Note

Orbital Debris: An Argument in Support of Keeping the Non-Binding Framework

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I. INTRODUCTION

As the world continues to become more and more reliant on satellite technology, the amount of orbital debris orbiting Earth is rapidly rising. By current estimates, there are more than 21,000 pieces of orbital debris larger than ten centimeters in diameter surrounding the Earth, approximately 500,000 pieces between one and ten centimeters in diameter, and more than 100 million pieces smaller than one centimeter.[1] As this amount of debris grows, the fear of a space collision between an operationally critical manmade object and a piece of orbital debris becomes more and more likely.[2]

To address this problem, international agencies such as the Inter Agency Space Debris Coordination Committee (IADC) and the Committee on the Peaceful Uses of Outer Space (COPUOS) have created guidelines and frameworks for member nations, ("States"), to implement in order to mitigate the amount of orbital debris.[3] States, such as the United States, have also implemented their own guidelines and frameworks regarding orbital debris domestically.[4] Yet despite the concerted efforts of the international bodies responsible for creating such guidelines, some observers have called for more formal and legally binding rules in outer space in order to battle orbital debris.

This paper sets out to argue that the current system of non-binding standards is sufficient to address the issue of orbital debris mitigation, and that anything more binding and formal is not only unnecessary but threatens the right of all mankind to use and explore outer space. Part II of this paper will provide a broad overview of orbital debris mitigation, along with the current treaties and laws that pertain to it. Part III will more closely examine the current system of non-binding debris mitigation guidelines and offer evidence that the current system is sufficient enough to combat orbital debris. Part IV identifies some of the remaining legal obstacles that need to be addressed before the international community can successful create an orbital debris mitigation system. Part V moves past orbital debris mitigation and examines what needs to happen in order to accomplish the next step of orbital debris remediation.

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1. *Orbital Debris Frequently Asked Questions*, NASA ORBITAL DEBRIS PROGRAM OFF., http://orbitaldebris.jsc.nasa.gov/faqs.html (last updated Mar. 2012).

2. *See generally Another Debris Avoidance Maneuver for the ISS*, 17 ORBITAL DEBRIS Q. NEWS, no. 1, Jan. 2013, at 3.

3. INTER-AGENCY SPACE DEBRIS COORDINATION COMM., IADC SPACE DEBRIS MITIGATION GUIDELINES 3 (September 2007), http://www.iadc-online.org/Documents/IADC-2002-01,%20IADC%20Space%20Debris%20Guidelines,%20Revision%201.pdf; UNITED NATIONS, OFFICE FOR OUTER SPACE AFFAIRS, SPACE DEBRIS MITIGATION GUIDELINES OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE 2 (2010), http://orbitaldebris.jsc.nasa.gov/library/Space%20Debris%20Mitigation%20Guidelines_COPUOS.pdf.

4. For an overview of State debris mitigation approaches, *see infra* p. 228.

II. Orbital Debris

A. What is Orbital Debris?

Orbital debris, also known as space debris or space junk, consists of natural or human made particles and objects that circle the Earth.[5] David Tan provides a more formal definition (excluding natural objects) defining orbital debris as, "any man-made earth-orbiting object which is non-functional with no reasonable expectation of assuming or resuming its intended function or any other function for which it is or can be expected to be authorized."[6] Examples of orbital debris include dead satellites, spent rocket stages, and other fragments associated with humanity's six decades of activity in space.[7] The Department of Defense ("DoD") tracks close to 23,000 pieces of human-generated debris in Earth orbit larger than 10 centimeters (4 inches) in size, each of which could destroy an active satellite in a collision, and scientists from various space agencies indicate there are an estimated 500,000 pieces of space debris between 1 and 10 centimeters (0.4 to 4 inches) in size that are largely untracked, each of which could severely damage an active satellite in a collision.[8] This debris is concentrated in the most heavily used regions of Earth's orbit: the Low Earth Orbit (LEO) region below 2,000 kilometers (1,200 miles) in altitude and the Geostationary/Geosynchronous Earth Orbit (GEO) region, approximately 36,000 kilometers (22,000 miles) above the equator.[9]

