# OFF

### 1NC – New affs bad

#### Interpretation: Debaters must disclose affirmative frameworks and advocacy text thirty minutes before round if they haven’t read the affirmative before

#### Violation: They didn’t – screenshots in doc

Text

Description automatically generated

#### Standards:

#### 1] Clash- Not disclosing incentivizes surprise tactics and poorly refined positions that rely on artificial and vague negative engagement to win debates. Their interpretation discourages third- and fourth-line testing by limiting the amount of time we have to prepare and forcing us to enter the debate with zero idea of what the affirmative is. Negatives are forced to rely on generics instead of smart contextual strategies destroying nuanced argumentation.

#### 2] Shiftiness- Not knowing enough about the affirmative coming into round incentivizes 1ar shiftiness about what the aff is and what their framework/advocacy entails. That means even if we could read generics or find prep, they’d just find ways to recontextualize their obscure advocacy in the 1ar.

#### No RVIs because its illogical – you wouldn’t win chess for playing properly – Prefer logic for it’s a litmus test for other arguments

### 1NC---DA

#### PC gets BBB across the finish line, but negotiations are key---interruption must be avoided.

Greve 1/8 [Joan; 1/8/22; politics breaking news reporter for Guardian US, based in Washington; “Democrats could still salvage Build Back Better – and perhaps their midterm prospects,” <https://www.theguardian.com/us-news/2022/jan/08/build-back-better-democrats-midterms>] brett

Manchin’s opposition to the bill has intensified concerns among Democratic leaders that many vulnerable members may lose re-election this year, as voters blame the party for failing to follow through on their campaign promises despite having full control of the White House and Congress.

“Voters have shown time and again that they want a robust economic environment creating good opportunities to build a better life for themselves and their family,” said Congressman Brad Schneider, chair of the political arm of the centrist New Democrat Coalition, the NewDem Action Fund. “At the end of the day, we have to show working families we’re responsive to their kitchen table concerns.”

Some Democratic strategists have argued the party’s best option now is to work with Manchin to craft a version of the Build Back Better Act that he can support and then move forward with that proposal.

“Mr Manchin said at various points that he could support a scaled-back bill that made long-term commitments to fewer priorities,” David Axelrod, a former adviser to Barack Obama, said in a recent New York Times column. “If, through a retooled Build Back Better Act, Mr Biden can achieve significant and durable progress on some major priorities that will benefit children and families for generations, Democrats would be wise to celebrate and tout those gains instead of complaining about what wasn’t possible.”

Schneider echoed that argument, telling the Guardian, “Since the start of negotiations, New Dems have been advocating to do a select number of things better for longer, and we still believe that approach is the best path forward.”

But a Manchin-approved version of the Build Back Better Act does not come without potential pitfalls. Manchin has raised concerns about the cost of the legislation and the impact on the national debt if all of its programs are made permanent. (Under the current version of the bill, many of its programs expire after a year or a few years.)

The child tax credit, which was expanded under the coronavirus relief package signed by Biden last year, is particularly worrisome for deficit hawks. The current version of the Build Back Better bill calls for the expanded program to continue through 2022, at a cost of $185bn. However, if the expanded program is made permanent, as many Democrats would prefer, the 10-year cost of that policy would be $1.6tn, according to the Congressional Budget Office.

Despite the cost of the policy, many Americans have come to rely on the monthly checks from the expanded child tax credit, and failing to extend the program could be disastrous for families’ budgets and Democrats’ electoral prospects.

“If [Manchin] brings down the price tag below $1.75tn, if he cuts really popular things like the child tax credit especially or any of the pharma provisions, then that could be disastrous for Democrats,” said Adam Green, the co-founder of the Progressive Change Campaign Committee.

But Green argued there may be an upside to Manchin’s deficit concerns. If Manchin is determined to lower the national debt, it could provide an opening for progressives to advocate for revenue-raising proposals that they support, such as a tax on billionaires.

“There’s actually a scenario where we raise $1.75tn and invest that money, and then on top of that implement a very popular billionaires tax, the majority of which goes toward debt reduction,” Green said. “What that would do is give Democrats this extremely popular talking point that we’re the ones who finally taxed billionaires.”

Of course, that scenario will only be possible if Democrats are successful at bringing Manchin back to the negotiating table and actually getting a bill across the finish line. “Depending on how the negotiations go, Manchin’s current involvement could make things disastrous or very good for Democrats,” Green said. “It really depends on where things land.”

#### Manchin supports climate provisions, but continued negotiations and PC is key.

Collins 1/6 [Lois; 1/6/22; covers policy and research that impact families for the Deseret News National team. A University of Utah graduate, she has won numerous national, local and regional journalism awards; “Is the ‘Build Back Better’ Act dead or just drifting?” <https://www.deseret.com/2022/1/6/22868795/is-bidens-build-back-better-bill-dead-or-just-drifing-social-policy-climate-change-joe-manchin>] brett

Per Politico, “Manchin called some of the bill ‘well-intended’ but argued other parts are a ‘far reach.’ In the past, he has raised questions about the price of the expanded child tax credit as well as the legislation’s paid leave provisions. On Tuesday, Manchin suggested that focusing the bill on climate might be easier than lumping in a hodgepodge of provisions that amount to much of his party’s domestic wish list from the past few years.”

“The climate thing is one that we probably could come to an agreement much easier than anything else,” Manchin said.

Senate Majority Leader Chuck Schumer has predicted Manchin will return to the negotiating table and talks will resume.

So what’s next?

According to Vox, Democrats must win over Manchin, but “thus far, they’ve had a hard time proposing a version of the bill that he’s willing to accept.”

In December, Manchin’s office released a statement on the bill and why he doesn’t support it in its existing form.

“I have always said, ‘If I can’t go back home and explain it, I can’t vote for it,’” he said in the news release. “Despite my best efforts, I cannot explain the sweeping Build Back Better Act in West Virginia and I cannot vote to move forward on this mammoth piece of legislation.”

He promised, however, to “continue working with my colleagues on both sides of the aisle to address the needs of all Americans and do so in a way that does not risk our nation’s independence, security and way of life.”

#### The plan trades off -- ratification requires PC and floor time.

---even if popular, even some opposition ensures immense floor time due to Senate procedures.

