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UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS

UNOOSA

AGENDA

Deliberation on International Cooperation and Legal Frameworks for the Mitigation and Management of Space Debris

BLUE BELLS INTERNATIONAL MODEL UNITED NATIONS 2025

INDEX

I. Letter from the Executive Board

Greetings Delegates!

It gives us immense pleasure to welcome you all to this simulation of the **United Nations Office for Outer Space Affairs (UNOOSA) at 'BBI Model United Nations 2025'**. We look forward to an enriching and rewarding experience.

The agenda for the session is: ***"Deliberation on International Cooperation and Legal Frameworks for the Mitigation and Management of Space Debris."***

This study guide is by no means the end of the research, we would very much appreciate it if the members are able to find new realms in the agenda and bring it forth to the committee. Such research combined with good argumentation and a solid representation of facts is what makes an excellent performance.

In the session, the executive board will encourage you to speak as much as possible, as fluency, diction, or oratory skills have very little importance as opposed to the content you deliver. So prime emphasis on research is recommended.

The Executive Board looks forward to an efficient & progressive committee as the issue is very sensitive. We, therefore, expect you all to play your roles with responsibility. Hopefully we, as members of the Executive Board, will also have a chance to gain insight from this committee.

All the best!
Regards,

Aaditya Wadhwa **Director**	**Kinza Rahman** **Deputy Director**	**Abeer Gujral** **Rapporteur**

II. Suggested Pattern For Researching

To start researching on the agenda of the committee, participating members should do the following:

1. Start researching your respective countries and its geopolitics. As no definite document may be found which contains the stand of a country, the delegates must do the tedious yet rewarding work of going through past news clippings/ magazine articles/ government websites/ social media handles/ YouTube videos to understand the country's stance on the said agenda.
2. After gaining knowledge about the portfolios, the delegates must start their research on the agenda at hand. This must be done by researching further upon the agenda using the footnotes and links given in the guide and from other sources such as academic papers, institutional or governmental reports, national reports, news articles, blogs etc.
3. Characterize the agenda into sub-topics and prepare speeches and statements on them. The delegates should also prepare a list of possible solutions and actions the UNOOSA can suggest/adopt on the issue.
4. Assemble proof/evidence for any important piece of information/ allegation you are going to use in committee and keep your research updated using various news sources, specifically government studies or data released by the same.
5. To have an edge in the committee in terms of debate, delegates must also research about the other countries and try to find their contradictory statements or controversial stands on various issues to raise allegations/ substantial questions in the committee.
6. Lastly, we would expect all the delegates to put in serious efforts in research and preparation for the simulation and work hard to make it a fruitful learning experience for all. Feel free to contact the undersigned if you have any queries or doubts.

III. Committee Overview

About UNOOSA

The United Nations Office for Outer Space Affairs (UNOOSA) is an office of the U.N. Secretariat that promotes and facilitates peaceful international cooperation in outer space. It works to establish or strengthen the legal and regulatory frameworks for space activities, and assists developing countries in using space science and technology for sustainable socioeconomic development.

The Office was established in 1958 to assist and advise the ad hoc **Committee on the Peaceful Uses of Outer Space (COPUOS)**, which was established by the UN General Assembly to discuss the scientific and legal aspects of exploring and using outer space to benefit humankind. The Committee became permanent the following year, with UNOOSA undergoing several structural changes before its relocation in 1993 to the United Nations Office in Vienna, Austria.

As the secretariat of COPUOS, the Office is responsible for helping implement the major international treaties, legal principles, and General Assembly resolutions that together comprise space law. Other duties include advising governments and nongovernmental organizations on space law; maintaining a registry of vessels and objects launched into space; convening forums to discuss various space-related matters; and sponsoring programmes that provide access to space technology.

Mandate

UNOOSA works primarily to implement the decisions of UN General Assembly and of the UN Committee on the Peaceful Uses of Outer Space. The office has the dual objective of supporting the intergovernmental discussions in the Committee and its Scientific and Technical Subcommittee and Legal Subcommittee, and of assisting developing countries in using space technology for development.

The mandate has been adjusted a number of times to allow the Office to undertake, among other tasks, the coordination of the inter-agency cooperation within the United Nations on the use of space technology - UN-Space (resolution 3234 implementing the United Nations Programme on Space Applications (resolution 2601A (XXIV)) and the UN-SPIDER Programme for disaster risk management and emergency response (resolution 61/110).

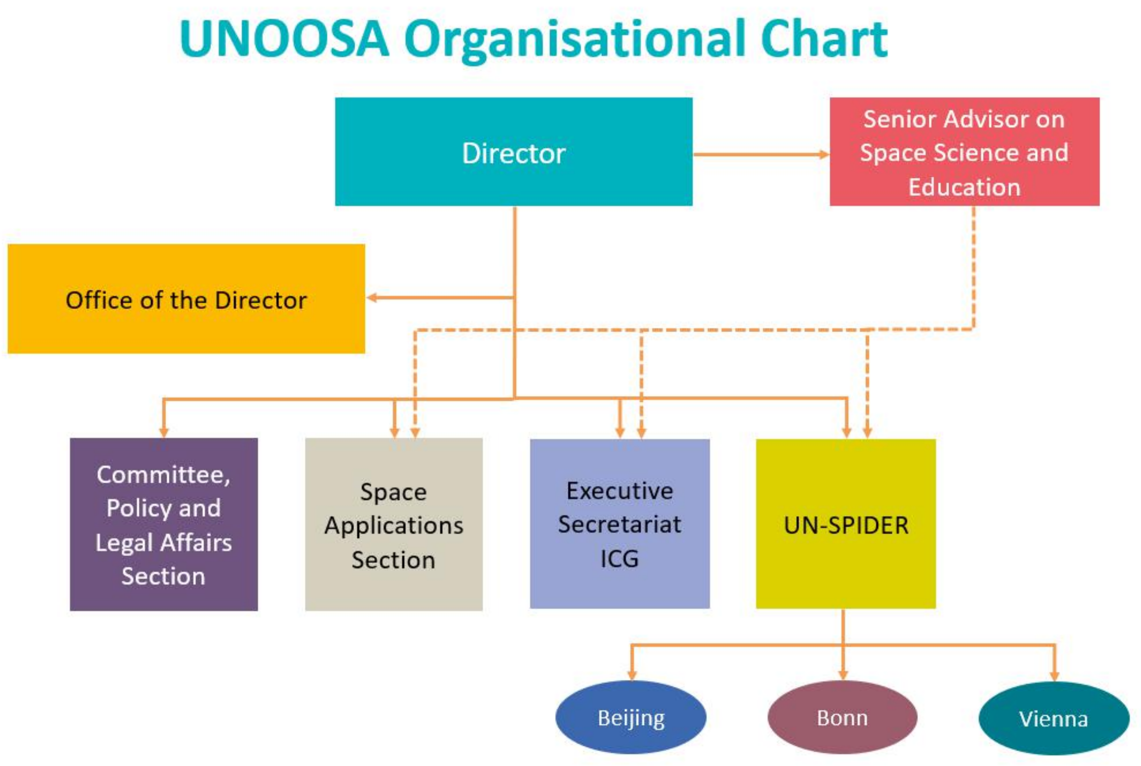
The Office also coordinates and cooperates with space agencies and intergovernmental and non-governmental organizations involved in space-related activities and, on behalf of the United Nations Secretary-General, the Register of Objects Launched into Outer Space. The office also helps poor nations suffering from climate change related problems by helping them access satellite images for free.

