The United Kingdom requires insurance coverage of GBP 100 million, but in contrast with the other states mentioned above, does not cover any liability beyond that amount.⁵⁶

47. *See id.* at 3–4.

48. Outer Space Treaty, *supra* note 13, arts. VI–VIII; Registration Convention, *supra* note 13, art. VI; *see also supra* Section II.A.

49. *See, e.g.*, 51 U.S.C. § 50914–50915 (2012); Law No. 2008-518 of June 3, 2008 Relating to Space Operations, *supra* note 44, at 9169; *Space Activities Act 1998* (Cth) ss 47–48, 69(4) (Austl.); *Space Activities Regulations 2001* (Cth) reg 7.02 (Austl.); Outer Space Act 1986, c. 38, §§ 4–5 (UK).

50. Linden, *supra* note 15, at 4–5.

51. *Id.*

52. 51 U.S.C. § 50914(a) (2012). The amount of insurance actually required is determined by the Maximum Probable Loss (the “MPL”), where the MPL is determined on a case-by-case basis by the Secretary of Transportation. *Id.* § 50914(a), (c).

53. *Id.* § 50915(a).

54. *Space Activities Act 1998* (Cth) ss 47–48, 69(4) (Austl.); *Space Activities Regulations 2001* (Cth) s 7.02 (Austl.).

55. Loi 2008-1443 du 30 décembre 2008 de finances rectificative pour 2008 [Law No. 2008-1443 of Dec. 30, 2008 on the Rectified Finances for 2008], JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE [J.O.] [OFFICIAL GAZETTE OF FRANCE], Dec. 31, 2008, p. 20518, art. 119.

56. Outer Space Act 1986, c. 38, §§ 4–5 (UK); *see* Linden, *supra* note 15, at 5.

The various approaches states take with regard to insurance and indemnification result from them balancing their interests against those of private entities. On the one hand, a state must minimize exposure to international liability by requiring high insurance coverage and providing a low governmental guarantee. On the other hand, the state must also attract private entities to register with the state by having lower and more flexible insurance requirements than other states, and a robust governmental guarantee.⁵⁷ A particular state's consideration of these two factors will result in varying insurance and indemnification laws, depending on that state's ambitions in space and risk tolerance. Likewise, a state will need to determine what balance to strike between respecting patents registered in other jurisdictions and providing favorable conditions to private entities, potentially by serving as a safe haven from those patents.

B. Regulatory Competition and the Degradation of Patent Protection

At least in part, the wide range of national laws with regard to regulation of space activity is the result of regulatory competition, which “occurs when states compete with each other, in their capacity as regulators, to attract resources and mobile factors of production.”⁵⁸ The rapid privatization of space activity has set the stage for competition among states: private entities have access to registration with any particular state, as well as information on the costs and benefits of each choice.⁵⁹ States compete to have more private entities conduct space activity under their auspices for economic, political, and social reasons.⁶⁰ Aside from the prestige arising from presence in space, states also benefit from the wealth of information accessible through satellites and the commercialization of technologies originally developed for use in space, such as nanofiber water filtration systems.⁶¹

It is worth noting that there are some advantages to regulatory competition as opposed to harmonization of regulatory approaches across

57. See Linden, *supra* note 15, at 5.

58. *Id.* at 6.

59. See *id.*

60. See, e.g., Press Release, United Kingdom, Lockheed Martin and Orbex to Launch UK into New Space Age (July 16, 2018, 5:00 AM), <https://www.gov.uk/government/news/lockheed-martin-and-orbex-to-launch-uk-into-new-space-age> [<https://perma.cc/U9F2-D7CN>]; Jeremy Keehn, *Welcome to the New Space Age*, BLOOMBERG BUSINESSWEEK (July 26, 2018), <https://www.bloomberg.com/news/features/2018-07-26/welcome-to-the-new-space-age> [<https://perma.cc/JU9G-5KXD>].

