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## ON AN AMERICAN STRATEGY TO FORGE GLOBAL SPACE LAW TO CURTAIL ORBITAL DEBRIS IN THE NEW SPACE AGE

*Michael B. Runnels\**

As the Ukrainian army enters its second year defending itself against the Russian Federation's criminal war,<sup>1</sup> the military communications vital for organizing the Ukrainian defense are powered by Starlink,<sup>2</sup> Earth's largest satellite constellation<sup>3</sup> and a product of the American corporation SpaceX.<sup>4</sup> Satellite constellations are networks of dozens to tens of thousands of mass-produced satellites that net the Earth like an exoskeleton<sup>5</sup> to perform everyday tasks like providing global broadband internet.<sup>6</sup> While the Russians violate international human rights law on the one

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<sup>1</sup> See, e.g., Robbie Gramer, *Ukraine's 'Nuremberg Moment' Amid Flood of Alleged Russian War Crimes*, FOREIGN POLICY MAGAZINE (June 10, 2022), <https://foreignpolicy.com/2022/06/10/ukraines-nuremberg-moment-amid-flood-of-alleged-russian-war-crimes/> (detailing the aftermath of Russia's withdrawal from the Kyiv region in April 2022, Gramer notes that the Russians "left in their wake nightmarish scenes of bodies strewn along the roads of Bucha... ." and that Russian war crimes during this conflict are so numerous that he advocates for the creation of a new court similar to the Nuremberg Court, convened in the aftermath World War II).

<sup>2</sup> See Vivek Wadhwa & Alex Salkever, *How Elon Musk's Starlink Got Battle-Tested in Ukraine: Fast Expanding Satellite Broadband Services are Proving Decisive During War and Other Emergencies*, FOREIGN POLICY MAGAZINE (May 4, 2022), <https://foreignpolicy.com/2022/05/04/starlink-ukraine-elon-musk-satellite-internet-broadband-drones/> (quoting a Ukrainian soldier regarding the centrality of Starlink to Ukraine's defense against Russia, the soldier argues that "Starlink is what changed the war in Ukraine's favor. Russia went out of its way to blow up all our comms. Now they can't. Starlink works under Katyusha fire, under artillery fire. It even works in Mariupol"); Yaroslav Trofimov, Micah Maidenberg, & Drew FitzGerald, *Ukraine Leans on Elon Musk's Starlink in Fight Against Russia*, WASH. ST. J. (July 16, 2022), <https://www.wsj.com/articles/ukraine-leans-on-elon-musks-starlink-in-fight-against-russia-11657963804> (describing how the Starlink internet service provider has kept front-line Ukrainian troops connected when regular cell networks failed); Volodymyr Verbyany & Daryna Krasnolutska, *Ukraine to Get Thousands More Starlink Antennas, Minister Says*, BLOOMBERG (Dec. 19, 2022), <https://www.bloomberg.com/news/articles/2022-12-20/ukraine-to-get-thousands-more-starlink-antennas-minister-says?leadSource=verify%20wall> (noting that there "is no alternative to satellite connections," Ukrainian Minister for Digital Transformation, Mykhailo Fedorov, characterizes the importance of Starlink early in the war and its ongoing critical importance as Russia continues their attempts to cut off Ukraine's internet access).

<sup>3</sup> See, e.g., *World's Most Advanced Broadband Satellite Internet*, SPACEX, <https://www.starlink.com/technology> (describing Starlink as "the world's first and largest satellite constellation using a low Earth orbit to deliver ... high-speed, low-latency internet to users all over the world").

<sup>4</sup> See, e.g., *Engineered by SpaceX*, SPACEX, <https://www.starlink.com/> (noting that "SpaceX is leveraging its experience in building rockets and spacecraft to deploy the world's most advanced broadband internet system").

<sup>5</sup> See Marina Koren, *Private Companies are Building an Exoskeleton Around Earth*, ATLANTIC (May 24, 2019), <https://www.theatlantic.com/science/archive/2019/05/spacex-satellites-starlink/590269/> [hereinafter Koren, *Private Companies*] (noting the development of satellite constellations by several companies and quoting the CEO of SpaceX, Elon Musk, regarding how its Starlink satellite constellation will unfurl. Once thousands of these satellites are in LEO, Musk notes that they will fan out across LEO "like spreading a deck of cards on the table").

<sup>6</sup> Starlink, for example, is a broadband internet service provider specializing in the expansion of coverage to rural and remote communities. It accomplishes this task by launching a constellation of satellites into LEO. See Michelle Shen & Elizabeth Pattman, *What is Starlink? Inside the Satellite Business that Could Make Elon Musk a Trillionaire*, USA TODAY (Dec. 5, 2021), <https://www.usatoday.com/story/tech/2021/12/05/elon-musk-starlink-satellites-spacex-broadband-internet-globe/8881858002/>.

hand,<sup>7</sup> they violate international space law on the other by intentionally destroying their satellites in low Earth orbit (LEO)<sup>8</sup> through anti-satellite missile strikes (ASAT),<sup>9</sup> which they implicitly threatened to do again—but to Starlink,<sup>10</sup> which owns nearly half of all satellites orbiting Earth.<sup>11</sup> Through their November 2021 LEO ASAT,<sup>12</sup> what the Russians have done already has created hundreds of pieces of “orbital debris”<sup>13</sup> that sent astronauts scrambling for safety aboard the

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<sup>7</sup> See, e.g., Alex Leff, Michele Kelemen, & Charles Maynes, *The International Criminal Court Issues an Arrest Warrant for Putin*, NATIONAL PUBLIC RADIO (Mar. 17, 2023), <https://www.npr.org/2023/03/17/1164267436/international-criminal-court-arrest-warrant-putin-ukraine-alleged-war-crimes> (detailing that Russian President, Vladimir Putin, was issued a warrant for “war crimes involving accusations that Russia has forcibly taken Ukrainian children”); Kenneth Roth, *How Putin and Xi Are Trying to Break Global Human Rights*, FOREIGN POLICY MAGAZINE (Oct. 27, 2022), <https://foreignpolicy.com/2022/10/27/putin-xi-russia-china-human-rights-united-nations/> (noting that the “International Criminal Court has opened an investigation in Ukraine and is expected to charge the Russian leadership for directing or overseeing war crimes there”).