There is now a general consensus among the scientific community that we have passed the critical point where the density of space debris will lead to random collisions between space debris, creating new debris even if no new satellites are launched.[10]

B. Risks Posed by Orbital Debris

The primary injury related problem caused by orbital debris is the risk of damage from a collision with a manned spacecraft or worse, with

5. Howard A. Baker, Space Debris: Legal and Policy Implications 5 (1988).

6. David Tan, *Towards a New Regime for the Protection of Outer Space as the 'Province of All Mankind'*, 25 Yale J. Int'l L. 145, 151 n.21 (2000) (citing definition proposed by the International Academy of Astronautics).

7. *Space Traffic Management: Preventing a Real Life 'Gravity': Hearing on H.R. 2318 Before the Subcomm. on Space of the H. Comm. on Science, Space, and Technology*, 113th Cong. 3 (2014) [hereinafter *Hearing (Weeden)*] (statement of Brian Weeden, Technical Advisor, Secure World Foundation), http://docs.house.gov/meetings/SY/SY16/20140509/102218/HHRG-113-SY16-Wstate-WeedenB-20140509.pdf.

8. *Id.*

9. Darren McKnight and Frank Di Pentino, *New Insights on the Orbital Debris Collision Hazard at GEO,* 85 Acta Astronautica 73, 73 (2013); Stanton Eigenbrodt, *Out to Launch: Private Remedies for Outer Space Claims,* 55 J. Air L. & Com. 185, 188 n.20 (1989).

10. *Hearing (Weeden)*, *supra* note 7, at 3 (describing the Kessler Syndrome).

an astronaut.[11] What makes these objects so dangerous, despite their size, is the extraordinary speed at which they travel, ranging from 7,000 to 20,000 mph.[12] There are several examples demonstrating the destruction caused from orbital debris. In 1983, a 0.2 mm paint chip struck the window of the space shuttle Challenger, requiring replacement at a cost of $50,000.[13] In 1998, orbital debris destroyed a spent portion of a U.S. intercontinental ballistic missile during a test flight over the Marshall Islands.[14] The most dangerous feature of orbital debris is due to its ability to become self-generating in a process called the "cascade effect."[15] Proponents of the cascade effect hypothesize that large space debris pieces will increasingly collide, break apart, and fill the orbit with smaller and more numerous bits of debris.[16] These smaller pieces of debris then collide with each other, thereby creating more fragments and increasing the chance of new impacts.[17]

C. Orbital Debris Mitigation and Prevention

There are steps that can be taken in order to minimize new orbital debris, such as "preventing the explosion of energy storage devices within satellites, reducing the number of mission related objects, and developing reusable launch components can all minimize the creation of space debris."[18] Removing any leftover fuel from a spacecraft tank costs nearly nothing and significantly lowers the risk of an explosion, a major cause of orbital debris.[19] Additionally, the de-orbiting of payloads at the termination of missions would reduce the number of inactive payloads in orbit and thus, lessen the long-term sources of the cascade effect.[20] Alternatively, satellites and similar payloads coming to the end of their useful life may be placed in a disposal orbit that is unusable by functioning craft.[21]

III. Existing Law Regarding Orbital Debris

A. Binding International Treaties

While the problem of orbital debris is not hard to identify, generally

11. Lawrence D. Roberts, *Addressing the Problem of Orbital Space Debris: Combining International Regulatory and Liability Regimes*, 15 B.C. Int'l & Comp. L. Rev. 51, 55 (1992).
12. *Id.*
13. Robert Bird, *Procedural Challenges to Environmental Regulation of Space Debris*, 40 A. Bus. J. 635, 640 (2003).
14. *Id.*
15. Baker, *supra* note 5, at 13.
16. *Id.*
17. Bird, *supra* note 13, at 643.
18. *Id.*
19. *See id.*
20. *Id.*
21. *Id.*

no tools exist to prevent it from happening. This is likely due to the fact that neither the Outer Space Treaty nor its progeny specifically address orbital debris. However, the treaties do discuss several principles that frame the responsibilities of States and help establish international guidelines with respect to orbital debris.[22]