Structure

UNOOSA is headed by a Director appointed by the UN Secretary-General, from 2023 this is Aarti Holla-Maini of Belgium and the UK. The Director's Office is responsible for public outreach, the Register on Objects in Outer Space, and programmes for youth engagement.

It has two sections: the committee, Policy, and Legal Affairs (CPLA), headed by Takemi Chiku from Japan, and the Space Applications Section (SAS), headed by Lorant Czaran from Romania. The CPLA fulfills the Office's secretarial duties to the Committee on the Peaceful Uses of Outer Space, its subcommittees, and its working groups. It also convenes and services the Inter Agency Meeting on Outer Space Activities, known as UN-Space, which is the central inter-agency coordination mechanisms in the UN system on overarching space matters. UN-Space meets annually to discuss current and future activities, emergent technologies of interest, and other related matters, particularly regarding the global development agenda. The section is concerned with the establishment of a legal and regulatory framework governing space activities, and actively fosters capacity-building in space law and policy.

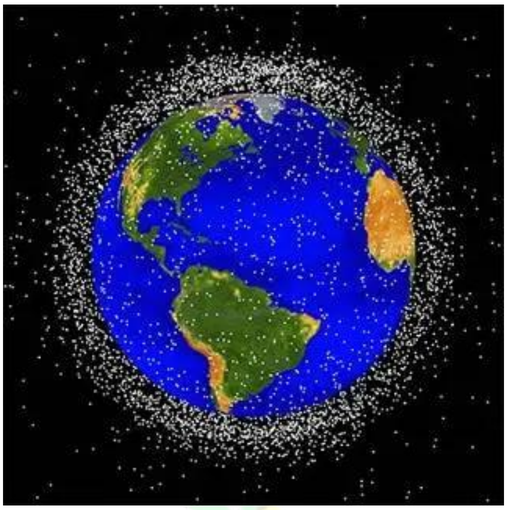
The Space Applications Section works on building capacities in the practical application of space technology and space-derived information for development. The Programme concentrates its efforts on ensuring the equal access of all countries to new space-based technologies, especially developing nations.



IV. Introduction

"The Universe is infinite
But space has its limits

Rockets are launching
Sat'lites are orbiting
Explosions in Space
Oh what a waste
Fragments go flying
And we go crying "Space junk we've got" Man-made or not
Then comes Kessler Who knows the better
When things collide
Their debris do multiply
Thanks to partnering
And NASA's gathering
We look for ways
To manage the spray"



– S. Thuy Nguyen-Onstott.

Although we don't see space junk in the sky, beyond the clouds and further than the eye can see, it enters low Earth orbit (LEO). LEO is an orbital space junk yard. There are millions of pieces of space junk flying in LEO. Most orbital debris comprises human-generated objects, such as pieces of space craft, tiny flecks of paint from a spacecraft, parts of rockets, satellites that are no longer working, or explosions of objects in orbit flying around in space at high speeds.

Most "space junk" is moving very fast and can reach speeds of 18,000 miles per hour, almost seven times faster than a bullet. Due to the rate of speed and volume of debris in LEO, current and future space-based services, explorations, and operations pose a safety risk to people and property in space and on Earth.

There are many reasons why LEO has developed into an orbital graveyard. For instance, the deliberate destruction of the Chinese Fengyun-1C spacecraft in 2007 and the accidental collision of an American and a Russian spacecraft in 2009 alone have increased the large orbital debris population in LEO by approximately 70%, posing greater collision risks for spacecraft operating in low Earth orbit.

There are no international space laws to clean up debris in our LEO. LEO is now viewed as the World's largest garbage dump, and it's expensive to remove space debris from LEO because the problem of space junk is huge. There are close to 6,000 tons of materials in low Earth orbit.

V. Understanding Space Debris

What are *'Space Debris'*?

Space debris (also known as space junk, space pollution, space waste, space trash, space garbage, or cosmic debris) are defunct human-made objects in space – principally in Earth orbit – which no longer serve a useful function. These include derelict spacecraft (nonfunctional spacecraft and abandoned launch vehicle stages), mission-related debris, and particularly numerous in-Earth orbit, fragmentation debris from the breakup of derelict rocket bodies and spacecraft. In addition to derelict human-made objects left in orbit, space debris includes fragments from disintegration, erosion, or collisions; solidified liquids expelled from spacecraft; unburned particles from solid rocket motors; and even paint flecks. Space debris represents a risk to spacecraft.