61. INT'L SPACE EXPLORATION COORDINATION GRP., BENEFITS STEMMING FROM SPACE EXPLORATION (2013), <https://www.nasa.gov/sites/default/files/files/Benefits-Stemming-from-Space-Exploration-2013-TAGGED.pdf> [<https://perma.cc/3V46-EQWS>]; NASA Technology, *Fast-Flow Nanofiber Filters Purify Water at Home and in the Field*, NASA SPINOFF, 2017, at 80.

states. For example, the diverging approaches states take in their competing regulatory frameworks can satisfy a wider range of preferences, such as those relating to insurance, intellectual property, and regulatory oversight.⁶² Regulatory competition may be particularly appealing to a young industry such as space exploration and travel, where there is a lack of standardization or convergence in industry practices. Relatedly, through experimentation and comparison, regulatory competition also generates useful information on participants' preferences, allowing states to identify competitive laws efficiently.⁶³

On the other hand, regulatory competition can also lead to a race to the bottom, where states enter "a cycle of systematic lowering of regulatory standards that ends up with all the states (and [private entities]) being in a position which is worse than the one they were in before this race to the bottom or by coordinating their policies."⁶⁴ A race to the bottom is more likely to occur when states compete for the placement of a limited amount of economic activity, such as space endeavors by private entities, because a state must offer a more attractive regulatory environment vis-à-vis other states in order to attract those entities.⁶⁵ Furthermore, because states are primarily concerned with attracting private entities and minimizing exposure to liability under international space law, regulatory competition in space law is especially likely to lead to a race to the bottom. To the extent that private entities may seek to register with a state specifically to avoid liability arising from patent infringement, states have an incentive to turn a blind eye to patents that exist in other jurisdictions, or going even further, invite private entities that simply copy space technologies that are patented elsewhere. Therefore, regulatory competition and the resultant race to the bottom may exacerbate the flags of convenience problem.

The impact that regulatory competition for space activities has on patent protection is a negative externality in that there is no patent infringement in a technical sense. However, this is a defining characteristic of the flags of convenience problem — a potential patent infringer in one jurisdiction avoids liability in outer space simply by registering its infringing space object with a state where the patent holder, for whatever reason, has failed to obtain a patent.⁶⁶ As space activity becomes increasingly privatized and commercialized, more states may

62. Linden, *supra* note 15, at 6.

63. *Id.*

64. *Id.* at 6–7; see also Paul B. Stephan, *Regulatory Competition and Anticorruption Law*, 53 VA. J. INT'L L. 53, 55 (2012).

65. Linden, *supra* note 15, at 6.

66. See *supra* Section II.B.

seek to gain access to outer space by playing this role.⁶⁷ If private entities systemically avoid patents in this way, patent protection may become ineffective across the borders of multiple jurisdictions, which seems particularly unfair as the underlying substance of these patents — technology for outer space activity — converge in space.

IV. HARMONIZATION OF PATENT PROTECTION IN OUTER SPACE

In analyzing the problems presented by regulatory competition related to space activities, it is important to remember that the current regulatory frameworks that compete against each other already exist within an overarching harmonized architecture: the UN Treaties.⁶⁸ The UN Treaties, including the Outer Space Treaty and the Registration Convention, were intended to address the space activities conducted by states and provide a multilateral framework that lays down ground rules for space activities and allocates responsibility and liability.⁶⁹ As a result, the UN Treaties do not directly address the activities of private entities.⁷⁰ For the same reason, the UN Treaties are also silent as to the protection of patents held by private entities.⁷¹ Today, as states balance their responsibilities under the UN Treaties with the need to attract private entities to register and conduct space activities under their jurisdiction, the degradation of patent protection across multiple countries is a potential negative externality.⁷² This Part presents a degree of regulatory harmonization as a solution to the negative externality, specifically with regard to the protection of patents related to space activities.