International space law is made up of four treaties: the Outer Space Treaty ("OST"), Return and Rescue Agreement, the Liability Convention, and the Registration Convention.[23] The main goal of each of these treaties is to protect the interests of all States in the exploration and use of outer space.[24] Article I of the OST states that outer space is the common heritage of all humankind, and is not subject to the appropriation by or for sovereignty.[25] It also states that outer space shall be free for exploration and use by all States and that everyone has a right of free access to all parts of outer space and celestial bodies.[26] Article VII provides that States retain jurisdiction and control of their objects launched into space.[27] Article III states that States must observe international law in the conduct of their space activities.[28] That sentence, paired with the fact that international law recognizes that states have an obligation to "ensure that activities within their jurisdiction and control respect the environment," creates an argument that the treaties impose some affirmative obligations on States to mitigate space debris.[29]

The treaties also strive to prevent damage caused to the outer space activities or interests of one State by another State.[30] As if to acknowledge the inherent risks of space activities, Article IX of the OST demands that States conduct their activities in outer space with "due regard" for

22. Nicholas D. Welly, *Enlightened State-Interest- A Legal Framework for Protecting The "Common Interest of All Mankind" From Hardinian Tragedy*, 36 MISS. J. SPACE L. 273, 275 (2010).

23. 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 (Oct. 10, 1967) [hereinafter Outer Space Treaty]; Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter the Rescue Agreement]; Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention]; Convention on Registration of Objects launched into Outer Space, Jan. 14, 1975, 1023 U.N.T.S. 15 [hereinafter Registration Convention].

24. *See* Outer Space Treaty, *supra* note 23, at art. I.

25. *Id.* at art. I.

26. *Id.*

27. *Id.* at art. VII.

28. *Id.* at art. III.

29. Welly, *supra* note 22, at 290 (quoting IAN BROWNLIE, PRINCIPLES OF PUBLIC INTERNATIONAL LAW 273 (6th ed., 2003).

30. Outer Space Treaty, *supra* note 23, at art. VII, IX; Liability Convention, *supra* note 23, at art. II, III, VII.

the activities and interests of other States party to the treaties, and prohibit causing "harmful contamination" to outer space through their activities.[31] States are also urged under Article IX to avoid causing "harmful interference" to the activities and interest of others.[32] When acknowledging this theme of "international cooperation," and "mutual assistance" among States, it is reasonable to suggest that since orbital debris jeopardizes space exploration, intentional debris-creating activities are in violation of the treaties.

The treaties also give a definition of space debris, repeatedly referring to "space objects."[33] While still slightly ambiguous, the Liability Conventions provide us with the clearest definition when they state, "The term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof."[34] The OST does not define "space object", it does use it in the context of launching.[35] Since the term "launching" includes "attempted launching" and because States retain jurisdiction and control (along with responsibility) of space objects, their responsibilities extend to objects that both do and don't make it into orbit.[36] Therefore, it can be inferred that States retain responsibility for satellites, components, launch vehicles, and everything else that likely fall within the definition of "debris."

