# 2NR

#### Independently, satellite constellations are not appropiation – they are usage but not appropiation

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These constellations are merely the exercise and enjoyment of the freedom of exploration and use of outer space and do not constitute any impermissible appropriation of the orbits that they transit. 18 C. D. Johnson Freedom of Access and Use Permits Constellations Rather than being a violation of other’s rights to access and explore outer space, the deployment of these constellations is more correctly viewed as the exercise and enjoyment of the right to access and use outer space. Article I of the Outer Space Treaty establishes a right to access and use space without discrimination. Not allowing an actor to deploy spacecraft, regardless of their number or destination, would be infringing with the exercise of their freedom. It would be discriminatory. Additionally, actors do not need permission from any other State, or group of States, to access and explore outer space. Aligned with the Intentions of the Outer Space Treaty This use of outer space by constellations in LEO, while not explicitly mentioned by the drafters of the Outer Space Treaty or other space law, actually is the fulfillment of their visions for the use of outer space. The preamble to the Outer Space Treaty (which contains the subject matter and purpose of the treaty and can be used for interpreting the operative articles of the treaty) speaks of the aspirations of humanity in exploring and using outer space. It is easy to see constellations that will provide Internet access to the world as fulfilling the visions of the drafters: The States Parties to this Treaty, Inspired by the great prospects opening up before mankind as a result of man’s entry into outer space, Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes, Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development, **Desiring to contribute to broad international cooperation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes, Believing that such cooperation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples, As such, subsequent article of the Outer Space Treaty should be read in a permissive light, as permitting constellations, rather than a restrictive light which only sees potential negative aspects of constellations. Due Regard and Harmful Contamination Will be Addressed Operators in LEO are well aware of the challenges to space sustainability that their constellations will pose and will be taking efforts to mitigate the creation of debris. OneWeb is keenly focused on space sustainability and has even argued that the current norm, whereby spacecraft are not in space for longer than 25 years and are deorbited from lower orbits at the end of their lifetime (aka post mission disposal), is not sufficient** The Legal Status of MegaLEO Constellations and Concerns About Appropriation... 19 to keep outer space clean and that shorter lifespan limits should be imposed on operators, especially operators in LEO, and operators of small satellites. Additionally, these systems will be able to cooperate with emerging space safety and space traffic management plans and can operate in ways that do not restrict or impinge on other users of the space domain. Because due regard is therefore displayed for the space domain, and to the interests of others, these constellations do not prejudice or infringe upon the freedoms of use and exploration of the space domain and are therefore not occupation, or possession, much less appropriation. This Does Not Constitute Possession, or Ownership, or Occupation The use of LEO by satellite constellations is substantially similar to the use of GSO, and therefore permissible. In each region, individual actors are given permission - either from a national administrator or from an international governing body (the ITU) via a national administer–to use precoordinated subsections of space. In a way that is overwhelmingly similar to the use of orbital slots in GSO, the placement of spacecraft into orbits in LEO or higher orbits does not constitute possession, ownership, or occupation of those orbits. This is because States (and their companies) have been occupying orbital slots in GSO for decades, and these uses of GSO have never been accused of “appropriating” GSO. The users have never claimed to be appropriating GSO, and their exercising of rights to use GSO is respected by other actors in the space domain. This is the same situation for other orbits, including LEO and other non-Geostationary orbits. And while GSO locations are relatively stable (subject to space weather and other perturbations, and require stationkeeping), spacecraft in LEO are actually moving through space and are not stationary, so it is even more difficult to see this use by constellations as occupation, much less appropriation. Moreover, Space Situational Awareness (SSA) and Space Traffic Management (STM) will allow other uses to use these orbits, and nothing about the use of any one user necessarily precludes others. Lastly, there is no intention by operators of constellations to exclusively occupy, must less possess or appropriate, these orbits. Would not the appropriation of outer space be an intentional, volutional act? No such intention can be found in the operators of global constellations. Conclusion The development and deployment of constellations is certainly a unique and impressive technological development which will bring unprecedented advancements to both space activity and concerns here on Earth. It offers more benefits than risks. Rather than being multiple users which would threaten orbital safety, a single user at any altitude makes SSA and STM easier, and the actor merely has to govern their own spacecraft, rather than worry about others spacecraft. No such data sharing issues will exist with global constellations. Consequently, and in conclusion, it is in the wider public interests to permit, and not prevent, actors from planning, developing, deploying, and operating constellations in LEO. This technological advancement, of plentiful, off-the-shelf spacecraft, is the wave of the future for space exploration and utilization. It should not only be 20 C. D. Johnson permitted, it should be positively authorized, fostered, and nurtured. It is a future we want, where all can benefit from space technologies and capabilities.

# 1NC

## OFF

#### Interp: Debaters must only defend the appropriation of outer space

#### Violation:

#### 1] Appropiation is a term of art that doesn’t mean occupation or usage. Satellites and objects in geosynchronous orbit do not constitute appropriation – it’s not permanent nor stationary

Gorove 84 Stephen Gorove, Major Legal Issues Arising from the Use of the Geostationary Orbit, 5 MICH. J. INT'L L. 3 (1984). Available at: <https://repository.law.umich.edu/mjil/vol5/iss1/1> //RD Debatedrills

Crucial to a proper analysis of this issue is an understanding of the concept of "appropriation." The term "appropriation" in law is used most frequently to signify "the taking of property for one's own or exclusive use with a sense of permanence." 12 The word" thus indicates something more than just casual use. The question then becomes whether the continued exclusive occupation by a geostationary satellite of the same physical area is a violation of the ban on national appropriation. While a state may certainly exercise exclusive control over a traditional object, such as a ship, or an aircraft, or a part of airspace, it is not clear that a satellite in geostationary orbit would be able to maintain its exact position and occupy the same area over a period of time. 13 Even if a position could be accurately maintained, and thus possibly constitute an "appropriation" within the meaning of article II, the satellite would have to be kept in that orbit with a "sense of permanence" and not on a temporary basis. It has been suggested that the keeping of a solar power satellite in geostationary orbit for a period of thirty years would not constitute appropriation. 14 In point of fact, thirty years would probably satisfy the "sense of permanence" requirement, unless the geostationary orbit were considered a natural resource as characterized by the International Telecommunication Convention of 1973 (ITC) 15 and as claimed by the equatorial countries. Authority exists to support the view that the ban on national appropriation of outer space does not relate to resources. 16 In view of this and the additional fact that solar energy is an inexhaustible and unlimited resource, its utilization for transmission to earth by satellites does not appear to fall under the prohibition of article II of the 1967 Treaty.

#### 2] Appropriation of outer space shouldn’t be determined by one legal author saying your aff is topical – rather through the past actions of space-faring actors and what has been allowed and rejected

**Trapp 13** (TIMOTHY JUSTIN TRAPP, JD Candidate @ UIUC Law, ‘13, TAKING UP SPACE BY ANY OTHER MEANS: COMING TO TERMS WITH THE NONAPPROPRIATION ARTICLE OF THE OUTER SPACE TREATY UNIVERSITY OF ILLINOIS LAW REVIEW [Vol. 2013 No. 4])//DebateDrills RD

As commercial space flight becomes more and more prevalent,153 the question of whether private entities can appropriate property in space becomes very important. Whereas once it took a nation to get into space, it will soon take only a corporation, and scholars have pondered whether these entities will be able to claim property in space.154 Though this seems allowable, since the treaty only prohibits “national appropriation,”155 allowing such appropriation would lead to an absurd result. This is because the only value that lies in recognition of a claim is the ability to have that claim enforced.156 If a nation recognized and enforced such a claim, this enforcement would constitute state action.157 It would serve to exclude members of other nations and would thus serve as a form of national appropriation, even though the nation never attempted to directly appropriate the property.158 Furthermore, the Outer Space Treaty also requires that non-governmental entities must be authorized and monitored by the entities’ home countries to operate in space.159 Since a nation cannot authorize its citizens to act in contradiction to international law, a nation would not be allowed to license a private entity to appropriate property in space.160 While this nonappropriation principle is great for allowing free access to space, thereby encouraging research and development in the field, it makes it difficult to create or police a solution to the space debris problem. A viable solution will have to work without becoming an appropriation. There is, however, very little substantive law on what actually counts as appropriation in the context of space.161 So, the best way to see what is and is not allowed is to look both at the general international law regarding appropriations and to look at the past actions of space actors to see what has been allowed (or at least tolerated) and what has been prohibited or rejected.

#### Standards:

#### 1] Precision- Their model incentivizes arbitrarily doing away with words in the resolution- outer space is a term of the art that requires a specific distinction.

#### 2] Neg Prep- Their model explodes the amount of potential affs because there’s thousands of different types of private satellites—in combination with the million of other things they can spec, neg prep becomes impossible since there’s no universal DA because each action has a different situation- limits k2 reciprocal engagement because it creates neg caselists.