Kelley & Pevehouse 15 [Judith G.\*, Duke Sanford School of Public Policy; AND Jon C.W.\*\*, University of Wisconsin-Madison; International Studies Quarterly (2015); “An Opportunity Cost Theory of US Treaty Behavior,” <https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/12521/isqu12185.pdf?sequence=1>] brett

An Opportunity Costs Theory

Although existing theories about veto players and political ideology explain the fate of some treaties, they leave some questions open. To complement these theories, we draw on economic theory to offer an opportunity cost theory of treaty ratification. In economics, the opportunity cost of a resource refers to the value of the nexthighest-valued alternative use of that resource. Scholars of domestic legislation have applied this concept to the time and resources of individual policymakers (Schiller 1995) but also to the fixed chamber time. For example, Koger refers to “[T]he foregone uses of the same [chamber] time for legislators as individuals as well as for the chamber collectively” (Koger 2010:22). Indeed, the Senate’s chamber time is not only fixed, but also scarce. A vast portion of its time goes to required routine business. This leaves little opportunity for discretionary activities (Walker 1977). Given that international policy matters have to draw on exactly the same remaining discretionary floor time as domestic policy, we argue that the United States sometimes delays or derails treaty ratification simply because political capital and Senate floor time are fixed and entail opportunity costs (Heitshusen 2013:4). As Koger (2010:33) argues more generally for legislation, “The expected gains from making a proposal must exceed the time and effort legislators invest in preparing it, organizing and coalition to support it, and taking the time of the chamber to debate and pass it.”

For a treaty to progress, the opportunity cost logic thus would mean that the net gains of the treaty must outweigh the opportunity costs of the advice and consent process. Thus, if the President or some Senators assign only low political value to a particular treaty or if they believe that passage of the treaty will take a lot of Senate floor time, they may decide that they would rather spend their political capital on other matters. If they think they have to fight a war of attrition to overcome opposition, this cost in terms of time and resources may tip the scales against moving the treaty forward. Under these conditions, the opportunity cost of processing the treaty may be too high for the treaty to gain attention, even if the President or more than the required two-thirds of the Senators think the treaty yields some benefits. As a result, whether or how fast a treaty makes it through the process depends on whether it has sufficient support to pass the constitutional process and on whether its value to politicians outweighs the opportunity cost of their political resources: legislative floor time and political capital.

The Fixed Political Agenda Space and Policy Priorities

Why do treaties incur these opportunity costs? Opportunity costs arise when resources are fixed and fully employed. Political agenda space is such a resource; there are only so many policy priorities a President can promote, and only so much Senate floor time to consider them. The media will pay attention to only so many issues on the Washington agenda. Both the President and the Senate must protect their legislative opportunities. They each face opportunity costs.

For the President, the transmittal process is not simple. If the United States signs an international agreement that falls under Article II of the Constitution, the President must transmit it to the Senate for advice and consent before the United States can ratify it. This process entails an analysis of the implications of the treaty including possible implementation legislation required, and the writing of a transmittal letter that serves as a report to the Senate Foreign Relations Committee (SFRC). Because of these requirements, usually there has to be some push from the White House (Halloran 2011), and this can take precious time away from domestic legislative priorities. Thus, transmittals can be costly, especially in the face of expected opposition. Indeed, in 1995 when President Clinton wanted to transmit the UN Convention on the Rights of the Child to the Senate, Jessie Helms, who chaired the SFRC, and 26 cosponsors introduced a resolution urging him to not transmit the Convention. Such opposition can be distracting or politically harmful for the President. Furthermore, because the President usually endorses the treaty in the transmittal letter, he may incur a reputational cost by transmitting treaties that stall (Krutz and Peake 2009:140). Dealing with treaties thus involves political costs, and withholding transmittal can conserve political capital.

For the Senate, floor time is of the essence. After transmittal, the SFRC must hold a meeting on the treaty, and eventually issue its own analysis and recommendation, and (if it has enough support) pass it out of committee. The treaty then has to be scheduled for debate, possible amendments, and a vote. To gain Senate advice and consent, the treaty must pass with at least a two-thirds majority. Crucial to differentiating the opportunity cost argument from a straight veto player model, the Senate rules for debate and passage enable opponents to increase the time expended on a treaty, even if they do not have the ability to vote it down on the floor. Dealing with a treaty thus ties up the SFRC time, but even more importantly, it could potentially take up scarce discretionary time on the Senate floor. Senators seek to maximize their reputational returns from the issues they spend time on, favoring issues that have broad appeal (Walker 1977:430). Before scheduling a treaty for debate and a vote, the relevant actors therefore have to consider the opportunity cost of dealing with the treaty: What else could the Senate accomplish with that time? Even if the Senate is not being productive in terms of passing legislation, what else does the Senate want to be seen focusing on at that moment? Even if there is strong support for a treaty, Senators may hold back if they anticipate serious and potentially time consuming opposition—opposition that can result in any number of procedural maneuvers that could take up costly time in the Senate. This explains why so few treaties ever take up much floor time for debate. If senators expect them to take time, they do not schedule them.

#### Oneweb and Boeing companies will lobby for their survival against the plan.

GC 17 [GC Magazine; Autumn 2017; Business thinking, In-house management, Published by legal500; “The new space race,” <https://www.legal500.com/gc-magazine/feature/the-new-space-race/>] brett

The upshot is that the ability to engage with legislators and policymakers will be essential for the long-term viability of companies like Planetary Resources.

‘We’re seeing already that with a regulatory framework laid out for a very quickly growing and expanding sector, there’s a lot of opportunity for policy engagement. That’s equally true in other countries too, which are either enacting their first national space laws or overhauling them,’ says Israel.

Before Israel joined the company, Planetary Resources was heavily involved in lobbying the US Congress to support the Spurring Private Aerospace Competitiveness and Entrepreneurship Act – better known as the SPACE Act.

That piece of legislation explicitly granted permission to US entities to ‘engage in the commercial exploration and exploitation of “space resources”.’ But the international community remains divided over whether the SPACE Act runs contrary to the obligations imposed on the US under the Outer Space Treaty.

‘The Americans are a sovereign state and according to their international treaty commitments, it’s hard to say that their domestic law is compatible with international law,’ says Smith.

Lobbying, both at a domestic and international level, stands to become increasingly critical, particularly as the US is in the process of crafting a framework for supervising non-governmental space activities, while ensure conformity with the Outer Space Treaty.

image of cartoon Mars Rover

‘It is incumbent on Congress to use the 50-year anniversary of the Outer Space Treaty to properly determine our actual international obligations, decide if specific articles in the Treaty are self-executing or not, and ensure that our domestic policy moving forward creates an environment that provides certainty for industry while protecting our national security,’ said Senator Ted Cruz, earlier this year.

‘The design and objectives in doing this must not only be to implement the government’s obligations, but to do so in a way that is not unduly burdensome on emerging space activities,’ adds Israel.