B. Non-Binding International Guidelines and Policies

1. Inter-Agency Space Debris Coordination Committee

Today, an international consensus is rapidly building upon the principle of space debris mitigation measures.[37] The Inter-Agency Space Debris Coordination Committee ("IADC") is one of the most important and influential sources of space debris policy. Dedicated to researching space debris problems and proposing solutions, the IADC is an international organization whose membership includes the space agencies of all the major space-faring nations.[38] The IADC has compiled a set of debris mitigation guidelines in order to minimize debris-creating events as well as avoid debris-caused hazards.[39] While these guidelines are not binding international law, space agencies are encouraged to apply them to the

31. Outer Space Treaty, *supra* note 23, at art. IX.
32. *Id.*
33. *See* Liability Convention, *supra* note 23; *see also* Rescue Agreement, *supra* note 23, at art. V.
34. Liability Convention, *supra* note 23, at art. I(d).
35. *See* Outer Space Treaty, *supra* note 23, at art. X.
36. *See* Liability Convention, *supra* note 23, at art. I(b).
37. Welly, *supra* note 22, at 300.
38. Inter-Agency Space Debris Coordination Comm., *supra* note 3, at 3.
39. *Id.* at 8-10.

"greatest extent possible."[40] The mitigation measures section of the guidelines lays out four recommendations for "spacecraft" operators: the first aims to limit debris released during normal operations; the second looks to minimize the potential for on-orbit break ups; the third calls for post mission disposal; and the fourth calls for "prevention of on orbit collusions", which involves assessing risk created by space debris and utilizing all necessary avoidance maneuvers.[41]

2. *Committee on the Peaceful Uses of Outer Space*

The UN's space-arm, The Committee on the Peaceful Uses of Outer Space ("COPUOS"), has also drafted a resolution for space debris mitigation standards, with theirs being largely based on the IADC guidelines.[42] With the goal of developing a wider acceptance among the global space community, COPUOS developed seven guidelines with respect to orbital debris mitigation.[43] The first is to limit debris released during normal operations; the second is to minimize the potential for break-ups during operational phases; the third is to limit the probability of accidental collision in orbit; the fourth is to avoid intentional destruction and other harmful activities; the fifth is to minimize potential for post-mission break-ups resulting from stored energy; the sixth is to limit the long-term presence of spacecraft and launch vehicle orbital stages in the low Earth orbit region after the end of their mission; and the seventh is to limit the long-term interference of spacecraft and launch vehicle orbital stages with geosynchronous region after the end of their mission.[44]

While the IADC and COPUOS are only non-binding in nature and may lack the force necessary to effectively prevent orbital debris mitigation, "there is nonetheless an expectation of, and reliance upon, compliance by the parties."[45] This expectation carries a moral or political weight at international law, one which can be expected to influence the behaviors of space-faring states.[46]

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40. *Id.* at 5.

41. *Id.* at 8-10.

42. *See* Laura Delgado Lopez et al, *The Importance of the United Nations Guidelines for the Long-Term Sustainability of Space Activities and Other International Initiatives to Promote Space Sustainability,* 20 OASIS 37, 42 (2014).

43. UNITED NATIONS, *supra* note 3, at 2-4.

44. *Id.*

45. Oscar Schachter, *The Twilight Existence of Non-binding International Agreements,* 71 AM. J. INT'L L. 296, 299 (1977).

46. *Id.* at 303.

C. United States Orbital Debris Law and Policy

1. The Orbital Debris Mitigation Standard Practices

In 2000, the Office of the Under Secretary of Defense issued joint DoD/NASA objectives and guidelines governing the design and operation of spacecraft and launch vehicle upper stages to mitigate the growth of orbital debris.[47] These guidelines, known as the U.S. Government Orbital Debris Mitigation Standard Practices ("Standard Practices"), apply to all agencies in the U.S. government with authority over space activities: launch, reentry, and spacecraft operation.[48] The Standard Practices provide guidelines for achieving four key objectives: (1) control of debris released during normal operations; (2) minimizing debris generated by accidental explosions; (3) selection of safe flight profile and operational configuration; and (4) post-mission disposal of space structures.[49] The three basic strategies of the Standard Practices ("placing a spacecraft into a decaying orbit where it will burn up in the Earth's atmosphere, placing a spacecraft into an unused orbit where it will not interfere with operational spacecraft, or retrieving a spacecraft after the completion of its mission") have been used to structure the policies throughout the U.S. government.[50]