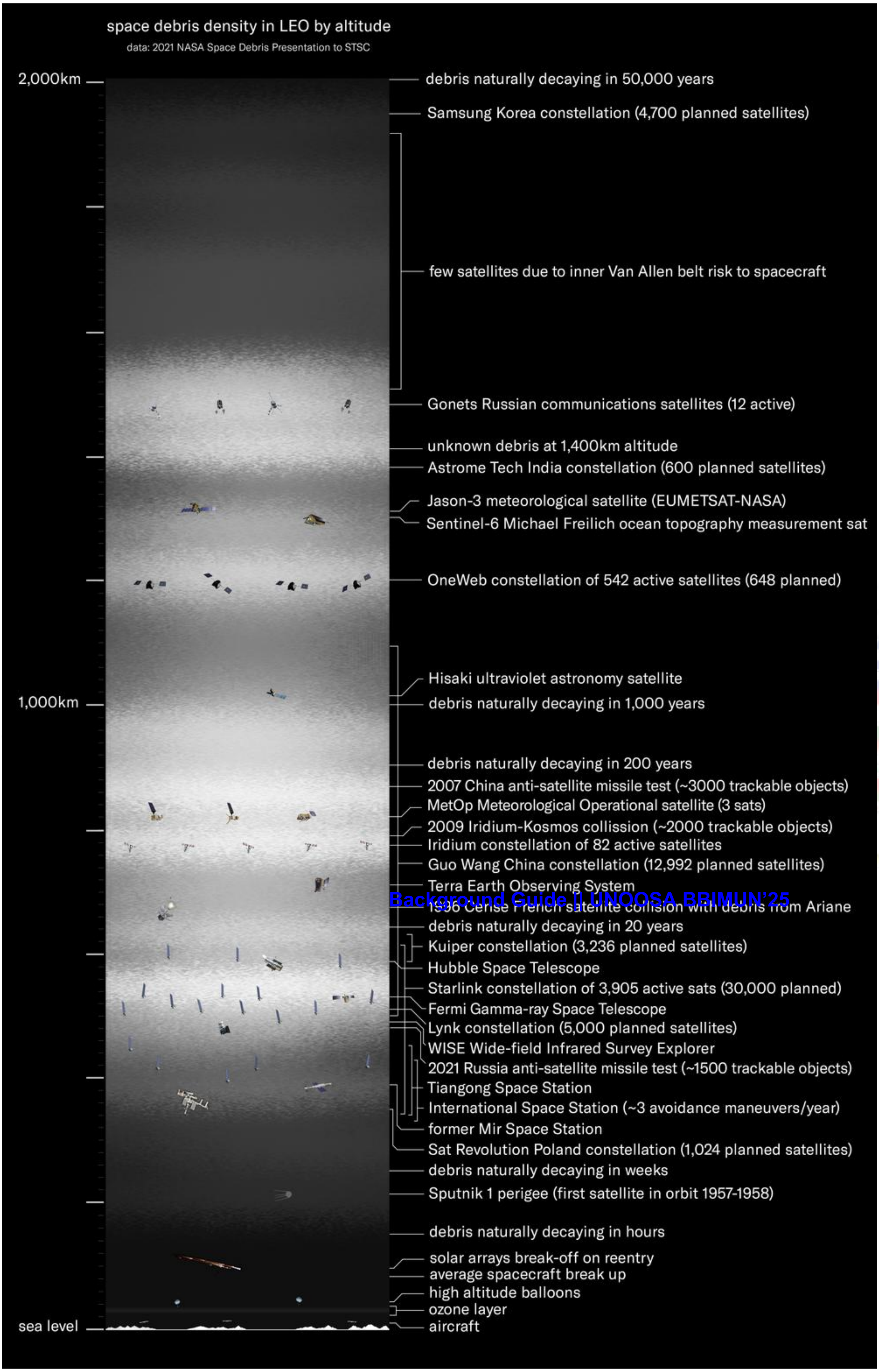
Space debris is typically a negative externality. It creates an external cost on others from the initial action to launch or use a spacecraft in near-Earth orbit, a cost that is typically not taken into account nor fully accounted for by the launcher or payload owner.

Several spacecraft, both crewed and un-crewed, have been damaged or destroyed by space debris. The measurement, mitigation, and potential removal of debris is conducted by some participants in the space industry.

As of April 2025, the European Space Agency's Space Environment statistics reported 40230 artificial objects in orbit above the Earth regularly tracked by Space Surveillance Networks and maintained in their catalogue.

However, these are just the objects large enough to be tracked and in an orbit that makes tracking possible. Satellite debris that is in a Molniya orbit, such as the Kosmos Oko series, might be too high above the Northern Hemisphere to be tracked. As of January 2019, more than 128 million pieces of debris smaller than 1 cm (0.4 in), about 900,000 pieces of debris 1–10 cm, and around 34,000 of pieces larger than 10 cm (3.9 in) were estimated to be in orbit around the Earth. When the smallest objects of artificial space debris (paint flecks, solid rocket exhaust particles, etc.) are grouped with micrometeoroids, they are together sometimes referred to by space agencies as MMOD (Micrometeoroid and Orbital Debris).

Collisions with debris have become a hazard to spacecraft. The smallest objects cause damage akin to sandblasting, especially to solar panels and optics like telescopes or star trackers that cannot easily be protected by a ballistic shield.


