

Why Space Debris Flies Through Regulatory Gaps

Space is filling with more satellites and commercial ventures, all threatened by orbital debris. It's time to clarify which agencies have authority to act.

Within an eight-day period in March 2023, astronauts on the International Space Station (ISS) fired their thrusters twice to avoid a projected collision. Part of a dead satellite was hurtling toward the ISS at an approximate impact speed of 22,000 miles per hour. Due to debris-tracking capabilities and ample warning time, the astronauts were able to steer clear of a possible crash that could have damaged the station and risked the lives of those on board. The station made similar moves to dodge debris three times in 2022.

The hazards of orbital debris have been a looming issue for decades. As far back as 1978, NASA scientist Donald Kessler posited that accumulating space junk could eventually prevent sending any craft into orbit (or beyond). Today, the US Department of Defense and some private companies are actively tracking tens of thousands of pieces of orbiting space debris, including discarded rocket stages, nonoperational satellites, and more. The problem is compounding: collisions break larger pieces into numerous smaller ones. Untracked debris includes some 500,000 objects between the diameter of a pea and a large apple, plus an estimated 100 million smaller specks. As activities in space increase, the number of debris objects in orbit also grows. Debris endangers the satellites that provide radio, television, and internet services, support weather forecasts, and monitor for hurricanes, solar flares, and other hazards.

Somewhat surprisingly, the US government agency exercising the broadest reach to address commercial space activities and space debris is the Federal Communications Commission (FCC). FCC licenses are required for any company that uses the radio frequency spectrum to operate a US satellite or that transmits to a US ground station. To play its part in minimizing the creation of debris, the FCC requires that licensing applications from commercial satellite operators specify orbital debris mitigation efforts,

including plans for disposal of a spacecraft when its mission is over. When the FCC was founded in 1934 “for the purpose of regulating interstate and foreign commerce in communication by wire and radio,” few envisioned a role to oversee satellites, but the FCC came to regulate them, along with other modern technologies such as touch-tone telephones and automatic tolling for automobiles.

The FCC is not the only regulator in space. The Office of Space Commerce in the Department of Commerce’s National Oceanic and Atmospheric Administration (NOAA) and the Office of Commercial Space Transportation in the Department of Transportation’s Federal Aviation Administration (FAA) have authority over other aspects of space activity, but each agency’s role in orbital debris is different. It’s apparent that the FCC is stepping in to fill a regulatory gap, but its role overseeing orbital debris is not crystal clear. Its authority relies on a clause in the founding legislation stating that the FCC is to “encourage . . . a more effective use of radio in the public interest.” The FCC has concluded that “orbital debris and related mitigation issues are relevant in determining whether the public interest would be served.”

The FCC’s role regarding space debris reveals a larger tension in space regulation. With technical expertise and authority over space activities widely distributed across the US government, officials need to determine the appropriate regulations and policies to address how space is changing. The changing nature of orbital debris policy is emblematic of how the space policy landscape is evolving as countries and companies rely more on space.

Who regulates space?

When Congress passed the Communications Satellite Act of 1962, and with the launch of the first commercial communications satellites in the early 1960s, the FCC

became the first federal agency with a regulatory role for space activities. However, the implications of this legislation would not become clear for decades because the FCC became a commercial regulator at a time when almost any human-made object in space had been put up there by national governments—mainly the United States and the Soviet Union.

By the 1970s and 1980s, NASA had begun calling attention to the problem of orbital debris, particularly for spacecraft in low Earth orbit. In the 1990s, a broad interagency consensus began to emerge that something needed to be done, and in 1999, the FCC proposed a rule requiring some commercial satellite operators to include debris mitigation plans with their license applications. In 2004, this requirement was extended to all satellite operators needing an FCC license, along with specifications for what the plans must contain.

These specifications have evolved slowly even as the growth in projected satellites in orbit has skyrocketed. Between 2014 and 2021, the cumulative number of satellites the FCC approved increased from hundreds to over 20,000. (Numbers

policy guidelines for both internal use and operations of its contractors adopted across the industry. What's more, NASA's guidelines often become accepted as best practices, and so influence regulation directly.

The FAA grants licenses for the launch vehicles and reentry vehicles that carry satellites, people, and cargo into space. Though it concerns itself mainly with public safety issues, the FAA also has authority to regulate space operators to mitigate debris created when satellites launch or when objects reenter Earth's atmosphere. In addition, it has jurisdiction over defunct rocket bodies ejected as satellites reach their final orbit. The FAA has plans to update its orbital debris regulations to align with the ODMSP.

NOAA is responsible for licensing any US company operating a remote sensing satellite outside the United States or any company that can collect satellite images of the United States. However, with regard to debris mitigation, NOAA's updated rules from 2020 defer to the FCC license requirements.

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of actual launches are considerably lower.) Approvals are not pro forma: they are conditioned on the submitted orbital debris mitigation plans. For example, the FCC held off granting a license for Amazon's Kuiper satellite constellation, which involves groups of hundreds or thousands of identical satellites at different orbits, until Amazon updated its request to include more details of its orbital debris mitigation plan.

The FCC takes its role in mitigating space debris seriously as it focuses on allocating radio frequency spectrum to commercial satellite operators, but technical research is not part of its mission. NASA is the agency that plays a dominant technical role. Starting in the 1990s, NASA led development of the US government's Orbital Debris Mitigation Standard Practices (ODMSP), which it updated in 2019. It also generates the computer models the FCC and others use to predict what debris might encounter satellites.