2. Federal Aviation Administration

While NASA has been planning on the private sector to expand its current operations in Earth's orbit to historic proportions in the near future, NASA is not the governing agency that licenses and regulates the launch of private sector space objects; that duty falls on the Department of Transportation through the Federal Aviation Administration ("FAA"), specifically the Office of Commercial Space Transportation.[51] Pursuant to the Commercial Space Launch Act of 1984, as amended, the FAA acts as the United States licensing authority for commercial launches.[52] The FAA regulates launches from Unites States territory and launch activities

47. Thierry Senechal, *Space Debris Pollution: A Convention Proposal*, in Protocol for a Space Debris Risk and Liability Convention 39, 47-48 (2007), http://pon.harvard.edu/wp-content/uploads/images/posts/Art.2-Part-A.pdf (last visited January 28, 2016).

48. *See* United Nations Office of Outer Space Affairs, Space Debris Mitigation Standards Adopted by States and International Organizations 44 (2015), http://www.unoosa.org/documents/pdf/spacelaw/sd/Space_Debris_Compendium_COPUOS_Sept_2015.pdf.

49. *U.S. Government Orbital Debris Mitigation Standard Practices,* NASA Orbital Debris Program Off., http://orbitaldebris.jsc.nasa.gov/library/usg_od_standard_practices.pdf (last visited January 28, 2016).

50. Benjamin Jacobs, *Debris Mitigation Certification and The Commercial Space Industry: A New Weapon in the Fight Against Space Pollution*, 20 Media L. & Pol'y 117, 125-26 (2011).

51. *Office of Commercial Space Transportation: About the Office*, Fed. Aviation Admin. http://www.faa.gov/about/office_org/headquarters_offices/ast/about/ (last visited Nov. 6, 2015).

52. Fed. Commc'n Comm'n, Notice of Proposed Rule Making in the Matter of Mit-

by United States nationals outside the United States.[53] The FAA regulations also provide detailed launch safety and liability insurance requirements.[54] Commercial applicants seeking to obtain a license must demonstrate that for all launch vehicle stages or components reaching the Earth orbit, there will be no unintended physical contact of the vehicle or its components with its payload after payload separation.[55] In addition, the FAA requires measures that prevent the conversion of energy sources into energy that could fragment a vehicle or its components, and examine safety matters concerning launch vehicles, such as safe flight profiles and assessment of risks.[56] This assessment includes the assessment of risk in the event a portion of a launch vehicle will reenter the Earth's atmosphere after attaining orbit.[57] In addition, the FAA undertakes a safety review of payloads, unless the payload belongs to or is operated by the United States Government, or is subject to regulation by the FCC or the National Oceanic and Atmospheric Administration.[58]

3. Federal Communications Commission

The Federal Communications Commission ("FCC" or "Commission") licenses and regulates commercial telecommunications satellites under the Communications Act of 1934.[59] "FCC licensing and regulation are governed by a core principle of the Communications Act – that issuing a license requires a finding that the public interest will be served."[60] In response to growing concerns about orbital debris, the FCC adopted debris mitigation regulations for the satellites services it licenses in 2004.[61] These rules required an applicant to describe debris mitigation plans, specifically, to describe steps taken to avoid accidental explosions, to identify and avoid collusion risks, and to safely dispose of the satellite at the end of its mission.[62] "The rules also include a requirement to dispose of geostationary satellites consistent with an International Telecom-

IGATION OF ORBITAL DEBRIS, at ¶14 (adopted March 14, 2002 and released March 18, 2002), https://apps.fcc.gov/edocs_public/attachmatch/FCC-02-80A1.pdf.

53. *Id.*

54. *Id.*

55. *Id.* at ¶15.

56. *Id.*

57. *Id.*

58. *Id.*

59. 47 U.S.C. §§ 151-52 (2014).