space debris density in LEO by altitude
data: 2021 NASA Space Debris Presentation to STSC
2,000km
1,000km
sea level
debris naturally decaying in 50,000 years
Samsung Korea constellation (4,700 planned satellites)
few satellites due to inner Van Allen belt risk to spacecraft
Gonets Russian communications satellites (12 active)
unknown debris at 1,400km altitude
Astrome Tech India constellation (600 planned satellites)
Jason-3 meteorological satellite (EUMETSAT-NASA)
Sentinel-6 Michael Freilich ocean topography measurement sat
OneWeb constellation of 542 active satellites (648 planned)
Hisaki ultraviolet astronomy satellite
debris naturally decaying in 1,000 years
debris naturally decaying in 200 years
2007 China anti-satellite missile test (~3000 trackable objects)
MetOp Meteorological Operational satellite (3 sats)
2009 Iridium-Kosmos collission (~2000 trackable objects)
Iridium constellation of 82 active satellites
Guo Wang China constellation (12,992 planned satellites)
Terra Earth Observing System
1996 Cerise French satellite collision with debris from Ariane
debris naturally decaying in 20 years
Kuiper constellation (3,236 planned satellites)
Hubble Space Telescope
Starlink constellation of 3,905 active sats (30,000 planned)
Fermi Gamma-ray Space Telescope
Lynk constellation (5,000 planned satellites)
WISE Wide-field Infrared Survey Explorer
2021 Russia anti-satellite missile test (~1500 trackable objects)
Tiangong Space Station
International Space Station (~3 avoidance maneuvers/year)
former Mir Space Station
Sat Revolution Poland constellation (1,024 planned satellites)
debris naturally decaying in weeks
Sputnik 1 perigee (first satellite in orbit 1957-1958)
debris naturally decaying in hours
solar arrays break-off on reentry
average spacecraft break up
high altitude balloons
ozone layer
aircraft

Sources of Space Debris

Dead spacecraft

Vanguard 1 is expected to remain in orbit for 240 years. In 1958, the United States of America launched Vanguard I into a medium Earth orbit (MEO). As of October 2009, it, the upper stage of Vanguard 1's launch rocket and associated piece of debris, are the oldest surviving artificial space objects still in orbit and are expected to be until after the year 2250. As of May 2022, the Union of Concerned Scientists listed 5,465 operational satellites from a known population of 27,000 pieces of orbital debris tracked by NORAD.

Occasionally satellites are left in orbit when they're no longer useful. Many countries require that satellites go through passivation at the end of their life. The satellites are then either boosted into a higher, graveyard orbit or a lower, short-term orbit. Nonetheless, satellites that have been properly moved to a higher orbit have an eight-percent probability of puncture and coolant release over a 50-year period. The coolant freezes into droplets of solid sodium-potassium alloy, creating more debris.

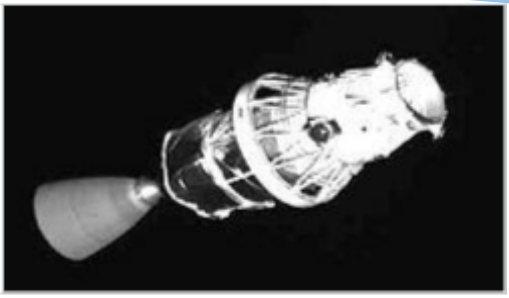
In addition to the accidental creation of debris, some has been made intentionally through the deliberate destruction of satellites. **This has been done as a test of anti-satellite or anti-ballistic missile technology**, or to prevent a sensitive satellite from being examined by a foreign power. The United States has conducted over 30 anti-satellite weapons tests (ASATs), the Soviet Union/Russia has performed at least 27, China has performed 10 and India has performed at least one. The most recent ASATs were the Chinese interception of FY-1C, Russian trials of its PL-19 Nudol, the American interception of USA-193 and India's interception of an unstated live satellite.

Lost equipment

Space debris includes a glove lost by astronaut Ed White on the first American space-walk (EVA), a camera lost by Michael Collins near Gemini 10, a thermal blanket lost during STS-88, garbage bags jettisoned by Soviet cosmonauts during Mir's 15-year life, a wrench, and a toothbrush. Sunita Williams of STS-116 lost a camera during an EVA. During an STS-120 EVA to reinforce a torn solar panel, a pair of pliers was lost, and in an

STS-126 EVA, Heidemarie Stefanyshyn-Piper lost a briefcase-sized tool bag.

Boosters



Spent upper stage of a Delta II rocket, photographed by the XSS 10 satellite

A significant portion of debris is due to rocket upper stages (e.g. the Inertial Upper Stage) breaking up due to decomposition of unvented fuel. The first such instance involved the launch of the Transit-4a satellite in 1961. Two hours after insertion, the Ablestar upper stage exploded.

Even boosters that don't break apart can be a problem. A major known impact event involved an (intact) Ariane booster.

Although NASA and the United States Air Force now require upper-stage passivation, other launchers – such as the Chinese and Russian space agencies – do not. Lower stages, like the Space Shuttle's solid rocket boosters or the Apollo program's Saturn IB launch vehicles, do not reach orbit.

Weapons

A former source of debris was anti-satellite weapons (ASATs) testing by the U.S. and Soviet Union during the 1960s and 1970s. North American Aerospace Defense Command (NORAD) only collected data for Soviet tests, and debris from U.S. tests were identified subsequently. By the time the debris problem was understood, widespread ASAT testing had ended. The U.S. Program 437 was shut down in 1975.

The U.S. restarted their ASAT programs in the 1980s with the Vought ASM-135 ASAT. A 1985 test destroyed a 1-tonne (2,200 lb) satellite orbiting at 525 km (326 mi), creating thousands of debris larger than 1 cm (0.39 in). At this altitude, atmospheric drag decayed the orbit of most debris within a decade. A de facto moratorium followed the test.

On 27 March 2019, Indian Prime Minister Narendra Modi announced that India shot down one of its own LEO satellites with a ground-based missile. He stated that the operation, part of Mission Shakti, would defend the country's interests in space. Afterwards, US Air Force Space Command announced they were tracking 270 new pieces of debris but expected the number to grow as data collection continues.

VI. Kessler Syndrome

The Kessler syndrome, proposed by NASA scientist Donald J. Kessler in 1978, is a theoretical scenario in which the density of objects in low Earth orbit (LEO) is high enough that collisions between objects could cause a cascade effect where each collision generates space debris that increases the likelihood of further collisions. He further theorized that one implication, if this were to occur, is that the distribution of debris in orbit could render space activities and the use of satellites in specific orbital ranges economically impractical for many generations.

