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JULY/AUGUST 2024
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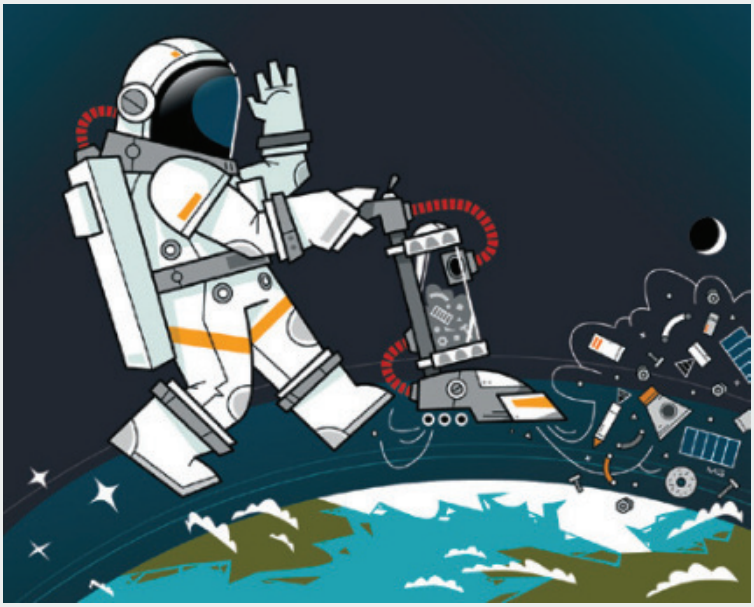


There Is Too Much Trash in Space

Debris from spacecraft threatens the burgeoning space economy. We need a global agreement to keep space clean **BY THE EDITORS**

SPACE SHOULD NOT be a garbage dump. Nevertheless, we have treated the sky as a wrecker's yard for more than half a century, and the amount of space junk orbiting Earth has skyrocketed in recent years. Now filled with the decaying hulks of defunct rockets and satellites, our polluted orbital environment is becoming more crowded by the day, threatening the growing space economy. It's time for nations—and the billionaires commoditizing space—to clean up Earth's near orbit.

The U.S. Air Force tracks more than 25,000 pieces of space junk larger than 10 centimeters—about the size of a bagel—weighing together some 9,000 metric tons. This dangerous trash zips around Earth at speeds of roughly 10 kilometers per second, or more than 22,000 miles per hour. Collisions between millimeter-scale objects too small to track and working satellites are now routine, as are near-miss disasters. One example is a NASA research satellite that almost hit a defunct Russian satellite in February. Orbital debris collisions cost satellite operators an estimated $86 million to $103 million in losses a year, a figure that will grow as each operator and each collision generate more debris.

The threat isn't just in space. In March part of a pallet from a discarded International Space Station battery fell to Earth, smashing through the roof of a Florida home. In 2020 an Ivory Coast village recovered a 12-meter-long pipe from space, courtesy of a Chinese rocket that cast off its empty core after launch. And a 2022 *Nature Astronomy* study puts the odds of space junk killing someone on the ground at 10 percent every decade. Needlessly.

Under the 1967 Outer Space Treaty, nations are supposed to be responsible for damages caused by space junk, even if it was originally launched by a private firm. That puts taxpayers, not space-exploring billionaires, on the hook for damages from orbital debris if its origin can be proved and the company shown negligent—a tough proposition for untraceable paint chips. No surprise, this hasn't worked. The problem is, after decades of discussion, there is still no international treaty that limits space junk or sets standards for negligence. We need one that outlines responsibilities and imposes fines on the companies whose spacecraft debris causes harm.

As long as doing the right thing is voluntary, it may not happen, concluded a 2018 Air Force Association report. The limited action since then tells us the world is way overdue for an agreement on mandatory standards. Few countries or companies currently design rockets for their complete life cycle. They must be forced to store enough fuel and retain the capability for spacecraft to steer safely out of space when their useful life is over. Painful financial and regulatory penalties should afflict spacefaring industries and nations that fail to play by the new rules.

Why? Because the physics of orbital debris spells doom. Between 775 and 975 kilometers overhead, derelict satellites pass within 1,000 meters of one another 1,000 times a year. Any collision would instantly double the amount of trackable debris in orbit and create countless smaller, yet still dangerous, bits of space junk to rain down on valuable satellites below them. The 2013 film *Gravity,* about astronauts lost in space after orbital debris destroyed their space shuttle, was fictional, but the threat of a cascade of space debris is real. This is the so-called Kessler syndrome, where smashups produce so much garbage that Earth's orbit becomes untenable. A 2023 study predicted that low-Earth orbit can hold only about 72,000 satellites without serious risk of this catastrophe occurring.

We are far closer to that red line than many people realize. There is a land rush happening right over our heads, in space. And it is coming from private companies, not national governments. There are almost 10,000 satellites in orbit right now, up from 6,500 only three years ago. The nearly 6,000 Starlink satellites launched by Elon Musk's SpaceX now make up more than half of the total, and they are part of a planned fleet of up to 42,000. Starlink is only the first of at least six more such "mega-constellations" underway or in the offing.

