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Communication Satellites, a Place with no Rules: The Beginners Guide

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Communication Satellites, a Place with no Rules: The Beginners Guide

Will the satellites bringing us better forms of communication live in a war zone? Or in a junk yard? Will they exist in an area with no rules? It has the potential for both riches (both scientific and commercial) and tragedy.

Many communication satellites are located in Low Earth Orbit (LEO) at about 1000 km above the earth, but some can be as low as 160 km. Other communications satellites are in Geosynchronous Orbit (GEO) when the satellite orbits in the same way the earth rotates and stays above the earth at the same spot.

The rush into space leaves a number of questions unanswered – questions that will have serious consequences. Who is going to clean up the debris that is orbiting around the planet? What happens if your space vehicle hits another space vehicle? Are satellites weapons?

Nobody knows.

And this is the last time anyone will even ask, “Who gets to put up communication satellites in which slots?” In a few years it will be too late. It is hard to take back a satellite slot – short of a war. If there is no agreement on these things the company (or its country) with the biggest lasers (they are already up in there) will decide. But before that happens, maybe somebody can agree on the rules of the road.

United Nations Treaties for Space

The United Nations has enacted several treaties but the number of countries who signed on gets smaller all time. There is an increasing fear that space policy looks more like the old Cold War and countries divide up into camps. The hard part is that there is no way to punish countries and companies who do bad things. And the treaties from the mid 20th Century do not anticipate commercial space ventures. The UN has an Outer Space Committee but it has been unable to come up with any rules that all members can agree to.ⁱ

Below are the treaties promulgated by the United Nations and the number of countries who signed on:

Outer Space Treaty 1967 ⁱⁱ	111
Rescue Agreement 1968 ⁱⁱⁱ	98
Liability Convention 1972 ^{iv}	98
Registration Convention 1975 ^v	70
Moon Agreement 1979 ^{vi}	18

The “somebody who can agree” on space rules might not be United Nations. The UN is made up of countries. The people going into space are countries *and* companies. And even for countries, the UN has become problematic. For now, space pioneers are still looking for a place that avoids local politics and accommodates both companies as well as countries.

In the old days, there was no doubt about many of these questions when governments were in charge. For most of mankind’s time in space, treaties were developed by the United Nations that were signed off by on by the respective spacefaring nations (and others) to the effect that space would only be used for peaceful purposes (lately, not so much).

Since 1957, when the USSR launched Sputnik, governments financed space adventures. Sputnik was the immediate motivation for the US to ramp up the program that would take it to the moon and convince other nations it was the most technically advanced cold warrior.

But an odd thing happened when, for a time, Russia, the US, and other countries began to cooperate in space. They began to imagine a Space Station that would gather all kinds of information and it would be available to everyone. This included things like mapping the earth’s magnetic field, and weather forecasting.

The cooperating governments would then send people to live on the International Space Station (ISS). And the people who were in charge on earth were from those governments. They all learned to work together. Former NASA administrator, Sean O’Keefe, said governments had a common objective for the ISS: the safety of the people there and their missions. “It was independent of politics and it worked pretty well in space. There were some culturally influenced things but not politics. We were looking at acquiring capabilities not assets.”^{vii}

Governments are still definitely not out of the picture. They are still where the money is. Companies who send up cargo to the International Space Station often use the big private launch companies such as Northrup Grummen, SpaceX, and Orbital. So, at least for the moment, these big launch companies are paid with tax dollars. Both large and small launch firms receive government-funded research.

But any rules for an ungovernable space involves both countries and companies so, at the moment, agreement seems to be fragile. There are numerous committees with representatives from various militaries, space agencies, companies, and academics to discuss almost everything. All with the very best intentions, but without authority.

Space may be a new thing, but we can learn something about other ungoverned places like the sea and the air that surrounds the planet. Looking up, space is like a very, very big ocean. There is no opposite shore and, seen from here, just lots of islands. Some of the technical problems may not be exact but the list problems to consider from port controls, liability for accidents, and pollution are worth consideration now.