The growth in the number of objects as a result of the late-1990s studies sparked debate in the space community on the nature of the problem and the earlier dire warnings. According to Kessler's 1991 derivation and 2001 updates, the LEO environment in the 1,000 km (620 mi) altitude range should be cascading. However, only one major satellite collision incident occurred: the 2009 satellite collision between Iridium 33 and Cosmos 2251. The lack of obvious short-term cascading has led to speculation that the original estimates overstated the problem. According to Kessler in 2010 however, a cascade may not be obvious until it is well advanced, which might take years.

The Kessler syndrome is troublesome because of the domino effect and feedback runaway wherein impacts between objects of sizable mass spall off debris from the force of the collision. The fragments can then hit other objects, producing even more space debris: if a large enough collision or explosion were to occur, such as between a space station and a defunct satellite, or as the result of hostile actions in space, then the resulting debris cascade could make prospects for long-term viability of satellites in particular low Earth orbits extremely low. However, even a catastrophic Kessler scenario at LEO would pose minimal risk for launches continuing past LEO, or satellites travelling at medium Earth orbit (MEO) or geosynchronous orbit (GEO). The catastrophic scenarios predict an increase in the number of collisions per year, as opposed to a physically impassable barrier to space exploration that occurs in higher orbits.

VII. Existing International Legal Frameworks

The Outer Space Treaty (1967)

The Outer Space Treaty, formally the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, is a multilateral treaty that forms the basis of international space law.

Negotiated and drafted under the auspices of the United Nations, it was opened for signature in the United States, the United Kingdom, and the Soviet Union on 27 January 1967, entering into force on 10 October 1967. As of May 2025, 117 countries are parties to the treaty—including all major spacefaring nations—and another 22 are signatories.
Key provisions of the treaty include prohibiting nuclear weapons in space; limiting the use of the Moon and all other celestial bodies to peaceful purposes; establishing that space shall be freely explored and used by all nations; and precluding any country from claiming sovereignty over outer space or any celestial body. Although it forbids establishing military bases, testing weapons and conducting military maneuvers on celestial bodies, the treaty does not expressly ban all military activities in space, nor the establishment of military space forces or the placement of conventional weapons in space.

The OST also declares that space is an area for free use and exploration by all and "shall be the province of all mankind". Drawing heavily from the Antarctic Treaty of 1961, the Outer Space Treaty likewise focuses on regulating certain activities and preventing unrestricted competition that were thought might lead to conflict at that time. Consequently, it is largely silent or ambiguous on newly developed space activities such as lunar and asteroid mining.

OST was at the heart of a 'network' of inter-state treaties and strategic power negotiations to achieve the best available conditions for nuclear weapons world security.

OST was the most important link in the chain of international legal arrangements for space from the late 1950s to the mid-1980s. The OST was followed by to four additional agreements, with varied levels of accession: the safe return of fallen astronauts (1967); liability for damages caused by spacecraft (1972); the registration of space vehicles (1976);and rules for activities on the Moon (1979). As the first and most foundational legal instrument of space law, the Outer Space Treaty and its broader principles of promoting the civil and peaceful use of space continue to underpin multilateral initiatives in space, such as the International Space Station and the Artemis Program.

Article VI of the Outer Space Treaty deals with international responsibility, stating that "the activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty" and that States Party shall bear international responsibility for

national space activities whether carried out by governmental or non-governmental entities.

As a result of discussions arising from Project West Ford in 1963, a consultation clause was included in Article IX of the Outer Space Treaty: "A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment."

Liability Convention (1972)

The Convention on International Liability for Damage Caused by Space Objects, also known as the Space Liability Convention, is a treaty from 1972 that expands on the liability rules created in the Outer Space Treaty of 1967. In 1978, the crash of the nuclear-powered Soviet satellite Kosmos 954 in Canadian territory led to the only claim filed under the convention.

States (countries) bear international responsibility for all space objects that are launched within their territory. This means that regardless of who launches the space object, if it was launched from State A's territory, or from State A's facility, or if State A caused the launch to happen, then State A is fully liable for damages that result from that space object.

Registration Convention (1976)

The Convention on Registration of Objects Launched into Outer Space (commonly known as the Registration Convention) was adopted by the United Nations General Assembly in 1974 and went into force in 1976. As of February 2022, it has been ratified by 72 states.

The convention requires states to furnish to the United Nations with details about the orbit of each space object. A registry of launchings was already being maintained by the United Nations as a result of a General Assembly Resolution in 1962.

The Registration Convention and four other space law treaties, including The Outer Space Treaty, The Rescue Agreement, The Liability Convention, and The Moon Agreement are administered by the United Nations Committee on the Peaceful Uses of Outer Space.

The European Space Agency, European Organization for the Exploitation of Meteorological Satellites, the European Telecommunications Satellite Organization, and the Intersputnik International Organization of Space Communications have submitted declarations of acceptance of rights and obligations according to the convention.

COPUOS Space Debris Mitigation Guidelines (2007, 2019)

The COPUOS Space Debris Mitigation Guidelines are a set of non-legally binding principles developed by the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and adopted by the UN General Assembly (62/217) in 2007 to reduce space debris. The guidelines focus on limiting debris generation during operations, preventing accidental breakups, avoiding collisions, preventing deliberate destruction, and ensuring spacecraft are safely removed from Earth orbit after their missions end, often using a 25-year rule for deorbiting or reorbiting.

The UN General Assembly resolution 62/217, adopted on 22 December 2007, reaffirms the principle that outer space is the province of all humankind and underscores the centrality of international cooperation in ensuring its peaceful use. It recalls the milestones of 2007, including the 40th anniversary of the Outer Space Treaty (1967), and emphasizes the importance of universal adherence to the five UN space treaties, particularly in preventing an arms race in outer space.

The resolution highlights space debris as a pressing global concern, endorsing the COPUOS Space Debris Mitigation Guidelines and urging states to integrate them into national mechanisms. It further stresses the potential of space technology in disaster management, telemedicine, education, and sustainable development, particularly for developing countries. Notably, the resolution endorsed the creation of UN-SPIDER (United Nations Platform for Space-based Information for Disaster Management and Emergency Response) to enhance global access to space-based disaster relief tools.