DTD and oweighs 1AR Theory since the abuse skewed my ability to engage in my round

Competing interps; a) arbitrary and increases judge intervention b) race to the bottom – less norms which turns their fairness/engagement args

## OFF

#### Cyber-attacks on critical infrastructure are coming now.

Underwood 20 [Kimberly Underwood, 6-24-2020, "China is Retooling, and Russia Seeks Harm to Critical Infrastructure," SIGNAL Magazine, <https://www.afcea.org/content/china-retooling-and-russia-seeks-harm-critical-infrastructure>] [pT]

Intelligence leader warns of the mounting threats of cyber espionage, digital attacks and influence operations from adversaries.

U.S. adversaries are trying to take control of cyberspace as a medium, resulting in implications to our freedom of maneuver and access in cyberspace, says Brig. Gen. Gregory Gagnon, USAF, director of Intelligence (A2), Headquarters Air Combat Command (ACC), Joint Base Langley-Eustis. Increasing cyberspace activity is coming from China, Russia, Iran and North Korea.

“We are seeing it not just in volume, but we are seeing an expansion in the ways that they use cyberspace, whether it is to steal information, whether it is to directly influence our citizens or whether it is to disrupt critical infrastructure,” Gen. Gagnon reports. The general spoke at the AFCEA Tidewater chapter’s recent monthly virtual luncheon.

China and Russia continue to pose the greatest espionage and cyber attack threats to the United States, but the intelligence leader anticipates that other adversaries and strategic competitors will also build and integrate cyber espionage, cyber attacks and influence operations into how they conduct business.

“Our strategic competitors will increasingly use cyber space capabilities including cyber espionage, cyber attack and continued influence operations to seek political, economic and military advantage over the United States, our allies and our partners,” he said. “This is not an ‘if,’ it is a yes. They are doing it and they will continue.”

Gen. Gagnon warned that China in particular is using cyber espionage to collect intelligence, target critical infrastructure and steal intellectual property. It is all part of China’s plan to move from being a regional actor to being seen as a global power. The shift also means a greater role for the adversary’s military. The Chinese military is in the process of transitioning from a defensive, inflexible ground-based force charged with domestic and peripheral security to a joint, highly agile, expeditionary and power projecting arm of Chinese foreign policy, he noted.

“What is going on in China is a dynamic revectoring of the objectives and goals of the People's Liberation Army,” Gen. Gagnon said. “This is not a small change. This is a major change in course and direction. They're doing it to be a power projection arm of a Chinese foreign policy that engages both in military diplomacy and operations around the globe, but also in predatory economic activity.”

Moreover, China’s military spending in 2018 exceeded $200 billion, an increase of about 300% since 2002, the general stated. And while it is not the $750 billion that the United States government spends every year on military defense, the Chinese funding does not reflect the same level of investment in manpower or healthcare.

A good portion of their $200 billion directly funds technology and capabilities. “A big chunk of our budget is not buying kit,” Gen. Gagnon explained. “If you're the CCP [Chinese Communist Party], you don't have the same extensive retirement programs that you have to pay for,” he said. “You don't have this extensive healthcare which you have to provide. So, when you think about $200 billion, think about that buying kit and buying operations. That is significant.”

#### Mega constellations function as critical infrastructure that increase resiliency and protect against cyberattacks.

Hallex and Cottom 20 [Matthew A. Hallex is a Research Staff Member at the Institute for Defense Analyses. Travis S. Cottom is a Research Associate at the Institute for Defense Analyses. “Proliferated Commercial Satellite Constellations: Implications for National Security.” 2020. <https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-97/jfq-97_20-29_Hallex-Cottom.pdf?ver=2020-03-31-130614-940>] [pT]

While potentially threatening the sustainability of safe orbital operations, new proliferated constellations also offer opportunities for the United States to increase the resilience of its national security space architectures. Increasing the resilience of U.S. national security space architectures has strategic implications beyond the space domain. Adversaries such as China and Russia see U.S. dependence on space as a key vulnerability to exploit during a conflict. Resilient, proliferated satellite constellations support deterrence by denying adversaries the space superiority they believe is necessary to initiate and win a war against the United States.28 Should deterrence fail, these constellations could provide assured space support to U.S. forces in the face of adversary counterspace threats while imposing costs on competitors by rendering their investments in counterspace systems irrelevant. Proliferated constellations can support these goals in four main ways.

First, the extreme degree of disaggregation inherent in government and commercial proliferated constellations could make them more resilient to attacks by many adversary counterspace systems. A constellation composed of hundreds or thousands of satellites could withstand losing a relatively large number of them before losing significant capability. Conducting such an attack with kinetic antisatellite weapons—like those China and Russia are developing—would require hundreds of costly weapons to destroy satellites that would be relatively inexpensive to replace.

Second, proliferated constellations would be more resilient to adversary electronic warfare. Satellites in LEO can emit signals 1,280 times more powerful than signals from satellites in GEO.29 They also are faster in the sky than satellites in more distant orbits, which, combined with the planned use of small spot beams for communications proliferated constellations, would shrink the geographic area in which an adversary ground-based jammer could effectively operate, making jammers less effective and easier to geolocate and eliminate.30

Third, even if the United States chooses not to deploy national security proliferated constellations during peacetime, industrial capacity for mass-producing proliferated constellation satellites could be repurposed during a conflict. Just as Ford production lines shifted from automobiles to tanks and aircraft during World War II, one can easily imagine commercial satellite factories building military reconnaissance or communications satellites during a conflict.

Fourth, deploying and maintaining constellations of hundreds or thousands of satellites will drive the development of low-cost launches to a much higher rate than is available today. Inexpensive, high-cadence space launch could provide a commercial solution to operationally responsive launch needs of the U.S. Government. In a future where space launches occur weekly or less, the launch capacity needed to augment national security space systems during a crisis or to replace systems lost during a conflict in space would be readily available.31

#### Cyberattacks cause extinction – false warnings, stealing nukes, and introducing vulnerability.

**Moniz et al. 18** [Ernest J. Moniz, Sam Nunn, and Des Browne, September 2018, “Nuclear Weapons in the New Cyber Age,” <https://media.nti.org/documents/Cyber_report_finalsmall.pdf>] [pT]

Cyber-based threats target all sectors of society—from the financial sector to the entertainment industry, from department stores to insurance companies. Governments face an even more critical challenge when it comes to cyberattacks on their most critical systems. Attacks on critical infrastructure could have extraordinary consequences, but a successful cyberattack3 on a nuclear weapon or related system—a nuclear weapon, a delivery system, or the related Nuclear Command, Control, and Communications (NC3) systems—could have existential consequences. Cyberattacks could lead to false warnings of attack, interrupt critical communications or access to information, compromise nuclear planning or delivery systems, or even allow an adversary to take control of a nuclear weapon.

Given the level of digitization of U.S. systems and the pace of the evolving cyber threat, one cannot assume that systems with digital components—including nuclear weapons systems—are not or will not be compromised. Among the reasons: nuclear weapons and delivery systems are periodically upgraded, which may include the incorporation of new digital systems or components. Malware could be introduced into digital systems during fabrication, much of which is not performed in secure foundries. In addition, there are a range of external dependencies, such as connections to the electric grid, that are outside the control of defense officials but directly affect nuclear systems. Finally, the possibility always exists that an insider, either purposefully or accidentally, could enable a cybersecurity lapse by introducing malware into a critical system.

Increased use of digital systems may also adversely affect the survivability of nuclear systems. New technologies can enhance reliability and performance, but they can also lead to new vulnerabilities in traditionally survivable systems, such as submarines or mobile missile launchers.4

## OFF

#### Space colonization only happens because of market demand from Starship – and our ev indicates the field is booming but on the brink

Maidenberg, 21, 12/28/21, WSJ, “SpaceX’s Future Depends on a Gigantic Rocket and 42,000 Internet Satellites”, He reports on longtime and newer space companies, as well as issues tied to the safe operation of commercial planes and other aircraft. As part of his work, he focuses on government agencies such as the National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA). Prior to his current role, Micah worked as a breaking news reporter for the Journal and the Dow Jones Newswires. He began writing about business and economic issues for Crain’s Chicago Business, where he reported on real estate, manufacturing and transportation beats. He also completed an investigative-reporting fellowship at the Columbia University School of Journalism, where he earned a Master's degree. URL: <https://www.wsj.com/articles/spacexs-future-depends-on-a-gigantic-rocket-and-42-000-internet-satellites-11640687404>, KR

SpaceX wants to use its Starship rocket for the kind of voyages to Mars and beyond that Elon Musk has long dreamed of pursuing.

Starship also forms an important foundation of the future business strategy at his space company, which wants to use the vehicle in part to build out Starlink, the satellite-internet service many investors believe could eventually form the bulk of the company’s revenue.

Space Exploration Technologies Corp., the formal name for the company Mr. Musk founded almost two decades ago, faces steep challenges in engineering Starship into a reusable rocket that would sharply drive down launch costs. Mr. Musk recently said the ship takes up more of his time than any other single initiative, and warned the vehicle, along with the internet service, are creating significant challenges for the company.

“Starship is a hard, hard, hard, hard project,” he said at a December event hosted by The Wall Street Journal. “This is the biggest rocket ever made.”

