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"

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INTRODUCTION

The phrase "space race" generally evokes thoughts of the Cold War-era competition between the United States and the Soviet Union, where each

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sought to achieve firsts in space flight capability. Few people are likely to think about this phrase in the context of the twenty-first century; however, today there is a new space race occurring among manufacturers of small satellites who are competing to blanket the globe with high-speed Internet access[1] by using satellite "mega-constellations."[2]

According to the Federal Communications Commission (FCC), 21.3 million Americans do not have access to a broadband Internet connection.[3] The International Telecommunications Union (ITU) reports that only 51% of the global population has Internet access.[4] The potential to bring dedicated and reliable high-speed Internet access to remote and underserved populations across the globe is a possibly revolutionary development.[5] Increased Internet access can foster economic development and growth among the general population by improving global connectivity and service in commercial areas, such as implementing high-speed trading, improving global shipping logistics and fleet management, and establishing smart factories.[6] Global high-speed Internet access also offers societal benefits by providing reliable and dedicated high-speed connectivity for schools, hospitals, emergency response and disaster relief, and other government services.[7] While these mega-constellations may usher in a whole new age of telecommunications connectivity, there are growing concerns that they will significantly accelerate a longstanding and relatively under-regulated issue—orbital debris.[8]

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1. David Jarvis et al., *High Speed from Low Orbit: A Broadband Revolution or a Bunch of Space Junk?*, *in* TECHNOLOGY, MEDIA, AND TELECOMMUNICATIONS PREDICTIONS 2020, at 46 (2019), https://www2.deloitte.com/content/dam/insights/us/articles/722835_tmt-predictions-2020/DI_TMT-Prediction-2020.pdf.

2. *See id.* at 46–47. "Constellation" refers to a group of satellites functioning together as a system, and the term "mega-constellation" refers to large constellations of hundreds to thousands of individual small satellites. *Id.*

3. Deployment of Advanced Telecomm. Capability to all Ams. in a Reasonable & Timely Fashion, 34 FCC Rcd. 3857, 3857–58 (2019).

4. *New ITU Statistics Show More than Half the World is Now Using the Internet*, ITU NEWS (Dec. 6, 2018), https://news.itu.int/itu-statistics-leaving-no-one-offline/.

5. *See* Jarvis et al., *supra* note 1, at 48 (noting the societal and economic benefits of bringing high-speed connectivity to populations outside the reach of traditional telecommunications infrastructure).

6. *Id.* at 50–51.

7. *Id.* at 48.

8. *See* Mark Harris, *Why Satellite Mega-Constellations are a Threat to the Future of Space*, MIT TECH. REV. (Mar. 29, 2019), https://www.technologyreview.com/s/613239/why-satellite-mega-constellations-are-a-massive-threat-to-safety-in-space/ (discussing the increased dangers of orbital debris in light of mega-constellations increasing orbital traffic in the Lower Earth Orbit (LEO)).

In the United States, the FCC is responsible for mitigating orbital debris among commercial satellite operators through its commercial satellites licensing process.[9] The Commission's regulations on orbital debris mitigation consist of a series of disclosures and certifications that operators are required to make to provide the Commission with adequate information to determine—on a case-by-case basis—whether the applicant has taken sufficient steps to minimize the creation of orbital debris during the lifetime of the planned satellite (or satellites).[10] When the Commission first promulgated its orbital debris mitigation rules in 2004, it declined to adopt particular methodology or specific regulations to mitigate orbital debris.[11] Instead, the FCC provided only general guidance on the content of the disclosures applicants must submit as part of the license application.[12] In response to changes in the orbital environment since the FCC's initial attempt at orbital debris mitigation in 2004, the Commission determined these rules were no longer adequate for today's space traffic management needs,[13] and recently completed a review of its orbital debris mitigation rules.[14]

The Commission's reevaluation of its orbital debris mitigation regulations for commercial satellites is much needed. Since the dawn of the Space Age—beginning with the Soviet Union's launch of its Sputnik satellite in 1957—more than 9,000 objects have been launched into space.[15] Of those objects humans have put into space, more than 2,000 are active satellites orbiting the Earth.[16] That number is set to increase dramatically with the onset of the mega-constellation space race. In the past two years alone, the Commission has authorized plans by the company SpaceX to launch 12,000 satellites into Low Earth Orbit (LEO) as part of its "Starlink" mega-

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9. *See* 47 C.F.R. § 25.114(d)(14) (2019) (requiring applicants to disclose operational and design strategies being employed to minimize the creation of orbital debris).

10. *See id.*

11. *See* Mitigation of Orbital Debris, 19 FCC Rcd. 11,567, 11,577 (2004).

12. *Id.*

13. *See* Mitigation of Orbital Debris in the New Space Age, 33 FCC Rcd. 11,352, 11,357 (2018) (noting the Commission's concern that large constellations represent an unprecedented increase in orbital traffic and increase the risk for "debris-generating events").

14. *See generally* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156 (2020) (voting to adopt additional debris mitigation rules while also seeking public comment on additional proposed rules).

15. *Online Index of Objects Launched into Space*, UNITED NATIONS OFF. FOR OUTER SPACE AFFS., http://www.unoosa.org/oosa/osoindex/search-ng.jspx?lf_id= (last visited Nov. 21, 2020) (cataloguing all registered objects launched into space, even the Tesla Roadster automobile launched into orbit by Elon Musk, CEO of SpaceX).

16. Jonathan O'Callaghan, *The Risky Rush for Mega Constellations*, SCI. AM. (Oct. 31, 2019), https://www.scientificamerican.com/article/the-risky-rush-for-mega-constellations/.

constellation.[17] SpaceX plans to launch 1,000 of these satellites by the end of 2020, which will account for an approximately 50% increase in the number of active satellites in orbit in a single year.[18] This is a dramatic increase in space traffic on its own, but SpaceX's aspirations for its Starlink mega-constellation go far beyond those 12,000 satellites;[19] ultimately, SpaceX envisions launching an additional 30,000 satellites as part of the project.[20] When considered with other companies rushing to launch their own mega-constellations, some estimates suggest that more than 50,000 satellites could be added to orbit within several.[21] Such a dramatic increase in the amount of traffic in orbit will result in a corresponding increase in the risk of orbital collisions.[22]

In the face of this potentially staggering increase in orbital traffic, the Commission's current debris mitigation rules are inadequate. The current disclosure and certification requirements fall short of imposing the uniformity in operational requirements and procedures needed for orbital debris mitigation among operators competing against one another commercially.[23] As operators bring their mega-constellations online, they will be competing against one another for market share in a satellite broadband industry that is estimated to be worth $412 billion by the year 2040.[24] Moving a satellite requires resources, particularly propellant—a precious resource for orbiting satellites.[25] The increase in orbital traffic is trending toward an environment where operators must either risk a relatively small chances of collision or instead execute hundreds of "collision avoidance maneuvers" daily.[26] As

17. *Id.*

18. *Id.*

19. *Id.*

20. *Id.*

21. *Id.*

22. *See* Harris, *supra* note 8 (reporting estimates that "over 67,000 'collision alerts'" could be generated annually).

23. *See* Geoff Brumfiel, *Space Traffic is Surging, and Critics Worry There Could be a Crash*, NPR (Jan. 29, 2020, 10:11 AM), https://www.npr.org/2020/01/29/800433686/space-traffic-is-surging-and-critics-worry-there-could-be-a-crash (noting that individual operators decide for themselves how to respond to notices of possible collisions and that there are incentives for them not to make maneuvers).

24. *A New Space Economy on the Edge of Liftoff*, MORGAN STANLEY (July 28, 2020) [hereinafter *Space Economy on the Edge*], https://www.morganstanley.com/Themes/global-space-economy.

25. *See* Brumfiel, *supra* note 23 (noting that "propellant is like platinum" because a satellite is unable to maintain service without it).

26. *See* O'Callaghan, *supra* note 16 (reporting estimates that collision avoidance maneuvers could increase from an average of three per day to eight per hour).

commercial competition increases, market incentives and cost considerations may encourage operators to accept those risks. In addition, individual operators each rely on their own operating systems for making maneuver determinations that may be functionally inadequate[27] and rely on data that varies in quality.[28] This self-regulatory approach is troubling when the room for error is small because even one debris-creating event can have a significant, lasting impact on the orbital environment.[29]

Part I of this Comment lays out the current regulatory scheme and statutory authority for the FCC's oversight of orbital debris mitigation for commercial telecommunication satellites. Part II examines the potential impact of satellite mega-constellations on the orbital environment and the inadequacies of the FCC's current orbital debris mitigation scheme. Part III analyzes the FCC's recent rulemaking on the challenges posed by satellite mega-constellations, and identifies where the FCC has made progress in incorporating stricter standards and methodologies and where critical regulatory gaps still exist. Finally, Part IV provides a recommendation for how the FCC can address regulatory gaps in satellite tracking and data sharing, which would provide greater clarity and uniformity in collision alert assessments by operators.