In essence, Resolution 62/217 strengthens the legal and institutional framework for space governance, linking space activities to the UN's sustainable development agenda while reiterating that peace, cooperation, and equitable access remain foundational to the future of outer space governance.

VIII. Challenges

Economic Challenges

From research and development to operational costs, debris remediation is a resource intensive pursuit, raising questions over who should foot the bill. As every spacefaring actor would benefit from cleaner orbits, a free rider problem and the ensuing Tragedy of the Commons loom. Alternatively, responsibility for funding the cleaning could be assigned to those actors who generated the debris. The United States, Russia, and China together generated 95% of the debris in orbit today. Nevertheless, the likelihood of convincing these geopolitical rivals to pool funds to clean up space for everyone else appears slim.

A May 2024 NASA report weighing the costs and benefits of debris remediation suggests active debris removal makes economic sense, with benefits hundreds of times higher than the upfront cost. This is not only true for the low hanging fruit — large debris in dense orbits — but also for centimeter-sized debris. Whereas this is an encouraging signal for a potential space sustainability market, providers will face difficulties in the absence of an explicit client.

Legal Challenges

The six UN treaties governing human activities in space were all signed before 1980, and do not adequately address the legal challenges raised by debris remediation. International law does not offer a solid definition of debris, let alone an explicit roadmap to handle legal issues. The Outer Space Treaty (OST) clearly assigns ownership of spacecraft and debris to the state that registered them. Hence, a debris remediation mission would likely require the consent of the debris owner, assuming it can even be traced. The OST also enjoins spacefaring nations to conduct space activities with "due regard" to others' interests, but never defines the scope of the "due regard" obligation.

In the case of an international debris remediation mission, questions of jurisdiction and export control arise. Liability in the case of failed missions is also insufficiently defined. The world needs more up-to-date and precise legal frameworks, but it is unclear if the requisite political consensus can be found.

Political Challenges

Whereas curbing excessive debris is a common challenge for all states, debris remediation may still prove to be a thorny political issue. Active debris removal is a dual-use technology. The ability to interfere with the trajectory of a debris implies the ability to interfere with active satellites too, making any debris remediation method a potential space weapon. The concerns the U.S. Government recently showed when a suspected Russian

orbital weapon approached a U.S. reconnaissance payload illustrate just how sensitive states are towards allowing their assets to be approached.

Outside of non-binding UN-led initiatives, the world's three largest debris producers barely cooperate on debris. Mistrust between great powers has stood in the way of effective global space sustainability governance, and can make active debris removal an escalatory issue. A lack of diplomacy threatens to fragment the global space policy landscape with insufficient overlap and cooperation.

Issues of State Sovereignty vs. Collective Responsibility

One of the most intractable dilemmas in space law is balancing state sovereignty with the collective responsibility to maintain outer space as a safe and sustainable domain.

The principle of sovereignty is central to international law and is preserved in Article I and

II of the Outer Space Treaty (OST, 1967). Article II explicitly prohibits national appropriation of outer space by claims of sovereignty, use, or occupation. However, under Article VIII OST, states retain jurisdiction and control over objects they launch into outer space. This effectively allows states to dictate how their satellites are operated, but creates challenges when those objects pose debris risks to the entire international community.

Conversely, collective responsibility emerges from the recognition of outer space as the "province of all mankind" (Article I, OST). This principle is reinforced in UNGA Resolution 1962 (XVIII) – Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (1963), which stresses that exploration should benefit all states, regardless of technological capability. Similarly, the UNCOPUOS Space Debris Mitigation Guidelines (2007, updated 2019) promote best practices in debris reduction, but remain non-binding due to sovereignty concerns.

The legal tension becomes more apparent when applying the Liability Convention (1972). Article II establishes that states are "absolutely liable" for damage caused by their space objects on Earth or to aircraft, and Article III imposes liability for damage in space if fault is proven. Yet, no state has ever been held internationally liable for debris generation, largely because proving "fault" requires penetrating sovereign control over space programs. This creates a structural loophole: while states insist on sovereign jurisdiction over their objects, the international community bears the collective risks of debris proliferation.

Further, sovereignty complicates enforcement mechanisms. For example, the EU Code of Conduct for Outer Space Activities (2008, revised 2014) and the draft UN Guidelines for the Long-Term Sustainability of Outer Space Activities (2019) seek to harmonize behavior, but participation is voluntary. Major spacefaring nations often resist binding commitments, citing national security and sovereign interests.

The problem of dual-use technologies—where debris mitigation measures (e.g., active debris removal, lasers, robotic arms) could be weaponized—exacerbates mistrust. States fear infringement on sovereignty through intrusive verification regimes, making collective enforcement difficult. This is mirrored in the failed efforts for a Prevention of an Arms Race in Outer Space (PAROS) treaty within the UN Conference on Disarmament, where sovereignty-based objections have stalled progress.

Ultimately, sovereignty provides states with exclusive jurisdiction but also fragments the regulatory landscape, while collective responsibility demands cooperative governance that transcends national boundaries. Until international law evolves to balance these dimensions—potentially through a binding instrument that operationalizes "polluter pays" principles or collective liability mechanisms—the governance of space debris will remain caught between sovereign rights and the shared duty to preserve the global commons.

Role of private actors (SpaceX, OneWeb, Blue Origin)

While the Outer Space Treaty (1967) vests primary responsibility for space activities with states, Article VI makes clear that non-governmental entities—including private corporations—may engage in outer space activities, provided that states authorize and continuously supervise their operations. This provision has become increasingly relevant in the 21st century as commercial actors dominate low Earth orbit (LEO), where the space debris problem is most acute.

SpaceX (Starlink)

SpaceX operates the world's largest satellite constellation through its Starlink program, which as of 2025 has deployed over 5,500 active satellites in LEO. While the system provides global broadband connectivity, its sheer scale intensifies orbital congestion. SpaceX has attempted to mitigate debris concerns by designing satellites with low-orbit lifespans (~550 km) so that failed satellites deorbit naturally within ~5 years due to atmospheric drag, in compliance with the U.S. FCC's updated 5-year disposal rule (2022). Moreover, the company has developed autonomous collision-avoidance systems, leveraging U.S. Space Command conjunction data. However, incidents in 2021 and 2022 where Starlink satellites conducted thousands of avoidance maneuvers raised questions about sustainability and coordination with other operators such as the European Space Agency (ESA).