‘This is particularly relevant when the exact contours of how the activity will be carried out are not known, which makes it imperative that the regulators do not get too far ahead of the technology and make guesses about how it will be done, what is feasible, then lock in standards that are ultimately irrelevant and unworkable.’

#### Prevents existential climate disaster.

Moncrief ’11-11 [Aliki; 2021; executive director of Florida Conservation Voters; Orlando Sentinel, “Build Back Better Act would help in climate crisis,” https://www.orlandosentinel.com/opinion/guest-commentary/os-op-climate-change-congress-act-now-20211111-44u6bgyn5fdvnp3eqievkebqpe-story.html]

Last week, Congress passed the Infrastructure Investment and Jobs Act. This bipartisan bill will address upgrades to things like our transportation system, rural broadband, public transit, and clean-water infrastructure. These are badly needed, overdue investments that will make our communities more resilient to the climate impacts we are already seeing. But we know much more is needed.

It’s not enough to just respond to extreme weather — we need to cut the pollution driving it in the first place. That’s why Congress must also pass the Build Back Better Act, the most transformational climate and jobs legislation in our nation’s history. By investing in clean energy and things like electric vehicles and more energy-efficient homes and businesses, we can stop making the problem worse and avoid a growing disaster. We don’t have time for half measures, and Floridians know it — more than 75% of registered voters in the state support bold congressional action on climate change.

The Build Back Better Act takes bold steps to dramatically reduce climate pollution for everyone. But it also centers those who have been disproportionately impacted by this crisis by taking steps to address the decades of unchecked environmental injustice, ensuring at least 40% of the benefits of this bill go to those communities hardest hit by pollution and climate change.

Building a clean energy economy is an investment that will pay dividends for families today and for generations to come. Preventing the most catastrophic hurricanes, floods and heat waves will help ensure that we still bring people from all over the world to our beaches, the Everglades, and every amazing destination across our state that supports our multi-billion dollar tourism industry.

And the robust clean-energy investments in the Build Back Better Act will create millions of good-paying jobs for Floridians in every corner of our state. Florida already ranks fourth in the nation for clean-energy employment, and this legislation would help this industry grow exponentially by tapping into the Sunshine State’s solar power potential.

Orlando has some great members of Congress who understand that climate change is an existential threat to our state and they ran on being a part of the solution to this crisis. Now, we are counting on them to take bold action and pass the Build Back Better Act. This is a win-win-win that creates jobs, lowers energy bills for Floridians, and begins to address the climate crisis at the same time.

#### Warming is a threat multiplier that encompasses all impacts.

Dr. Michael T. Klare 20, Five Colleges Professor of Peace and World Security Studies at Hampshire College, Ph.D. from the Graduate School of the Union Institute, BA and MA from Columbia University, Member of the Board of Director at the Arms Control Association, Defense Correspondent for The Nation, “How Rising Temperatures Increase the Likelihood of Nuclear War”, The Nation, 1/13/2020, https://www.thenation.com/article/archive/nuclear-defense-climate-change/

Climbing world temperatures and rising sea levels will diminish the supply of food and water in many resource-deprived areas, increasing the risk of widespread starvation, social unrest, and human flight. Global corn production, for example, is projected to fall by as much as 14 percent in a 2°C warmer world, according to research cited in a 2018 special report by the UN’s Intergovernmental Panel on Climate Change (IPCC). Food scarcity and crop failures risk pushing hundreds of millions of people into overcrowded cities, where the likelihood of pandemics, ethnic strife, and severe storm damage is bound to increase. All of this will impose an immense burden on human institutions. Some states may collapse or break up into a collection of warring chiefdoms—all fighting over sources of water and other vital resources.

A similar momentum is now evident in the emerging nuclear arms race, with all three major powers—China, Russia, and the United States—rushing to deploy a host of new munitions. This dangerous process commenced a decade ago, when Russian and Chinese leaders sought improvements to their nuclear arsenals and President Barack Obama, in order to secure Senate approval of the New Strategic Arms Reduction Treaty of 2010, agreed to initial funding for the modernization of all three legs of America’s strategic triad, which encompasses submarines, intercontinental ballistic missiles, and bombers. (New START, which mandated significant reductions in US and Russian arsenals, will expire in February 2021 unless renewed by the two countries.) Although Obama initiated the modernization of the nuclear triad, the Trump administration has sought funds to proceed with their full-scale production, at an estimated initial installment of $500 billion over 10 years.

Even during the initial modernization program of the Obama era, Russian and Chinese leaders were sufficiently alarmed to hasten their own nuclear acquisitions. Both countries were already in the process of modernizing their stockpiles—Russia to replace Cold War–era systems that had become unreliable, China to provide its relatively small arsenal with enhanced capabilities. Trump’s decision to acquire a whole new suite of ICBMs, nuclear-armed submarines, and bombers has added momentum to these efforts. And with all three major powers upgrading their arsenals, the other nuclear-weapon states—led by India, Pakistan, and North Korea—have been expanding their stockpiles as well. Moreover, with Trump’s recent decision to abandon the Intermediate-Range Nuclear Forces (INF) Treaty, all major powers are developing missile delivery systems for a regional nuclear war such as might erupt in Europe, South Asia, or the western Pacific.

### 1NC---CP

#### CP text: States should implement an Orbit Tax

Kesharwani and Chaturvedi 20 Urvisha Kesharwani, Atika Chaturvedi, students at National University of Study and Research in Law, Ranchi., 3-8-2020, "Orbit tax – mitigating space debris or aggravating economic disparity?," No Publication, <https://voelkerrechtsblog.org/orbit-tax-mitigating-space-debris-or-aggravating-economic-disparity/> // ella