I. OVERVIEW OF THE CURRENT U.S. REGULATORY STRUCTURE FOR COMMERCIAL SPACE ACTIVITY

A. Which Agencies are Responsible for What?

The regulatory scheme for mitigating orbital debris in the context of commercial space activity is largely split between three agencies.[30]

Under the Commercial Space Launch Act—later amended and re-codified in 2010 by the National and Commercial Space Programs Act—the

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27. A near miss between a SpaceX satellite and European Space Agency satellite was the result of a collision alert notification getting trapped in a spam folder. *See* Brumfiel, *supra* note 23.

28. *See id.* (noting that while the data relied on by companies for their own satellites is highly accurate, they often use lower-quality public date to track other objects).

29. Half of the tracked debris in orbit are the result of two incidents, both of which occurred over a decade ago. *See* GLENN PETERSON ET AL., AEROSPACE CORP., SPACE TRAFFIC MANAGEMENT IN THE AGE OF NEW SPACE 2 (2018), https://aerospace.org/sites/default/files/2018-05/SpaceTrafficMgmt_0.pdf.

30. *See* Mitigation of Orbital Debris, 17 FCC Rcd. 5586, 5592 (2002) (explaining that "[l]icensing authority for non-government space activities" is split between the Federal Aviation Administration (FAA), National Oceanic and Atmospheric Administration (NOAA) and FCC).

Federal Aviation Administration (FAA)[31] is authorized to license both the launch and reentry of nongovernmental space vehicles.[32] The FAA is responsible for regulating the safety of launch and reentry vehicles, including preventing accidents that could generate orbital debris.[33] The FAA's scope of authority in the context of orbital debris is essentially limited to launch and reentry, and does not extend to regulating satellites during their orbital lifetime.[34]

In addition, the National and Commercial Space Programs Act of 2010 directs the Secretary of Commerce to license "private remote sensing space systems,"[35] which are private and commercial satellites used for imaging, measuring, and analyzing environmental information.[36] Under the Act, the National Oceanic and Atmospheric Administration (NOAA)[37] requires that "[a] licensee shall dispose of any satellites operated by the licensee upon termination of operations under the license in a manner satisfactory to the President."[38] Pursuant to this regulation, applicants for a remote sensing satellite license must provide a plan to minimize the potential for orbital debris resulting from the post-mission disposal of the satellite.[39] NOAA's regulatory authority over orbital debris mitigation does not extend beyond these remote sensing satellites, leaving oversight of commercial telecommunications satellites to an unlikely agency: the FCC.[40]

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31. The FAA is responsible for regulating civil aviation, which includes commercial space launches. *A Brief History of the FAA*, FED. AVIATION ADMIN., https://www.faa.gov/about/history/brief_history/ (Jan. 4, 2017, 4:42 PM).

32. *See generally* 51 U.S.C. §§ 50901–50923; 14 C.F.R. §§ 417, 420, 431, 435 (2019) (outlining the FAA's regulatory authority over commercial space launches and reentry).

33. ELENI M. SIMS & BARBARA BRAUN, AEROSPACE CORP., NAVIGATING THE POLICY COMPLIANCE ROADMAP FOR SMALL SATELLITES 6 (2017). https://aerospace.org/sites/default/files/2018-05/SmallSatRegulations_0.pdf.

34. *Id.*

35. MARLON SORGE, AEROSPACE CORP., COMMERCIAL SPACE ACTIVITY AND ITS IMPACT ON U.S. SPACE DEBRIS REGULATORY STRUCTURE 3 (2017), https://aerospace.org/sites/default/files/2018-05/CommercialDebrisRegulation.pdf.

36. *See* 15 C.F.R. § 960.3 (2019).

37. NOAA is a scientific research agency within the Department of Commerce, and primarily focuses on the planet's atmosphere, oceans, and other major waterways. However, in facilitating such scientific pursuits, it also has some responsibility over licensing of private satellites. *Our Work*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.noaa.gov/our-work (last visited Nov. 21, 2020).

38. 15 C.F.R. § 960.11.

39. SORGE, *supra* note 35, at 2–3.

40. *See* Mitigation of Orbital Debris, 17 FCC Rcd. 5586, 5592 (2002) (noting that the regulatory authority of NOAA does "not alter the authority of the FCC" in this area).

B. The Statutory Basis for the FCC's Legal Authority in the Field

The FCC, through its licensing process, regulates orbital debris mitigation for commercial telecommunications satellites in the United States.[41] In the Communications Act of 1934 (Act), Congress vested the Commission with authority to promulgate regulations through notice-and-comment rulemaking for the licensing of commercial communications services.[42] The Act applies to interstate and foreign communication and transmission of energy, either originating within the United States or simply received in the United States, by wire or radio.[43] Section 301 of the Act further requires that no entity may operate any "apparatus" that transmits energy, communications, or signals by radio to, from, or within the United States, without a license granted by the Commission.[44] The Act defines both communication by radio and transmission of energy by radio to be broadly inclusive.[45] The Commission has interpreted the Act's licensing provisions to include nongovernment satellites because they qualify as an apparatus involved in the communication and transmission of energy by radio.[46]

When the FCC initiated notice-and-comment rulemaking in the 1970s for its first satellite licensing regulations, it anticipated pushback against the interpretation that the licensing of a new emergent technology—unanticipated at the time of the Act's passage—was within the Commission's statutory jurisdiction.[47] The FCC articulated its view that Congress intended for the Act to empower the Commission to regulate novel uses of radio to "develop the most desirable deployment and utilization of the Nation's

41. *See generally* 47 C.F.R. §§ 5, 25, 97 (2019) (outlining the FCC's licensing processes and procedures for experimental, commercial, and amateur telecommunications satellites, respectively).

42. The Communications Act of 1934 delegates expansive regulatory authority to the FCC for the telephone, television, and radio communications industries. *See* Communications Act of 1934, Pub. L. No. 73-416, 48 Stat. 1064 (codified as amended in scattered sections of 47 U.S.C.).

43. 47 U.S.C. § 152(a).

44. *Id.* § 301.

45. *See id.* § 153(40), (57) (defining both "communication by radio" and "transmission of energy by radio" to include those instrumentalities, apparatus, facilities, and services associated with such transmissions).

46. *See* Establishment of Domestic Comm'cn-Satellite Facilities by Nongovernmental Entities, 22 F.C.C.2d 86, 129 (1970) (explaining the Commission's opinion that the Act "clearly include[s] non-Government satellite and earth station facilities used for interstate communication or transmission of energy by radio").

47. *Id.* (affirming the Commission's view that its jurisdiction "is not affected by the circumstance that the radio transmission involves stations located in space and a new technology not explicitly mentioned in that act").

communications facilities."[48] The Commission pointed to § 303(g), which directs the FCC to "[s]tudy new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest."[49] The FCC saw the language of § 303(g) as reflective of the policy explicitly articulated in congressional hearings surrounding the Act's passage.[50] Thus, the Commission reasoned that establishing rules to license telecommunications satellite facilities was in line with the legislative policy underlying the Act.[51]

The FCC is not alone in its view that the Act granted it expansive power to regulate uses of radio not foreseen at the time of its enactment, as courts have also read the Act in such a way. In *National Broadcasting Co. v. United States*,[52] several broadcasters challenged the FCC's authority to regulate a broadcasting technique called "chain broadcasting."[53] Broadcasters argued that regulating network broadcasting practices was outside the scope of the FCC's authority because the Act constrained the FCC's licensing duties to the technical and engineering aspects of radio signals only.[54] In rejecting this narrow reading of the Commission's role, the Court noted that Congress intended the Act to give the FCC expansive powers in a nascent and quickly evolving field.[55] Likewise, in *United States v. Storer Broadcasting Co.*,[56] the Court noted that the FCC's authority "covers new and rapidly developing fields."[57] The Court felt that it was important to read the Act "as a whole and with

48. *Id.*

49. 47 U.S.C. § 303(g).