Illustration by Martin Gee

SpaceX and its rocket industry competitors plan to further fill space as we move into the new space economy. The jumbo Starship rocket Musk is testing right now in Texas promises to be able to carry six times more satellites to orbit than its predecessor, the workhorse Falcon 9 rocket, at a lower cost per pound. The economy of the 21st century will run on the ubiquitous fleets of satellites delivered by these kinds of rockets, providing communications, transactions, observations, and much else. Unless we wreck the sky.

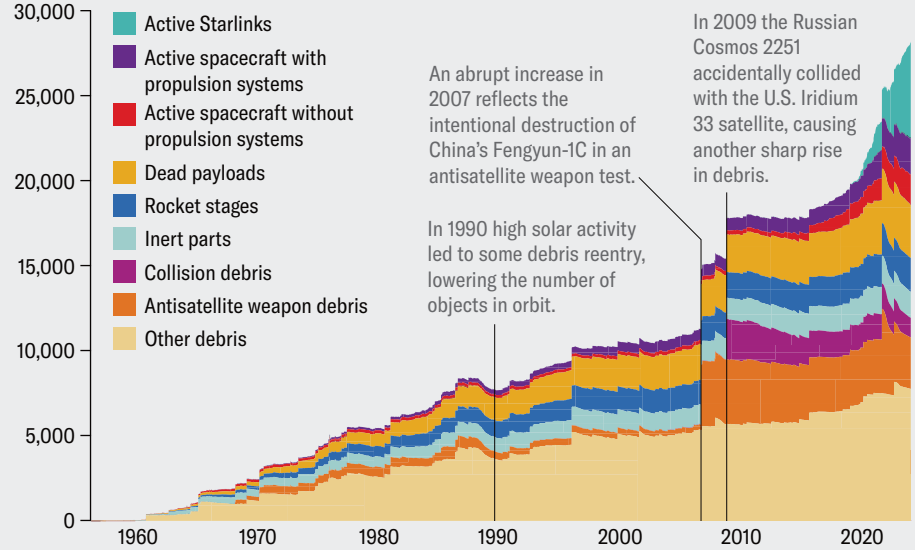
Satellite slots are now allocated by the International Telecommunications Union (ITU), based in Geneva, as well as individual nations' rules. The ITU largely concerns itself with ensuring that satellite radio-frequency assignments don't interfere with one another. The agency doesn't even check that satellites are actually in their promised orbits, to address collision concerns. In 2020 the Inter-Agency Space Debris Coordination Committee, governed by 13 space agencies, including the U.S., Russian and Chinese ones, released guidelines for limiting space debris. They called for deorbiting satellites—burning them back to Earth or retrieving them—within 25 years, which the Federal Aviation Administration made a rule for U.S. launches only last year. This is an overdue but good start from the U.S.

Although commerce might be the bulk source of space debris, the militarization of space has had and will continue to play a role in cluttering orbits. We need a global treaty along the lines of the Antarctic convention to keep space clean before tensions rise any further. This could be led by the United Nations Committee on the Peaceful Uses of Outer Space. In 2023 NASA proposed a comprehensive plan to remove derelict hulks in orbit and smaller debris. We should fund that endeavor as a mission of the civilian space agency, starting with deorbiting U.S. derelicts. The mission would be a boon to the growing U.S. space industry, as if common sense didn't offer reason enough.

Along those economic lines, even without a Kessler syndrome cascade, economists estimate space debris will cost nearly 1 percent of global gross domestic product in losses every year by the next century, the one wherein a Kessler cascade will almost certainly take place if we aren't careful. That might not sound like a lot, but that penny tax would represent a trillion-dollar cost to humanity—an unnecessary one, even by the size of today's world economy.

The laws governing satellite orbits and operations were written during the cold war in the mid to late 20th century, at a time when only a few governments operated only a few satellites. We live in a new era of private space exploration, one that is more extractive and invasive than before, with many nations and companies participating. We need better rules to keep us from trashing Earth's orbit as badly as we have trashed Earth itself. ●

Number of Tracked Objects in Orbit, 1957–2024



Source: "Satellite Statistics: Satellite and Debris Population," Jonathan's Space Report https://planet4589.org/space/stats/active.html (data)

Graphic by Amanda Montañez

We Need a Public Service Internet

The profit-led business models of big tech are harming society

BY HELEN JAY

IN ITS RAW POWER, "big tech" now outdoes the notorious trusts of the Gilded Age. Companies such as Google, Meta, Apple and Microsoft rest in the hands of some of the wealthiest men in the world. They share not just vast reach and influence but a common thirst for maximum profit, to the detriment of the public interest.

Critics, including author and social psychologist Shoshana Zuboff and Facebook whistleblower Frances Haugen, have highlighted the direct relationship between big tech's rapacious profit-seeking business model and subsequent civic and personal harms. The damage digital platforms do to their users—by causing anxiety, impinging on their privacy, spreading misinformation, promoting extremism, and more—is a natural consequence of the way digital businesses now work, encouraging platform users to stay as long as possible on the sites so they can monetize people's attention.

Studies have shown that divisive, emotional and potentially harmful content drives attention online. Thus, not only are companies disincentivized to remove harmful content, but they are actually incentivized to promote it—regardless of ramifications. As political scientist Francis Fukuyama argues in the *Journal of Democracy,* it is "unsurprising that these platforms have been blamed for propagating conspiracy theories, slander, and other toxic forms of viral content: This is what sells."

The social and democratic impacts of this dynamic arrangement show no sign of