OneWeb

OneWeb, backed by the UK government and Bharti Global, has pursued a constellation of over 600 satellites at ~1,200 km altitude—where debris lifetimes are significantly longer (decades to centuries). Although the constellation is smaller than Starlink, its higher orbit magnifies long-term debris risks. OneWeb satellites are equipped with onboard propulsion for deorbiting and adhere to Inter-Agency Space Debris Coordination Committee (IADC) guidelines, but concerns persist regarding "mega-constellation competition." Unlike SpaceX, which uses low orbits to allow natural reentry, OneWeb's choice of higher altitudes may exacerbate congestion if deorbit systems fail.

Blue Origin (Kuiper Project)

Blue Origin's Project Kuiper, supported by Amazon, has been licensed by the FCC to deploy over 3,200 satellites in LEO. Like SpaceX, Kuiper plans to operate in lower orbital shells (590–630 km), with design-for-demise features to minimize debris persistence. The FCC requires Kuiper to submit regular debris-mitigation plans, including collision-avoidance protocols and reliability thresholds for deorbit systems. Blue Origin has also partnered with NASA's Orbital Debris Program to explore active debris removal (ADR) technologies and supports international efforts to develop a UN-led Space Traffic Management regime.

Equity Concerns: Access to Space for Developing Nations

The rapid proliferation of satellites, particularly through mega-constellations launched by private companies, has raised pressing concerns about equitable access to outer space. Article I of the Outer Space Treaty (1967) declares that outer space shall be "the province of all humankind" and that exploration and use must be carried out "for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development." In practice, however, access is increasingly skewed in favor of technologically advanced states and private corporations with vast resources.

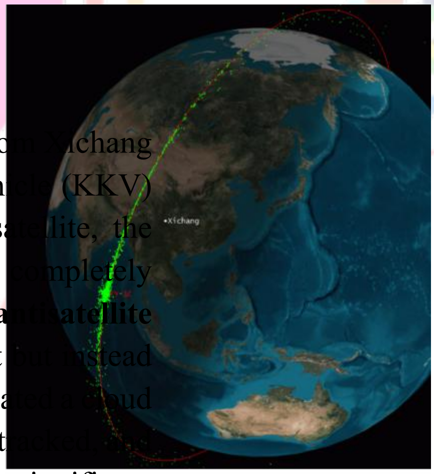
The dominance of actors like SpaceX (over 5,500 active satellites in 2025) and OneWeb has led to the occupation of prime orbital slots and radio-frequency spectrum, particularly in low Earth orbit (LEO). This creates a form of "orbital enclosure," where developing nations face diminishing opportunities to launch their own satellites without collision risks or interference. Spectrum management is another critical issue: as frequencies become saturated, smaller states risk being permanently sidelined.

The principle of equitable access has been reinforced in UN resolutions such as UNGA Resolution 1962 (1963) and the Declaration on International Cooperation in the Exploration and Use of Outer Space (1996), which stress fairness in allocation of benefits. Yet, in reality, regulatory regimes often operate on a “first-come, first-served” basis, disproportionately benefiting wealthier nations and corporations. This imbalance risks deepening global inequalities, as developing countries increasingly depend on foreign satellite services rather than developing their own space capabilities.

A sustainable legal framework for debris mitigation must therefore account not only for environmental and safety concerns but also for inclusivity—ensuring that orbital commons are not monopolized. Proposals include: setting aside orbital slots for emerging space nations, capacity-building programs led by UNOOSA, and binding commitments from major spacefaring states to avoid practices that restrict equitable access.

IX. Case Studies

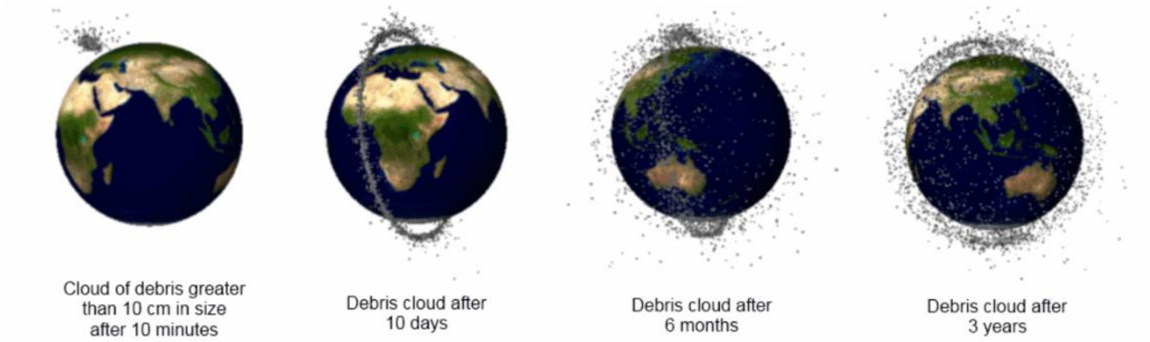
2007 Chinese ASAT test



Simulation of the ASAT test 5 minute after impact [1]

On January 11, 2007, China launched a ballistic missile from Xichang Space Launch Center. The payload was a kinetic kill vehicle (KKV) that collided with a non-operational Chinese weather satellite, the Fengyun-1C (FY-1C), at an altitude of 863 km (534 mi), completely destroying the satellite. This is known as a direct ascent **anti-satellite (ASAT) attack**, where the KKV does not enter into orbit but instead travels through space on a ballistic arc. The destruction created a cloud of more than 3,000 pieces of space debris, the largest ever tracked, and much of it will remain in orbit for decades, posing a significant collision threat to other space objects in Low Earth Orbit (LEO).