50. Establishment of Domestic Comm'cn-Satellite Facilities by Nongovernmental Entities, 22 F.C.C.2d at 129.

51. *See id.* at 133 (concluding that the 1934 Communications Act provides the Commission with the requisite legal authority to "authorize domestic communications satellite facilities upon finding that such facilities would serve the public convenience, interest, or necessity").

52. 319 U.S. 190 (1943).

53. *Id.* at 196. "Chain broadcasting" is the "simultaneous broadcasting of an identical program by two or more connected stations." 47 U.S.C. § 153(10). National broadcasting networks used the technique to dominate programming, and because it could produce a monopolistic outcome in programming that was contrary to the public interest, the FCC determined it should regulate the practice. 319 U.S. at 196–98.

54. *Nat'l Broad. Co.*, 319 U.S. at 215.

55. *Id.* at 219 ("Congress was acting in a field of regulation which was both new and dynamic . . . . In the context of the developing problems to which it was directed, the Act gave the Commission . . . expansive powers.").

56. 351 U.S. 192 (1956).

57. *Id.* at 203 (holding that the FCC had the authority to impose concrete standards in preventing monopolistic practices in pursuit of its public interest obligations).

appreciation of the responsibilities" charged to the FCC by Congress in regulating communications in light of the growing complexity of the economy.[58] While *National Broadcasting Co.* and *Storer Broadcasting Co.* involved the expansion of the FCC's authority by recognizing its regulatory authority under the Act to regulate broadcasting business practices as well as technical and engineering aspects of radio communication, both cases exemplify the Court's acknowledgment that the FCC has a certain degree of latitude under the Act to recognize and respond to new industry developments in telecommunications.[59]

The FCC did not incorporate orbital debris considerations for all satellites under its licensing scheme until 2004.[60] In adopting the 2004 rules, the FCC relied on § 307 of the Act, which permits the FCC to require applicants to provide all information it deems relevant to determining whether granting a license serves the "public interest."[61] The FCC views orbital debris as a relevant public interest consideration for its licensing scheme in two ways. First, satellites are important tools that provide communications and other valuable services to the national and global public, and orbital debris threatens the reliability, cost, and capabilities of those services.[62] Second, orbital debris threatens not only the safety of persons and property engaged in manned space flight but also persons and property on the surface of the Earth.[63]

Though Congress was certainly not considering satellites and orbital debris when the Act was passed in 1934, the FCC's broad reading of its statutory public interest obligations to encompass orbital debris mitigation is in step with how the public interest standard has been applied historically.[64] At the narrowest reading, courts have recognized the Commission's public

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58. *Id.*

59. *See* Establishment of Domestic Comm'n-Satellite Facilities by Nongovernmental Entities, 22 F.C.C.2d 86, 129 (1970) (citing *Storer Broad. Co.* and *Nat'l Broadcasting Co.* as affirmation of the Commission's "comprehensive power over newly developing instrumentalities" and the "wide discretion" left to it under the public interest standard in the Communications Act).

60. Mitigation of Orbital Debris, 19 FCC Rcd. 11,567, 11,571 (2004) (explaining that between 2000 and 2003 the FCC adopted orbital debris mitigation disclosure for only certain classes of satellites).

61. 47 U.S.C. § 307(a), (c)(2).

62. Mitigation of Orbital Debris, 19 FCC Rcd. at 11,575.

63. *Id.*

64. *See* Erwin G. Krasnow & Jack N. Goodman, *The "Public Interest" Standard: The Search for the Holy Grail*, 50 FED. COMM'CNS. L.J. 605, 625–26 (1998) (noting that the courts have historically given the FCC wide latitude to interpret the public interest standard and its flexibility has been "enormously significant to the FCC . . . as a means of modifying policies to meet changed conditions").

interest obligations in its licensing processes to include public safety considerations.[65] As the FCC noted when it announced the adoption of the 2004 orbital debris mitigation rules, orbital debris poses a very real public safety concern.[66] At a broader level, the Supreme Court has recognized that the FCC's judgment as to how the "public interest" is best served is entitled to substantial judicial deference.[67] If regulations adopted by the FCC pursuant to its public interest obligations in the Communications Act are based on "permissible public-interest goals," then they fall within the general rulemaking authority of the FCC so long as the regulations are a reasonable means of achieving those goals.[68]

Generally, the Supreme Court has construed the Act as granting the Commission broad authority to determine what considerations are important to fulfill the public interest requirements for licensing under the Act.[69] For example, in *FCC v. National Citizens Committee for Broadcasting*,[70] broadcaster associations challenged FCC rules that considered whether broadcasting license applicants held "common ownership of a radio or television broadcast station and a daily newspaper located in the same community."[71] The broadcasters charged that the FCC was effectively enforcing antitrust policies and that doing so was clearly outside the scope of the authority delegated to it under the Communications Act.[72] However, the Court upheld the regulations as a valid consideration for the FCC's licensing determinations under its public interest obligations, even though the Commission does not generally have power to enforce antitrust laws.[73] The Court reasoned that the public had a valid interest in the diversification of ownership of the broadcast spectrum due to its physical scarcity, making such

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65. *See* Deep S. Broad. Co. v. FCC, 278 F.2d 264, 267 (D.C. Cir. 1960) (holding that the design specifications of a radio tower and whether it will be structurally sound and safe are relevant considerations under the FCC's public interest obligation); Simmons v. FCC, 145 F.2d 578, 579 (D.C. Cir. 1944) (upholding the FCC's denial of an application for the construction of a radio tower that would threaten safe air navigation).

66. Mitigation of Orbital Debris, 19 FCC Rcd. at 11,575.

67. *See* FCC v. WNCN Listeners Guild, 450 U.S. 582, 596 (1981) ("[T]he Commission's judgment regarding how the public interest is best served is entitled to substantial judicial deference."); FCC v. Nat'l Citizens Comm. for Broad., 436 U.S. 775, 810 (1978) ("[T]he weighing of policies under the 'public interest' standard is a task that Congress has delegated to the Commission in the first instance . . . .").

68. *Nat'l Citizens Comm. for Broad.*, 436 U.S. at 796.

69. *WNCN Listeners Guild,* 450 U.S. at 596; *Nat'l Citizens Comm. for Broad.*, 436 U.S. at 810.

70. 436 U.S. 775 (1978).

71. *Id.* at 779.

72. *Id.* at 794.

73. *Id.* at 795–96.

a consideration a valid exercise of the Commission's public interest obligations in granting broadcast licenses.[74]

The physical scarcity of broadcast spectrums justification in *National Citizens Committee for Broadcasting* is analogous to the physical scarcity of orbital space for communications satellites. Satellites in orbit provide the public a wide array of valuable services that individuals have come to depend on in their daily lives.[75] Though expansive, orbital space is still bounded by physical scarcity. As orbital space becomes more crowded and the risk of orbital debris grows, that physical scarcity becomes an ever more prevalent consideration, and the public interest is threatened when orbital space is not protected to allow for its sustained use.[76] Based on the reading of the Court's opinion in *National Citizens Committee for Broadcasting,* the FCC's authority to consider orbital debris mitigation under its public interest obligations in its satellite licensing processes would appear to be in step with prior judicial deference afforded to the FCC to make such determinations.[77]

C. The FCC's Orbital Debris Mitigation Rules

When the FCC conducted its first notice-and-comment rulemaking on orbital debris mitigation in 2004, the Commission settled on fairly open-ended disclosure rules that required applicants to provide operational information related to debris mitigation.[78] Operators must explain how they assessed and limited any planned generation of debris during normal operation of the satellite and the possibility of the satellite becoming a source of debris in the event of a malfunction or a collision that disables the satellite.[79] The operator must also disclose assessments made regarding limiting the potential for accidental explosions that could cause the satellite to generate debris.[80] Finally, the operator must provide an "end of life" plan, which details the disposal strategy for the satellite following completion of its mission.[81]

On April 23, 2020, the FCC voted to adopt additional debris mitigation rules to strengthen and expand these disclosure requirements, while in some instances incorporating technical guidance and requirements from the National Aeronautics and Space Administration (NASA) and the U.S.

74. *Id.* at 799.

75. *See* Mitigation of Orbital Debris, 19 FCC Rcd. 11,567, 11,569 (2004) (pointing out that satellites are used to deliver video, voice and data services, as well as GPS navigational services).

76. *See* discussion *infra* Part II.C.

77. *See* cases cited *supra* note 67 and accompanying text.

78. 47 C.F.R. § 25.114(d)(14) (2019).

79. *Id.* § 25.114(d)(14)(i), (iii).

80. *Id.* § 25.114(d)(14)(ii).

81. *Id.* § 25.114(d)(14)(iv).