Starship, which would be blasted to orbit on a booster dubbed Super Heavy, stands 160 feet tall and has a diameter of 30 feet, creating room to send hundreds of Starlink satellites to orbit at once, more than the several dozen it is able to deploy right now on one of its Falcon 9 rockets. More than half of the launches tracked by U.S. flight-safety regulators that the company has conducted the past two years have been Starlink deployments. The company plans to rapidly boost the pace of satellite launches in the years ahead. SpaceX, in a July presentation to the Federal Communications Commission, said it had so far launched around 1,800 Starlink satellites and was active in more than 20 countries. The FCC has authorized SpaceX to launch around 12,000 satellites, but the company wants to add at least around 30,000 more, according to commission filings. Mr. Musk said at an industry conference this summer that SpaceX is likely to invest at least $5 billion and perhaps as much as $10 billion in Starlink before it fully starts generating cash, with ongoing investments after that. In a November tweet, Mr. Musk said if severe global recession cut into the availability of capital and liquidity while SpaceX was losing billions on Starship and Starlink, then bankruptcy “while still unlikely, is not impossible.” Over the past two years, the company began equity sales that raised at least $3.8 billion, according to filings that some private companies like SpaceX may have to disclose under Securities and Exchange Commission rules. SpaceX doesn’t release financial statements. A spokesman for the company pointed to a recent statement posted to SpaceX’s website that said in part the company’s year ahead would include a potential first orbital mission for Starship and expanding Starlink. Mr. Musk unveiled Starlink in 2015, aiming to develop a network of smaller satellites in a low orbit around Earth that could provide high-speed internet access around the world. SpaceX set out aggressive targets for Starlink, projecting that year more than 40 million subscribers by 2025, The Wall Street Journal previously reported. SpaceX said this summer that it had around 140,000 Starlink customers. Starlink lists costs for the service at $99 a month, with a $499 charge for an internet terminal—or roughly half the amount it costs the company to make it, Mr. Musk said over the summer. Other companies, such as London-based OneWeb, are also creating networks of internet satellites, and an Amazon.com Inc. unit plans to do so in the future. Around 3.7 billion people globally remain unconnected to the internet, according to a recent report from two agencies at the United Nations, while U.S. officials have worked for years to improve access to high-speed internet in underserved areas. “There’s a need for connectivity in places that don’t have it right now,” or where connections are very limited or expensive, Mr. Musk said this summer. In addition to consumers, Mr. Musk has indicated Starlink could offer services to other businesses, recently saying in a tweet that fliers should ask airlines for Starlink.

The internet service creates a source of demand for Starship, said Matt Weinzierl, a Harvard Business School professor who has studied the space economy.

Historically, those behind big rockets without a clear use for them have faced challenges: “If we don’t know why we built them, it can be a real losing proposition,” Mr. Weinzierl said, adding he thinks the company will identify other uses for the rocket.

Starship, meanwhile, has at least one confirmed customer in place: the National Aeronautics and Space Administration, which in April awarded SpaceX a $2.9 billion contract to develop a Starship to take astronauts back to the surface of the moon.

As it works to develop Starship and Starlink, SpaceX has built out a business based on government customers such as NASA and on commercial-satellite operators.

The value of its contracts with public-sector clients amounted to $2.2 billion for the federal government’s 2021 fiscal year, up from $195 million a decade earlier, according to a contracts database. SpaceX typically charges private clients $60 million to $65 million for Falcon 9 launches, according to people familiar with the matter.

The company’s valuation has soared as it proved its spacecraft like Falcon 9 could work as intended and as it started constructing its fleet of Starlink satellites. SpaceX was valued at $100 billion in October, more than double its valuation in the summer of 2020, according to PitchBook. The latest figure rests heavily on prospects for Starlink because the potential demand for the high-speed internet service globally is much larger than the size of the launch market, investors say.

#### Specifically, Starship from spaceX is the most prominent solution

O’Callaghan, 21, 12/7/21, MIT Review, “How SpaceX’s massive Starship rocket might unlock the solar system—and beyond”, Jonathan O'Callaghan is a freelance space journalist based in London, UK who covers commercial spaceflight, astrophysics, and space exploration. URL: <https://www.technologyreview.com/2021/12/07/1041420/spacex-starship-rocket-solar-system-exploration/>, KR

Much has already been made of Starship’s human spaceflight capabilities. But the rocket could also revolutionize what we know about our neighboring planets and moons. “Starship would totally change the way that we can do solar system exploration,” says Ali Bramson, a planetary scientist from Purdue University. “Planetary science will just explode.”

If it lives up to its billing, scientists are already talking about sending missions to Neptune and its largest moon in the outer solar system, bringing back huge quantities of space rock from Earth’s moon and Mars, and even developing innovative ways to protect Earth from incoming asteroids.

Starship—which is being built at a Texas site dubbed “Starbase”—consists of a giant spaceship on top of a large booster, known as Super Heavy. Both can land back on Earth so they can be reused, reducing costs. The entire vehicle will be capable of lifting 100 metric tons (220,000 pounds) of cargo and people into space on regular low-cost missions. The volume of usable space within Starship is a whopping 1,000 cubic meters—big enough to fit the entire Eiffel Tower, disassembled. And that’s got scientists excited.

“Starship is, like, wow,” says James Head, a planetary scientist from Brown University.

In mid-November, speaking in a publicly accessible virtual meeting about Starship hosted by the US National Academies of Sciences, Engineering, and Medicine, Musk discussed the project’s scientific potential. “It’s extremely important that we try to become a multiplanet species as quickly as possible,” he said. “Along the way, we will learn a great deal about the nature of the universe.” Starship could carry “a lot of scientific instrumentation” on flights, said Musk—far more than is currently possible. “We’d learn a tremendous amount, compared to having to send fairly small vehicles with limited scientific instrumentation, which is what we currently do,” he said.

“You could get a 100-ton object to the surface of Europa,” said Musk.

Cheap and reusable

Central to many of these ideas is that Starship is designed to be not just large but cheap to launch. Whereas agencies like NASA and ESA must carefully choose a smattering of missions to fund, with launch costs in the tens or hundreds of millions of dollars, Starship’s affordability could open the door to many more. “The low cost of access has the potential to really change the game for science research,” says Andrew Westphal, a lecturer in physics at the University of California, Berkeley, with flights potentially as low as $2 million per launch. “You can imagine privately financed missions and consortia of citizens who get together to fly things.”

NASA has selected SpaceX’s Starship as the lander to take astronauts to the moon

When the first astronauts in over 50 years set foot on the moon, they’ll be riding to the surface aboard Starship.

What’s more, Starship has a key advantage over other super-heavy-lift rockets in development, such as NASA’s much-delayed Space Launch System and Blue Origin’s New Glenn rocket. The upper half of the rocket is designed to be refueled in Earth orbit by other Starships, so more of its lifting capability can be handed over to scientific equipment rather than fuel. Taking humans to the moon, for example, might require eight separate launches, with each consecutive “tanker Starship” bringing up fuel to the “lunar Starship” that then makes its way to the moon with scientific equipment and crew.

Scientists are now starting to dream of what Starship might let them do. Earlier this year, a paper published by Jennifer Heldmann of NASA Ames Research Center explored some of the scientific opportunities that might be opened by Starship missions to the moon and Mars. One great benefit is that Starship could carry full-sized equipment from Earth—no need to miniaturize it to fit in a smaller vehicle, as was required for the Apollo missions to the moon. For example, “you could bring a drilling rig,” says Heldmann. “You could drill down a kilometer, like we do on Earth.” That would afford unprecedented access to the interior of the moon and Mars, where ice and other useful resources are thought to be present. Before, such an idea have been “a little bit insane,” says Heldmann. But with Starship, “you could do it, and still have room to spare,” she adds. “What else do you want to bring?”

Because Starship can land back on Earth, it will also—theoretically—be able to bring back vast amounts of samples. The sheer volume that could be returned, from a variety of different locations, would give scientists on Earth unprecedented access to extraterrestrial material. That could shed light on a myriad of mysteries, such as the volcanic history of the moon or “the question of life and astrobiology” on Mars, says Heldmann.

Starship could also enable more extravagant missions to other locations, either via a direct launch from Earth or perhaps by using the moon and Mars as refueling stations, an ambitious future envisioned by Musk.

#### Space exploration solves extinction and endless resource wars.

Collins 10 [Patrick Collins, professor of economics at Azabu University in Japan, and a Collaborating Researcher with the Institute for Space & Astronautical Science, as well as adviser to a number of companies, Adriano V. Autino is President of the Space Renaissance International; Manager, CEO/CTO, Systems Engineering Consultant / Trainer at Andromeda Systems Engineering LLC; and Supplier of methodological tools and consultancy at Intermarine S.p.A, Acta Astronautica, Volume 66, Issues 11–12, June–July 2010, “What the growth of a space tourism industry could contribute to employment, economic growth, environmental protection, education, culture and world peace”, Pages 1553–1562]

7. World peace and preservation of human civilisation

The major source of social friction, including international friction, has surely always been unequal access to resources. People fight to control the valuable resources on and under the land, and in and under the sea. The natural resources of Earth are limited in quantity, and economically accessible resources even more so. As the population grows, and demand grows for a higher material standard of living, industrial activity grows exponentially. The threat of resources becoming scarce has led to the concept of “Resource Wars”. Having begun long ago with wars to control the gold and diamonds of Africa and South America, and oil in the Middle East, the current phase is at centre stage of world events today [37]. A particular danger of “resource wars” is that, if the general public can be persuaded to support them, they may become impossible to stop as resources become increasingly scarce. Many commentators have noted the similarity of the language of US and UK government advocates of “war on terror” to the language of the novel “1984” which describes a dystopian future of endless, fraudulent war in which citizens are reduced to slaves.

