

June 30, 2025

A COMMON-SENSE ORBITAL DEBRIS STRATEGY

As the ticking time bomb of orbital debris races closer to critical mass, the U.S. unknowingly holds the keys to safeguard our vital orbital infrastructure.

The orbital debris phenomenon, a.k.a. Kessler Syndrome, was brought before the government nearly a half century ago. In recent decades, Earth's governments have spent billions to enable experts to develop guidelines, standards, best practices, and analysis software to resolve the problem through policy, mitigation, and situational awareness to slow the growth of the orbital debris population. NASA hence warned that waiting for debris to deorbit itself nor stopping future launches would prevent collisions and thus highlighted the need for Active Debris Removal (ADR), even though ADR is outside their purview. Following suit, U.S. Space Force generals have explicitly stated their strategy to outsource ADR, but have yet to convince Congress to relinquish funds. However, U.S. taxpayers, and our global neighbors, are keenly aware that orbital debris (space junk, space debris) is an acute problem that deserves vigorous global attention to avoid collisions and the associated jeopardies related to reduced gross domestic product (economic prosperity), national security, and scientific exploration.

More recently, the U.S. Space Traffic Management policy was succinctly defined in Space Policy Directive-3 (SPD-3) in 2018, but neglected to shine a light on ADR. Yet, while a plan was captured in the National Orbital Debris R&D Plan in 2021, it did consider ADR and development of risk and cost-benefit analysis, but failed to clearly define a funding mechanism, which **will be outlined later in this paper**.

From an urgency standpoint, let us not forget, the Kessler Syndrome was postulated back when orbital launches were occurring a few times per year. Today, however, the orbital launch cadence has increased to a few launches per week or month, and We The People understand hundreds of millions of orbital debris objects comingled with thousands of active satellites (that support our way of life) is a recipe for disaster.

An ominous future of satellites and debris collisions loom (some say it began years ago) on a very slow scale and taxpayer dollars are spent for the International Space Station to routinely perform debris avoidance maneuvers, as do commercial satellite operators. While many government / federal programs have characterized the orbital debris problem and spread the word to space professionals and the general public, relatively few successful accomplishments have been made to actively remove debris from humanity's valuable orbital infrastructure. Why? **Funding.** Period.

So, let's layout a very brief foundation of knowledge and then define a governance and funding model to bring home a common-sense solution to a world-wide problem. This high-level information should enable a champion to legislate, obtain POTUS' signature, and finally deliver a new U.S. industry that has ample funding to safeguard our orbital infrastructure. It's time!

LAYING THE FOUNDATION

It is difficult to understand why the U.S. has not proactively engaged in leading the development of a whole new STM industry that includes ADR. It only makes sense, since the primary ADR objective is to safeguard the orbital infrastructure environment that our benefactors helped build and we still benefit from today. Regrettably, STM and especially ADR progress has been slow, arduous, and honestly stagnant compared to our global cohorts, who are all trying to avoid the tragedy of the commons.

In this section, we shall define how we got here, who is responsible for sustainment of our orbital infrastructure, gaps in current governance, and why the Executive Branch lacks the information required to drive management and budgetary decisions most closely related to orbital debris. Afterward, a solution to governance and a funding mechanism shall be presented.

How We Got Here

Its interesting. All this public hoopla about orbital debris. To the keen observer, the space industry and the public rarely hear about space collisions other than the Iridium 33 / Cosmos 2251 disaster, when in fact there have been other known collisions with active satellites that have missed notoriety:

- 1990 [LDEF / MMOD](#) (30,000+ impacts in 5.5 years)
- 1996 [Cerise](#) / debris
- 2009 [HST WFPC2](#) / MMOD (~685 impacts in 15.5 years)
- 2009 [Iridium33](#) / Cosmos 2251
- 2013 [Fengyun FY-1C](#) / BLITS
- 2013 [NEE-01 Pegaso](#) / Cosmos 1666 debris
- 2013 [Cubebug-1](#) / Cosmos 1666 debris
- 2019 [Intelsat 29e](#) / debris
- 2021 [Yunhai 1-02](#) / Zenit-2 debris

Additionally, it's likely that few space innovators have digested the contents of the NASA report on the "[History of On-Orbit Satellite Fragmentations](#)" to understand that nearly 400 debris generating events have occurred, mostly related to satellite break-ups and other anomalous events around spent rocket bodies that neglected to deplete their battery charge and/or propellant reserves, which is an explosive mix. These fragmentation events have resulted in a debris population of over 100 million objects, which travel at hypervelocity (many times faster than a bullet) and the small ones cannot be tracked.