Since the launch of Russian satellite Sputnik-1 in 1957, the space industry has never looked back. Currently, there are about 20,000 satellites orbiting the earth, and with the private players like SpaceX and OneWeb in the market, it is estimated that by 2025 the space industry will be launching about 1,100 satellites per year. As mankind moves forward in the era of hyper-dependency on satellite supported technologies, the pollution known as space debris, caused due to congestion of satellites cannot be overlooked. The problem of space debris is growing with each passing second, creating risk of collisions in orbits around Earth. With the current technological advancements, the satellite operators are able to track space debris and manoeuvre operational satellites out of harm’s way. However, with increasing risks of collisions, such technologies are getting more and more expensive. In a report recently published by the Organisation for Economic Co-operation and Development (OECD), it has been estimated that, if such a trend continues, then the tracking and manoeuvring costs could go about 5%-10% or even higher of the total mission’s cost for satellites. Despite several discussions on the international level regarding the issue of space debris, until now the solutions have mostly been scientific. A study (“Study”) published earlier this year in the Proceedings of the National Academy of Sciences by Akhil Rao, Matthew G. Burgees, and Daniel Kaffine claims that the problem of space debris can be effectively tackled by levying ‘Orbit Tax’ on orbiting satellites. This article seeks to critically analyse the concept of orbit tax and highlight its adverse implications on the budding space industries around the globe. ­­Space debris majorly comprises of dead satellites orbiting the earth, components of rockets used to launch satellites, and even flecks of paint chipped off from wear and tear of satellites and their launching rockets. These pieces of debris move at about 30,000 kilometres per hour, releasing vast amounts of energy. Even a small piece of debris, as tiny as 1 millimetre, can cause an inoperable damage to a satellite. Congestion of such debris in the orbit increases the risk of collision and hence can be catastrophic. In 1978 Donald J. Kessler, a NASA scientist, pointed out that an increase in the number of space objects in the earth’s orbit can create an environment where collisions among the space objects will become inevitable and will lead to a cascading effect. This phenomenon known as Kessler syndrome could render the lower orbit of the earth economically unviable and other orbits difficult to access. Based on this, a research was published in 2006 which predicted that with the current trend, the number of objects measuring 10 cm or larger in the lower earth orbit (LEO) will triple in 200 years, leading to 10 times increase in collisional probabilities among objects in this region. Until now there has been little to no focus on developing legal regulations for mitigating the problem of space debris. The Outer Space Treaty (OST), that is considered to be the ‘Magna Carta’ of space law, is too generic to deal with the problem of space debris, though one clause of Article IX of the OST does obligate the states to inform and consult other states that can be affected by foreseeable potentially harmful consequences of space activities undertaken by the former state. Further, Article VII and Article VI of the OST provide jurisdictional power to the states over the space object registered in their national registry and binds them to bear international responsibility for national activities in outer space. However, this does not prohibit a state from generating space debris nor does it obligate them to remove such debris once it is created. On the other hand, the Convention on International Liability for Damage Caused by Space Objects (“Liability Convention”) sets up a regime of liability for damage caused by space objects. However, the Liability Convention only focuses on causation and damage rather than prevention or mitigation of space debris. Space Debris Mitigation Guidelines (“Guidelines”), adopted by UN in 2007, is the only international instrument solely dealing with the problem of space debris. But the non-binding nature of the Guidelines renders its compliance arduous. Despite of the guidelines and various technological solutions, the growing problem of the space debris persists. The Study highlights that the core of the current problem is the dearth of incentives. Currently, the satellites are being launched without consideration of the collision risks they impose on other operators. Satellite operators are unable to secure exclusive property rights to their orbital paths or recover collision-related costs imposed by others. Hence, the operators end up facing two choices – either launching a profitable satellite and risk the future cost of collision or not launching the satellite and leave these profits to their competitors. This has led to what economists call the ‘Tragedy of Commons’, where the individuals acting in their own self-interest destroy a commonly shared resource. The Study suggests that this problem can be curbed by incentive-based solutions, such as fees or tradable permits per year in orbit (orbit tax). This orbit tax will help to quantify the economic benefits of implementing de-orbiting technologies by the satellite operators with their respective satellites. Further, the added costs of operating satellites will influence the decisions of launching satellites in the orbit. The proposed tax or fees, as estimated by the Study, will quadruple the value of the satellite industry by 2040 making it a 3 trillion-dollar industry. What is an Orbit Tax? The proposed orbit tax is an internationally coordinated “orbital use fee” (“OUF”) designed to sway the satellite launch decisions. This tax shall be collected annually on the orbiting satellite as it is the orbiting objects that directly impose collision risk on other satellites, as opposed to launching fees that are levied on satellites before launching. Such OUF shall be collected by the respective government under which the satellite is registered. OUF will act as a Pigouvian tax that is imposed to generate negative externalities by taxing the product correlated to externality. An example of such tax would be tax on carbon emissions, or plastic bags. Through this mechanism the cost of the externalities is borne by the producer that generates such externality. The OUFs might vary depending upon the factors that determine the collision risk of one satellite with another. Such factors include the orbital path and altitude of the satellite, its structure and the ownership design.

# Case

### Underview

#### Presumption and permissibility negate – a) more often false than true since I can prove something false in infinite ways which outweighs on probability b) real world policies require positive justification before being adopted which outweighs on empirics c) ought means the aff has to prove an obligation if that definition is legitimate which means lack of that obligation negates.

### 1NC -- Alt Causes

#### Alt causes:

#### 1] Tons of other megaconstellations are alt causes. SpaceX alone dwarfs boeing and oneweb.

Boley & Byers 21 [Aaron C., Department of Physics and Astronomy @ The University of British Columbia\*, and Michael, Department of Political Science @ The University of British Columbia; Published: 20 May 2021; Scientific Reports; “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth,” <https://www.nature.com/articles/s41598-021-89909-7>] brett

Companies are placing satellites into orbit at an unprecedented frequency to build ‘mega-constellations’ of communications satellites in Low Earth Orbit (LEO). In two years, the number of active and defunct satellites in LEO has increased by over 50%, to about 5000 (as of 30 March 2021). SpaceX alone is on track to add 11,000 more as it builds its Starlink mega-constellation and has already filed for permission for another 30,000 satellites with the Federal Communications Commission (FCC)1. Others have similar plans, including OneWeb, Amazon, Telesat, and GW, which is a Chinese state-owned company2. The current governance system for LEO, while slowly changing, is ill-equipped to handle large satellite systems. Here, we outline how applying the consumer electronic model to satellites could lead to multiple tragedies of the commons. Some of these are well known, such as impediments to astronomy and an increased risk of space debris, while others have received insufficient attention, including changes to the chemistry of Earth’s upper atmosphere and increased dangers on Earth’s surface from re-entered debris. The heavy use of certain orbital regions might also result in a de facto exclusion of other actors from them, violating the 1967 Outer Space Treaty. All of these challenges could be addressed in a coordinated manner through multilateral law-making, whether in the United Nations, the Inter-Agency Debris Committee (IADC), or an ad hoc process, rather than in an uncoordinated manner through different national laws. Regardless of the law-making forum, mega-constellations require a shift in perspectives and policies: from looking at single satellites, to evaluating systems of thousands of satellites, and doing so within an understanding of the limitations of Earth’s environment, including its orbits.

Thousands of satellites and 1500 rocket bodies provide considerable mass in LEO, which can break into debris upon collisions, explosions, or degradation in the harsh space environment. Fragmentations increase the cross-section of orbiting material, and with it, the collision probability per time. Eventually, collisions could dominate on-orbit evolution, a situation called the Kessler Syndrome3. There are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraft and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the long-term evolution of debris suggest that LEO is already in the protracted initial stages of the Kessler Syndrome, but that this could be managed through active debris removal4. The addition of satellite mega-constellations and the general proliferation of low-cost satellites in LEO stresses the environment further5,6,7,8.