7.1. Expansion into near-Earth space is the only alternative to endless “resource wars”

As an alternative to the “resource wars” already devastating many countries today, opening access to the unlimited resources of near-Earth space could clearly facilitate world peace and security. The US National Security Space Office, at the start of its report on the potential of space-based solar power (SSP) published in early 2007, stated: “Expanding human populations and declining natural resources are potential sources of local and strategic conflict in the 21st Century, and many see energy as the foremost threat to national security” [38]. The report ended by encouraging urgent research on the feasibility of SSP: “Considering the timescales that are involved, and the exponential growth of population and resource pressures within that same strategic period, it is imperative that this work for “drilling up” vs. drilling down for energy security begins immediately” [38].

Although the use of extra-terrestrial resources on a substantial scale may still be some decades away, it is important to recognise that simply acknowledging its feasibility using known technology is the surest way of ending the threat of resource wars. That is, if it is assumed that the resources available for human use are limited to those on Earth, then it can be argued that resource wars are inescapable [22] and [37]. If, by contrast, it is assumed that the resources of space are economically accessible, this not only eliminates the need for resource wars, it can also preserve the benefits of civilisation which are being eroded today by “resource war-mongers”, most notably the governments of the “Anglo-Saxon” countries and their “neo-con” advisers. It is also worth noting that the $1 trillion that these have already committed to wars in the Middle-East in the 21st century is orders of magnitude more than the public investment needed to aid companies sufficiently to start the commercial use of space resources.

Industrial and financial groups which profit from monopolistic control of terrestrial supplies of various natural resources, like those which profit from wars, have an economic interest in protecting their profitable situation. However, these groups’ continuing profits are justified neither by capitalism nor by democracy: they could be preserved only by maintaining the pretence that use of space resources is not feasible, and by preventing the development of low-cost space travel. Once the feasibility of low-cost space travel is understood, “resource wars” are clearly foolish as well as tragic. A visiting extra-terrestrial would be pityingly amused at the foolish antics of homo sapiens using long-range rockets to fight each other over dwindling terrestrial resources—rather than using the same rockets to travel in space and have the use of all the resources they need!

7.2. High return in safety from extra-terrestrial settlement

Investment in low-cost orbital access and other space infrastructure will facilitate the establishment of settlements on the Moon, Mars, asteroids and in man[/woman]-made space structures. In the first phase, development of new regulatory infrastructure in various Earth orbits, including property/usufruct rights, real estate, mortgage financing and insurance, traffic management, pilotage, policing and other services will enable the population living in Earth orbits to grow very large. Such activities aimed at making near-Earth space habitable are the logical extension of humans’ historical spread over the surface of the Earth. As trade spreads through near-Earth space, settlements are likely to follow, of which the inhabitants will add to the wealth of different cultures which humans have created in the many different environments in which they live.

Success of such extra-terrestrial settlements will have the additional benefit of reducing the danger of human extinction due to planet-wide or cosmic accidents [27]. These horrors include both man-made disasters such as nuclear war, plagues or growing pollution, and natural disasters such as super-volcanoes or asteroid impact. It is hard to think of any objective that is more important than preserving peace. Weapons developed in recent decades are so destructive, and have such horrific, long-term side-effects that their use should be discouraged as strongly as possible by the international community. Hence, reducing the incentive to use these weapons by rapidly developing the ability to use space-based resources on a large scale is surely equally important [11] and [16]. The achievement of this depends on low space travel costs which, at the present time, appear to be achievable only through the development of a vigorous space tourism industry.

## OFF

#### CP: Private actors should:

#### Deorbit all large satellite constellations in the LEO before their operational end period

#### Replace the aluminum infrastructure with titanium

#### That solves

Siegel, 19, Forbes, “This Is How Elon Musk Can Fix The Damage His Starlink Satellites Are Causing To Astronomy”, I am a Ph.D. astrophysicist, author, and science communicator, who professes physics and astronomy at various colleges. I have won numerous awards for science writing since 2008 for my blog, Starts With A Bang, including the award for best science blog by the Institute of Physics. URL: <https://www.forbes.com/sites/startswithabang/2019/11/20/this-is-how-elon-musk-can-fix-the-damage-his-starlink-satellites-are-causing-to-astronomy/?sh=792b79a64ccc>, KR

Previous constellations of satellites, such as the extremely successful Iridium constellation, proceeded in clearly defined and predictable orbits, were few in number (66 total), and only flared brightly when their orientation reflected sunlight in a particular manner. The Starlink satellites, along with similar planned constellations such as Kuiper Systems and OneWeb, pose a new and unique hurdle for ground-based astronomy.

According to Cees Bassa from the Netherlands Institute for Radio Astronomy, up to 140 such satellites will be visible at any one time from every observatory on Earth. However, if the companies behind these new constellations are willing to take just a few simple steps, all of these hurdles can be overcome. Here's what a responsible steward of the night sky ought to do, and how SpaceX can undo the damage they're in the process of inflicting on astronomy.

1.) De-orbit the current batch of Starlink satellites, and place a moratorium on the launch of new ones until the proper modifications have been made. Unlike most of the GPS and communications satellites we have today, **the current Starlink** satellites are large, reflective, and already causing some astronomers to throw out significant portions of their data. Currently at an altitude of 280 km, where they're visible to the naked eye, they can now easily and safely be de-orbited.

But once they're raised to their operational altitude of 550 km, they become a much more permanent problem. In addition, public awareness will drop, but they will remain visible to all binoculars and telescopes: the astronomer's most essential tools. Every moment that these satellites are up there is the astronomical equivalent of callously rollin' coal in the face of every scientist, researcher, and especially the undergraduate and graduate students who rely on hard-to-obtain telescope time in order to start their careers.

2.) Either redesign or coat the satellites to significantly reduce their reflectivity. Part of the problem with these new satellites is that they're both large and highly reflective. But these problems are unnecessary: they're choices. Choosing a different design, where the satellites can be oriented to minimize the impact on astronomy, would ameliorate the problem. Even more cost-effectively, simply coating the satellites with a very dark, low-albedo outer layer would go a long way to reducing the astronomically polluting effects of this constellation.

Albedo reduction, it is very clear from the current Starlink satellites, was not even considered as part of the design. By incorporating some common sense steps to reduce it — and I know plenty of astronomers willing to help with recommendations — the apparent brightness of these satellites can be reduced by a factor of approximately ~100.

3.) Provide real-time trajectory plans, predictions, and adjustment information for each satellite to observatories worldwide. One of the worst things about these satellites is that they come without predictable trajectories. If their paths were known, astronomers could schedule observations that absolutely minimized their impact on the science, making good use of every moment of good seeing.

It should be not only easy, but mandatory, to set up a global network that tracked the predicted paths of each satellite in real-time, updated continuously to account for any maneuvers or course-corrections that were taken. By providing this information to astronomers, the polluted areas can be avoided at any moment in time, while still taking quality observations of as much of the sky as possible.

The first 122 Starlink satellites have now been successfully deployed, and are already causing... [+] headaches for astronomers. To offset this, it's only fair that the companies placing these satellites in orbit pay astronomers to develop the necessary measures to minimize their impact on professional astronomy.

4.) Provide funding to assist astronomers in the development of hardware and software-driven solutions to subtracting out as much of the satellite pollution as possible. Even if all of these steps are taken, it will still be an arduous and expensive task for astronomers to account for the contamination that remains in their data. It's unreasonable to expect that Starlink or any satellite-based company will have no impact on astronomy at all, but it's extremely reasonable to demand that they fund the mitigation efforts astronomers will need to take.

#### Root cause of megaconstellation ozone damage is aluminum

Delbert, 21, Popular Mechanics, “All the Satellites in Space Could Crack Open the Ozone Layer”, Caroline Delbert is a writer, book editor, researcher, and avid reader. URL: <https://www.popularmechanics.com/space/satellites/a36651845/satellite-pollution-starlink-ozone/>, KR

“We have 54 tonnes (60 tons) of meteoroid material coming in every day,” lead study author Aaron Boley told Space.com. “With the first generation of Starlink, we can expect about 2 tonnes (2.2 tons) of dead satellites reentering Earth’s atmosphere daily. But meteoroids are mostly rock, which is made of oxygen, magnesium and silicon. These satellites are mostly aluminum, which the meteoroids contain only in a very small amount, about 1 [percent].”

Aluminum is key to everything at stake here. First, it burns into reflective aluminum oxide, or alumina, which could turn into an unwitting geoengineering experiment that could alter Earth’s climate. And second, aluminum oxide could damage and even rip a new hole in the ozone layer. Let’s look at each threat separately and try to figure it out.