In fact, stock market investors have contributed massive amounts of money to cash in on the innovation that space offers. Unfortunately, satellite operators have neglected to safeguard the environment from which they have profited, all in an effort to keep investors happy.

Who's Leading the Way?

While historical accountability of orbital debris has been hindered by our myopic quest for the almighty dollar, SPD-3 does identify the principles, goals, and guidelines for those identified on the memorandum distribution list:

JD Vance	Vice President
Marco Rubio	Secretary of State
Marco Rubio	National Security Advisor
Pete Hegseth	Secretary of Defense
Howard Lutnick	Secretary of Commerce
Sean Duffy	Secretary of Transportation
Kristi Noem	Secretary of Homeland Security
Tulsi Gabbard	Director of National Intelligence
Russ Vought	Director of the Office of Management and Budget
Janet Petro (acting)	Administrator of the National Aeronautics and Space Administration
Michael Kratsios	Director of the Office of Science and Technology Policy
Stephen Miller	Deputy Assistant to the President for Homeland Security & Counterterrorism
USAF General Dan Caine	Chairman of the Joint Chiefs of Staff

In 2020, the National Academy of Public Administration did recommend the Office of Space Commerce as the leading candidate to head up the Space Traffic Management effort defined in Space Policy Directive-3 (SPD-3). Let us not forget that SPD-3 neglects to succinctly identify active debris removal as one of the goals, even though it recognizes that spaceflight safety is a global challenge and that the United States should pursue active debris removal as a necessary *long-term approach* to ensure the safety of flight operations in key orbital regimes. Nothing in SPD-3 identifies ADR principles, goals, nor guidelines, yet it defines that Space Traffic Management shall mean the planning, coordination, and on-orbit synchronization of activities to enhance the safety, stability, and sustainability of operations in the space environment. Confusing, right? It's no wonder considering the lack of leadership surrounding this very complex problem.

Governance Gaps

Historically, we could say that ADR has been the government's 'hot potato'. Given the complexity of the entire Space Traffic Management program (including ADR), and lack of funding, it's no wonder Space Force, NASA, and satellite operators have quickly passed on leading ADR activities, thus avoiding accountability.

What has been missing is clear program definition, followed by scope management, control, monitoring, resource (funding) allocation and scheduling. While pieces of the STM program have been funded to the tune of billions of dollars and implemented over the recent few decades, ADR has been neglected. In an ideal program, ADR should have been managed and developed right alongside SSA, so that ADR could be implemented as soon as SSA benefits comes online. The

time value of money was for some reason overlooked, likely due to paralysis from analysis. As a result, ADR is now going to cost more money due to the late start. We cannot get that back, but we could start now to avoid further financial losses. Instead of going in circles again, the first thing to do would be to redefine the program scope to include ADR under the STM umbrella and then get busy with identification, evaluation, and development of feasible ADR technologies for various ADR methods for the different types of debris.

Another governance gap, that some diligently argue, comes from the Department of Homeland Security (DHS) failing to recognize satellites and our orbital infrastructure as a critical infrastructure and key resource. The Homeland Security Act of 2002 was a direct result of the 9/11 terrorist attack upon the United States, which began operation of the Department of Homeland Security (DHS) in 2003. As defined in the 2006, 2009, and 2013 [National Infrastructure Protection Plan](#) (NIPP), the [DHS mission](#) is bound to its ability to protect our critical infrastructure and key resources (CIKR). The benefit of identifying satellites as CIKR is that vulnerability assessments would protect critical satellites, in case of emergency. And based upon our country's current way of life, it would be nice to know which satellites provide critical functionality to our daily lives. After reading the third bullet (just below) in the section "Fox Guarding the Hen House" regarding the 2017 report from the National Risk Management Center, just remember that GPS/PNT is not the only critical satellite constellation we should be considering.