The ungovernable places

Imagine the boundless sea. It gave the explorers who set out in wooden ships the sense of no borders and no restrictions. A place ungoverned by kings. Even today, vast areas of the world’s ocean are ungoverned and outside any country’s offshore limits. It was not until 1982 that the US ratified the United Nations Convention on the Law of the Sea and declared its sovereignty to be twelve nautical miles from the low-water line along the coast. A country can also control (it is not sovereign territory) another 200 nautical miles for EEZ (Exclusive Economic

Zones) to enforce their exclusive rights to fisheries, minerals, and sea-floor deposits. "Innocent passage" is permitted through both territorial waters and the EEZ (even by military vessels) provided they do no harm to the country or break any of its laws.

There is no international agreement on how high up a nation's sovereignty goes. Some countries assert governance to about 30 km (19 miles)—the extent of the highest aircraft and balloons. Other countries claim about 160 km (99 miles)—the lowest range of short-term stable orbits for LEO's. The Fédération Aéronautique Internationale has established the Kármán line—at an altitude of 100 km as the boundary between the Earth's atmosphere and outer space. The United States considers anyone who has flown above 80 kilometres (to be an astronaut but descending space shuttles have flown closer than 80 km over other nations, such as Canada, without requesting permission first. Nonetheless, both the Kármán line and the U.S. definition are merely working benchmarks, without any real legal authority over how high is national sovereignty. Sovereign air space for passenger jets extends to 12 nautical miles beyond the coastline – just like the line for the sea. For aircraft, a UN treaty handles everything outside a country's jurisdiction.

The ships who sail the ungoverned sea leave from a home port. The law of that home port is their law for things like how they treat their crew and how they repair the ship. Many cargo vessels fly "flags of convenience." Investors in one country own them but they fly the flag of another country. So the countries of the flags of convenience control for things like pollution, ship safety, and labor laws which would be illegal in most of the developing world. All this re-flagging happened in the early days of World War II so that ships carrying goods from the US to Europe were flagged in Panama to maintain the appearance of US neutrality. But by the end of the War the advantage of Flags of Convenience were obvious: you could escape the high cost of regulation of all kinds.

Traffic Control

Who handles the traffic in space? The UN's International Maritime Organization is responsible for publishing the International Code of Signals for use on the sea between vessels.

Although the International Civil Aviation Organization (another UN agency) has a similar responsibility for collisions during air travel, both Europe and the US (and the companies there) have been unwilling get involved in a UN process for space collisions they see this process as long and expensive. But many see space collisions as inevitable.

To avoid collisions means you know where things are in space. This is called space situational awareness (SSA). The U.S. Department of Defense has the lead in tracking space traffic but for several years it has wanted to give somebody else responsibility for warning commercial and international satellite operators of potential collisions.

Collision in the air and in space are both called “deconfliction” (smashing into each other). At the moment, we are generally talking about satellites deconflicting but the launches themselves could be next. Satellites are now changing their paths to avoid collisions. For example, in 2019 the European Space Agency diverted a satellite to avoid a collision with a SpaceX satellite. The ESA spokesperson said, “... this example does show the urgent need for proper space traffic management, with clear communication protocols and more automation.”^{viii}The ESA plans to automate these deconflict situations by using artificial intelligence that would automatically change orbits and limit the coordination between the satellite’s owners.

Several groups attempting to deal with collision control and craft safety are starting to think about this. These include: the International Code of Conduct for Outer Space Activities (by the Secure World Foundation); a data center with info on what is up there and how to avoid it called the Commercial Space Operations Center (by Analytical Graphics); The Consortium for Execution of Rendezvous and Servicing Operations; International Association for Space Safety. All are groups with really good intentions, but they have given the potentially deconflicted parties only possible standards, guidelines and best practices.

In 2020, the Center for Strategic and International Studies (CSIS) and the Secure World Foundation (SWF) released separate reports that raised alarm about the lack of traffic management in space. The CSIS lists “four Ds”: space is more *diverse*, with more countries and

companies using space; these new entrants are *disruptive* in terms of who is using space and how; therefore space is becoming more *disordered*, with a lack of accepted norms and gaps in laws and treaties; and more *dangerous*, with “juicy” U.S. satellites that are vulnerable and a proliferation of counterspace capabilities (i.e., the ability to engage in space warfare).^{ix}

In addition to agreement about traffic management, other possible port controls we could get from the earth’s sea and the air might include policing contraband for things like life forms (from the earth and other places) and illegally mined minerals. Another decision that will be critical to some of the space companies is whether a vessel is a common carrier. If it launches from port “A” must it automatically go back there or can it go to other places, like planes who leave from one airport and go to another airport. The common carrier label would almost certainly require a lot more regulation.