<sup>8</sup> LEO is defined as the region from Earth’s edge to 2000 kilometers of altitude, or roughly 1200 miles above Earth’s edge. See *LEO Economy FAQs*, NASA (Feb. 18, 2022), <https://www.nasa.gov/leo-economy/faqs>; Thomas G. Roberts, *Aerospace 101: Popular Orbits 101*, CTR. FOR STRATEGIC & INT’L STUD. (2022), <https://aerospace.csis.org/aerospace101/popular-orbits-101/>. The majority of all orbital debris is located in LEO. See *NASA’s Efforts to Mitigate the Risks Posed by Orbital Debris*, NASA OFF. OF INSPECTOR GEN., REP. NO. IG-21-0113 (2021), <https://oig.nasa.gov/docs/IG-21-011.pdf>.

<sup>9</sup> Press Release, United States Space Command, Russian Direct-Ascent Anti-Satellite Missile Test Creates Significant, Long-Lasting Space Debris (Nov. 15, 2022), <https://www.spacecom.mil/Newsroom/News/Article-Display/Article/2842957/russian-direct-ascent-anti-satellite-missile-test-creates-significant-long-last/> (explaining that “Russia has demonstrated a deliberate disregard for the security, safety, stability, and long-term sustainability of the space domain for all nations,” U.S. Army Gen. James Dickinson, U.S. Space Command commander, further argued that the LEO “debris created by Russia’s [ASAT] will continue to pose a threat to activities in outer space for years to come, putting satellites and space missions at risk, as well as forcing more collision avoidance maneuvers. Space activities underpin our way of life and this kind of behavior is simply irresponsible”).

<sup>10</sup> See generally Michael Kan, *Russia Makes Veiled Threat to Destroy SpaceX’s Starlink*, PCMAG (September 19, 2022), <https://www.pcmag.com/news/russia-makes-veiled-threat-to-destroy-spacexs-starlink> (noting that Russia issued a veiled threat to “retaliate” against SpaceX’s satellite constellation for aiding the Ukrainian military); Christiaan Hetzner, *Putin Could Try to Shoot Down Elon Musk’s Starlink Satellites*, FORTUNE (October 28, 2022), <https://fortune.com/2022/10/28/russia-putin-elon-musk-starlink-satellites-ukraine-war-target/>; Lonnie Lee Hood, *Elon Musk: SpaceX Can Launch Satellites Faster Than Russia Can Shoot Them Down*, THE BYTE (March 27, 2022), <https://futurism.com/the-byte/elon-musk-spacex-satellites-russia> (commenting on Russian threats to destroy Starlink in orbit, SpaceX CEO, Elon Musk, argued that “I hope we do not have to put this to a test, but I think we can launch satellites faster than they can launch anti-satellites missiles”).

<sup>11</sup> See generally Rebecca Heilweil, *Elon Musk’s Starlink is Only the Beginning*, VOX (January 10, 2023), <https://www.vox.com/recode/2023/1/10/23548291/elon-musk-starlink-space-internet-satellites-amazon-oneweb> (detailing the advent of satellite constellations in LEO and how the increasing congestion of LEO with these projects exacerbates Earth’s orbital debris problem).

<sup>12</sup> See Kan, *supra* note 10 and accompanying text; see Hetzner, *supra* note 10 and accompanying text; see Hood, *supra* note 10 and accompanying text.

<sup>13</sup> See, e.g., United Nations Off. for Outer Space Aff., *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, at 1, U.N. Doc. V.09-88517 (2010), [http://www.unoosa.org/pdf/publications/st\\_space\\_49E.pdf](http://www.unoosa.org/pdf/publications/st_space_49E.pdf) (defining “space debris” as “all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional”); Orbital Debris Program Off., *Frequently Asked Questions*, ARES, <https://www.orbitaldebris.jsc.nasa.gov/faq/#> (defining “orbital debris” as “any human-made object in orbit about the Earth that no longer serves any useful purpose”); see also 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) (noting space debris can be defined 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”); Jennifer M. Seymour, *Note, Containing the Cosmic Crisis: A Proposal for Curbing the Perils of Space Debris*, 10 GEO. INT’L ENV’T L. REV. 891, 892 (1998) (“There is no internationally accepted definition of the

International Space Station in October 2022.<sup>14</sup> Orbiting at speeds of up to 17,500 mph,<sup>15</sup> this debris remains in Earth orbits for years until it decays, deorbits, explodes, or collides with another object, thus creating more debris.<sup>16</sup> If one were to imagine how perilous sailing the high seas would be if all the ships ever lost in history were still drifting atop the water, then one would understand the current situation in LEO, which cannot be allowed to persist.<sup>17</sup>

For these reasons, the Russian-created orbital debris is causing a “harmful interference” with other countries’ sustainable “use of outer space” in a likely violation of Article IX of the 1967 Outer Space Treaty (OST),<sup>18</sup> which is the foundation of all international space regulation and which proclaims space as the “province of all mankind.”<sup>19</sup> Indeed, as sustainable Earth orbits are indispensable to the operation of GPS, electronic commerce, weather forecasting, climate

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term ‘space debris.’ However, the term’s popular meaning is any non-functional human-made object or objects in outer space”).