Government Orbital Debris Mitigation Standard Practices (ODMSP).[82] Of important note are the rules adopted, which: implement a specific threshold for collision probability with large and small orbital objects in required disclosures;[83] require applicants to disclose measures in place to coordinate with other systems in their planned orbits to avoid collisions;[84] instruct operators to certify that they will take "all possible" steps to review, assess, and mitigate a collision risk upon receipt of a collision alert;[85] require a disclosure regarding the trackability of satellites and whether the operator plans to share tracking information with other operators and/or space traffic management entities;[86] and adopt specific metrics for assessing post-mission disposal plans.[87]

In practice, an operator submits a licensing application for satellites to the FCC and provides documentation outlining the design and operational methodologies it plans to employ to reduce the risk of the satellite generating debris.[88] The FCC then reviews these disclosures and opens the application up for comment from other interested parties.[89] In addition to the review by the FCC's Satellite Division, commentators can raise issues that they feel should be addressed in the application before it merits approval by the FCC.[90] The operator can respond to and rebut the concerns raised by other commentators, and the FCC then decides whether to make a final determination or request further information from the operator.[91]

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82. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156, 4159–60 (2020).

83. Mitigation of Orbital Debris in the New Space Age, 85 Fed. Reg. 52,422, 52,450 (Aug. 25, 2020) (to be codified at 47 C.F.R. § 25.114(d)(14)(ii), (iv)(A)(1)) (requiring that applicants' assessments of the probability of collision with orbital debris/objects show whether it is .01 or less for small objects, and .001 for large objects).

84. *Id.* at 52,451 (to be codified at 47 C.F.R. § 25.114(iv)(A)(2)).

85. *Id.* at 52,451 (to be codified at 47 C.F.R. § 25.114(iv)(A)(5)).

86. *Id*. (to be codified at 47 C.F.R. § 25.114(v)).

87. *See id.* (to be codified at 47 C.F.R. § 25.114(vii)(D) (requiring disposal plans show the probability of successful disposal is .9 or better for a single satellite, and a *goal* of .99 or better for individual satellites making up large systems).

88. *See generally* Space Expl. Holdings, LLC, 34 FCC Rcd. 2526 (2019) (evaluating SpaceX's debris mitigation assessments as part of its satellite licensing application).

89. *See generally* Theia Holdings A, Inc., 34 FCC Rcd. 3526 (2019) (detailing Theia Holdings' amendment to its application in response to comments received after the Public Notice issued by the FCC).

90. *See* Space Expl. Holdings, LLC, 34 FCC Rcd. at 2533 (citing objections raised by OneWeb and CSSMA about the adequacy of SpaceX's risk collision analysis and whether the maneuverability of its satellites meet reliability standards).

91. *Id.* at 2534 (noting that the Commission found SpaceX's debris mitigation disclosures sufficient, based on the representations the Company made in its application).

In 2004, the FCC specifically declined to adopt a particular methodology for the evaluation of debris mitigation plans.[92] Instead, operator applicants were encouraged, but not required, to use U.S. Government Standard Practices and NASA's own safety standard guidelines for developing orbital debris mitigation plans and procedures.[93] The FCC agreed with comments from industry participants asserting that economic self-interest and incentives would drive operators to take active measures to avoid collisions, ensure satellites were designed to prevent accidents and promote reliability, and exercise due diligence in coordinating and sharing information as necessary.[94] The FCC believed such positions were generally accurate and that disclosure requirements would impose minimal costs on operators while safeguarding the public interest by preserving a safe and accessible orbital environment.[95]

The result of the 2004 rulemaking produced guidelines that operators were merely encouraged to follow, and which their orbital debris mitigation plans were measured against. The recent rule changes adopted by the FCC make an effort to address the lack of specific requirements in areas of debris mitigation. Importantly, the rule changes strengthen safeguards for the orbital environment by including specific probability requirements for both collision risk disclosures and disclosures regarding the reliability of post-mission disposal plans.[96] However, other expanded disclosure requirements that were adopted, while a positive step, fall short of placing affirmative requirements on operators to: share data with each other and space traffic management entities;[97] take specific steps to assess collision alerts;[98] and employ more comprehensive tracking technologies.[99] In the absence of stricter tracking, data sharing, and collision alert assessment requirements,

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92. Mitigation of Orbital Debris, 19 FCC Rcd. 11,567, 11,577 (2004).

93. *Id.* at 11,577–78.

94. *Id.* at 11,576, 11,579, 11,581.

95. *Id.* at 11,576.

96. *See* Mitigation of Orbital Debris in the New Space Age, 85 Fed. Reg. 52,422, 52,450–51 (Aug. 25, 2020) (to be codified at 47 C.F.R. § 25.114(d)(14)(ii), (iv), (vii)) (requiring operators to show whether the collision risk and reliability of post-mission disposal for a satellite meets specific thresholds).

97. *See id.* at 52,432 (to be codified at 47 C.F.R. § 25.114(d)(14)(v)(C)) (requiring operators merely disclose any plans to share data).

98. *See id.* at 52,433 (to be codified at 47 C.F.R. § 25.114(d)(14)(iv)(A)(5)) (requiring that operators certify they will respond to collision alerts by taking all possible steps to assess collision risk, without specifying what steps those must entail).

99. *See id.* at 52,431 (to be codified at 47 C.F.R. § 25.114(d)(14)(v)(A)) (adopting a disclosure requirement as to how operators' satellites can be tracked, but failing to endorse specific tracking standards).

operators are left to largely make their own determinations in assessing and responding to collision risks, which becomes an issue as competition between operators in orbit increases, as discussed in Part II.[100]

D. Authority of the FCC to Move Beyond Disclosure

Any action by the FCC to impose additional orbital debris mitigation requirements may invite challenges to its legal authority.[101] But considering how courts have afforded substantial deference to the FCC in determining how to interpret its statutory public interest obligations in its licensing proceedings,[102] as well as the deference generally afforded to agencies in interpreting their statutory authority under *Chevron U.S.A., Inc. v. National Resource Defense Council, Inc.*,[103] the FCC should withstand a legal challenge against more expansive and defined requirements for orbital debris mitigation.

In applying *Chevron*, courts first ask whether the agency is acting pursuant to authority delegated to it by Congress.[104] If this threshold requirement is met, a two-step review of agency action tests: (1) whether the statute is ambiguous or unambiguous in addressing the issue at hand; and, (2) if the statute is ambiguous, whether the agency's interpretation of the statute is permissible.[105] If a statute is unambiguous on the authority delegated to the agency on a specific issue, then no deference is afforded to agency action that is contrary to Congress's intent.[106] However, if the agency action is a permissible interpretation of an ambiguous statute, then the court should defer to the agency's interpretation regardless of whether the court itself would have reached a different interpretation.[107]

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100. *See infra* Part II (discussing the impact of mega-constellations on the crowding of space).

101. In the FCC's February 2019 Notice of Proposed Rulemaking, the Commission itself seemingly invites comment on its own legal authority over orbital debris mitigation. Mitigation of Orbital Debris in the New Space Age, 84 Fed. Reg. 4742, 4744 (proposed Feb. 19, 2019) (to be codified at 47 C.F.R. pts. 5, 25, & 97).

102. *See* discussion *supra* Part I.B.

103. 467 U.S. 837 (1984).

104. *See* United States v. Mead Corp., 533 U.S. 218, 226–27 (2001) (explaining that *Chevron* deference is afforded only when the agency is exercising action under authority delegated to it by Congress to make rules carrying the force of law).

105. *Chevron,* 467 U.S. at 842–43. While *Chevron* created only two steps, scholars argue that the Supreme Court has since created several additional steps, such as a "step zero" that discusses whether the *Chevron* analysis should be applied to begin with. *See, e.g.*, Cass R. Sunstein, *Chevron Step Zero*, 92 VA. L. REV. 187, 191–93 (2006) (defining step zero and discussing Supreme Court cases that address this question).

106. *Chevron*, 467 U.S. at 842–43.

107. *Id.* at 843–44.