A regulator that “everybody could agree on.” Not today.

Port controls taken from the ungoverned sea and air might suggests that somebody considers: Flags of Convenience, signals for collision avoidance, contraband policing, and vessels as common carriers. What we do *not* know is who is going to consider this and who has the authority to make these rules stick. We can’t even agree on the mess that is already up there.

Pollution in the ungoverned

The world’s oceans contain many forms of pollution that were caused by mankind, but, because it is in international waters, no one will take responsibility to clean it up. Some of it floats in vast mats that move with the ocean currents. Even now, pollution is happening in space, particularly in LEO.

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.^x

Most people call it Space Junk. It is pollution. It refers to the debris from artificially created objects in space, like defunct satellites or pieces of them. NASA's web page says, "There are more than 20,000 pieces of debris larger than a softball orbiting the Earth. They travel at speeds up to 17,500 mph, fast enough for a relatively small piece of orbital debris to damage a satellite or a spacecraft. There are 500,000 pieces of debris the size of a marble or larger. There are many millions of pieces of debris that are so small they can't be tracked."

Several times every year, the International Space Station maneuvers to avoid a potentially catastrophic collision with space junk. The US is responsible for the most debris in space, followed by Russia and China.

So, who will clean it up?

Well, nobody really knows. There are some "guidelines" in place that will require any launching country to oblige new satellites to have plans that will make them fall back to earth when their life expectancy is done, known as End of Life (EOL) disposal. That does not help all the junk up there now. And it does not help any launch country that does not agree to these guidelines.^{xi} Most of the junk will fall back to earth and burn up – eventually. Except the International Space Station which of course is way too big. So, they plan to cut it up into pieces but big enough to come down in pieces. Maybe in 10 years.

All this is to prevent a scenario known as the Kessler Syndrome: when so much stuff is in space, one collision leads to several others, and those crashes lead to even more — littering space with so much debris that it becomes incredibly risky to leave Earth. But is it years away? Tim Flohrer, Senior Space Debris Monitoring Analyst, at the European Space Agency, says, "In some regions we see indications that it may already have started." He thinks it may be a little like climate change. "Some people are not seeing it happening now, so..."^{xii}

There are more than 2,000 active satellites orbiting Earth in Low Earth Orbit (LEO). It is believed that this may increase to 8000 in the coming years. They will provide internet and digital service to remote areas of the world. SpaceX will launch thousands of satellites to beam broadband around the globe and has been used in the war in Ukraine. These are large dinner table-size satellites, each weighing over 500 pounds. When they reach space, they extend a large solar panel for power. This can only significantly increase the risk of collisions and ultimately of more space junk. In January of 2020, two satellites came very close to collision over Pittsburg, Pennsylvania (USA), and that would have given space junk a big increase in an orbit where many satellites are working.

While governments say they are worried about the space junk hazard, the focus has been on funding private efforts to design some sort of practical solution. There are companies who want to corral the junk and send them back to disintegrate when they reenter the atmosphere but (and it is a very big *but*) the international law says you cannot easily touch another country's satellite. Some have proposed a treaty that allows for the salvage of inoperable satellites. This would be like the salvage of derelict ships in the ocean, but satellites may have technology that the owner may not want anyone else to have - even if it is not working.

Japan's space agency has been in discussion with a 100-year-old maker of fishing nets to develop a wire mesh that could fling debris out of harm's way. Other international efforts include a sweep, a lasso and a harpoon that will gather up debris. But nothing looks workable any time soon. For a larger piece of junk, The European Space Agency has approved a demonstration funding for a vehicle that will go into space, track down an inoperable European satellite, grab it, and both will then dive back into the atmosphere where they will burn up. Expensive, but may be effective for the bigger junks.