<sup>14</sup> See W. Robert Pearson, *2022 Is the Year for a Space Summit*, FOREIGN POLICY MAGAZINE (January 1, 2022), <https://foreignpolicy.com/2022/01/01/space-russia-anti-satellite-test-debris/> (describing that “immediately after the satellite was destroyed, NASA told ISS personnel to conduct shelter-in-place drills to prepare for a potential collision. NASA implemented further procedures to duck and dodge danger based on a calculation that the ISS would pass ‘through or near the cloud every 90 minutes.’” Similarly, Russia’s debris’ close proximity to Starlink also forced individual satellites, within the satellite constellation, to take evasive action); see also Press Release, *supra* note 9 (noting that the U.S. government’s “initial assessment is that the debris will remain in orbit for years and potentially for decades, posing a significant risk to the crew on the International Space Station and other human spaceflight activities, as well as multiple countries’ satellites.” The Press Release goes on to quote the commander of the U.S. Space Command’s argument that “Russia is developing and deploying capabilities to actively deny access to and use of space by the United States and its allies and partners” ... and that “Russia’s tests of direct-ascent anti-satellite weapons clearly demonstrate that Russia continues to pursue counterspace weapon systems that undermine strategic stability and pose a threat to all nations”).

<sup>15</sup> See *NASA’s Efforts to Mitigate the Risks Posed by Orbital Debris*, NASA OFF. OF INSPECTOR GEN., REPORT NO. IG-21-011 3 (2021), <https://oig.nasa.gov/docs/IG-21-011.pdf> (characterizing the orbital mechanics of debris, NASA explains that “the average speed at which one object impacts another in space is approximately 10 km per second—more than 10 times faster than a bullet. At these speeds, even millimeter-sized debris pose a threat . . . [to human space flight and robotic missions]”).

<sup>16</sup> *Id.*

<sup>17</sup> See Jeremy Miller, *December Stargazing: Trashing Space – Humans Treat Space Like We Treat the Planet*, SIERRA CLUB (Dec. 1, 2021), <https://www.sierraclub.org/sierra/december-stargazing-trashing-space> (quoting the then Director General of the European Space Agency, Jan Wörner, characterizing the hazardous state of LEO environment).

<sup>18</sup> See 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, 610 U.N.T.S. 205 [hereinafter the OST] (The OST was the first international space law treaty, which was originally negotiated between the United States and the Soviet Union).

<sup>19</sup> *Id.* at art. I. Regarding the sustainable use of the outer space environment requirement arising from Article IX of the OST, Article IX provides, in relevant part, that:

[i]n the exploration and use of outer space . . . States Parties to the Treaty . . . shall conduct all their activities in outer space . . . with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination . . . If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space . . . would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space . . . it shall undertake appropriate international consultations before proceeding with any such activity or experiment.

research,<sup>20</sup> internet access,<sup>21</sup> national security,<sup>22</sup> and human spaceflight safety,<sup>23</sup> to name only a few critical Earth services, the failure to mitigate the risks posed by orbital debris threatens both the functioning of Earth's information infrastructure<sup>24</sup> and the scientific investigation of outer space.<sup>25</sup> Yet, it is not just the Russians operating as if they live in a lawless void of space, as the People's Republic of China also casually explodes their satellites in LEO<sup>26</sup> while allowing the spent rocket stages from their launches to fall uncontrollably back to Earth.<sup>27</sup>

Within this geopolitical context, we are also experiencing a golden age of scientific discovery,<sup>28</sup> particularly regarding our access to the economic bounties of outer space,<sup>29</sup> which

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<sup>20</sup> See USC Global Security Staff, *What Are Satellites Used For?*, UNION CONCERNED SCIENTISTS (Jan. 15, 2015), <https://www.ucsusa.org/nuclear-weapons/space-weapons/what-are-satellites-used-for#.XDfGNM9Kiu4>.

<sup>21</sup> See Nathan Hurst, *Why Satellite Internet Is the New Space Race*, PCMAG (July 30, 2018), <https://www.pcmag.com/article/362695/why-satellite-internet-is-the-new-space-race>.

<sup>22</sup> See Jeff Foust, *U.S. Air Force Releasing More Data on Orbits of Military Satellites*, SPACENEWS (Dec. 17, 2018), <https://spacenews.com/u-s-air-force-releasing-more-data-on-orbits-of-military-satellites/>.

<sup>23</sup> See Pearson, *supra* note 14 and accompanying text; see Press Release, *supra* note 9 and accompanying text.

<sup>24</sup> See Owen Brown, Travis Cottom, Michael "Mick" Gleason, Matthew Hallex, Andrew Long, Edgar Rivera, David Finkleman, Theresa Hitchens, Moriba Jah, David Koplou & Ray Sedwick, *Orbital Traffic Management Study: Report on Space Traffic Management Assessments, Frameworks and Recommendations*, SCI. APPLICATIONS INT'L CORP. 1, 4 (2016), <https://spacepolicyonline.com/wp-content/uploads/2016/12/Orbital-Traffic-Mgmt-report-from-SAIC.pdf>.