Lack of Vulnerability Assessments

As foundational elements of the DHS NIPP, [vulnerability assessments](#) are **voluntary and nonregulatory**. While CISA [Protective Security Advisors](#) (PSA) offer assessments *at the request* of critical infrastructure owners and operators, since orbital assets are not identified as critical infrastructure, vulnerability assessments do not *officially* fall under the purview of the PSA program. Without satellite operators requesting vulnerability assessments, of course the NSTAC report for POTUS excludes budgetary requirements to protect our country's orbital assets. So, why has orbital debris escaped DHS scrutiny?

THE FOX GUARDING THE WHITE (HEN) HOUSE

It should be no surprise that there is a lack of action regarding the increasing risk of orbital debris.

- The 2008 [NSTAC Report to the President on Commercial Communications on the Global Positioning System \(GPS\)](#) neglected to mention orbital debris or collisions as a risk.
 - The 2009 [NSTAC Report to the President on Commercial Satellite Communications Mission Assurance](#) did identify orbital debris as a *low* potential for collision with active satellites. This makes sense as more satellites capable of debris avoidance maneuvers have been launched. Additionally, the NSTAC report recommended the Secretary of Defense make safety of flight and the preservation of the orbital environment a leading national security driver for enhanced space situational awareness efforts, which can be viewed as shifting the blame (responsibility) from satellite operators to the DoD.
 - The 2017 DHS CISA National Risk Management Center [Report on Positioning, Navigation, and Timing \(PNT\) Backup and Complementary Capabilities to the Global](#)
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[Positioning System \(GPS\)](#) clearly identified precise PNT as a requirement for agriculture, port operations, consumer location-based services, and maritime navigation and that a 30-day loss of GPS would negatively affect the economy by \$1 billion per day, which could be 50% higher if disruption occurred at an inopportune time (during war).

- The 2019 [NSTAC Factsheet](#) does not list recent NSTAC publications about orbital debris.
- The NSTAC Report neglects to discuss debris to debris collisions, of which there would be higher likelihood, as stated by Kevin O'Connell (former Office of Space Commerce Director) at the [2022 STM Conference](#) (ref. 14:20). Mr. O'Connell identified that since SDA/SSA data are coming online, that conjunction warning statistics indicate that 3% of the warnings are from active satellite to active satellite, 30% are active satellite to debris, and 67% are debris to debris.

NSTAC has identified potential resiliency stressors (i.e., electromagnetic pulse, solar flare, PNT disruption, long-term outage, supply chain cyber-attacks) for critical infrastructure sectors, but has not vigorously assessed orbital debris, which is an issue clearly identified as a concern across the satellite end-user community. The DHS Communications Sector Partnership Model identifies NSTAC as the partner responsible for advising the President of the United States. Is POTUS making budgetary decisions based upon omissive NSTAC reports submitted to the Oval Office?

Perhaps the [Office of Management and Budget](#) (OMB) needs to evaluate the effectiveness of the DHS governance model to improve its administrative management, performance measures and coordinating mechanisms to reduce unnecessary public burdens. Afterall, the OMB critical mission is to:

1. Develop and execute budgets, a prominent government-wide process managed from the Executive Office of the President (EOP) and a device by which a president implements policy, priority, and action in everything from the DoD to NASA.
2. Manage other agencies' financial, paperwork, and IT.

The fox (satellite industry) has lurked in the shadows to capture the eggs (massive profits) while the farmer (government) provides no oversight of the hen house (orbital commons), thus allowing the tragedy to grow out of control. It's no wonder the industry has no vested interest in pursuing satellite safety with vigor.