Results

The overall setting

The rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defines NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with effects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph.

Figure 1

[Figure 1 omitted]

Cumulative on-orbit distribution functions (all orbits). Deorbited objects are not included. The 2007 and 2009 spikes are a Chinese anti-satellite test and the Iridium 33-Kosmos 2251 collision, respectively. The recent, rapid rise of the orange curve represents NewSpace (see "Methods").

Full size image

Although the volume of space is large, individual satellites and satellite systems have specific functions, with associated altitudes and inclinations (Fig. 2). This increases congestion and requires active management for station keeping and collision avoidance9, with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, after failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency.

Figure 2

[Figure 2 omitted]

Orbital distribution and density information for objects in Low Earth Orbit (LEO). (Left) Distribution of payloads (active and defunct satellites), binned to the nearest 1 km in altitude and 1° in orbital inclination. The centre of each circle represents the position on the diagram, and the size of the circle is proportional to the number of satellites within the given parameter space. (Right) Number density of different space resident objects (SROs) based on 1 km radial bins, averaged over the entire sky. Because SRO objects are on elliptical orbits, the contribution of a given object to an orbital shell is weighted by the time that object spends in the shell. Despite significant parameter space, satellites are clustered in their orbits due to mission requirements. The emerging Starlink cluster at 550 km and 55° inclination is already evident in both plots (Left and Right).

Full size image

When completed, Starlink will include about as many satellites as there are trackable debris pieces today, while its total mass will equal all the mass currently in LEO—over 3000 tonnes. The satellites will be placed in narrow orbital shells, creating unprecedented congestion, with 1258 already in orbit (as of 30 March 2021). OneWeb has already placed an initial 146 satellites, and Amazon, Telesat, GW and other companies, operating under different national regulatory regimes, are soon likely to follow.

Enhanced collision risk

Mega-constellations are composed of mass-produced satellites with few backup systems. This consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also considerable discarded equipment. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of de-orbiting satellites will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difficult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC (see “Methods”). The large density spikes show that some shells will have satellite number densities in excess of n=10−6 km−3.

Figure 3

[Figure 3 omitted]

Satellite density distribution in LEO with the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC. Provided that the orbits are nearly circular, the number densities in those shells will exceed 10–6 km−3. Because the collisional cross-section in those shells is also high, they represent regions that have a high collision risk whenever debris is too small to be tracked or collision avoidance manoeuvres are impossible for other reasons.

Full size image

Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some companies might be less-than-fully transparent about events13 in LEO.

Despite the congestion and traffic management challenges, FCC filings by SpaceX suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the filings do not account for untracked debris6, including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 after one year. Thus, if at any time there are 230 pieces of untracked debris decaying through the 550 km orbital shell, there is a 50% chance that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if subsequent fragmentation events lead to similar amounts of debris within that orbital shell, a runaway cascade of collisions could occur.

Fragmentation events are not confined to their local orbits, either. The India 2019 ASAT test was conducted at an altitude below 300 km in an effort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. A major fragmentation event from a single satellite could affect all operators in LEO.

Even if debris collisions were avoidable, meteoroids are always a threat. The cumulative meteoroid flux15 for masses m > 10–2 g is about 1.2 × 10–4 meteoroids m−2 year−1 (see “Methods”). Such masses could cause non-negligible damage to satellites16. Assuming a Starlink constellation of 12,000 satellites (i.e. the initial phase), there is about a 50% chance of 15 or more meteoroid impacts per year at m > 10–2 g. Satellites will have shielding, but events that might be rare to a single satellite could become common across the constellation.

One partial response to these congestion and collision concerns is for operators to construct mega-constellations out of a smaller number of satellites. But this does not, individually or collectively, eliminate the need for an all-of-LEO approach to evaluating the effects of the construction and maintenance of any one constellation.

#### 2] China.

**Jones**, Andrew. **2021** https://spacenews.com/china-is-developing-plans-for-a-13000-satellite-communications-megaconstellation/

China is to oversee the construction and operation of a national satellite internet megaconstellation through coordinating the country’s major space actors.

Recent comments by senior officials indicate that plans are moving ahead to alter earlier constellation plans by space sector state-owned enterprises and possibly make these part of a larger “Guowang” or “national network” satellite internet project.

Spectrum allocation filings submitted to the International Telecommunication Union (ITU) by China in September last year revealed plans to construct two similarly named “GW” low Earth orbit constellations totaling 12,992 satellites.

#### 3] Russia.

---Roscosmos is stated owned.

**Forrester**, Chris **2018** https://advanced-television.com/2018/05/25/russia-wants-288-satellite-mega-constellation/

Russia has plans to join the club of major players with massive satellite constellations.

Russian news agency TASS says that Russian Space Systems Company (Roscosmos) wants to create a global constellation of 288 satellites, operating from 870 kms above the ground.The constellation, called Efir, would start operating in 2025, says the report quoting project chief Yuri Mishin.

#### 4] Solar storms.

**Wild 15** (Jim Wild, Professor of Space Physics at Lancaster University, “With So Much Vested In Satellites, Solar Storms Could Bring Life To A Standstill,” July 30, 2015, https://theconversation.com/with-so-much-vested-in-satellites-solar-storms-could-bring-life-to-a-standstill-45204)

These can disrupt satellite operations by depositing electrical charge within the on-board electronics, triggering phantom commands or overloading and damaging sensitive components. The effects of space weather on the Earth’s upper atmosphere disrupts radio signals transmitted by navigation satellites, potentially introducing positioning errors or, in more severe cases, rendering them unusable.

These are not theoretical hazards: in recent decades, solar storms have caused outages for a number of satellites services – and a handful of satellites have been lost altogether. These were costly events – satellite operator losses have run into hundreds of millions of dollars. The wider social and economic impact was relatively limited, but even so it’s unclear how our growing amount of space infrastructure would fare against the more extreme space weather that we might face.

When Space Weather Becomes A Hurricane

The largest solar storm on record was the Carrington event in September 1859, named after the British astronomer who observed it. Of course there were no Victorian satellites to suffer the consequences, but the telegraph systems of the time were crippled as electrical currents induced in the copper wires interfered with signals, electrocuted operators and set telegraph paper alight. The geomagnetic storm it triggered was so intense that the northern lights, usually a polar phenomenon, were observed as far south as the Bahamas.