<sup>25</sup> See Marit Undseth, Claire Jolly & Mattia Olivari, *Space Sustainability: The Economics of Space Debris in Perspective*, OECD SCI., TECH. AND INDUS. POL'Y PAPERS, No. 87 1, 22–23 (2020), [https://read.oecd-ilibrary.org/science-and-technology/space-sustainability\\_a339de43-en#page1](https://read.oecd-ilibrary.org/science-and-technology/space-sustainability_a339de43-en#page1) (detailing the dangers of unchecked orbital debris in Earth orbits); see also Clement Hearey, *When You Wish Upon a "Starlink": Evaluating the FCC's Actions to Mitigate the Risk of Orbital Debris in the Age of Satellite "Mega-Constellations,"* 72 ADMIN. L. REV. 751, 770 (2020) (arguing that the failure to mitigate the risks posed by orbital debris would render "satellite systems unreliable, if not completely useless. . . . GPS would become unreliable or unusable, and military and scientific research would stall"); see also Paul Ratner, *How the Kessler Syndrome Can End All Space Exploration and Destroy Modern Life*, BIG THINK (Aug. 29, 2018), <https://bigthink.com/paul-ratner/how-the-kessler-syndrome-can-end-all-space-exploration-and-destroy-modern-life>; see Pearson, *supra* note 14 and accompanying text; see Press Release, *supra* note 9 and accompanying text; see, e.g., the OST, *supra* note 18, at art. I (providing that the "exploration and . . . scientific investigation" of outer space, the Moon, and other celestial bodies "shall be carried out for the benefit and in the interests of all countries" and "be the province of all mankind").

<sup>26</sup> See, e.g., Bates Gill and Martin Kleiber, *China's Space Odyssey: What the Antisatellite Test Reveals About Decision-Making in Beijing*, FOREIGN AFFAIRS (2007), <https://www.foreignaffairs.com/articles/china/2007-05-01/chinas-space-odyssey> (arguing that China's 2007 ASAT test has "cast doubt on China's reliability as a global partner . . ." as this test, as of 2007, created more orbital debris "than any other single human event, putting at risk China's own satellites and those of other countries for decades to come." In detailing the effects on satellites in LEO from China's ASAT, the authors argue that "Beijing not only demonstrated its capacity to threaten U.S. military assets in space but also showed a lack of concern for other countries' interest in the safe operation of satellites for day-to-day civilian activities, such as weather forecasting, financial transactions, and telephone calls").

<sup>27</sup> See Andrew Jones, *Chinese Rocket Stage Crashes to Earth Over Texas*, SPACE.COM (Mar. 14, 2023), <https://www.space.com/chinese-rocket-stage-crashes-earth-over-texas>.

<sup>28</sup> See George Musser, *Our Fate Is in the Stars*, THE AMERICAN SCHOLAR (June 3, 2019), <https://theamericanscholar.org/our-fate-is-in-the-stars/> (advocating for a revitalization of America's space program, Musser argues that future generations "will see today as a golden age of discovery in many areas of science and technology, but especially in astronomy").

<sup>29</sup> See, e.g., *Space: Investing in the Final Frontier*, MORGAN STANLEY (July 24, 2020), <https://www.morganstanley.com/ideas/investing-in-space> (estimating that the global space industry could generate revenue of more than \$1 trillion or more in 2040, up from the current \$447 billion); *Capital Flows as Space Opens for Business*, MORGAN STANLEY (July 21, 2020), <https://www.morganstanley.com/ideas/future-space-economy> (describing the nascent space economy as demonstrable fertile grounds for private investment). The article notes that this new "space race is being powered not just by government but by a new crop of startups and visionaries.

cannot be accessed if LEO is enshrouded in a near impenetrable maelstrom of orbital debris moving at speeds faster than a bullet.<sup>30</sup> While ASATs can cause this catastrophe, the likeliest source of this debris field does not come from the ASATs of rogue authoritarian states, but rather from the exponential growth of the commercial satellite constellation industry and the regulatory void within which it thrives.<sup>31</sup> Indeed, several recent studies highlight how the risk of LEO collisions will be exponentially increased by the deployment of satellite constellations.<sup>32</sup> Notwithstanding these risks, companies are launching satellites at an unprecedented rate to build satellite constellations in LEO.<sup>33</sup> Clearly, Earth is one planet and, equally as clear, orbital debris in LEO is a planetary problem demanding a planetary solution.<sup>34</sup> What is less clear, however, is

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...[E]ntrepreneurs, strategic partnerships, and venture capital have been leading the charge on funding” for these ventures and that, for some of these investments, “the exit plans can be 50 years out.” The article further discusses that “[we’re] seeing a tremendous amount of interest in this area from angel investors, venture capital and private-equity firms...” and that much of this is real passion in the industry, though “some of it is simply fear of being late to the party. Things are changing at such a rapid pace that investors are saying they have to keep up with the times... [and] [b]ecause success in space promises to be a multidecade endeavor - with returns on some lofty endeavors that could be many years away - this new economy requires patient investors. One sign of investors’ willingness to wait is the increasing reliance on permanent and long-term capital funds.” *Id.*; *ESA Space Resources Strategy*, EUROPEAN SPACE AGENCY (May 23, 2019), [https://sci.esa.int/documents/34161/35992/1567260390250-ESA\\_Space\\_Resources\\_Strategy.pdf](https://sci.esa.int/documents/34161/35992/1567260390250-ESA_Space_Resources_Strategy.pdf) (concluding that 88 billion to 206 billion dollars over the 2018–2045 period are expected from space resource utilization). *Id.* at 5; *Opportunities for Space Resources Utilization: Future Markets & Value Chains*, LUXEMBOURG SPACE AGENCY (Dec. 2018), <https://space-agency.public.lu/dam-assets/publications/2018/Study-Summary-of-the-Space-Resources-Value-Chain-Study.pdf> (noting that the nascent space resources utilization industry is expected to generate a market revenue of 88 billion to 206 billion dollars over the 2018–2045 period, supporting a total of 845,000 to 1.8 million full time employees). *Id.* at 9. The report further notes that the “[i]ncorporation of space resources into exploration missions will reduce costs and improve their economic viability” and that, as such, “[s]pace resources will play a foundational role in the future of in-space economies;” *Space: The Next Investment Frontier*, GOLDMAN SACHS EQUITY RESEARCH REPORT (April 4, 2017) at 4, <http://www.fullertreacymoney.com/system/data/files/PDFs/2017/October/4th/space%20-%20the%20next%20investment%20frontier%20-%20gs.pdf> (noting that “[w]hile relatively small markets today, rapidly falling costs are lowering the barrier to participate in the space economy, making new industries like space tourism, asteroid mining, and on-orbit manufacturing viable”).