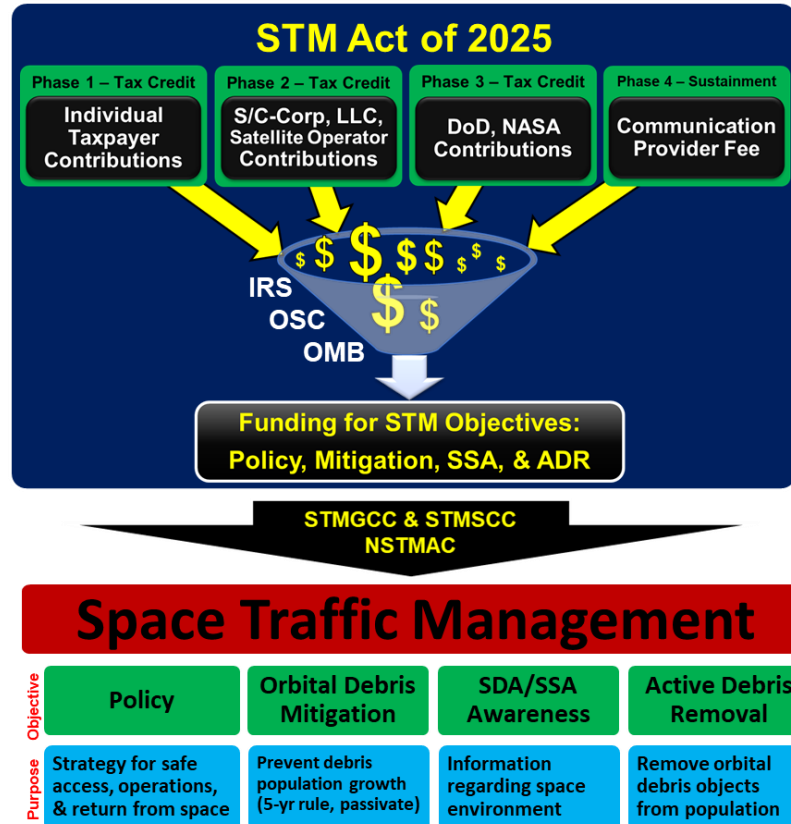
A GOVERNANCE AND FUNDING STRATEGY

To date, temporary and vagrant Capitol Hill personalities, OSTP, federal agencies, space professionals, academia, etc., have achieved torpid progress regarding orbital debris over the past half century. Funding decisions are the primary excuse for not bringing industry together with a laser focused vision.

In summary, the foundation of the [STM Act of 2025](#) is to incentivize financial contributions from U.S. taxpayers to generate funding for all the STM objectives, which, at the time of POTUS' signature, shall include ADR. What kind of incentives? Tax credits. Not tax deductions, which reduce taxable income, but tax credits that directly reduce your tax bill \$3 for every \$1 contributed. For

John Q Public that means a contribution of \$1,000 would reduce his/her tax bill by \$3,000. Now that is motivating. For satellite operators and philanthropists, that means a \$1 million contribution would reduce their tax bill by \$3 million dollars. This would finally encourage the satellite industry to stop ignoring orbital debris.

By establishing 'Space Traffic Management' as the 17th DHS critical infrastructure sector, the existing operating framework of methodologies from other sectors could be leveraged into an effective organization solely focused on STM and ADR. A STM government coordination council (STMGCC) comprised of legislators, Congressional committees and sub-committee members from various economic, revenue, commerce, space, OSTP, and other member deputies identified in the SPD-3 distribution memorandum list, who could coordinate policy, mitigation, SDA/SSA, and ADR priorities. The STMGCC could partner with a STM sector coordination council (STMSCC) who advocates industry positions for STM and ADR objectives and priorities for working groups, and special committees comprised of [Satellite Industry Association](#) members, academia, NASA, USSF, DoC OSC, and experts in policy, SSA, mitigation, and ADR. The National STM Advisory Committee (NSTMAC) could coordinate required budgets and funding allocations with OMB and advise POTUS.