A. Global Patent Jurisdiction for Patents Related to Space Activities

A natural solution to the current international framework's lack of global patent protection is to add a new dimension of global jurisdiction for patents related to space activities. More specifically, an authority with global patent jurisdiction can be created through an additional multilateral treaty to provide protection for patents necessary for activities in space.⁷³ Such an authority with global jurisdiction "would give

67. See generally Williams, *supra* note 1 (showing increasing commercialization of space); Linden, *supra* note 14, at 6–7 (discussing regulatory competition in space); Pannell, *supra* note 10, at 751–52 (showing consequences of patent avoidance in space).

68. See *supra* Part II.

69. See Pannell, *supra* note 11, at 743; see also *supra* Part II.

70. See *supra* Part II.

71. See *supra* Part II.

72. See *supra* Section III.B.

73. See FRANCIS LYALL & PAUL B. LARSEN, *SPACE LAW: A TREATISE* 127 (2009).

investors confidence in outer space research and encourage [space] activities.”⁷⁴ Furthermore, this system would mitigate the global degradation of patent protection resulting from state competition to attract private entities.⁷⁵ This solution neither seeks to replace regulatory competition altogether with a harmonized approach, nor asserts that the latter would be more or less efficient than the former. However, a global authority with limited patent jurisdiction is a feasible solution that specifically and effectively targets the degradation of patent protection that arises from the current regulatory competition framework.

At the most basic level, an authority with global patent jurisdiction would oversee the application and enforcement of patents related to space activities, in cooperation with any states implicated by the relevant private entities. One can imagine much variety with regard to the specific requirements for a covered patent application. For example, the global patent jurisdiction could cover any technology that relates to any space activities or only technologies that are central to operating space objects. Similarly, there could be many variations in how the patents recognized by this global authority are enforced. For instance, the authority may provide a forum for litigating alleged infringements of such patents and pass down judgments that are recognized by states and enforced by their courts. Alternatively, the authority may simply maintain a registry of valid global patents that are litigated in the courts of relevant states. Furthermore, the relevant states may be any combination of the state where the alleged infringer’s space object is registered (pursuant to the Registration Convention) or located, the state where the alleged patentee’s space object is registered or located, and the state where the alleging party holds substantially similar patents. As states currently employ vastly different standards in recognizing and enforcing patents, the same array of standards are candidates to be employed by the global patent authority.⁷⁶ Finally, one can imagine many different penalty mechanisms as well, from the allocation of patent infringement liability, to the suspension of registration to conduct activities in space.

While there are many variables, the gist of the proposed solution is that a central authority with global patent jurisdiction would, at a minimum, maintain a registry of patents that are uniformly recognized in space by states party to an underlying multilateral agreement. The existence and enforcement of this global registry would prevent the flags of convenience problem in relation to patent rights; private entities would no longer be able to avoid patent liability simply by choosing to

74. *Id.*

75. *See supra* Section III.B.

76. *See Pannell, supra* note 11, at 753 (“Many European countries base their patents upon a ‘personality’ justification while the United States relies on Lockean ideals.”).

register with states where the relevant patent does not exist.⁷⁷ This solution adds an extra layer of patent protection in a way that is conceptually comparable to the destination port in maritime law.⁷⁸ Even if a private entity was initially able to escape patent liability by choosing a flag of convenience, it would also need to adhere to the patent protection architecture provided by this global registry in order to conduct activities in space without liability.⁷⁹ It is notable that all states that currently have the capability to launch spacecraft are signatories to the UN Treaties — participation by at least these states in the global patent jurisdiction would ensure effective enforcement of this solution.⁸⁰

Creating a new global patent jurisdiction would necessitate a multilateral treaty and therefore requires the participation of numerous states to be meaningful. States have previously demonstrated willingness to lend international support for the protection of copyright in relation to space activities.⁸¹ The Convention Relating to the Distribution of Programme-Carrying Signals Transmitted by Satellite of 1974 (“Brussels Satellite Convention”), administered by the World Intellectual Property Organization (“WIPO”), declares the obligation of states to “take adequate measures to prevent the distribution on or from its territory of any programme-carrying signal by any distributor for whom the signal emitted to or passing through the satellite is not intended.”⁸² While the Brussels Satellite Convention protects the signals emitted by satellites and not the content carried by those signals, and therefore technically does not provide copyright protection, the result is functionally equivalent.⁸³ Furthermore, the Brussels Satellite Convention also builds in special exceptions for developing countries that mirror the concept of fair use in copyright law, such as the “education or information use of parts of programs.”⁸⁴ The Brussels Satellite Convention now has thirty-eight contracting parties, including the United States.⁸⁵

77. *See supra* Sections II.B, III.B.