<sup>30</sup> See, e.g., Donald J. Kessler & Burton G. Cour-Palais, *Collision Frequency of Artificial Satellites: The Creation of a Debris Belt*, 83 J. GEOPHYSICAL RSCH. 2637, 2637 (1978) (characterizing this scenario as the “Kessler Syndrome,” Donald Kessler, the NASA astrophysicist who helped assess the International Space Station’s vulnerability to orbital debris, was the first person to understand this reality of debris as a form of high-speed environmental damage and is credited with developing the first credible theory that characterizes this damage).

<sup>31</sup> See, e.g., Michael B. Runnels, *On Clearing Earth’s Orbital Debris & Enforcing the Outer Space Treaty in the U.S.*, AM. BAR. ASS’N (Jan. 13, 2022), <https://perma.cc/3GYE-SNES> (detailing that as the OST does not “compellingly disincentivize debris creation in orbit,” Runnels argues that this lack of clear regulation “enable[s] the creation of orbital debris”).

<sup>32</sup> See Chuan Chen & Wulin Yang, *The Impact of Large Constellations on Space Debris Environment and its Countermeasures*, 8<sup>TH</sup> EUROPEAN CONFERENCE FOR AERONAUTICS AND SPACE SCIENCES, 2019, at 2–6; S. Le May et al., *Space Debris Collision Probability Analysis for Proposed Global Broadband Constellations*, 151 ACTA ASTRONAUTICA 445, 445–55 (2018); Jonas Radtke et al., *Interactions of the Space Debris Environment with Mega Constellations—Using the Example of the OneWeb Constellation*, 131 ACTA ASTRONAUTICA 55, 55– 68, (2017); see also, e.g., Mitre Corp., *supra* note 54 and accompanying text.

<sup>33</sup> See Samantha Masunaga, *A Satellite’s Impending Fiery Demise Shows How Important it is to Keep Space Clean*, L.A. TIMES (June 27, 2021), <https://www.latimes.com/business/story/2021-06-27/satellites-self-destruct-clean-up-space-junk>.

<sup>34</sup> See Pearson, *supra* note 14 (characterizing the Russian ASAT that created a harmful debris field in LEO as a disturbing manifestation of the escalating geopolitical tensions that occur as “space becomes more intensely used,” Pearson argues that “the establishment of regulatory norms for space activities is a global challenge requiring a multilateral approach”).

how one might achieve this desired outcome. As America leads the world in the total number of satellites in space per country<sup>35</sup> and SpaceX will own more satellites than each country in the world combined once it fully deploys Starlink,<sup>36</sup> America is uniquely positioned to begin filling this regulatory void.

Arguing that the “satellite industry is growing at a record pace, but here on the ground our regulatory frameworks for licensing them have not kept up,”<sup>37</sup> the Federal Communications Commission (FCC) voted unanimously to reorganize its International Bureau into a “Space Bureau”<sup>38</sup> (Bureau) in January 2023. The purpose of the Bureau will be to “develop, recommend, and administer policies, rules, standards, and procedures for the authorization and regulation of domestic and international satellite systems.”<sup>39</sup> The adoption of this reorganization was preceded by the FCC’s September 2022 adoption of a new rule changing the deorbiting timeframe for satellites ending their missions in LEO from a twenty-five year recommendation<sup>40</sup> to a five year legal requirement.<sup>41</sup> In explaining the rationale for this rule, FCC Chairwoman, Jessica Rosenworcel, argued that “[we] are [taking] action to care for our skies ... [o]ur space economy is moving fast. The second space age is here. For it to continue to grow, we need to do more to clean up after ourselves so space innovation can continue to expand.”<sup>42</sup> These rules are consistent with the 2020 National Space Policy of the United States of America (National Space Policy), which declared that “[t]o preserve the space environment for responsible, peaceful, and safe use, and with a focus on minimizing space debris, the United States shall: [c]ontinue leading the development and adoption of international and industry standards and policies... .”<sup>43</sup>

The FCC’s recent regulatory activity also followed on the heels of the July 2022 unveiling of the United States’ National Orbital Debris Implementation Plan (Orbital Debris Plan),<sup>44</sup> declaring that “the challenges posed by orbital debris to the sustainability of outer space have

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<sup>35</sup> See, e.g., Kelly Kizer Whitt, *Who Owns all the Satellites?*, EARTHSKY (Feb. 8, 2022), <https://earthsky.org/space/who-owns-satellites-company-country/>.

<sup>36</sup> *Id.*

<sup>37</sup> See *Chairwoman Rosenworcel Announces Plan to Modernize the FCC by Establishing a Space Bureau and Office of International Affairs*, FCC (2022), <https://docs.fcc.gov/public/attachments/DOC-387720A2.pdf>.

<sup>38</sup> See *Commission Votes to Establish a Space Bureau and Office of International Affairs*, FCC (2023), <https://docs.fcc.gov/public/attachments/DOC-390599A1.pdf>.

<sup>39</sup> See *Establishment of the Space Bureau and the Office of International Affairs and Reorganization of the Consumer and Governmental Affairs Bureau and the Office of the Managing Director*, FCC 23-1, 12 (2023), <https://docs.fcc.gov/public/attachments/FCC-23-1A1.pdf>.