Before applying *Chevron*, courts ask whether the FCC is promulgating rules pursuant to authority delegated to it by Congress.[108] A court should find its answer in § 303(r) of the Communications Act, which grants authority to the FCC to generally make rules and proscribe "restrictions and conditions" necessary to carry out the Act's provisions.[109] This establishes Congress's grant of authority to the Commission to engage in rulemaking necessary to carry out the duties delegated in other sections, such as § 307 of the Act—which the FCC to grant a license upon a finding that the "public convenience, interest, or necessity will be served thereby."[110]

With this threshold question satisfied, courts examine the ambiguity of the statute as to how the Commission can define whether granting a license to an applicant serves the public interest. Prior judicial decisions aimed at interpreting the public interest obligations of the FCC in developing rules for its licensing procedures suggest that the statute is explicitly ambiguous,[111] and that Congress intended the FCC to receive substantial deference in determining those considerations that best serve public interest.[112]

The next question under *Chevron* is whether the FCC's adoption of strengthened orbital debris mitigation standards would be a permissible interpretation of the Commission's public interest obligations. As previously discussed, courts have formerly held both public safety[113] and the allocation of scarce communications resources[114] as permissible public interest goals for the FCC to consider in its licensing processes.[115] Orbital debris poses a threat to public safety and impacts the scarcity of orbital space, a vital telecommunications resource.[116] The new challenges posed by the satellite mega-constellations require the adoption of more defined orbital debris mitigation standards in order to further the public interest.

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108. *Mead Corp.*, 553 U.S. at 229–30.

109. 47 U.S.C. § 303(r).

110. *Id.* § 307(a).

111. *See* FCC v. WNCN Listeners Guild, 450 U.S. 582. 594 (1981) ("Congress had granted the Commission broad discretion in determining how [the goals of the Communications Act] could best be achieved.").

112. *See id.* at 596 ("Our opinions have repeatedly emphasized that the Commission's judgment regarding how the public interest is best served is entitled to substantial judicial deference.").

113. *See* Deep S. Broad. Co. v. FCC, 278 F.2d 264, 266–67 (D.C. Cir. 1960); Simmons v. FCC, 145 F.2d 578, 579 (D.C. Cir. 1944).

114. *See* FCC v. Nat'l Citizens Comm. for Broad., 436 U.S. 775, 795 (1978) (holding that the scarcity of the broadcast spectrum justified consideration of monopolistic ownership practices in granting licenses to promote diversification of media in furtherance of the public interest).

115. 47 U.S.C. § 307(a).

116. *See* discussion *infra* Part II.C.

Opponents may argue that the ambiguous statutory language of § 307 of the Act, and the broad discretion afforded to the FCC to define public interest goals in its licensing processes, makes *Chevron* deference inappropriate because it essentially permits the FCC to define the scope of its own jurisdiction through its licensing processes. However, in *City of Arlington v. FCC*,[117] the Supreme Court rejected the argument that *Chevron* deference should not apply in instances where an agency is interpreting "statutory ambiguity that concerns the scope of the agency's statutory authority."[118] Though the FCC acts according to its statutory public interest obligations, the FCC's scope of authority over the regulation of commercial satellites seems to expand or contract through the promulgation of licensing requirements. This constant shifting, however, does not invalidate *Chevron's* application.

II. THE IMPACT OF SATELLITE MEGA-CONSTELLATIONS

A. The Dawn of the Mega-Constellations Space Race

The two primary types of orbits for communications satellites are LEO and Geosynchronous Equatorial Orbit (GEO). GEO satellites operate at a much higher altitude than those deployed at LEO.[119] In addition, GEO satellites orbit in a fixed nature, while LEO satellites fly around the Earth at because they orbit much closer to the planet's surface.[120] GEO satellites have three main drawbacks in the communications context. Their high-altitude orbit results in a long communication time-lag when sending and receiving signals, making them inefficient for communicating with devices with smaller antennas, such as mobile phones and other personal computing devices.[121] Additionally, due to their fixed nature, signal blockage can easily occur between the GEO satellite and end-user.[122]

In contrast, satellites deployed in LEO can connect with small handheld receivers, such as mobile phones and personal computers, while providing low

117. 569 U.S. 290 (2013).

118. *Id.* at 316 (Roberts, C.J., dissenting).

119. *See Satellites 101: LEO vs. GEO*, IRIDIUM (Sept. 11, 2018) [hereinafter *Satellites 101*], https://www.iridium.com/blog/2018/09/11/satellites-101-leo-vs-geo/ (explaining that Geosynchronous Equatorial Orbit (GEO) satellites orbit at a height of around 35,000 km above the planet's surface, while LEO satellites orbit within an altitudinal range of 160 km to 2,000 km).

120. *See* Jarvis et al., *supra* note 1 (noting that GEO satellites orbit at a speed that matches the rotation of the earth, while LEO satellites complete an orbit around the planet within 90 to 120 minutes).

121. *Satellites 101*, *supra* note 119.

122. *Id.*

latency connection times.[123] This makes LEO satellites prime candidates to bring about global high-speed Internet coverage and bridge the digital divide that has left rural, poor, and underdeveloped areas without reliable Internet access.[124] However, because of their lower orbital altitude and higher orbital speed, LEO satellites need to be deployed in networks to provide continuous global coverage.[125] These networks are called "constellations."[126] A constellation is a network of satellites that work in concert as a single system to fulfill a particular function.[127] Satellites today can be built quicker, smaller, and cheaper.[128] Thus, the cost of putting a satellite into orbit has dropped dramatically.[129] This reduced overhead has lured companies to space in the quest to bring high-speed Internet access to the globe through large satellite constellations, or more aptly, "mega-constellations."[130]

The advent of the satellite mega-constellation brings with it the very real potential to blanket the globe in high-speed Internet that provides around-the-clock connectivity to anywhere on earth.[131] Due to the lucrative potential of space-based high-speed Internet market, numerous companies are planning to launch competing mega-constellation projects.[132]

B. The Crowding of Low Earth Orbit (LEO) and Increased Risk of Orbital Debris

If even half of the mega-constellations currently planned for service are successfully put into orbit, it would represent more than twice the number of objects put into orbit over the past sixty years, resulting in a six-fold increase in the quantity of active satellites in orbit.[133] Naturally, more active satellites in

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123. *See id.*

124. Jarvis et al., *supra* note 1, at 48–49, 51, 53.

125. *See id.* at 47 (explaining that these characteristics limit the communication range of a single LEO satellite).

126. *Id.*

127. *Id.*

128. *See id.* at 48–49 (describing how technological advances and mass-production methods allow companies to produce small satellites cost-effectively and quickly).

129. *See id.* (reporting that the cost of putting an object in orbit has decreased approximately 85% since 1970).

130. *See id.* (noting that technological advances and mass production have made constellations containing hundreds to thousands of satellites a reality).

131. *See id.* at 53 ("The biggest impact of satellite broadband constellations and mega-constellations . . . can be to bring low-latency, high-speed connectivity to people who currently are not within the reach of cellular towers or connected to high-speed lines.").

132. *See* Theodore J. Muelhaupt et al., *Space Traffic Management in the New Space Era*, 6 J. SPACE SAFETY ENG'G 80, 80–81 (2019) (showing nearly two dozen companies have proposed launching over twenty thousand satellites in the next decade).

133. *Id.* at 80.

orbit means more chances for satellites to cross one another's path and potentially collide. Currently, an average of three collision avoidance maneuvers occur per day.[134] Add mega-constellations to the orbital picture and some estimates predict that number will increase drastically, to eight per hour.[135]

As discussed in Part I, the current FCC rules for orbital debris mitigation focus on disclosure, and despite the recent rule change to strengthen those disclosures, the rules provide little in the way of bright-line requirements and standards for satellite tracking, data sharing, and the assessment of collision alerts.[136] As a result, decisions as to how to evaluate and respond to collision risks largely lies in the hands of operators.[137] Each operator relies on their own individually developed methodologies, procedures, and systems to evaluate and respond to risks.[138] In addition, operators rely on data of differing quality for evaluating risks posed by other orbital objects.[139] While operators rely on their own high-quality positioning data for their own satellites, they generally must also consider lower-quality noncooperative data that is either publicly available or relayed to them by other monitoring groups when a potential collision risk is detected.[140] Suffice to say, different quality data can produce different evaluations of collision risks, meaning there is no guarantee that operators are looking at the same picture when deciding to move a satellite.

While some operators have made pledges and proclamations about fostering a sustainable orbital environment,[141] these are merely aspirational calls to responsibility. Market incentives and competition among operators in the lucrative and relatively open-for-the-taking new space economy could

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134. O'Callaghan, *supra* note 16.

135. *Id.*

136. *See generally* 47 C.F.R. § 25.114(d)(14) (2019) (listing the information that should be included in the description of the design and operational strategies that will be used to mitigate orbital debris for an application for space station authorization); Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156, 4183–84, 4188–90 (2020) (declining to adopt active tracking requirements, mandatory data sharing, and collision assessment best practices).