60. *Space Traffic Management: Preventing a Real Life 'Gravity': Hearing on H.R. 2318 Before the Subcomm. on Space of the H. Comm. on Science, Space, and Technology*, 113th Cong. 2 (2014) [hereinafter *Hearing (Nelson)*] (statement of Robert Nelson, Chief Engineer, International Bureau, Federal Communications Commission), http://docs.house.gov/meetings/SY/SY16/20140509/102218/HHRG-113-SY16-Wstate-NelsonR-20140509.pdf.

61. *Id.*

62. 47 C.F.R. § 97.207(g)(1) (2015).

munication Union recommendation adopted in 2003, and a requirement that all satellites be left in a safe, "low energy" configuration through, for example, the venting of remaining fuels and pressurants."[63] The plans are then assessed and the FCC has in some circumstances "conditioned licenses on modification of that plan, or worked with applicants prior to licensing in order to modify a plan."[64]

IV. Legal Hurdles in Orbital Debris Mitigation and Remediation

Even if the international community successfully halts the amount of orbital debris, several legal issues need to be addressed before the process of remediation can begin. First, is the absence of an international consensus on the legal definition of "space debris" since the most prominent legal issue associated with debris removal relates to the ownership of objects in space. Article VIII of the OST declares that space objects continue to belong to the country or countries that launched them.[65] The launching State retains "jurisdiction and control" for a space object while it is in outer space, on a celestial body, and upon its return to Earth.[66] The launching State never loses authority over the object, and no other nation has the legal authority to remove or otherwise interfere with it without authorization from the State of registry.[67] This is true even if the space object is nonfunctioning or fragmented.[68]

There is also no right of salvage in space, meaning that even though a satellite or some other space object may not be functioning, it does not automatically imply that it has been abandoned by the nation that launched it.[69] Fragments and components from space objects are also deemed as individual space objects themselves according to International space law, thus requiring identification to determine the owner and consent to remove it from orbit.[70] Absent consent or international agreement, the United States could only retrieve and remove objects only from its own registry.[71]

63. *Hearing (Nelson), supra* note 60, at 2.

64. *Id.*

65. Outer Space Treaty, *supra* note 23, at Art. VIII.

66. *Id.*

67. *See id.*

68. *See id.*

69. Michael Listner, *Legal Issues Surrounding Space Debris Remediation*, The Space Review, August 6, 2012, http://www.thespacereview.com/article/2130/1.

70. *Id.*

71. Steven A. Hildreth & Allison Arnold, Threats to U.S. National Security Interests in Space: Orbital Debris Mitigation and Removal, 12 (2014) (Congressional Research Service Report No. R43353).

V. Conclusion

Addressing the issue of space debris does not require an overhaul of the existing space law, as doing so would threaten the continued viability of these foundational legal instruments.[72] Cooperation remains the key to sustainable activity in outer space, evidenced by the significant progress that States have made in addressing their own orbital debris creation through COPUOS and IDAC. There is also a very strong argument to be made that the language within the main space law treaties negatively addresses orbital debris, implying that an international obligation to prevent creating orbital debris exists. However, this does not mean that change will not be needed as humanity continues to push the limits of space. Certain provisions that have been in place for over forty years, such as the Rescue Agreement, may actually impede orbital debris mitigation since its plain meaning suggests that debris mitigation may require orbital debris to be returned to the launching State to the extent that the launching State can be identified. In order for humanity to push forward in their exploration of the universe, while still maintaining the basic principles of the OST, the international community will need to continue to cooperate with orbital debris.

72. Marietta Benko & Kai-Uwe Schrogl, *Space Debris in the UN: Aspects of Law and Policy*, *in* Proc. of the Second Eur. Conf. on Space Debris 749, 752 (Mar. 17-19, 1997), http://adsabs.harvard.edu/full/1997ESASP.393. .749B (noting that renegotiating the provisions of the Outer Space Treaty or the Liability Convention might lead to an attempt by developing countries to soften the existing provisions, leaving the treaties in an altogether weaker position than their original condition).