<sup>40</sup> See Debra Werner, *Will Megaconstellations Cause a Dangerous Spike in Orbital Debris*, SPACE NEWS (Nov. 15, 2018), <https://spacenews.com/will-megaconstellations-cause-a-dangerous-spike-in-orbital-debris/> (explaining that the 25-year rule is voluntary UN guideline, published in 2007 by the Inter-Agency Space Debris Coordination Committee, recommending that satellites in LEO be deorbited no more than 25 years after the end of operations to minimize the risk of collisions that would create debris); *Id.*

<sup>41</sup> See FCC Adopts New ‘5-Year Rule’ for Deorbiting Satellites to Address Growing Risk of Orbital Debris, September 29, 2022, <https://www.fcc.gov/document/fcc-adopts-new-5-year-rule-deorbiting-satellites>.

<sup>42</sup> See STATEMENT OF CHAIRWOMAN ROSENWORCEL, September 29, 2022, <https://docs.fcc.gov/public/attachments/DOC-387720A2.pdf>.

<sup>43</sup> See *The National Space Policy*, 85 Fed. Reg. 81,755, 81,671–72 (Dec. 16, 2020); see also, e.g., Exec. Off. of the President, *United States Space Priorities Framework 7* (2021), <https://www.whitehouse.gov/wp-content/uploads/2021/12/United-States-Space-Priorities-Framework--December-1-2021.pdf>.

<sup>44</sup> See NATIONAL ORBITAL DEBRIS IMPLEMENTATION PLAN, July 28, 2022, <https://www.whitehouse.gov/wp-content/uploads/2022/07/07-2022-NATIONAL-ORBITAL-DEBRIS-IMPLEMENTATION-PLAN.pdf>.

inherent similarities to other human-made global environmental challenges,”<sup>45</sup> and tasking several Federal agencies, including the FCC,<sup>46</sup> with reviewing the effectiveness of United States policies regarding the expanding risks of orbital debris in LEO. Consistent with both the National Space Policy and the Orbital Debris Plan, the FCC’s new rules are expected to be among the first of several draft rules regarding orbital debris from the FCC.<sup>47</sup> However, while FCC rules may appear to substantively address the risks posed by orbital debris, they continually fail to do so in three critical areas.

First, they do not adopt specific requirements from their applicants for sharing the data that is key to establishing a safe space traffic management (STM) system.<sup>48</sup> Second, they do not enforce the National Environmental Policy Act (NEPA)<sup>49</sup> in their commercial satellite application process by not requiring that their applicants prepare an Environmental Assessment (EA)<sup>50</sup> on LEO orbits, which would assess the impacts of satellite constellation projects on the creation of orbital debris.<sup>51</sup> Third, regarding the FCC’s compliance with the OST, the FCC’s regulatory practice of assigning orbital regions to satellite constellation operators on a first-come, first-served basis,<sup>52</sup> without

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<sup>45</sup> *Id.* at 5.

<sup>46</sup> *Id.* at 7 (explaining that the Orbital Debris Plan details several Federal agencies as engaged in orbital debris risk management, specifically numerous U.S. Government departments and agencies are involved in orbital debris risk management. The National Aeronautics and Space Administration (NASA) uses radars, telescopes, and in situ measurements to statistically sample debris too small to be tracked but still large enough to threaten human spaceflight and robotic missions. NASA also leads the development of the U.S. Government Orbital Debris Mitigation Standard Practices (ODMSP), which are directly applicable to U.S. Government operators. NASA also maintains an office to monitor the space environment for its own satellites. The Department of Defense (DOD) collects data on and tracks space objects and notifies spacecraft operators of possible collision. DOD is transitioning the responsibility of providing notifications for civil and commercial operators to the Department of Commerce (DOC). The Federal Aviation Administration (FAA) and the Federal Communications Commission (FCC) have policies or regulations that are intended to limit the creation or accumulation of debris.

<sup>47</sup> See FCC OPENS PROCEEDING ON SERVICING, ASSEMBLY, AND MANUFACTURING IN SPACE, August 5, 2022, <https://www.fcc.gov/document/fcc-opens-proceeding-servicing-assembly-manufacturing-space>.

<sup>48</sup> See, e.g., Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156, at 4184, 4188–89 (2020) (explaining that the Commission declined to adopt specific requirements because it wanted to provide flexibility to operators); see also Theodore J. Muelhaupt, Marlon E. Sorge, Jamie Morin & Robert S. Wilson, *Space Traffic Management in the New Space Era*, 6 J. OF SPACE SAFETY ENG’G 80, 80–81 (2019) (discussing the importance of tracking and data accuracy in assessing collision alerts and noting that current practices and tracking accuracy may leave satellite operators having to “sort through an enormous haystack to find the needles”); see also Hearey, *supra* note 25, at 761–64 (providing a detailed analysis of how the FCC created its Guidelines).

<sup>49</sup> NEPA, 42 U.S.C. § 4321 (2018) (requiring “federal agencies to take a hard look at the environmental consequences of their projects before taking action”) (requiring an agency be responsible for NEPA review of its actions if it is reasonably foreseeable that those actions could lead a third party to engage in activity that could significantly impact the environment). See, e.g., Brady Campaign to Prevent Gun Violence v. Salazar, 612 F.Supp. 2d 1, 13 (D.D.C. 2009).

<sup>50</sup> See 40 C.F.R. § 1508.9(a)(1) (indicating an EA is a “concise public document” that provides evidence and analysis as to whether the agency’s action will have a significant impact on the environment) (explaining the process either concludes in a “finding of no significant impact,” or a requirement to complete an Environmental Impact Statement (EIS)).

<sup>51</sup> See, e.g., Michael B. Runnels, *On Launching Environmental Law into Orbit in the Age of Satellite Constellations*, J. AIR L. & COMM. 88 J. Air L. & Com. 181 (2023) (arguing that LEO should qualify as a “human environment” under the National Environmental Protection Act, Runnels provides draft legislation that codifies this argument, which will ensure that commercial satellite applicants perform an EA on LEO orbits as a requirement for receiving a license to launch.