137. Brumfiel, *supra* note 23.

138. *See* Muelhaupt et al., *supra* note 132, at 83 (noting that "there are likely as many operational plans as there are operators").

139. Brumfiel, *supra* note 23.

140. *See* Muelhaupt et al., *supra* note 132, at 83 (explaining that cooperative sharing of data between operators would allow for more accurate collision assessments and cut down on false-positive alerts, which in turn would reduce the number of collision risks operators would need to assess).

141. *See* Jeff Foust, *Can Satellite Megaconstellations be Responsible Users of Space?*, SPACE NEWS (Sept. 3, 2019), https://spacenews.com/can-satellite-megaconstellations-be-responsible-users-of-space/ (reporting that both SpaceX and OneWeb have publicly pledged to operate their constellations in manner that promotes the sustainability of the orbital environment).

encourage operators to make decisions that prioritize their economic interests over the sustainability of the orbital environment.[142] Orbital maneuvers have a costly impact on a satellite's resources, and a decision to give a competitor the right of way will come at the expense of that operator's bottom line by shortening the length of that satellite's operational life.[143] A short-term, easily calculable gain by conserving resources may seem more tangible than a remote risk.[144] This a very real and problematic concern because even a single collision event can have catastrophic, lasting consequences.[145]

C. The Catastrophic Consequences of Collisions

Operators are assessing collision probabilities in the range of 1 in 100,000 to 1 in 10,000.[146] While these risks seem incredibly remote, the consequences can be significant. About half of the debris currently in space was generated by only two events, one being a February 10, 2009, collision between two satellites—Iridium-33 and Cosmos-2251.[147] The risk of the collision between Iridium-33 and Cosmos-2551 was not an outlier among regularly occurring collision probabilities—in that same week, there were thirty-seven other conjunctions with collision risks that exceeded the risk of the collision between these two satellites.[148] The collision between Iridium-33 and Cosmos-2551 released thousands of trackable debris into orbit and thousands more of smaller, yet still lethal, un-trackable debris.[149] NASA estimates that more than half of the debris will remain in orbit for as long as a century.[150]

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142. Best practices for a sustainable orbital environment may fall to the wayside where the potential reward is establishing market dominance in an untapped industry worth $412 billion. *See Space Economy on the Edge*, *supra* note 24.

143. *See* Brumfiel, *supra* note 23 (explaining the use of propellant as costly to both orbiting satellites and operators' bottom lines).

144. *See* PETERSON ET AL., *supra* note 29, at 4 (explaining that operators must assess serious but seemingly remote risks as a 1 in 100,000 chance to 1 in 10,000 chance of collision).

145. *See id.* at 2–3 (noting that two collision incidents from more than a decade ago account for approximately half of the tracked debris currently in orbit).

146. *Id.* at 4.

147. *See* BRIAN WEEDEN, SECURE WORLD FOUND., 2009 IRIDIUM-COSMOS COLLISION FACT SHEET 1 (2010), http://swfound.org/media/205392/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf. This 2009 incident was the first ever collision of satellites in orbit, and involved Iridium-33, an active communications satellite operated by the U.S. based company Iridium Communications, LLC, and Cosmos-2551, an inactive Russian communications satellite. *Id.*

148. PETERSON ET AL., *supra* note 29, at 4.

149. *See* WEEDEN, *supra* note 147, at 1 (providing estimates that the collision created 2,000 pieces of trackable debris, as well as thousands of smaller un-trackable pieces).

150. *Id.* at 2.

The release of orbital debris is of great concern because uncontrolled debris in orbit can have a cascading effect.[151] The so-called "nightmare scenario" is that enough debris gets released into orbit that a critical threshold is reached that results in what is known as "Kessler Syndrome."[152] A feedback loop is created where collision events increase, creating more debris, which in turn raises the likelihood of further collisions.[153] In this scenario, even if humans add nothing else to orbit, the amount of debris will increase faster than natural orbital decay can reduce it.[154] Orbital space will become clogged with an exponentially increasing amount of uncontrolled debris, making the safe navigation of space increasingly difficult, if not impossible.[155] Some scientists are warning that the concentration of debris in certain regions of LEO has already reached this threshold level.[156]

The global community relies on satellites for communication, weather tracking, national security, global position systems (GPS), and scientific research, just to name a few uses.[157] Satellite systems are a critical backbone to a variety of services humans rely on. The amount of uncontrolled debris—some trackable and some not resulting from a Kessler Syndrome scenario—would render those satellite systems unreliable, if not completely useless.[158]

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151. Loren Grush, *As Satellite Constellations Grow Large, NASA is Worried About Orbital Debris*, VERGE (Sept. 28, 2018, 10:05 AM), https://www.theverge.com/2018/9/28/17906158/nasa-spacex-oneweb-satellite-large-constellations-orbital-debris.

152. *See* Eyder Peralta, *Space Debris Has Reached a 'Tipping Point'*, NPR (Sept. 1, 2011, 1:30 PM), https://www.npr.org/sections/thetwo-way/2011/09/01/140114894/study-space-debris-has-reached-a-tipping-point. "Kessler Syndrome" is named after Donald Kessler, the retired chair of NASA's Orbital Debris Program Office. *Id.* It describes a scenario where the amount of debris in orbit reaches a critical mass triggering a continual cascade of collisions and debris. *Id.*

153. *Id.*

154. *Id.*

155. *See Micrometeroids and Orbital Debris (MMOD)*, NASA (June 14, 2016), https://www.nasa.gov/centers/wstf/site_tour/remote_hypervelocity_test_laboratory/micrometeoroid_and_orbital_debris.html ("Once collisional cascading begins, the risk to satellites and spacecraft increases until the orbit is no longer usable.").

156. Some simulations predict that the region in LEO between 700 and 900 kilometers will experience significant debris creating collisions every five to nine years, even if no new satellites are launched. *See Space Situational Awareness: Examining Key Issues and the Changing Landscape Before the Subcomm. on Space & Aeronautics of the H. Comm. on Sci., Space, & Tech.,* 116th Cong. 5 (2020) [hereinafter *Space Awareness Hearing*] (testimony of Dr. Brian Weeden, Director of Program Plan., Secure World Found.).

157. 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.

158. *Id.*

Global communication would be more difficult and take longer, GPS would become unreliable or unusable, and military and scientific research would stall.[159] Thus, the risk of orbital debris is not just a high-minded technical concern for those industry operators involved in space flight, but a very real threat to humanity's scientific pursuits and current standard of living.

III. ANALYSIS OF RECENT RULEMAKING BY THE FCC

On June 18, 2018, President Trump issued Space Policy Directive-3 (SPD-3) and National Space Traffic Management Policy.[160] The directive ordered an inter-agency effort, which included the FCC, to update the U.S. Governmental Orbital Debris Mitigation Standard Practices, establish new guidelines for satellite design and operation, and develop best practices for Space Traffic Management (STM).[161] SPD-3 then required the Departments of Commerce and Transportation, in consultation with the FCC, to assess where they can incorporate these updated standards and best practices into their licensing processes based on applicable law.[162]

As a result of the President's directive, in February 2019, the FCC initiated a new notice-and-comment rulemaking with the goal of promulgating new orbital debris mitigation regulations for its satellite licensing processes.[163] On April 23, 2020, the FCC voted to adopt several new rules expanding and clarifying the disclosure requirements in its orbital debris mitigation rules.[164] Of the many changes the Commission adopted, of particular note is the incorporation of specific requirements and methodologies that will help address the risks posed by mega-constellations in two important areas of orbital debris mitigation: collision risk thresholds and post-mission disposal reliability.

Under the newly revised debris mitigation rules, operators must now show that the lifetime collision probability for a planned satellite is less than .001 (1 in 1000) for collisions with other large objects, and .01 (1 in 100) or less for

159. *See id.* (discussing the consequences that could come to pass if the predictions of Kessler Syndrome are correct).

160. *See generally* National Space Traffic Management Policy, 83 Fed. Reg. 28,969 (June 21, 2018) (outlining the policy of the United States towards the management of traffic in space).

161. *Id.* at 28,974.

162. *Id.*

163. Mitigation of Orbital Debris in the New Space Age, 84 Fed. Reg. 4742, 4742, 4743 (proposed Feb. 19, 2019) (to be codified at 47 C.F.R. pt. 5, 25 & 97).