NASA is hugely influential in policy and practices in this realm. It provides expert recommendations as new regulations are considered and is the US member of the Inter-Agency Space Debris Coordination Committee (IADC), which brings together more than a dozen space agencies from various countries and regions to exchange information and facilitate cooperation on research projects. As one of the biggest customers of commercial space companies, NASA sees its

As space activities grow, the space community would benefit from more effective regulation of products and activities that might add orbital debris, but current mechanisms are limited. Groups representing both industry and government, such as the ad hoc Space Safety Coalition (made of up companies, both domestic and international, and other groups), have issued recommendations on best practices to avoid creating more orbital debris, but cannot enforce them. And space operators have mixed incentives that may result in their not adopting best practices or following recommendations.

That said, commercial space operators have given indications that they want to be responsible stewards of space. Calls for more regulation often imply commercial actors are misbehaving, but that impression is largely unfounded. They share spacecraft location data, build autonomous maneuvering systems into satellites to avoid collisions, and have welcomed discourse on space regulation.

Meanwhile, authority and expertise are dispersed across the US government, complicating efforts to reduce or remove debris directly or through international coordination. The result is that, for the foreseeable future, the shared domain of low Earth orbit lacks enforceable regulations to keep orbits clear of hazards.

This set of overlapping capabilities and authorities means that at the moment—since most satellites require radio spectrum to transmit data and information from space—the FCC is the de facto debris regulator for satellite operators (but not launch providers). This situation is further complicated by the FCC's stature. As an independent agency governed by a five-member board (appointed by the US president for five-year terms) that is subject to partisan balance, the FCC need not be in lockstep with the rest of the executive branch. Consequently, while it can act more quickly than a multiagency process would require, it may act counter to the administration's desires or get out ahead of a coordinated administration position.

Deorbiting debate

The questions of who in the government will provide oversight and how to ensure that satellite operators mitigate debris remain sticking points. When the FCC issued a rule in September 2022 to reduce the time satellite operators had to deorbit satellites that reach the end of their operating life, from 25 years to five, the community response was mixed. The creation and reception of this new rule show the complexities of developing a broader regulatory framework for space.

Deorbiting is the primary way to ensure unused spacecraft do not remain in low Earth orbit and contribute to debris: satellites are brought closer to Earth, where friction from the atmosphere causes them to eventually fall out of orbit and burn up while reentering Earth's atmosphere. In 2001, NASA issued guidelines (as part of the ODMSP) for deorbiting within 25 years of the end of a satellite's mission. Similar mitigation guidelines were established by the IADC in 2002, followed by development of the United Nations Committee on the Peaceful Uses of Outer Space's Space Debris Mitigation Guidelines, which were endorsed by the UN General Assembly in 2007—providing consistency across commercial and international satellite missions.

Discussions had long been underway to change the 25-year rule to five years. In 2020, the head of the European Space Agency declared that 25 years was too long. Since 2019, many satellite companies have endorsed five years as a voluntary guideline, as promoted by the Space Safety Coalition. The Satellite Industry Association also came out in favor of five years. And SpaceX, the company owned by Elon Musk, expressed support. Other satellite companies have advocated for guidelines that would reduce the deadline to one year. In June 2023, the World Economic Forum released a set of debris mitigation guidelines for space operators—further supporting the five-year rule.

Most of the tension is not from technical disagreements, but rather hinges on who has the authority to act. Opposition to the five-year rule came from US agencies and Congress. The head of the Office of Space Commerce

at NOAA said the FCC was well intentioned, but pushing the boundaries of its authority too aggressively. NASA has submitted comments in the past to the FCC arguing that decreasing the deorbiting time would do little to reduce space debris. Such a decrease would also conflict with NASA guidelines, subjecting companies to one requirement for NASA projects and another for their commercial satellites. The US House of Representatives Committee on Science, Space, and Technology sent the FCC a letter in September 2022 saying that NASA has led coordination of space debris mitigation guidelines and that the FCC's actions could undermine national and international efforts to deal with orbital debris. After receiving the letter, the FCC commissioners voted unanimously in favor of the five-year rule. In April 2023, the FCC launched its Space Bureau, demonstrating its commitment to space policy.

Interagency efforts are active

In July 2022, the White House issued an Orbital Debris Implementation Plan identifying actions and research the government will pursue to minimize the creation of debris, track and characterize the current space environment, and remediate or remove debris from orbit. For example, satellites could be equipped with engines to maneuver away from hurtling debris, or they could be redesigned with better shielding or stronger materials to be more resilient. Today, however, debris regulation is locked into a discussion of mitigation or deorbiting, as policies and regulations to actively move debris out of the way or clear debris already in orbit have no current regulatory home.

Revamped regulatory structures are now being explored by the National Space Council within the Executive Office of the President, chaired by the vice president. Last September, the council announced it was working on developing a framework for regulating commercial space activities. Although it has not yet announced specifics on orbital debris policy, such plans are presumably part of its remit for regulating space activities that are not already regulated.

However, the National Space Council will not have sole authority to launch a new regulatory framework in space. Congress will also need to act by providing agencies the appropriate authority to address space activities including around orbital debris policy. As the world prepares to put more objects into space, low Earth orbit will become more congested, accelerating accumulation of debris. In the decades to come, the need for clear authority over how to manage debris will only increase.

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