<sup>52</sup> See, e.g., FCC, IB DOCKET NO. 16-408, FACT SHEET, UPDATING RULES FOR NON-GEOSTATIONARY-SATELLITE ORBIT FIXED-SATELLITE SERVICE CONSTELLATIONS, 17 (2017),



either formally assessing the effects on the use of LEO orbits by other nations<sup>53</sup> or the likely orbital debris-related environmental impacts to those orbits,<sup>54</sup> likely violates Article I of the OST, declaring that outer space must be explored and used “for the benefit and in the interests of all countries,”<sup>55</sup> Article II, prohibiting States from claiming a “national appropriation” of outer space “by means of use or occupation, or by other means,”<sup>56</sup> and Article IX, requiring nations to conduct their activities in outer space in a way that does not cause “potentially harmful interference” with the use of outer space by other nations.<sup>57</sup>

Such concerned arguments regarding the environmental sustainability of LEO orbits are seemingly not lost on the Government Accountability Office (GAO), which was tasked in 2020 with reviewing whether the FCC’s practices of excluding satellite applicants from NEPA review are appropriate, and whether Congress should revoke them.<sup>58</sup> In its resulting September 2022 report,<sup>59</sup> the GAO found that the FCC “has not sufficiently documented its decision to apply its categorical exclusion when licensing large constellations of satellites”<sup>60</sup> and recommended that the FCC “(1) review and document whether licensing large constellations of satellites normally does not have significant effects on the environment, ... [and] (2) establish a timeframe and process for a periodic review of its categorical exclusion under NEPA ... .”<sup>61</sup> In developing their recommendations, the GAO presumed, without opining on the intent of NEPA’s text, that satellite operations in LEO do have an environmental effect due to “orbital debris and risk to satellites [in LEO] ... [explaining that] [a]lthough these effects might be small for single satellites, the effects of many satellites operating in large constellations are larger, or in some cases, unknown.”<sup>62</sup> The GAO report then noted that the FCC agreed with their recommendations.<sup>63</sup> Nonetheless, given the

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[https://transition.fcc.gov/Daily\\_Releases/Daily\\_Business/2017/db0907/DOC-346584A1.pdf](https://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0907/DOC-346584A1.pdf); *see generally supra* note 31 (discussing how the FCC’s “first-come, first-served” allocation practice may violate the OST).

<sup>53</sup> *See supra* note 31 (noting the FCC’s lack of consideration of how its LEO assignment procedures interferes with the use of outer space by other nations).

<sup>54</sup> *Id.*; *see also, e.g.* Mitre Corp., *The Impacts of Large Constellations of Satellites* 101–2 (2021), [https://www.nsf.gov/news/special\\_reports/jasonreportconstellations/#:~:text=review%20the%20full-,PDF%20report](https://www.nsf.gov/news/special_reports/jasonreportconstellations/#:~:text=review%20the%20full-,PDF%20report) [hereinafter JASON]. (noting that the only real FCC regulations that constrain the growth of mega-constellations regard the availability of radio spectrum, arguing that the FCC’s 2020 orbital debris guidelines are mere requirements for disclosure rather than mandated thresholds, and concluding that FCC regulations fail to effectively mitigate orbital debris in LEO orbits and “fall well short of what the FCC evidently thinks are required for safe traffic management in space. . . .”). JASON was asked by the National Science Foundation and Department of Energy to assess the possible growth and impact of future mega-constellations on orbital debris, mega-constellation impacts on optical astronomy generally, infrared astronomy, radio astronomy, cosmic microwave background studies, and laser guide-star observations. *Id.* at 1.

<sup>55</sup> *See* the OST, *supra* note 18, at art. I.

<sup>56</sup> *Id.*; *see also* the OST, *supra* note 18, at art. II.

<sup>57</sup> *See supra* note 19 and accompanying text.

<sup>58</sup> *See* Jonathan O’Callaghan, *Satellite Constellations Could Harm the Environment, New Watchdog Report Says*, SCIENTIFIC AMERICAN, available at <https://www.scientificamerican.com/article/satellite-constellations-could-harm-the-environment-new-watchdog-report-says/> (detailing that the GAO report notes that Elon Musk’s Starlink and other satellite constellation projects are sources for orbital debris and, thus, should face an environmental review).

<sup>59</sup> *See, e.g. Satellite Licensing: FCC Should Reexamine Its Environmental Review Process for Large Constellations of Satellites*, U.S. GOV’T ACCOUNTABILITY OFFICE, ii (2022), <https://www.gao.gov/products/gao-23-105005>.

<sup>60</sup> *Id.*

<sup>61</sup> *Id.*

<sup>62</sup> *Id.* at 6.

<sup>63</sup> *See supra* note 59

United States Supreme Court's June 2022 ruling in *West Virginia v. EPA*,<sup>64</sup> which reversed Environmental Protection Agency (EPA) carbon dioxide regulations by arguing that the Clean Air Act<sup>65</sup> does not explicitly authorize the EPA to regulate carbon dioxide emissions,<sup>66</sup> FCC rulemaking in the area of orbital debris may not survive judicial scrutiny as the FCC is similarly not explicitly authorized by Congress to regulate orbital debris.