#### **Titanium solves ozone – it can replace aluminum**

Space Daily 20’Staff Writers, 12-8-2020, "The use of Titanium on the spacecraft was effective in reducing the load," Space Daily, [https://www.spacedaily.com/reports/The\_use\_of\_Titanium\_on\_the\_spacecraft\_was\_effective\_in\_reducing\_the\_load\_999.html //](https://www.spacedaily.com/reports/The_use_of_Titanium_on_the_spacecraft_was_effective_in_reducing_the_load_999.html%20//) MonVisRD

designing or engineering a component of spacecraft, the crucial challenge is weight optimization, and it can't come at the expense of component strength or performance. Materialize Manufacturers and engineers come with the unique idea of using [titanium metal](https://www.samaterials.com/7-titanium) and its alloys for the aerospace sector to transfer high mechanical loads in structures like satellites. With optimized design produced through 3D metal Printing, the titanium inserts are generated of the initial weight, with improved properties. It can be used as mounting points to attach devices to spacecraft and satellites. These titanium inserts are highly suitable for heavy loads, lifting a large and heavy structure that means they have to exhibit a great strength-to-weight ratio. It's a part with high specific strength and rigidity but at a minimal weight. The weight reduction will allow the increase of sound equipment to be used in satellites and result in considerable cost savings in each launch. Besides weight reduction, titanium and its alloys resolved thermo-elastic stress issues with spacecraft designs. As the titanium inserts are installed during the curing process of carbon fiber-resistant polymers, they are focused on thermo-elastic stresses. Properties of Titanium make it a suitable element for aerospace and aeronautics 1. Density The new revolution in material science is the use of titanium and its alloys for space programs. There is possibly no other material more closely related to aerospace than titanium and its alloys. This is because it has a density of 4.5g/cm3, and it is about half as heavy as steel or Ni-based alloys; due to this unique property, Titanium yields an excellent strength-to-weight ratio. Temperature Resistance The titanium and its alloys in the aerospace industry will be highlighted, including engine, airframe, helicopter, and space applications. Titanium and Ti-alloys are normally chosen for their mechanical properties, temperature resistance, or chemical resistance. Corrosion Resistance: Titanium has outstanding corrosion resistance properties. This specific property makes titanium ideal for the spacecraft industry. Conventional Ti-alloys are also used for primary and secondary structures, fasteners, plumbing systems, and in areas where operating temperatures rule out the use of aluminum alloys. Characteristics of Titanium and its alloys make it suitable for the aerospace industry The characteristics of titanium and its alloys are grouped according to their metallurgical structure controlled by the heat-treatment and chemical composition. Commercially pure titanium products are selected for chemical resistance. Impurities in titanium can increase its strength, but corrosion resistance becomes lesser. Ti- alloys are ideal for contact with CFRP due to their low CTE and matched galvanic corrosion properties. Titanium alloys are selected for their remarkable strength properties, which depend on several heat-treatments such as quench, age hardening, and temper. The most used titanium alloy is Ti6Al4V, due to broad mechanical and corrosion properties. All classical shaping and forming processes can be used, with wrought products being produced by rolling, forging, extrusion, cast products. Owing to titanium's high similarity for oxygen and other gases, casting and melting processes are carried out under controlled vacuum to prevent infectivity and subsequent property degradation.

## CASE

### 1NC—Circumvention

#### Big problem with the aff is that “large satellite constellations” isn’t a term of art and can be circumvented with a slightly less satellite constellation-- **Their solvency ev concedes this**

1AC Takaya et al 18 “The Principle of Non-Appropriation and the Exclusive Uses of LEO by Large Satellite Constellations” Yuri Takaya-Umehara [Visiting researcher at the University of Tokyo since April 2017. She was affiliated to the Kobe University to provide a course on space law to post-graduate students (2011-2017). She chairs a working group on the formulation of global norms in space law organized by the Keio University since 2018. She obtained her Ph.D. degree at the IDEST of Paris XI University in France, LL.M. at the Leiden University in the Netherlands.] Quentin Verspieren [Ph.D. in public policy @ The University of Tokyo, Assistant Professor of Space Policy @UTokyo, General Manager, Global Strategy @ArkEdge Space Inc., Associate Research Fellow @ESPI] Goutham Karthikeyan [The University of Tokyo & Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (ISAS-JAXA)] 2018 https://www.researchgate.net/publication/328094878\_The\_Principle\_of\_Non-Appropriation\_and\_the\_Exclusive\_Use\_of\_LEO\_by\_Large\_Satellite\_Constellations SM

* LSC = large satellite constellations
* Outlines “L”SC thresholds

By investigating expected large satellite constellation projects and by reviewing existing interpretations of international space law, this paper argues that the exclusive use of specific LEO orbits by a large constellation of satellite could constitute a violation of the non-appropriation principle by means of occupation and by means of use, drawing a parallel between orbits as resources and the exploitation of tangible mineral resources in space. Based on this, the important question to be raised is what constitutes an exclusive use of a specific orbit. In other words, an important hurdle in the concrete evaluation of whether a planned or established constellation potentially violates the non-appropriation principle through an exclusive use of LEO resides in the lack of clear definition on what can be considered an exclusive use. While the authors claim that legal issue can be clearly solved in abstracto, it naturally shifts towards a regulatory challenge.

This regulatory challenge consists in first defining qualitatively what is the exclusive use of an orbit before translating this definition into measurable, technical rules. In this paper, the authors define an exclusive use of an orbit by a state40 as any use that would prevent/hinder the usage of the same orbit by any other state. Translating this definition into an applicable regulation could consist in defining a threshold of orbital collision risk or a threshold of density of satellites along an orbit based on its altitude, shape, relative velocity of neighbouring objects, etc. It is however not the purpose of this space law paper. What is more appropriate here is to think about which organization or forum would be in charge of elaborating this technical definition. Serious candidates could be the ITU, with excellent track-record in dealing with the use of the GEO region but which would have to review its “first come, first served” principle, or the UNCOPUOS, aiming for the widespread adoption of a new piece of international law. Moreover, even if its rules suffer from a low implementation rates, the IADC would be an appropriate discussion platform thanks to its very deep technical focus.6. Conclusion

The various announced projects of LSC, also called mega-constellations, push existing regulations and practices to their limit, forcing researchers and practitioners around the world to rethink the applicability of existing space law principles to this new trend. In this paper, the authors, after providing background information on current LSC plans as well as recalling the legal status of the LEO region, investigate whether the deployment of an LSC having an exclusive use of an orbit constitutes a violation of the nonappropriation principle as stated in OST Article II. This paper concludes that:

♣ The exclusive use of an orbit by an LSC constitutes a violation of the non-appropriation principle by means of occupation due to the innate nature of orbit being a specific location in space that can be occupied, but most notably by means of use, considering orbits as “limited natural resources” and invoking parallels with the exploitation of natural resources in outer space;

♣ ITU’s “first come, first served” principle is reaching its limits with current LSC projects and should be re-evaluated;

♣ The main challenge ahead is not legal but technical and regulatory and consists in defining precisely what can constitute an exclusive use of an orbit and in translating such definition into a clear regulation or code of conduct.

#### Private companies use and have historically used legal ambiguities to appropiate outer space

Stockwell 20 Legal ‘Black Holes’ in Outer Space: The Regulation of Private Space Companies Written by Samuel Stockwell This PDF is auto-generated for reference only. As such, it may contain some conversion errors and/or missing information. For all formal use please refer to the official version on the website, as linked below. Legal ‘Black Holes’ in Outer Space: The Regulation of Private Space Companies https://www.e-ir.info/2020/07/20/legal-black-holes-in-outer-space-the-regulation-of-private-space-companies/ SAMUEL STOCKWELL, JUL 20 2020

Lunar rock samples from the Apollo missions containing rare Earth resources, such as Helium-3 which produces more power and less waste than traditional nuclear reactors on Earth, have since fuelled incentives for extraterrestrial resource mining (Brearley, 2006: 44-46). This was further facilitated by suggestions that near-earth objects (NEOs) like the so-called ‘Anteros asteroid’ could comprise of over five trillion dollars’ worth of magnesium silicate and aluminium (Kramer, 2017: 131). Envisaging appropriation concerns that might arise from the future extraction of space assets by spacefaring nations, Article II of the UN OST declared that: “Outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means” (UN, 1967). The emphasis on claims of national sovereignty were intimately tied to the Cold War context at the time, where space activities were under the exclusive monopoly of governmental agencies and initiated for goals of military dominance or national prestige (Sachdeva, 2017: 210). However, the privatisation of the space industry that has occurred since the 1980s has meant that the legislation leaves an enormous amount of legal ambiguity and interpretation regarding the regulation of private resource mining in space. As Shaer (2016) demonstrates, the Article II provision fails to address either the exploitation of space for financial gain or the property claims of commercial enterprises (Shaer, 2016: 47). Nevertheless, Article VI of the UN OST asserts that: “States shall be responsible for national space activities whether carried out by governmental or non-governmental entities” (UN, 1967; own emphasis). Some scholars have suggested that this clause significantly restrains the activities of private space corporations by incentivising states to regulate their domestic organisations for fear of liability concerns (Abeyratne, 1998: 168). However, the US government recently enacted a piece of legislation which exploited this clause, in order to circumvent its own restrictions and strengthen US economic influence in space. The passage of the 2015 SPACE Act enabled US citizens to privately “possess, own, transport, use, and sell the resources” they obtain in outer space, whilst making careful consideration to deny national sovereign claims over such materials (Leon, 2018: 500). Yet, regardless of whether it is an American private company or public venture, the US is still satisfying its geopolitical interests; by exclusively siphoning off extra-terrestrial resources for American gain, the nation’s soft power is thereby extended at the expense of spacefaring adversaries such as China (Basu & Kurlekar, 2016: 65). Indeed NewSpace actors cleverly played on these strategic concerns prior to the bill’s passage, with billionaire space entrepreneur Robert Bigelow asserting that the biggest danger wasn’t private enterprises on the Moon, but that “America is asleep and does nothing, while China comes along… surveying and laying claim [to the Moon]” (Klinger, 2017: 222). The US government’s support for private space companies is also likely to lead to the reinforcement of Earth-bound wealth inequalities in space. Many NewSpace actors frame their long-term ambitions in space with strong anthropogenic undertones, by offering the salvation of the human race from impending extinction through off-world colonial developments (Kearnes & Dooren: 2017: 182). Yet, this type of discourse disguises the highly exclusive nature of these missions. Whilst they seem to suggest that there is a stake for ordinary citizens in the vast space frontier, the reality is that these self-described space pioneers are a member of a narrow ‘cosmic elite’ – “founders of Amazon.com, Microsoft, Pay Pal… and a smattering of games designers and hotel magnates” (Parker, 2009: 91).