78. *See supra* Section II.B.

79. *See supra* Section II.B.

80. There are currently nine states and one multinational state organization that have the capability to launch spacecraft: China, India, Iran, Israel, Japan, Russia, North Korea, South Korea, the United States, and the European Space Agency. NAT’L AIR & SPACE INTELLIGENCE CTR., *COMPETING IN SPACE* 12–13 (2018) <https://media.defense.gov/2019/Jan/16/2002080386/-1/-1/1/190115-F-NV711-0002.PDF> [<https://perma.cc/4SVD-UJ5G>].

81. *See, e.g.*, Brussels Convention Relating to the Distribution of Programme-Carrying Signals Transmitted by Satellite, May 21, 1974, T.I.A.S. No. 11078, 1144 U.N.T.S. 3.

82. *Id.* art. 2 ¶ 1.

83. *See* Barbara Luxenberg, *Protecting Intellectual Property in Space*, PROC. OF THE INT’L INST. OF SPACE LAW OF THE INT’L ASTRONAUTICAL FED’N 27TH COLLOQUIUM ON L. OUTER SPACE, 172, 173 (1984).

84. *Id.*

85. *WIPO-Administered Treaties*, WORLD INTELLECTUAL PROP. ORG., http://www.wipo.int/treaties/en/ShowResults.jsp?lang=en&treaty_id=19 [<https://perma.cc/V8RX-PGX9>]. Five of the nine states that currently have the capability to launch spacecraft

One possible reason that the Brussels Satellite Convention achieved such participation is that states have discretion in determining and implementing “adequate measures.”⁸⁶ Similarly, a multilateral treaty for the creation of a global patent jurisdiction may seek to realize widespread participation by delegating enforcement to the individual states and leveraging existing multilateral platforms such as WIPO.

B. Challenges of the Global Patent Jurisdiction

It is important to recognize that significant challenges accompany the potential solution of creating a global patent jurisdiction. A major obstacle for this global patent authority is that states have different requirements for granting and challenging patents.⁸⁷ For example, in the United States, an inventor must include the best method for practicing her invention in the patent application, meaning that the inventor cannot acquire a patent while keeping an important element secret.⁸⁸ There is no comparable requirement under the European Patent Convention, which currently has thirty-eight European states as signatories.⁸⁹ Also, until as recently as March 16, 2013, the United States granted patents to the first inventor when faced with multiple applications for the same invention, whereas the European Patent Convention granted patents to the first filer.⁹⁰ The United States adopted the first-to-file approach through the Leahy-Smith America Invents Act on September 16, 2011, but this was a critical difference between the United States and Europe for the preceding two centuries and is indicative of the discrepancies that still exist between the two patent systems.⁹¹ The two patent systems also have important differences with regard to the procedural and substantive standards for challenging the validity of an existing patent.⁹²

(China, India, Iran, Japan, and North Korea) are not signatories to the Brussels Satellite Convention. Participation by these states would ensure effective enforcement of the global patent registry.

86. See Luxenberg, *supra* note 82, at 173.

87. See Pannell, *supra* note 11, at 753.

88. 35 U.S.C. § 112 (2018).

89. See Convention on the Grant of European Patents, Jan. 11, 1978, 1065 U.N.T.S. 254.

90. *Differences Between US and European Patents*, IUS MENTIS (Oct. 1, 2005), <http://www.iusmentis.com/patents/uspto-epodiff/#ff-fi> [<https://perma.cc/NJ39-A9TX>].

91. Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011). Notably, a major objective of the Leahy-Smith America Invents Act was to “promote harmonization of the United States patent system with the patent systems commonly used in nearly all other countries throughout the world,” namely the first-to-file system. David W. Trilling, *Recognizing a Need for Reform: The Leahy-Smith America Invents Act of 2011*, 2012 U. ILL. J.L. TECH. & POL’Y 239, 246.

92. See Olga A. Partington & Paul A. Calvo, *A Comparison of US and EPO Post Grant Practices*, LEXOLOGY (June 16, 2017), <https://www.lexology.com/library/detail.aspx?g=bd361876-a09d-4e55-99f6-afa30dc9cabb> [<https://perma.cc/Z2ZG-UWAB>].

Naturally, the multitude of differences among the patent systems of various states might make it difficult to achieve widespread international participation.⁹³ Furthermore, some states may opt out of the multilateral treaty to take advantage of the flags of convenience problem by becoming a haven for private entities hoping to avoid patent liability.⁹⁴ However, regulatory competition may result in a race to the bottom that exacerbates the flags of convenience problem across the globe.⁹⁵ Accordingly, regulatory harmonization through a multilateral treaty presents an opportunity to reduce, if not eliminate, the global degradation of patent protection.⁹⁶

V. CONCLUSION

Privatized commercial activity in space is poised to grow rapidly in the coming years, but the body of international law that pertains to such space activity is largely limited to the UN Treaties that were entered into force between 1967 and 1984. The UN Treaties focus on harmonizing states' approaches to space activities toward "enhancing the well-being of all countries and human kind," and as a result are largely silent to the issues of space activity by private entities and protection of patents.⁹⁷ Nonetheless, two treaties offer a good starting point for analyzing the status of patents in space: the Outer Space Treaty and the Registration Convention. Under these two treaties, the state with which a space object is registered exercises jurisdiction over, and becomes responsible for damages arising from, that object.⁹⁸

The current framework of international space law bears resemblance to maritime law, and both bodies of law suffer from the flags of convenience problem. Pursuant to the Outer Space Treaty and the Registration Convention, a state's jurisdiction in space is limited to the specific space objects that are registered with that state.⁹⁹ In the context of patents, this means that a private entity conducting space activity can avoid responsibilities related to patents in one country by simply registering with another, while still having substantially equal access to space and the opportunities thereof.¹⁰⁰ As more states seek to attract private entities by providing favorable operating conditions, they may contribute to a systematic and global degradation of space-related pa-

93. See Linden, *supra* note 15, at 10.

94. See Pannell, *supra* note 11, at 755–56; see also *supra* Section III.B.

95. See *supra* Section III.B.

96. See *supra* Section IV.A.

97. *Space Law Treaties and Principles*, *supra* note 8.

98. Outer Space Treaty, *supra* note 13, arts. VI–VIII; Registration Convention, *supra* note 13, art. II.

99. See *supra* Section II.A.

100. See *supra* Section II.B.

tent protection, exacerbating the flags of convenience problem. Regulatory competition among states to provide the most relaxed national space laws and regulations that satisfy the needs of private entities conducting space activities is one condition from which such a degradation can occur. There are already significant differences among states with regard to liability insurance and indemnification, which are key considerations for private entities. Ineffective patent protection across multiple jurisdictions is one negative externality that could occur if states were to engage in a race to the bottom, as neglecting patents of other jurisdictions has no immediate impact on a state's responsibilities under international space law.

Such a race to the bottom can be prevented by creating a global patent jurisdiction for the application and protection of patents related to space activities. In effect, this solution would remove patent liabilities from the scope of regulatory competition through a multilateral treaty. The global patent authority can take many different forms depending on the types of technology protected, legal standards applied, allocation of enforcement powers and definition of relevant states, among many more considerations. The divergent patent systems which exist across different states will present a significant difficulty in achieving international support and agreement for a global patent jurisdiction. However, the presence of such widespread discrepancies is consistent with heightened regulatory competition and a race to the bottom and therefore is a reason to consider harmonizing approaches to patent protection in space.