164. *See generally* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156 (2020) (Report and Order) (updating the FCC's existing rules on orbital debris mitigation and seeking comments for further rulemaking); Mitigation of Orbital Debris in the New Space Age, 85 Fed. Reg. 52422 (Aug. 25, 2020) (to be codified at 47 C.F.R. § 25.114(d)(14)(i)–(viii)) (adopting amendments to rules to reflect the Report and Order).

collisions with other small objects.[165] By employing a uniform set standard for lifetime collision risk adopted from NASA's own guidelines,[166] the FCC is ensuring that all operators adhere to a baseline threshold of risk in the deployment of their satellites. In addition, the FCC requires that operators use NASA's freely available Debris Assessment Software or a "higher fidelity assessment tool" to produce these risk assessments.[167] This will ensure that assessments provided by operators are derived using a uniform methodology with an acceptable baseline accuracy. Otherwise, the reliability of operators' risk assessments will vary based on how each operator makes its calculations. It is important to note, however, that the FCC has invited further comment on whether regulations should assess collision risk for large constellations in the aggregate, i.e. "on a system-wide basis."[168] Though commentators may push back against stricter standards, the prudent approach is to not ease the risk calculation requirements for large systems when applying the regulation to a system that may consist of up to as many as 30,000 satellites.[169]

The FCC also strengthened its disclosure rules by incorporating specific requirements for post-mission disposal of satellites.[170] For a single satellite, the Commission now requires operators to report whether the probability of successful post-mission disposal is at least .9 (90%).[171] Proposals for satellite systems consisting of multiple satellites will be more closely scrutinized to achieve a reliability goal of .99 (99%) or greater.[172] The metrics adopted by the Commission are taken from NASA's own recommended guidelines.[173] The .99 reliability goal for multi-satellite constellations is of specific importance. The satellites in mega-constellations are anticipated to have a much shorter lifespan than typical satellites.[174] To maintain the operational range of constellations, operators must continuously replenish the satellites in the system as they reach the end of their operational lifespan.[175] With so many satellites being added into orbit as individual satellites are

165. Mitigation of Orbital Debris in the New Space Age, 85 Fed. Reg. at 52450 (to be codified at 47 C.F.R. § 25.114(d)(14)(ii), (iv)(A)(1) (revising the disclosures operators must provide detailing lifetime collision risk assessments).

166. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. at 4171, 4173.

167. *Id.*

168. *Id.* at 4172.

169. *See* O'Callaghan, *supra* note 16.

170. Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. at 4200–01.

171. *Id.* at 4201.

172. *Id*.

173. *Id.* at 4200–01.

174. *See* Muelhaupt et al., *supra* note 132, at 81 (noting that the small satellites in planned mega-constellations are expected to have "operational lifetimes" of only five to ten years).

175. *Id.*

decommissioned and replenished, it is important to remove decommissioned satellites from the environment as efficiently as possible.[176] A NASA study on mega-constellations found that a 99% deorbiting rate was able to significantly combat the orbital congestion caused by rapid replenishment of large constellations.[177] Adopting this benchmark for the post-disposal evaluation of satellites in mega-constellations ensures that operators will remove satellites at a rate to sustain the safety of the orbital environment.[178]

While the FCC's rule changes are important steps to bring more force to orbital debris mitigation by implementing specific requirements and guidelines in the critical areas of satellite collision risk and post-mission disposal, the Commission's rulemaking fell short in other areas. Specifically, the rulemaking failed to implement certain strengthened requirements that are crucial to orbital debris mitigation in the age of mega-constellations: satellite tracking and data sharing to facilitate more effective and efficient assessments of collision alerts.

In addition to setting specific standards for lifetime collision risks, the FCC also adopted a rule requiring operators to certify that they will review any received collision alert (also called a "conjunction warning") and take "all possible steps" to assess and mitigate the risk "if necessary."[179] While this rule helps alleviate some operational uncertainty among operators by creating an affirmative duty to review and address collision alerts, the rule leaves open troubling gaps by only encouraging and suggesting operators to follow industry best practices in addressing these alerts.[180] Ideally, this requirement could address concerns about disparities in the quality of data operators rely on when analyzing collision alerts by codifying best practices already recognized by NASA, thereby creating a regulatory requirement to share data and actively communicate with one another when deciding to execute maneuvers.[181] But the rule as constructed is undermined by the lack of concrete requirements as to *how* collision risks must be assessed. The rule

176. Grush, *supra* note 151.

177. *See id*. (estimating a 99% disposal rate results in only a very slight rise in the number of estimated collisions risked over 200 years, while a 90% disposal rate significantly increases the risk to about 260 collisions over 200 years).

178. *Id.*

179. Mitigation of Orbital Debris in the New Space Age, 85 Fed. Reg. 52422, 52,433 (Aug. 25, 2020) (to be codified at 47 C.F.R. § 25.114(d)(14)(iv)(A)(5)).

180. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156, 4190 (2020) (noting that, in the desire to allow flexibility, operators are asked to take steps "[a]s appropriate" and are only encouraged to follow industry-best practices recognized by NASA).

181. *See id.* (indicating that there are already recognized best practices in this area that the Commission could draw from in crafting such regulatory requirements); O'Callaghan, *supra* note 16.

may encourage operators to coordinate with one another and share data, but it fails to create any uniform operational and procedural standards.[182]

The FCC also had an opportunity to address the issue of satellite tracking and data sharing for assessing collision alerts through two rules it adopted addressing those points.[183] But instead of implementing specific guidelines or requirements, the Commission opted only for informational disclosures.[184] Efficient and reliable assessment of collision warnings is dependent on the quality and accuracy of the tracking data available to operators.[185] The FCC should revisit its decision and adopt tracking and data sharing standards that drive the industry to adopt practices that make the assessment of collision alerts a more manageable, and thus less risky, process. In this way, the failure to implement meaningful standards in satellite tracking and data sharing also undermines the rule discussed immediately prior to collision alert assessments.

IV. RECOMMENDATIONS

The FCC's recent rulemaking[186] demonstrates that the government recognizes that mega-constellations stand to dramatically change the nature of the orbital environment. As discussed in Section III, the FCC has moved towards adopting more affirmative standards in certain areas, some of which represent a prudent approach to strengthening orbital debris mitigation measures and imposing affirmative requirements on operators of mega-constellations.[187] However, in its recent rulemaking, the Commission failed to adopt meaningful standards in satellite tracking and data sharing, which play an important role in allowing operators to effectively make collision alert assessments.

Under the largely self-regulatory framework of collision alert assessment for mega-constellations, a primary challenge of operators is that they are

182. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. at 4256.

183. *See* Mitigation of Orbital Debris in the New Space Age, 85 Fed. Reg. at 52,450–51 (to be codified at 47 C.F.R. § 25.114(d)(14)(iv)(A)(5), (v)).

184. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. at 4184, 4188–89 (explaining the Commission declined to adopt specific requirements because it wanted to provide flexibility to operators).

185. *See* Muelhaupt et al., *supra* note 132, at 82–83 (discussing the importance of tracking and data accuracy in assessing collision alerts, and noting that current practices and tracking accuracy may leave operators having to "sort through an enormous haystack to find the needles").

186. *See generally* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4156 (updating the FCC's existing rules regarding orbital debris mitigation).

187. *See* discussion *supra* Part III.

weighing chances of remote risk[188] against competitive market incentives.[189] In assessing those risks, operators must typically rely on a mix of their own high-quality tracking data and lower-quality externally available, noncooperative data to calculate potential collision risks.[190] Due to the lack of consistent, high-quality data to evaluate potentials for collisions, high numbers of false-positive alerts are created that operators must sift through.[191] Facilitating the sharing, distribution, and availability of better tracking data would cut down on false-positive alerts, thereby giving greater confidence to operators that collision alerts necessitate action despite other competing market incentives.[192]

The Department of Defense employs the most comprehensive Space Surveillance Network (SSN) in the world, which provides tracking data to the U.S. Space Force's 18th Space Control Squadron (formerly part of the Air Force).[193] The 18th Space Control Squadron (18SPCS) uses its catalogue of space objects and tracking data to then provide services to outside entities, which includes providing collision alerts to satellite operators.[194] Combining the orbital tracking data catalog of the 18SPCS with more precise tracking data that operators have on their own satellites would allow for the 18SPCS to provide operators with more accurate collision alerts that reduce the number of false-positives.[195] By reducing the overall number of collision alerts generated, careful assessment of those alerts becomes more manageable for operators.

Pursuant to this objective, the FCC should *require* operator applicants to supply the 18SPCS with their tracking data and orbital flight plans,[196] as well as include noninvasive powered transponders in licensed satellites to provide

188. PETERSON ET AL., *supra* note 29, at 4.

189. *See Space Economy on the Edge*, *supra* note 24 (noting the industry is worth billions of dollars).