The KKV collided with the FY-1C at a relative velocity of over 32,400 km/hr. Although there were no explosives on board the KKV, the force of the impact completely destroyed the satellite. In hypervelocity impacts such as this ASAT test, normally solid objects behave like liquids. Thus, the FY-1C and KKV effectively passed through each other, and the resulting cloud of debris fragments from each object continued largely in the same direction and velocity as before. Within minutes after the collision, the debris cloud started to spread around the satellite's original orbit. Ten days after the ASAT test, the debris had spread throughout the entire orbit, resulting in a "ring" of debris around the Earth. Three years after the test, the debris has spread out even more, effectively covering much of LEO. As of mid-September, 2010, the U.S. military's Space Surveillance Network (SSN) has tracked a total of 3,037 pieces of debris from this event, 97% of which have remained in orbit. Scientists estimate more than 32,000 smaller pieces from the event are currently untracked. The debris from the destruction of the FY-1C currently spreads from altitude as low as 175 km and as high as 3,600 km. This is the largest debris cloud ever generated by a single event in orbit.



Evolution of the debris cloud from a kinetic kill ASAT attack[9]

2009 Iridium-Kosmos collision

On 10 February 2009, operational Iridium-33 (≈560 kg) and defunct Kosmos-2251 (≈900 kg) collided at ~790 km over Siberia—the first known accidental, hypervelocity satellite-satellite collision. The impact produced >1,800 cataloged fragments (>10 cm) across the two orbital planes, instantly adding roughly 10% to the tracked debris population at the time. NASA analyses projected that while enhanced solar activity would eventually de-orbit some fragments, a significant portion would persist for years to decades, periodically threatening spacecraft traversing popular LEO shells. The event validated long-standing models predicting increased collision probability in dense orbital regimes and accelerated industry and governmental investment in conjunction screening, maneuver automation, and data-sharing. It also exposed systemic governance gaps: no binding global Space Traffic Management regime, uneven adoption of end-of-life disposal rules, and unclear liabilities when an active satellite is struck by a derelict from another state. In subsequent years, debris counts and breakup events reflected the lasting signature of Iridium-Cosmos in the catalog, reinforcing the need for coordinated standards and real-time data exchanges to prevent repeat accidents.

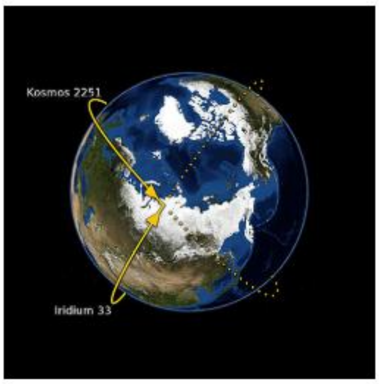
Kosmos 2251 was a Russian Strela military communications satellite owned by the Russian Space Forces. Kosmos 2251 was launched on a Russian Cosmos-3M carrier rocket on June 16, 1993. This satellite had been deactivated prior to the collision, and remained in orbit as space debris. The other spacecraft, Iridium

33, was a U.S.-built commercial satellite that was part of the Iridium constellation for satellite phones. It was launched on September 14, 1997, atop a Russian Proton rocket.

NASA, the U.S. space agency, initially estimated ten days after the collision that the satellite space incident had created at least 1,000 pieces of debris larger than 10 cm (4 in), in addition to many smaller ones. By July 2011, the U.S. Space Surveillance Network had catalogued over 2000 large debris fragments from the collision. NASA determined the risk to the International Space Station, which orbits about 430 kilometres (270 mi) below the collision course, to be low, as was any threat to the shuttle launch (STS-119) then planned for late February 2009. However, Chinese scientists have said that the debris does pose a threat to Chinese satellites in Sun-synchronous orbits, and the ISS did have to perform an avoidance maneuver due to collision debris in March 2011.

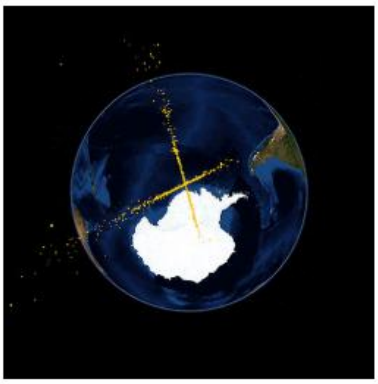
By December 2011, many smaller pieces of the debris were in an observable orbital decay towards Earth, and were expected to burn up in the atmosphere within one to two years. In 2016, Space News listed the collision as the second-biggest fragmentation event in history, with Kosmos-2251 and Iridium 33 producing, respectively, 1,668 and 628 pieces of catalogued debris, of which 1,141 and 364 pieces of tracked debris remained in orbit as of January 2016. In 2024, 15 years after the collision, the U.S. Space Surveillance Catalog listed 916 and 212 pieces of debris still in orbit, respectively.

This collision and numerous near-misses have renewed calls for mandatory disposal of defunct satellites (typically by deorbiting them, or at minimum, sending them to a graveyard orbit), but no such international law exists as of 2024. Nevertheless, some countries have adopted such a law domestically, such as France in December 2010. The United States Federal Communications Commission (FCC) requires all geostationary satellites launched after March 18, 2002 to commit to moving to a graveyard orbit at the end of their operational life.



Point of collision

Debris fields after 20 minutes



Debris fields after 50 minutes

X. Focus Questions

1. What is the current legal and regulatory framework for space debris mitigation? How do national space agencies and international organizations cooperate to manage space debris?

2. What are the key technological and policy challenges in active debris removal?

3. How can the legal concept of state liability be applied to private companies and their space debris? How can liability for debris-caused damage be shared between launching states and private actors?

4. What new international agreements or treaties are being proposed to address the growing space debris problem? Should the UN adopt a binding international treaty on space debris mitigation? If yes, how enforceable?

5. How can developing states be supported to access space safely while debris risks grow?

6. How can military actions (like ASAT tests) be addressed under international law to prevent debris creation?

XI. List of Valid Sources

1. United Nations Digital Library
2. UN Official Website
3. UN Organs' Websites
4. Past UN Resolutions
5. Government Websites of various Countries