Statistical analysis of this and other severe solar storms suggests that we can expect an event of this magnitude once every few hundred years – it’s a question of “when” rather than “if”. A 2007 study estimated a Carrington event today would cause US$30 billion in losses for satellite operators and threaten vital infrastructure in space and here on the ground. It’s a risk taken sufficiently seriously that it appears on the UK National Risk Register and has led the government to draw up its preparedness programme.

#### 5] EMP attacks are coming and wreck satellites

Graham 19 (William Graham, Chairman of the Congressional EMP Commission, White House Science Advisor to President Reagan, Ambassador R. James Woolsey, CIA Director and Senior Advisor to the Congressional EMP Commission, and Peter Vincent Pry, Chief of Staff of the Congressional EMP Commission, Served on the Staffs of the House Armed Services Committee and the CIA, “The EMP Executive Order — Where Were Bush and Obama?” The National Review. May 3, 2019. <https://www.nationalreview.com/2019/05/emp-executive-order-trump-administration-takes-threat-seriously/>) [language modified]

A threat that could literally mean the end of civilization is finally getting the attention it needs under Trump.

Washington and the press call almost everything an “existential threat” these days. But the threat from a natural or man-made electromagnetic pulse (EMP) really is one, as our congressional commission reported in 2017:

The critical national infrastructure in the United States faces a present and continuing existential threat from combined-arms warfare, including cyber and manmade electromagnetic pulse (EMP) attack, as well as EMP from a solar superstorm. During the Cold War, the U.S. was primarily concerned about an EMP attack generated by a high-altitude nuclear weapon as a tactic by which the Soviet Union could suppress the U.S. national command authority and the ability to respond to a nuclear attack — and thus negate the deterrence value of assured nuclear retaliation. Within the last decade, newly-armed adversaries, including North Korea, have been developing the ability and threatening to carry out an EMP attack against the United States.

The bottom line:

Such an attack would give countries that have only a small number of nuclear weapons the ability to cause widespread, long-lasting damage to critical national infrastructures, to the United States itself as a viable country, and to the survival of a majority of its population.

The EMP Commission warns that potential adversaries are developing a revolutionary new way of warfare combining cyber-attacks, sabotage, and nuclear EMP attack against national electric grids and other critical infrastructures to achieve quick and decisive victory:

Combined-Arms Cyber Warfare, as planned by Russia, China, North Korea, and Iran, may use combinations of cyber-, sabotage-, and ultimately nuclear EMP-attack to impair the United States quickly and decisively by blacking-out large portions of its electric grid and other critical infrastructures. Foreign adversaries may also consider nuclear EMP attack as the ultimate cyber “denial of service” weapon, one which can gravely damage the U.S. by striking at its technological Achilles’ heel, without having to engage the U.S. military. . . .

The synergism of such combined-arms is described in the military doctrines of all these potential adversaries as the greatest Revolution in Military Affairs (RMA) in history — one which anticipates rendering obsolete many, if not all, traditional instruments of military power.

Alarmingly, in the military doctrines of potential adversaries, nuclear EMP attack is considered a dimension of cyber warfare, because EMP is not directly injurious to people, only to electronics. High-altitude EMP attack entails exo-atmospheric detonation (30 to 500 kilometers high), so none of the blast, fire, radiation, radioactive fallout, or other effects associated with a nuclear attack on a city would occur — only the EMP.

Yet EMP, like a super-energetic radio wave that can destroy all kinds of electronics across a region as vast as North America with a single weapon, could in the long run kill far more Americans through its indirect effects than nuclear bombing of a city. Fatalities estimated from a protracted nationwide blackout lasting one year range from 67 to 90 percent of the U.S. population, due to starvation, disease, and societal collapse.

The EMP Commission tried, but could not figure out a way to keep 328 million Americans alive for a year without food and water. In 1880, just before the invention of the first electric grid in 1882, and long before the advent of our high-tech electronic civilization, the U.S. population was about 50 million, sustained by horse-drawn, coal-fired, and mechanical critical infrastructures that no longer exist.

Nuclear deterrence may not prevent an EMP attack, which can be executed anonymously using a balloon or a private jet or by doing a zoom-climb, with a short-range missile launched off a freighter (as practiced by Iran), or by satellite (as practiced by North Korea). Retaliatory threats are credible only if you know who attacked.

EMP also [destroys] ~~blinds~~, at the speed of light, satellites, radars, and other National Technical Means used for threat assessment and identifying attackers. Super-EMP weapons now possessed by Russia, China, and probably North Korea could generate 100,000 volts/meter or more, greatly exceeding the U.S. military hardening standard (50,000 volts/meter) and potentially [undermining] ~~paralyzing~~ U.S. nuclear and conventional retaliatory capabilities.

### 1NC -- AT: Space War

#### No space war -- Official statements prove

Colby 16 (Elbridge, Senior Fellow at the Center for a New American Security, “From Sanctuary to Battlefield: A Framework for a U.S. Defense and Deterrence Strategy for Space”)SLAIR

But such a threat is of substantially decreasing credibility. In today’s much different context, no one really believes that a limited space attack would necessarily or even plausibly be a prelude to total nuclear war. Would the United States respond with a major strategic strike if China or Russia, in the context of a regional conflict with the United States, struck discriminately at implicated U.S. space assets in the attempt to defang U.S. power projection, all while leaving the broader U.S. space architecture alone? Not only does such a massive response seem unlikely – it would be positively foolish and irresponsible. Furthermore, would other nations regard attacks on assets the United States was actively employing for a local war as off limits to attack? Indeed, any reasonable observer would have to judge that such discriminate attacks on U.S. space assets would not necessarily be illegitimate, as, by the United States’ own admission, it relies greatly on its space architecture for conventional power projection. Moreover, official U.S. statements on how the United States would respond to attacks on its space assets – to the limited extent such statements exist and the degree to which those given are clear – offer no indication it would respond massively to such strikes.53 Perhaps more to the point, senior responsible U.S. officials have telegraphed that the United States would indeed not necessarily respond massively to attacks against its space assets.54 In light of these factors, any U.S. space deterrence strategy that is predicated on an all-or-nothing retaliation to space attacks will become increasingly incredible and thus decreasingly effective – and indeed might even invite an adversary’s challenge in order to puncture or degrade U.S. credibility. In other words, since space assets can increasingly be attacked segmentally and discriminately rather than totally, this means that credibly and effectively deterring such attacks requires a less than total response. Since the threat is more like a rapier than a broadsword, the United States needs rapier-like ripostes of its own. Accordingly, the United States Any U.S. space deterrence strategy that is predicated on an all-or-nothing retaliation to space attacks will become increasingly incredible and thus decreasingly effective. needs a more discriminate deterrent for space. In particular, it needs a flexible deterrent capable of meeting the intensifying challenge of deterring an adversary – and particularly a highly capable potential opponent like China or Russia – from attacking (or attacking to a sufficient degree) those U.S. space assets needed for the United States to effectively and decisively project power and ultimately prevail in a conflict in a distant theater. At the same time, this flexible deterrent must contribute to dissuading such an enemy from striking at the nation’s broader military and civilian space architecture, and in particular those core strategic space assets needed for central deterrence.