190. *See* Muelhaupt et al., *supra* note 132, at 83 (explaining that the sharing of high-quality "owner-operator" data could help make collision alerts more accurate, and thus more manageable for operators to assess reliably).

191. *See id.* ("[C]urrent tracking accuracy and processes might produce millions of warnings per year for NewSpace operators to prevent half a dozen actual collisions.").

192. *Id.* at 86.

193. *Space Awareness Hearing*, *supra* note 156, at 13.

194. *Id.*

195. *Id.* at 14.

196. *See* Muelhaupt et al., *supra* note 132, at 86 (identifying "owner-operator data and flight plans" as the most reliable source to cut down on false-positives).

an additional source of accurate positional data.[197] The 18SPCS could then process operators' tracking data, orbital flight plans, and transponder information to provide collision alerts with greater accuracy. Having 18SPCS serving as a central entity to process and disseminate this data will provide operators with more reliable and accurate collision alerts.[198] Operators would be reassured that those alerts present a more concrete likelihood of collision, thus cutting against the impulse to ignore constant remote risk in favor of more tangible market incentives.[199]

To facilitate these improvements, this Comment recommends the FCC should revise its rules on data sharing and tracking as follows:

> Where the application is for NGSO systems, the operator *must certify* the following: (A) Each individual space station will have active on-board tracking in the form of an independently powered GPS enabled transponder; (B) that, prior to deployment, each individual space station will be registered with the 18th Space Control Squadron or successor entity; and (C) the operator will submit all information regarding tracking, orbital flight plans, and planned maneuvers to the 18th Space Control Squadron or successor entity.[200]

Requiring operators to share this data and employ such tracking methods would be permissible under the FCC's statutory public interest obligations because it not only promotes public safety but also furthers a sustainable allocation of orbital space in an telecommunications environment (orbital space) bounded by scarcity.[201] Implementing these operational requirements

197. *See id.* (noting that small transponders can be placed on satellites to broadcast "GPS-quality-position data," and because they are independently powered, could even transmit tracking data should the satellite become damaged or inoperable).

198. As proposed by the FCC, 47 C.F.R. § 25.114(d)(14)(v)(C) would permit a decentralized and fragmented Space Management Network. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. 4256, 4257 (2020) (asking operators to disclose whether they will share data with "other entities that engage in . . . space traffic management functions"). Funneling this data to the 18th Space Control Squadron moves away from a fragmented Space Management Network comprised of competing private entities.

199. *See Space Economy on the Edge*, *supra* note 24 (evaluating the space internet market to be worth an untapped $412 billion).

200. The language as proposed here places an affirmative requirement on the operator, whereas the current rule—as adopted by the FCC on April 23, 2020, implemented by final rule on August 25, 2020, and to be to be codified at 47 C.F.R. § 25.114(d)(14)(v)—requires that operators only disclose: whether a satellite will have active or passive tracking; whether a satellite will be registered with the 18th Space Control Squadron (18SPCS); and, whether it will continue to share orbital flight plan and tracking information with the 18SPCS or some other entity involved in space traffic management functions. *See* Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. at 4257.

201. *See* discussion *supra* Parts I.B, I.D.

would also place little burden on the resources and expertise of the Commission by simply requiring greater coordination between operators and the 18SPCS, an entity that already has the resources and expertise needed to put the data provided by operators to effective use.[202]

This proposal would avoid the concerns previously expressed by the Commission, that it lacks the necessary expertise to become too involved in establishing specific metrics and standards for orbital debris mitigation,[203] because this proposal does not require the FCC to exercise any technical or expert analysis over the tracking information operators would share with 18SPCS. This solution would also impart a relatively low impact on the operations and business choices of operators.[204] Operators would only need to disclose data already in their possession, while still being free to design and develop satellite systems and operational procedures without additional regulatory interference from the FCC. The rules recently adopted by the FCC abstained from placing an affirmative requirement on operators to share such data out of concerns commentators expressed over protecting proprietary information and security.[205] Given the risks posed by increased space traffic and orbital debris,[206] those business concerns should not outweigh the practical and efficient benefits provided by this cost-effective solution, which only places a relatively small burden on operators and the Commission. In addition, requiring that this data be shared with 18SPCS, which would not disseminate that information to other operators and only use it to produce more reliable collision alerts, should alleviate some concern about competitors accessing proprietary information. Furthermore, this proposal also adheres to the goals of the Trump Administration's Space Policy Directive-3 (SPD-3) and National Space Traffic Management Policy

202. *See generally* JOINT FUNCTIONAL SPACE COMPONENT COMMAND, 18TH SPACE CONTROL SQUADRON, LAUNCH CONJUNCTION ASSESSMENT HANDBOOK (2018), https://www.space-track.org/documents/LCA_Handbook.pdf (outlining the processes for satellite operators to register with the 18th Space Control Squadron and access space situational awareness data).

203. *See* Mitigation of Orbital Debris in the New Space Age, 33 FCC Rcd. 11,352, 11,408, 11,412–13 (2018) (statements of Michael O'Rielly, Comm'r, and Brendan Carr, Comm'r) (questioning whether the FCC possesses the technical expertise to establish appropriate orbital debris mitigation standards).

204. *See* Muelhaupt et al., *supra* note 132, at 86 (concluding that providing operators with higher quality tracking data is the most cost-effective method of improving orbital debris mitigation without implementing more extensive overhauls to collision avoidance "framework").

205. Mitigation of Orbital Debris in the New Space Age, 35 FCC Rcd. at 4187–88.

206. *See* discussion *supra* Part II (discussing the correlation between the rise in active satellites and the potential for collisions).

by furthering the goal of improving space situational awareness data sharing.[207]

CONCLUSION

The development of mega-constellations, and their impact on the orbital environment,[208] necessitate strengthened FCC orbital debris mitigation rules because the evaluation of, and response to, orbital collision alert assessments are largely in the hands of operators who are competing against one another for control of the orbital broadband market.[209]

Based on the above analysis, the FCC is well within its statutory authority to determine that orbital debris poses a threat to public safety and impacts the scarcity of orbital space, a vital telecommunications resource, and thus may impose additional requirements on operators to implement active tracking measures and share tracking data for dissemination among operators to allow for more accurate collision avoidance alerts.[210] Although the FCC has recently made progress in incorporating technical standards and best practice requirements to strengthen its orbital debris mitigation rules,[211] the FCC has failed to sufficiently address the important area of satellite tracking and data sharing to facilitate more efficient and reliable collision alert assessments for operators.[212]

The courts have traditionally given the FCC substantial deference in determining how the public interest is best served when adopting regulations pursuant to its licensing authority under the Communications Act.[213] In areas other than satellite licensing, the courts have recognized the FCC's authority to consider public safety factors under its public interest obligations.[214] The courts have also upheld the Commission's authority under its public interest obligations to adopt other specific regulations it would not otherwise be able to enforce, such as antitrust policies, in the

207. *See* National Space Traffic Management Policy, 83 Fed. Reg. 28,969 (June 21, 2018) (outlining the United States' policy towards the management of traffic in space).

208. *See* discussion *supra* Part II (demonstrating the consequences of collisions).

209. *See* discussion *supra* Part I.C (noting that operators have great autonomy in assessing collision risks).

210. *See* discussion *supra* Parts I.B, I.D.

211. *See* discussion *supra* Part III (noting what legislation the FCC has implemented).

212. *See* discussion *supra* Part III.

213. *See* FCC v. WNCN Listeners Guild, 450 U.S. 582, 596 (1981); FCC v. Nat'l Citizens Comm. for Broad., 436 U.S. 775, 810 (1978).

214. *See* Deep S. Broad. Co. v. FCC, 278 F.2d 264, 267 (D.C. Cir. 1960); Simmons v. FCC, 145 F.2d 578, 579 (D.C. Cir. 1944).

interest of regulating the allocation of broadband spectrums.[215] Orbital debris poses a threat to public safety and impacts the scarcity of orbital space, a vital telecommunications resource. Therefore, in light of the challenges posed by satellite mega-constellations, the FCC should exercise its authority—in alignment with public interest—to establish rules that require operators to employ active tracking for satellites and disclose high quality tracking data for dissemination to operators through the 18SPCS, allowing operators to receive more reliable and accurate collision alerts.[216]

215. *Nat'l Citizens Comm. for Broad.*, 436 U.S. at 795.

216. *See* discussion *supra* Part IV (recommending how the FCC can mitigate risks).