IRS would enable taxpayer tax credits in their financial systems, update IRS Code and tax forms, and certify that contributions do not exceed limitations meant to prevent fraud and abuse.

OSC would publish SSA data, an ADR Priority List, and a Client ID List. They would also establish Qualified Service Provider (QSP) requirements based upon objectives, maintain the QSP List, invite QSP's to bid on projects, review client service contracts, and review contribution details. Service contract tallies would benefit the IRS for end of year validation for tax return claims.

OMB would develop inputs for POTUS budget requests and ensure service contract compliance.

The Qualified Service Provider would need to meet requirements established by OSC in order to be put on the QSP List. The QSP would review the Client ID List to determine if they want to participate in the contracting process, then submit negotiated contracts to OSC for review, before executing contract terms.

The draft [STM Act of 2025](#) is the funding mechanism that would be leveraged by these councils, committees, and STM Service Providers. Since the Bill requires change to IRS Code, it must be legislated, as any tax incentive (EV, child/dependent, solar), to spur **vigorous** contribution from satellite operators, philanthropists, and other taxpayers, if the tax credit was substantial enough. Expected benefits would not only supercharge immediate contributions, but additionally drive investor decisions that would expediate investment in sectors outside STM.

The U.S. has sufficient leadership, engineering, and orbital expertise. However, the cost to perform STM (especially ADR) design, launch, and orbital operation requires legislation of the [STM Act of 2025](#). Ultimately, legislation would require the government to initially sacrifice tax revenue income, which could be tapered in subsequent years once the industry is established. Given the size of the orbital debris problem, an innovative funding mechanism is required to initiate and instantiate tangible progress to stay ahead of the expected monumental orbital debris growth. A conservative \$50B could be expected to roll out a 7-year industry-wide program that covers policy, SSA, mitigation, and ADR.

CLOSING

How could orbital infrastructure be left off the CIKR list? Perhaps [it's time to declare orbital systems as critical infrastructure](#) and organize STM, Policy, mitigation, SSA, and ADR partners into an optimized, functioning membership.

Orbital debris is imperceptibly growing while the United States government and industry have minimized the danger to our future.

After nearly [6,550 space launches](#), NASA has cataloged [nearly 400 fragmentation events](#) that substantiates the estimated [100 million debris objects](#) orbiting Earth. As 19% of the [tracked debris](#) reside in or transit through medium Earth orbit (MEO), the danger takes on a whole new perspective considering one-quarter of our [nearly \\$27 trillion U.S. GDP](#) is the direct result of GPS, which operates in MEO. Not to mention that within the next decade, [17 times more space](#)

[missions](#) are slated to launch as [Space Force wants to outsource ADR](#) and [NASA OIG reports](#) their agency lacks the initiative and leadership to develop or acquire ADR technologies.

American confidence in our usurped election infrastructure, as described in [Devolution – Part 5](#), was a hit to our national security. Similarly, we must overcome our [false sense of security](#) pertaining to the effects of orbital debris. We must act according to the time value of money to:

- Establish a governance model to safeguard our satellite infrastructure.
- Legislate a funding mechanism, like [STM Act of 2025](#) for the Internal Revenue Service to implement tax incentivizes that enable temporary financial contributions from taxpayers.
- Perform assessments for orbital carrying capacity, space traffic footprint, and risk vulnerability for the whole of the environment, including active satellites, defunct satellites, expended hardware, and small flotsam.
- Prioritize mission planning based upon vulnerability assessments.
- Develop ADR while STM, SDA, and SSA come online.

Without action the U.S. and the rest of the globe are on a disastrous trajectory, because while occurring on a slower time scale than a nuclear fission reaction, once an orbit exceeds its carrying capacity (reaches [critical mass](#)) a chain reaction of collisions will explode out of control. Are we so arrogant that we are waiting for another Chernobyl-type incident? Or are we merely waiting for blood on the streets before we take action.

Contributed by:

Ken Eppens
Founder & CEO
OrbitGuardians, Inc.
562-553-2310 mobile
ken@orbitguardians.com