Given the increasing probability that the current unfettered growth of orbital debris will compromise the exploration and scientific investigation of outer space, enforceable global space laws are needed to curtail this possible outcome. While the geopolitical will to forge a new global treaty does not seem forthcoming,<sup>67</sup> the current geopolitical context provides an opportunity for an American-led strategy for establishing foundational global space laws consistent with the text of the OST. Because Article VI of the OST provides that “[p]arties to the treaty shall bear international responsibility for [their] activities in outer space” whether “carried on by governmental agencies or by non-governmental entities,”<sup>68</sup> it requires the “authorization and continuing supervision”<sup>69</sup> of their commercial actors. Furthermore, Article VIII of the OST provides that nation signatories “on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object . . . while in outer space.”<sup>70</sup> For these reasons, when the United States creates regulations concerning the commercial space industry, it also implements domestic legislation of the OST.<sup>71</sup>

Given the central role that the FCC plays in licensing commercial satellite constellations, and given the purpose of its newly-created bureau, this American-led strategy should be rooted in (1) Congress first adopting domestic implementing legislation of the OST that is responsive to both the looming threats of LEO orbital debris and the Supreme Court's recent EPA ruling, which will then; (2) serve as the basis for bilateral and multilateral treaty negotiations with both current and potential space-faring nations. This resulting network of treaties would provide the basis for a customary international law that will mitigate orbital debris that poses potentially harmful

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<sup>64</sup> *West Virginia v. Env't Prot. Agency*, 142 S. Ct. 2587, 2610–16 (June 30, 2022) (reversing EPA carbon dioxide regulations and articulating that the Clean Air Act does not explicitly authorize the EPA to regulate carbon dioxide emissions in a manner that triggers a nationwide transition away from the use of coal, and that Congress must speak clearly on the subject in order for the EPA to exercise this power).

<sup>65</sup> 42 U.S.C. § 7401 (1963).

<sup>66</sup> See *supra* note 64 and accompanying text.

<sup>67</sup> See generally Matthew G. Looper, *International Space Law: How Russia and the U.S. are at Odds in the Final Frontier*, 18 S.C. J. INT'L L. & BUS. 111, 120–25 (noting how initial U.S-Russian relationships helped forge the OST, Looper goes on to argue that the Russian-Chinese geopolitical alignment, which is occurring at the expense of both countries' relationship with the U.S. hinders the further pursuit of global space governance).

<sup>68</sup> See the OST, *supra* note 18, at art. VI.

<sup>69</sup> *Id.*

<sup>70</sup> *Id.* at art. VIII. The issue of each nation's jurisdiction is addressed under a transnational law through a system of registration. The 1976 Registration Convention requires a launching nation to maintain a registry of launched space objects. The convention provides that “[w]hen a space object is launched into earth orbit . . . the launching State shall register the space object by means of an entry in an appropriate registry which it shall maintain.” See Convention on Registration of Objects Launched into Outer Space art. II, ¶ 1, Nov. 12, 1974, S. Treaty Doc. No. 94-18, 1023 U.N.T.S. 15.

<sup>71</sup> See Major John S. Goehring, *Properly Speaking, the United States Does Have an International Obligation to Authorize and Supervise Commercial Space Activity*, 78 A.F. L. Rev. 101, 104 (2018) (identifying the need for Congress to fill in regulatory mechanisms in order to fulfill U.S. obligations pertaining to “authorization and continuing supervision” of outer space activities under the OST).

interference with the use of outer space by other nations. In contrast to the general principles enshrined in the American-led Artemis Accords,<sup>72</sup> this strategy would seek the inclusion of specific requirements within enforceable OST domestic implementing legislation that will enhance the sustainability of LEO orbits. This legislation should (1) require commercial satellite operators to disclose data that is key to establishing a safe STM system;<sup>73</sup> (2) require commercial satellite operators to prepare an EA on LEO orbits;<sup>74</sup> and (3) require commercial satellite operators to pay an orbital use fee that will fund orbital debris remediation and research.<sup>75</sup>

Indeed, under Article VI, new rules can and should be formulated in conformity with the OST.<sup>76</sup> Moreover, consistent with the National Space Policy and the purpose of the FCC's newly-created bureau, taking a leadership position in implementing new policies for in-orbit environmental impacts will allow America to influence other nations positively and engage them in an internationally constructive approach.<sup>77</sup> Such a legislative and diplomatic strategy would meet these challenges by helping to operationalize the OST's proclamation establishing space as the "province of all mankind,"<sup>78</sup> and promoting its peaceful use and exploration for the "benefit and in the interests of all countries."<sup>79</sup>

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<sup>72</sup> The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, § 1, Oct. 13, 2020, NASA, <https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf>.

<sup>73</sup> See, e.g., Michael B. Runnels, *Protecting Earth and Space Industries from Orbital Debris: Implementing the Outer Space Treaty to Fill the Regulatory Vacuum in the FCC's Orbital Debris Guidelines*, *Am Bus Law J.* 60, 175-229 (2023) (arguing that the FCC's current regulatory regime certainly violates the spirit the OST, while likely violating the letter of the OST, Runnels provides draft legislation to amend Title 51 of the United States Code to require commercial satellite operators to disclose the data vital to establishing a safe STM system as a requirement for receiving a license to launch).

<sup>74</sup> See, e.g., *supra* note 51 and accompanying text.

<sup>75</sup> See, e.g., *supra* note 31 (providing draft legislation to amend Title 51 of the United States Code to create an orbital use fee, which will be levied on commercial satellite operators as a requirement for receiving a license to launch).

<sup>76</sup> See the OST, *supra* note 18, at art. I.

<sup>77</sup> See generally Richard Green et al., *SATCON2: Policy Working Group Report*, in *REP. OF THE SATCON2 WORKSHOP 1*, 81 (2021), <https://baas.aas.org/pub/q099he5g> (noting arguments concerning how satellites negatively impact ground-based astronomy, SATCON2 argues that the U.S. should demonstrate leadership on such matters through implementing domestic legislation based on the OST).

<sup>78</sup> See the OST, *supra* note 18, at art. I.

<sup>79</sup> *Id.*