### 1NC—Plan Flaw

#### Plan flaw – their plantext says lower Earth orbit which isn’t a term of art – voting issue for precision

NASA 21 (National Aerospace Agency) 11/17/2021 https://www.nasa.gov/leo-economy/faqs

What is LEO (Low-Earth Orbit)?

Low-Earth orbit (often known as LEO) encompasses Earth-centered orbits with an altitude of 2,000 km (1,200 mi) or less. For the purposes of the Commercial Use Policy, low-Earth orbit is considered the area in Earth orbit near enough to Earth for convenient transportation, communication, observation and resupply. This is the area where the International Space Station currently orbits and where many proposed future platforms will be located.

### 1NC­—Collisions

#### No Kessler Syndrome –

**1] Probability – 0.1% chance of a collision.**

**Salter 16** [(Alexander William, Economics Professor at Texas Tech) “SPACE DEBRIS: A LAW AND ECONOMICS ANALYSIS OF THE ORBITAL COMMONS” 19 STAN. TECH. L. REV. 221 \*numbers replaced with English words] TDI

The probability of a collision is currently low. Bradley and Wein estimate that the maximum probability in LEO of a collision over the lifetime of a spacecraft remains below one in one thousand, conditional on continued compliance with NASA’s deorbiting guidelines.3 However, the possibility of a future “snowballing” effect, whereby debris collides with other objects, further congesting orbit space, remains a significant concern.4 Levin and Carroll estimate the average immediate destruction of wealth created by a collision to be approximately $30 million, with an additional $200 million in damages to all currently existing space assets from the debris created by the initial collision.5 The expected value of destroyed wealth because of collisions, currently small because of the low probability of a collision, can quickly become significant if future collisions result in runaway debris growth.

**2] Time frame – Kessler effect 200 years away**

**Stubbe 17** [(Peter, PhD in law @ Johann Wolfgang Goethe University Frankfurt) “State Accountability for Space Debris: A Legal Study of Responsibility for Polluting the Space Environment and Liability for Damage Caused by Space Debris,” Koninklijke Brill Publishing, ISBN 978-90-04-31407-8, p. 27-31] TDI

The prediction of possible scenarios of the future evolution of the debris p o p ulation involves many uncertainties. Long-term forecasting means the prediction of the evolution of the future debris environment in time periods of decades or even centuries. Predictions are based on models84 that work with certain assumptions, and altering these parameters significantly influences the outcomes of the predictions. Assumptions on the future space traffic and on the initial object environment are particularly critical to the results of modeling efforts.85 A well-known pattern for the evolution of the debris population is the so-called Kessler effect’, which assumes that there is a certain collision probability among space objects because many satellites operate in similar orbital regions. These collisions create fragments, and thus additional objects in the respective orbits, which in turn enhances the risk of further collisions. Consequently, the num ber of objects and collisions increases exponentially and eventually results in the formation of a self-sustaining debris belt aroundthe Earth. While it has long been assumed that such a process of collisional cascading is likely to occur only in a very long-term perspective (meaning a time 1 n of several hundred years),87 a consensus has evolved in recent years that an uncontrolled growth of the debris population in certain altitudes could become reality much sooner.88 In fact, a recent cooperative study undertaken by various space agencies in the scope of i a d c shows that the current l e o debris population is unstable, even if current mitigation measures are applied. The study concludes:

Even with a 90% implementation of the commonly-adopted mitigation measures [...] the l e o debris population is expected to increase by an average of 30% in the next 200 years. The population growth is primarily driven by catastrophic collisions between 700 and 1000 km altitudes and such collisions are likely to occur every 5 to 9 years.89

#### 3] Public sector mining thumps

NASA 19 [“NASA Invests in Tech Concepts Aimed at Exploring Lunar Craters, Mining Asteroids,” NASA, June 11, 2019, <https://www.nasa.gov/press-release/nasa-invests-in-tech-concepts-aimed-at-exploring-lunar-craters-mining-asteroids>] TDI

NASA Invests in Tech Concepts Aimed at Exploring Lunar Craters, Mining Asteroids

Robotically surveying lunar craters in record time and mining resources in space could help NASA establish a sustained human presence at the Moon – part of the agency’s broader [Moon to Mars exploration](https://www.nasa.gov/specials/moon2mars/) approach. Two mission concepts to explore these capabilities have been selected as the first-ever Phase III studies within the [NASA Innovative Advanced Concepts](https://www.nasa.gov/niac) (NIAC) program.

“We are pursuing new technologies across our development portfolio that could help make deep space exploration more Earth-independent by utilizing resources on the Moon and beyond,” said Jim Reuter, associate administrator of NASA’s Space Technology Mission Directorate. “These NIAC Phase III selections are a component of that forward-looking research and we hope new insights will help us achieve more firsts in space.”

The Phase III proposals outline an aerospace architecture, including a mission concept, that is innovative and could change what’s possible in space. Each selection will receive as much as $2 million. Over the course of two years, researchers will refine the concept design and explore aspects of implementing the new technology. The inaugural Phase III selections are:

Robotic Technologies Enabling the Exploration of Lunar Pits

William Whittaker, Carnegie Mellon University, Pittsburgh

This mission concept, called Skylight, proposes technologies to rapidly survey and model lunar craters. This mission would use high-resolution images to create 3D model of craters. The data would be used to determine whether a crater can be explored by human or robotic missions. The information could also be used to characterize ice on the Moon, a crucial capability for the sustained surface operations of NASA’s Artemis program. On Earth, the technology could be used to autonomously monitor mines and quarries.

[Mini Bee Prototype to Demonstrate the Apis Mission Architecture and Optical Mining Technology](https://www.nasa.gov/directorates/spacetech/niac/2019_Phase_I_Phase_II/Mini_Bee_Prototype)

Joel Sercel, TransAstra Corporation, Lake View Terrace, California

This flight demonstration mission concept proposes a method of asteroid resource harvesting called optical mining. Optical mining is an approach for excavating an asteroid and extracting water and other volatiles into an inflatable bag. Called Mini Bee, the mission concept aims to prove optical mining, in conjunction with other innovative spacecraft systems, can be used to obtain propellant in space. The proposed architecture includes resource prospecting, extraction and delivery.

#### 4] No impact scenario – vaguely talks about countries like North Korea, South Korea, Japan and china but has 0 escalation scenario – who uses first, what weapons, who responds, draw in, etc. – also def doesn’t rise to the level of the nuclear war assumed by Edwards

### 1NC — Hacking

#### 1] No impact to hacking – this evidence lists past examples from 2008 and 2018 that didn’t escalate and states like Iran have tried and failed which prove it is difficult and unlikely – also massively increases the severity of the hacking they need to win happens

#### 2] Your blatt evidence is about ASATs and offense dominant systems causing miscalc – not debris - Very least alt causes I read blue

Blatt 20 [Talia, joint concentration in Social Studies and Integrative Biology at Harvard, specialization in East Asian geopolitics and security issues] “Anti-Satellite Weapons and the Emerging Space Arms Race,” Harvard International Review, May 26, 2020, <https://hir.harvard.edu/anti-satellite-weapons-and-the-emerging-space-arms-race/> TG

Despite their deterrent functions, ASATs are more likely to provoke or exacerbate conflicts than dampen them, especially given the risk they [pose](https://thebulletin.org/2019/06/arms-control-in-outer-space-the-russian-angle-and-a-possible-way-forward/) to early warning satellites. These satellites are a crucial element of US ballistic missile defense, capable of [detecting missiles](https://www.globalsecurity.org/space/world/japan/warning.htm) immediately after launch and tracking their paths.