#### Outer space has existential deterrence.

Bowen 18 [Bleddyn, Lecturer in International Relations at the University of Leicester; ELN; 20 Februrary 2018; “The Art of Space Deterrence,” <https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/>] brett

Fourth, the ubiquity of space infrastructure and the fragility of the space environment may create a degree of existential deterrence. As space is so useful to modern economies and military forces, a large-scale disruption of space infrastructure may be so intuitively escalatory to decision-makers that there may be a natural caution against a wholesale assault on a state’s entire space capabilities because the consequences of doing so approach the mentalities of total war, or nuclear responses if a society begins tearing itself apart because of the collapse of optimised energy grids and just-in-time supply chains. In addition, the problem of space debris and the political-legal hurdles to conducting debris clean-up operations mean that even a handful of explosive events in space can render a region of Earth orbit unusable for everyone. This could caution a country like China from excessive kinetic intercept missions because its own military and economy is increasingly reliant on outer space, but perhaps not a country like North Korea which does not rely on space. The usefulness, sensitivity, and fragility of space may have some existential deterrent effect. China’s catastrophic anti-satellite weapons test in 2007 is a valuable lesson for all on the potentially devastating effect of kinetic warfare in orbit.

#### Even absent treaty cred, no space war—interdependence checks.

Bragg et al 18—(principle research scientist at NSI, Inc. Lecturer in polisci @ Texas A&M). , July 2018.. Allison Astorino-Courtois. Robert Elder. Belinda Bragg. “Contested Space Operations, Space Defense, Deterrence, and Warfighting: Summary Findings and Integration Report,” NSI, <https://nsiteam.com/social/wp-content/uploads/2018/11/Space-SMA-Integration-Report-Space-FINAL.pdf>

Everyone needs space While the US may be relatively more dependent on space for national security than are other states, it is far from alone in relying on space. Nuclear armed states are dependent on space for important command and control functions, and major powers are increasingly using space for battlefield situational awareness and communications. China and Russia were identified as having significant (and fairly equal) levels of strategic risk in space (ViTTa Q16), although their regional security priorities and (to date) less spacedependent economies place them at an advantage to the US. They may, therefore, see the strategic risk of conflict is space as lower than does the US. Still, space capabilities remain a source of economic expansion and national pride for both, and their calculations of the cost of conflict involving space may include consideration of these factors. Even now, there is a general consensus that the US and other actors have more to gain from space than they have from the loss of space-based capabilities (ViTTa Q3). This suggests that, although the US is more vulnerable in the space domain than are other states, the likelihood that aggressive action against an adversary’s space assets would be reciprocated may provide a degree of security. It also creates another incentive for actors to use diplomacy and international law to reduce risk and increase transparency in the space domain.

### 1NC – China

#### Multiple checks on US China conflict

**Leon, 17** – David Pak Yue, Assistant Professor Department of Political Science & History, Keuka College (“Economic Interdependence and International Conflict: Situating China's Economic and Military Rise,” Asian Politics & Policy, vol 9, is 1, January 2017, Wiley //Red)

China has, in the past 30 years, experienced economic growth and military modernization to such an extent as to position itself as a power capable of shaping the Asian regional order and, potentially, the rules and institutions governing the international system.1 In the existing literature, various policy analysts and international relations scholars have argued that, historically, systemic risks of conflicts tend to increase at critical junctures of power transitions or major power shifts when the power gap narrows between a hegemon and a rising challenger, especially a revisionist one committed to overturning the established set of institutional arrangements (see Copeland, 2000; Gilpin, 1983; Kugler & Lemke, 1996; Organski, 1958; see also Chan, 2008; Harris, 2014). An increasingly powerful China in the context of the relative decline of the United States (Layne, 2012; Zakaria, 2008; although see Beckley, 2011) has brought these debates into sharper relief because whether or not China can rise peacefully and whether or not it will challenge the United States in its dual role as the premier global power and traditional underwriter of global governance institutions will have major implications for both theory and policy as analytical apparatuses are reexamined and reworked, and policy prescriptions developed and dispensed. This article first suggests that neither theoretical nor policy questions pertaining to China's rise can be properly addressed without examining the nature and meaning of any power shifts that are said to be in process, or the balance of economic and military forces within the intersecting global and East Asian regional systems. Clarifying these issues in turn requires an analysis of such factors as the trajectories, reversibility, and distributional consequences of differential growth; the possibilities and constraints of China's current and expected military capabilities, especially in relation to power projection and strategic means of coercion (i.e., naval and air forces capable of long-range operations, as well as nuclear forces and the capabilities and ranges of delivery vehicles); economic interdependence; and China's dispositions toward rule-based international institutional complexes. This article argues that while China has seen tremendous economic growth and substantial military modernization, sustaining its economic prosperity depends to a large extent on global trade, internal and external stability, and the ability to access natural resources. A deep level of international institutional engagement that it has exhibited while rising in wealth and power is quite dissimilar to aggressive rising challengers in the past (e.g., Imperial Japan and Nazi Germany) where autarky or economic self-sufficiency and aloofness from rule-based institutions tended to mark their behavior. Inasmuch as engagement and enmeshment continue to be prioritized in Chinese foreign policy, China will likely have strong disincentives to initiate conflicts that may disrupt trade and resource flows and essentially slow its own rise. For the foreseeable future, its military also does not have the kind of power projection capability and its foundational sources—or what can be called the command of the commons (Pose, 2003)—that would allow it to mount a serious challenge to U.S. military primacy in the Western Pacific, much less to initiate a revisionist war to reorder the core systemic arrangements; on the contrary, it has seldom been more involved and engaged in such arrangements in modern times. This relatively benign conclusion, however, is conditional on China's continued access to the resources necessary for further development and growth by means of trade or acquisition, which also serves as a linchpin of domestic regime stability. This can be attributed to Deng Xiaoping's admonition for China to “hide its capabilities and bide its time” in international politics, a concept traceable to Sun Tzu's classic notion that high strategic virtue lies in winning without a fight (see Sun, 2009; see also Friedberg, 2011; Kissinger, 2011). It is still too early to tell if tensions in China's geographical periphery and China's more recent assertiveness in international affairs indicate a fundamental reorientation or an adjustment in policy, but in any case, such tensions and the possibility of escalation should not be taken lightly. In short, China has been rising within a rule-based system characterized by the institutionalization of world trade and politics (Baviera, 2016; Ikenberry, 2011), conceived initially as U.S.-led institutional design, and more broadly intensified in the closing decades of the 20th century and the beginning of the 21st century. If this institutional architecture proves not to be robust and resilient enough to ensure reasonably unhindered access to the lifeblood of growth, dangers may still loom for a concerted drive for autarky that in earlier times had emanated from great power anxieties and heralded international conflicts. The very existence and pervasiveness of contemporary global institutions, however, do present China with the possibility to rewrite or create its own set of global institutions, something that totalitarian rising powers in the first half of the 20th century did not seriously attempt to do.