Suppose a US early warning satellite goes dark, or is shut down. Going dark could signal a glitch, but in a world in which other countries have ASATs, it could also signal the beginning of an attack. Without early warning satellites, the United States is much more susceptible to nuclear missiles. Given the strategy of counterforcing—[targeting](https://www.belfercenter.org/sites/default/files/files/publication/isec_a_00273_LieberPress.pdf) nuclear silos rather than populous cities to prevent a nuclear counterattack—the Americans might believe their nuclear weapons are imminently at risk. It could be [twelve hours](https://books.google.com/books?id=ET8lDwAAQBAJ&pg=PA1&lpg=PA1&dq=%22Protecting+Space+Assets%22+johnson-freese&source=bl&ots=6Oq0IdeBjw&sig=ACfU3U1G6Hj8QdP4JlCRNxA6i5XplZwHyg&hl=en&sa=X&ved=2ahUKEwj1n-jT2YzpAhUugnIEHUuMCu4Q6AEwA3oECAkQAQ#v=onepage&q=%22Protecting%20Space%20Assets%22%20johnson-freese&f=false) before the United States regains satellite function, which is too long to wait to put together a nuclear counterattack. The United States, therefore, might move to mobilize a nuclear attack against Russia or China over what might just be a piece of debris shutting off a satellite.

Additionally, accidental warfare, or strategic miscalculation, is uniquely likely in space. It is [much easier](https://books.google.com/books?id=VyXTDwAAQBAJ&pg=PA339&lpg=PA339&dq=space+offense+dominant&source=bl&ots=Mw0bgJ51qf&sig=ACfU3U3DeZiEHpr9nfszlCbJZIoyyssIpg&hl=en&sa=X&ved=2ahUKEwjrs-WD3IzpAhVulHIEHbL0AE4Q6AEwCXoECAoQAQ#v=onepage&q=space%20offense%20dominant&f=false) to hold an adversary’s space systems in jeopardy with destructive ASATs than it is to [sustainably defend](https://www.cnas.org/publications/commentary/the-us-military-should-not-be-doubling-down-on-space) a system, which is expensive and in some cases not technologically feasible because of limitations on satellite movement. Space is therefore [considered](https://books.google.com/books?id=VyXTDwAAQBAJ&pg=PA339&lpg=PA339&dq=space+offense+dominant&source=bl&ots=Mw0bgJ51qf&sig=ACfU3U3DeZiEHpr9nfszlCbJZIoyyssIpg&hl=en&sa=X&ved=2ahUKEwjrs-WD3IzpAhVulHIEHbL0AE4Q6AEwCXoECAoQAQ#v=onepage&q=space%20offense%20dominant&f=false) offense-dominant; offensive tactics like weapons development are prioritized over defensive measures, such as [improving GPS](https://www.politico.com/story/2018/04/06/outer-space-war-defense-russia-china-463067) or making satellites more resistant to jamming.

As a result, countries are left with poorly defended space systems and rely on offensive posturing, which increases the risk that their actions are perceived as aggressive and incentivizes rapid, risky counterattacks because militaries cannot rely on their spaced-based systems after first strikes.

There are several hotspots in which ASATs and offensive-dominant systems are particularly relevant. Early warning satellites [play](https://www.politico.com/story/2018/04/06/outer-space-war-defense-russia-china-463067) a central role in US readiness in the event of a conflict involving North Korea. News of North Korean missile launches comes from these satellites. Given North Korea’s [history](https://www.bbc.com/news/world-asia-pacific-11813699) of nuclear provocations, unflinchingly hostile rhetoric towards the United States and South Korea, and diplomatic opacity, North Korea is always a threatening, unknowable adversary, but recent developments have magnified the risk. With the health of Kim Jong-un [potentially in jeopardy](https://apnews.com/f5d302ae65b03838173e40848223b771), a succession battle or even civil war on the peninsula [raises the chances](https://www.express.co.uk/news/world/1273890/Kim-Jong-un-dead-North-Korea-nuclear-weapon-news-latest-death-US) of loose nukes. If the regime is terminal, traditional MAD risk calculus will become moot; with nothing to lose, North Korea would have no reason to hold back its nuclear arsenal. Or China [might decide](https://foreignpolicy.com/2020/04/28/kim-jong-un-china-north-korea/) to seize military assets and infrastructure of the regime. If the US does not have its early warning satellites because they have been taken out in an ASAT attack, the US, South Korea, and Japan are all in imminent nuclear peril, while China could be in a position to fundamentally reshape East Asian geopolitics.

The South China Sea is another hotspot in which ASATs could risk escalation. China [is developing](https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china-anti-access-area-denial-coming-soon/) Anti-Access Area Denial (A2/AD) in the South China Sea, a combination of long range radar with air and maritime defense meant to deny US freedom of navigation in the region. Given the disputed nature of territory in the South China Sea, the United States and its allies do not want China to successfully close off the region.

#### 3] Early warning satelites are located TENS of THOUSANDS OF KILOMETERS above the LEO in high orbit - aff can’t solve.

Acton et al 21’ James M. Acton Thomas D. MacDonald Pranay Vaddi REIMAGINING NUCLEAR ARMS CONTROL A Comprehensive Approach Carnegie Endownmet for International Peace May 2021MES M. ACTON holds the Jessica T. Mathews Chair and is co-director of the Nuclear Policy Program at the Carnegie Endowment for International Peace. THOMAS D. MACDONALD is a fellow in the Nuclear Policy Program at the Carnegie Endowment for International Peace. He holds a PhD in nuclear science and engineering from MIT. PRANAY VADDI was a fellow in the Nuclear Policy Program at the Carnegie Endowment for International Peace, having formerly worked at the U.S. Department of State on arms control, treaty compliance, verification, nuclear deterrence, and other issues. He returned to the State Department in May 2021. //MonVis RD

Military communication and early-warning satellites in high-altitude orbits play critical roles in enabling nuclear operations—so much so, in fact, that they might be attacked as a prelude to a nuclear strike. However, threats to space-based nuclear C3I capabilities could also arise unintentionally. States periodically reposition their satellites to optimize their performance. If repositioning brought a satellite into proximity with one involved in nuclear operations, it could be misconstrued as preparation for an attack against the latter—especially in a crisis or conflict. To make matters worse, many—perhaps all—satellites involved in nuclear operations are dual-use. As a result, in a conventional conflict, they might be attacked in an attempt to disrupt nonnuclear operations being conducted by their possessor. Such attacks, however, would have the effect of degrading the target state’s nuclear C3I system. Inadvertent threats to, and attacks on, space-based nuclear C3I capabilities would not be preparations for a nuclear war, but they could risk being interpreted as such—potentially sparking catastrophic escalation.1 In fact, the United States has threatened to resort to nuclear use should its nuclear C3I system come under attack.2 China and Russia are probably less reliant on satellites than the United States for nuclear C3I. Even so, attacks by the United States, or even perceived preparations for them, against any Chinese or Russian satellites involved in nuclear operations would still be very provocative—especially if the target were Russia’s early-warning satellites, given its launch-under-attack posture.3 The American and Russian nuclear C3I systems, and perhaps the Chinese system too, use satellites in two different kinds of high-altitude orbits: geostationary and Molniya. Geostationary satellites remain above a fixed point on the Earth’s equator at an altitude of roughly 36,000 kilometers (22,000 miles). The United States uses this orbit for communication satellites involved in nuclear operations (all of which are dual-use).4 An object in a Molniya orbit (a type of highly elliptical orbit) hangs above the Northern Hemisphere at altitudes approaching 40,000 kilometers (25,000 miles) before it quickly traverses the Southern Hemisphere at much lower altitudes. Russia’s early-warning satellites are located in such orbits.5 Its Unified Satellite Communication System (which is likely used for both nuclear and conventional operations) and the United States’ space-based early-warning system (which is definitely dual-use) comprise satellites in both geostationary and Molniya orbits.6 Less is known about the Chinese nuclear C3I system. Various Chinese military communication satellites and at least one possible early-warning satellite operate in geostationary orbit—though it is not known for sure whether any are involved in nuclear operations.7

#### 4] Geosynch private satellites are an alt cause to hacking – aff only bans leo megaconstellations

**Nichols 21** ‘Steven Vaughan-Nichols, 8-5-2021, "Starlink is better than its satellite competition but not as fast as landline internet," ZDNet, <https://www.zdnet.com/article/starlink-is-better-than-its-satellite-competition-but-not-as-fast-as-landline-internet//> MonVis RD

To no great surprise, [Ookla found Starlink beats HughesNet and Viasat handly](https://www.speedtest.net/insights/blog/starlink-hughesnet-viasat-performance-q2-2021/). The company found that "Starlink was the only satellite internet provider in the United States with fixed-broadband-like latency figures, and median download speeds fast enough to handle most of the needs of modern online life at 97.23 Megabits per second (Mbps) during Q2 2021. HughesNet was a distant second at 19.73 Mbps and Viasat third at 18.13 Mbps." As for latency, the time between when you start an activity over the internet and when you get a response back, it's not even a competition. Starlink's median latency, 45 milliseconds (ms) is close to fixed broadband's 14 ms. Low latency is vital for voice and video calling, gaming, and live content streaming. By comparison, Viasat, 630 ms, and HughesNet, 724 ms, are almost unusable for these purposes. Why was there such a huge difference? It's simple physics. Unless we ever get [quantum networking](https://www.energy.gov/articles/us-department-energy-unveils-blueprint-quantum-internet-launch-future-quantum-internet), we can't network faster than the speed of light. Starlink uses low earth orbit (LEO) satellite constellations, flying above us at a relatively close 550 to 1,200 kilometers (km), while HughesNet and Viasat have far higher geosynchronous orbits of about 35,000km.

#### 5] Half of your evidence concedes NASA satellites being hacked – Insert rehighlighting here

1AC Akoto 20 “Hackers could shut down satellites -- or turn them into weapons” February 13, 2020 William Akoto [a postdoctoral research fellow at the University of Denver.] <https://www.upi.com/Top_News/Voices/2020/02/13/Hackers-could-shut-down-satellites-or-turn-them-into-weapons/4091581597502/> SM

Makers of these satellites, particularly small CubeSats, use off-the-shelf technology to keep costs low. The wide availability of these components means hackers can analyze them for vulnerabilities. In addition, many of the components draw on open-source technology. The danger here is that hackers could insert back doors and other vulnerabilities into satellites' software.

The highly technical nature of these satellites also means multiple manufacturers are involved in building the various components. The process of getting these satellites into space is also complicated, involving multiple companies. Even once they are in space, the organizations that own the satellites often outsource their day-to-day management to other companies. With each additional vendor, the vulnerabilities increase as hackers have multiple opportunities to infiltrate the system.

Hacking some of these CubeSats may be as simple as waiting for one of them to pass overhead and then sending malicious commands using specialized ground antennas. Hacking more sophisticated satellites might not be that hard either.

Satellites are typically controlled from ground stations. These stations run computers with software vulnerabilities that can be exploited by hackers. If hackers were to infiltrate these computers, they could send malicious commands to the satellites.

History hacks

This scenario played out in 1998 when hackers took control of the U.S.-German ROSAT X-Ray satellite. They did it by hacking into computers at the Goddard Space Flight Center in Maryland. The hackers then instructed the satellite to aim its solar panels directly at the sun. This effectively fried its batteries and rendered the satellite useless. The defunct satellite eventually crashed back to Earth in 2011. Hackers could also hold satellites for ransom, as happened in 1999 when hackers took control of the U.K.'s SkyNet satellites.

Over the years, the threat of cyberattacks on satellites has gotten more dire. In 2008, hackers, possibly from China, reportedly took full control of two NASA satellites, one for about two minutes and the other for about nine minutes. In 2018, another group of Chinese state-backed hackers reportedly launched a sophisticated hacking campaign aimed at satellite operators and defense contractors. Iranian hacking groups have also attempted similar attacks.

Although the U.S. Department of Defense and National Security Agency have made some efforts to address space cybersecurity, the pace has been slow. There are no cybersecurity standards for satellites and no governing body to regulate and ensure their cybersecurity. Even if common standards could be developed, there are no mechanisms in place to enforce them. This means responsibility for satellite cybersecurity falls to the individual companies that build and operate them.

As they compete to be the dominant satellite operator, SpaceX and rival companies are under increasing pressure to cut costs. There is also pressure to speed up development and production. This makes it tempting for the companies to cut corners in areas like cybersecurity that are secondary to actually getting these satellites in space.

### Astronomy

#### 1] Urban illumination is a massive alt cause that overwhelms satellites in low earth orbit

ISC 12/21/21 (International Science Council Interviewing Piero Benvenuti of the International Astronomical Union, "The artifical constellations impacting on astronomical science," <https://council.science/current/blog/the-artificial-constellations-impacting-on-astronomical-science/> DD)

The urban illumination or ALAN (Artificial Light At Night); The optical/infrared trails of the satellites in low-Earth orbits (LEO); The radio transmission by ground and space emitters that affects radio astronomy. The interference by ALAN, that affects both amateur and professional astronomers, has become an acute problem with the advent of the LED (Light Emission Diodes), particularly by those with a high level of blue light. The International Astronomical Union has established a recommended maximum tolerable threshold of light pollution for astronomical sites of 10% above natural background levels. Light pollution is growing globally at an estimated rate of 2 to 6 % per year and is reducing darkness everywhere, including at observatory sites where world-class sites risk hitting the 10% threshold in the next decade. In addition to the impact on astronomy, artificial light at night may have significant biological effects, to flora and fauna, vertebrates and invertebrates, which requires further study by appropriate experts.

#### 2] Impact is inevitable – even if megaconstellations are stopped, other satellites still launch which will still create reflections and light that make observation more difficult

3] Err neg on calculations since it’s the most logical to not act on something unreasonable – their asteroids ev concedes it impossible to predict when an asteroid will come

4] Alt cauess to asteroid deflection – things like a kinectic impactor, etc.. are things they cant’ solve

5] Dark mode solves – empirically proven by things like Starlink’s shift which helped astronomers

### Ozone

#### 1] Montreal protocol checks and thumps their impacts to a few decades

Senpati, 21, “Ozone layer recovery may take several lifetimes. But Montreal Protocol saved the Earth”, Down to Earth, <https://www.downtoearth.org.in/blog/environment/ozone-layer-recovery-may-take-several-lifetimes-but-montreal-protocol-saved-the-earth-79147>, URL: <https://www.downtoearth.org.in/blog/environment/ozone-layer-recovery-may-take-several-lifetimes-but-montreal-protocol-saved-the-earth-79147>, KR

There are two types of ultraviolet rays that reach the earth’s surface — UVB and UVA. UVB rays are responsible for producing sunburn and can cause skin cancers, crop damage, etc.

Experiments on fish suggest that 90-95 per cent of malignant melanomas (a form of skin cancer) may be due to UVA & UVB radiations. Plants are sensitive to UV radiation below 300 nanometers.

Several commonly used chemicals have been found to be damaging to the stratospheric ozone layer.

Halocarbons are chemicals in which one or more carbon atoms are linked to one or more halogen atoms (fluorine, chlorine, bromine or iodine). Halocarbons containing bromine usually have much higher ozone-depleting potential (ODP) than those containing chlorine.

Man-made chemicals that have provided most of the chlorine and bromine for ozone depletion are methyl bromide, methyl chloroform, carbon tetrachloride and families of chemicals known as halons and chlorofluorocarbons (CFCs).

Ozone depletion also affects the climate, though the impact is not clearly understood. With its depletion, the spectrum of incoming radiation will change and the ozone layer may produce new molecular species that change the radiation-emitting and absorbing properties of the atmosphere.

This may cause the formation of more tropospheric ozone, which will not be desirable.

In the absence of the ozone layer, the radiations will directly flow to the earth’s surface and change the vertical distribution of molecules in the troposphere and stratosphere. This, in turn, will change the rate of vertical circulation.

In 1994, the United Nations General Assembly proclaimed September 16 as World Ozone Day, commemorating the date of the signing of the Montreal Protocol in 1987. The theme for World Ozone Day, 2021 was Montreal Protocol: Keeping us, our food and vaccines cool.

As an international response in 1987 an international meeting in Montreal, Canada, produced the Montreal Protocol to phase out the use of CFCs by 2000. Montreal Protocol is an international treaty designed to protect the ozone layer by phasing out the production of substances that are responsible for ozone depletion.

CFC production in most developed countries has fallen sharply since 1989. The Montreal Protocol has been successful in reducing ozone-depleting substances and reactive chlorine and bromine in the stratosphere to avoid up to 0.4 degrees Celsius of global temperature rise.

CFCs are being substituted by HCFCs (hydrochlorofluorocarbons), which release much less chlorine per molecule.

The 2019 ozone hole is indeed the smallest it has been since 1982, when agencies started recording its size. But the ozone is also influenced by temperature shifts and dynamics in the atmosphere through climate change.

In 50 years or so, the stratospheric ozone levels are expected to be back to normal. However, the final recovery is expected to require several lifetimes.

#### 2] That works – top empirics prove

Truu, 19, SBS, “The ozone layer is on track to completely repair itself in our lifetime”, URL: <https://www.sbs.com.au/news/the-ozone-layer-is-on-track-to-completely-repair-itself-in-our-lifetime/f996087d-42ee-4434-a2dc-b042d08f568a>, KR

\*UN Secretary-General António Guterres

In 1987, UN members signed a treaty - known as the Montreal Protocol - aimed at phasing out ozone-depleting substances and developed replacements. According to the UNEP, the Montreal Protocol has successfully led to the removal of 99 per cent of chlorofluorocarbons, which previously existed in refrigerators, air-conditioners and other consumer products.

"The Montreal Protocol is both an inspirational example of how humanity is capable of cooperating to address a global challenge and a key instrument for tackling today’s climate crisis," Mr Guterres said.

"Under this international treaty, nations have worked for 32 years to slash the use of ozone-depleting chemicals, used largely by the cooling industry. As a result, the ozone layer that shields us from the sun’s harmful ultraviolet radiation is healing."

3] Dozens of alt causes like rocket ships and other forms of appropriation thump – compounded by the fact that their ev doesn’t say how much of a brink is important which means things like global warming also solve