## 1NC –

#### Tracking debris exists now and solves collisions.

**Mosher** **’19** [Dave; September 3rd; Journalist with more than a decade of experience reporting and writing stories about space, science, and technology; Business Insider, “Satellite collisions may trigger a space-junk disaster that could end human access to orbit. Here’s How,” <https://www.usafa.edu/app/uploads/Space_and_Defense_2_3.pdf>; GR]

The Kessler syndrome plays center-stage in the movie "Gravity," in which an accidental space collision endangers a crew aboard a large space station. But Gossner said that type of a runaway space-junk catastrophe is unlikely. "Right now I don't think we're close to that," he said. "I'm not saying we couldn't get there, and I'm not saying we don't need to be smart and manage the problem. But I don't see it ever becoming, anytime soon, an unmanageable problem." There is no current system to remove old satellites or sweep up bits of debris in order to prevent a Kessler event. Instead, space debris is monitored from Earth, and new rules require satellites in low-Earth orbit be deorbited after 25 years so they don't wind up adding more space junk. "Our current plan is to manage the problem and not let it get that far," Gossner said. "I don't think that we're even close to needing to actively remove stuff. There's lots of research being done on that, and maybe some day that will happen, but I think that — at this point, and in my humble opinion — an unnecessary expense." A major part of the effort to prevent a Kessler event is the Space Surveillance Network (SSN). The project, led by the US military, uses 30 different systems around the world to identify, track, and share information about objects in space. Many objects are tracked day and night via a networkof radar observatories around the globe. Optical telescopes on the ground also keep an eye out, but they aren't always run by the government. "The commercial sector is actually putting up lots and lots of telescopes," Gossner said. The government pays for their debris-tracking services. Gossner said one major debris-tracking company is called Exoanalytic. It uses about 150 small telescopes set up around the globe to detect, track, and report space debris to the SSN. Telescopes in space track debris, too. Far less is known about them because they're likely top-secret military satellites. Objects detected by the government and companies get added to a catalog of space debris and checked against the orbits of other known bits of space junk. New orbits are calculated with supercomputers to see if there's a chance of any collisions. Diana McKissock, a flight lead with the US Air Force's 18th Space Control Squadron, helps track space debris for the SSN. She said the surveillance network issues warnings to NASA, satellite companies, and other groups with spacecraft, based on two levels of emergency: basic and advanced. The SSN issues a basic emergency report to the public three days ahead of a 1-in-10,000 chance of a collision. It then provides multiple updates per day until the risk of a collision passes. To qualify for such reporting, a rogue object must come within a certain distance of another object. In low-Earth orbit, that distance must be less than 1 kilometer (0.62 mile); farther out in deep space, where the precision of orbits is less reliable, the distance is less than 5 kilometers (3.1 miles). Advanced emergency reports help satellite providers see possible collisions much more than three days ahead. "In 2017, we provided data for 308,984 events, of which only 655 were emergency-reportable," McKissock told Business Insider in an email. Of those, 579 events were in low-Earth orbit (where it's relatively crowded with satellites).

#### The debris propagation model is a process not an event---timeframe is decades and intervening actors check. Err neg -- this is Kessler, whose research their models is based on

Burns Interviewing Kessler **’**13 Corrinne Burns, interviewing Donald Kessler, who made up the concept. [Space junk apocalypse: just like Gravity? 11-15-2013, https://www.theguardian.com/science/blog/2013/nov/15/space-junk-apocalypse-gravity]//BPS

Now? Are we in trouble? Not yet. Kessler syndrome isn't an acute phenomenon, as depicted in the movie – it's a slow, decades-long process. "It'll happen throughout the next 100 years – we have time to deal with it," Kessler says. "The time between collisions will become shorter – it's around 10 years at the moment. In 20 years' time, the time between collisions could be reduced to five years." Fortunately, communications satellites are, in the main, situated high up in geosynchronous orbit (GEO), whereas the risk of collisions lies mainly in the much lower, and more crowded, low Earth orbit (LEO). But that doesn't mean we can relax. "We've got to get a handle on it – we need to prevent the cascade process from speeding up." And the only way to do that is, he says, to begin actively removing junk from space. Charlotte Bewick agrees. She's a mission concepts engineer with the German space technology company OHB System, with special expertise in space junk – specifically, how we can capture it and bring it back to Earth. While agreeing with Kessler that the movie scenario is exaggerated, she remains concerned. "Fragments of junk can naturally re-enter the atmosphere [and so be removed from orbit]. But we're at the stage where the rate of creation of new debris fragments is higher than the rate of natural removal. The orbits most at risk harbour important space assets – satellites for weather forecasting, oil spill and bush fire detection, and polar ice monitoring." Bewick highlights the case of Envisat, a defunct 8,000kg spacecraft circling Earth in an orbit that is very popular with space agencies and, hence, pretty crowded. "If Envisat collides with a piece of debris or a micrometeorite, the fragments could render the whole orbital region unusable." So can we get the junk down, I asked Massimiliano Vasile, part of the Mechanical & Aerospace Department at the University of Strathclyde and co-ordinator of the Stardust network. He told me defunct satellites in the high GEO region have, for some time, been shifted to higher "graveyard orbits" to keep them out of the way. But that's not an option for items in low Earth orbit. For this, he tells me, researchers are looking seriously into active debris removal – in-orbit capture techniques like harpooning, netting and tethering, the use of contactless systems like ion-beams or lasers, and even onboard robotics to position the junk away from high-risk orbital regions. As for middle Earth orbit – well, ideas are welcome, he says. We're in no immediate danger from Kessler syndrome – but it's not a problem that's going away. Despite Gravity's artistic license, Donald Kessler is pleased to see the phenomenon represented on the big screen. "It is very improbable that events would play out as they did in the film," he says. "But if it raises awareness, then that's great."