What about the big geostationary satellites (GEO's) that are also used for telecommunications? They are many, many miles above the junk layer, over 22,000 miles. When their useful life is done they are sent into a "graveyard orbit" where they will be out of

the way for so long nobody here even thinks about it. The companies who originally put them up are putting them in the graveyard orbit so as not to litter the geostationary orbit. Some governments mention this in their guidelines for the satellites and others have made this a national law. Depending on where the satellite was launched from. Other companies just do it.

Space Junk may not be the only space pollution. Space launches can have significant carbon emissions if the rocket is burning solid rocket fuels. But many rockets are propelled by liquid hydrogen fuel, which produces 'clean' water vapor exhaust. On the other hand, the initial production of the hydrogen itself can cause significant carbon emissions. Rocket engines release trace gases and soot into the upper atmosphere that contribute, in some part, to ozone depletion. But, you guessed it, nobody really knows what the effects are and what they will be when launches are increased.

Are satellites weapons?

Yes, some of them definitely are. The US has begun the newest branch of military service called Space Force to defend activities in space. Their mission is not always safety patrol. In a February 2020, Lt. Gen. David Thompson, U.S. Space Force vice commander told a Pentagon news conference that there is an "increasing challenge and threat to our use of that domain by potential adversaries." He said that, "They are fielding weapons systems. They have communicated the intent to take our use of space away from us in conflict." Satellites could be destroyed with a land-based weapons pointed their way but also with spaced-based electronic weapons that will make them useless.

Current military tactics include spying on spy satellites. On January 2020, a Russian satellite was closely shadowing a US spy satellite but there is not much the US can do about it. International law says no one can touch another country's satellites, but not that you can't park close by. Of course, hackers do not see themselves as subject to International law. So they may be able to shut down, spoof (send wrong information), or even move a satellite onto a collision course with other debris up there (more space junk). In its 2020 report, the Secure World

Foundation,^{xiii} compares where various countries stand in the development of five types of counterspace systems: direct-ascent or co-orbital kinetic antisatellite systems in different orbits, electronic warfare, directed energy, or cyber. Each country is ranked in terms of whether such systems are in research and development (R&D), testing, operational, or used in conflict. But “only non-kinetic (things that do not go “boom”) capabilities are actively being used in current military operations.”

International laws say space must be used for peaceful purposes, but it is, undoubtedly, the new battlespace.

Conclusion

There are a number of ways “someone” will make the decisions discussed here.

- First, and what’s more likely, we just let it happen. The space companies and countries would set up something often called a “regime” that gradually comes to some understandings. Reinsurance companies will evaluate the risks (if possible) and other risks will be handled by investors or taxpayers.
- Organization of the space faring companies and nations could come together to decide things they can all agree on like port controls and deconflicting. Or they could have separate organizations for companies and countries with diplomatic ties.
- The space faring nations decide their company’s need property *ownership* and ignore the Space Treaty. This could mean some peaceful division of things like orbital slots for LEO’s, or some less-peaceful divisions.

So, as if the earth is not facing its own problems, now there is space. A vast, ungoverned place that lures politicians, the wealthy, and investors to look for something of great benefit there. Like the seafaring explorers before them, they may be happy with no rules now, but sooner or later the safety of some rules will be oblivious.

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- ⁱ W. Henry Lambright, ed., *Space Policy and the 21st Century*, Johns Hopkins University Press, Baltimore and London, p. 95
- ⁱⁱ Outer Space Treaty, <https://history.nasa.gov/printFriendly/1967treaty.html>
- ⁱⁱⁱ <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/rescueagreement.html>
- ^{iv} <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html>
- ^v <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html>
- ^{vi} <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html>
- ^{vii} Interview with author December 2022
- ^{viii} [ESA spacecraft dodges potential collision with Starlink satellite - SpaceNews](#), September 3, 2019.
- ^{ix} [Space Situational Awareness and Space Traffic Management Coordination Among US Agencies - Aerospace Security \(csis.org\)](#) November 17, 2020.
- ^x <https://www.nasa.gov/headquarters/library/find/bibliographies/space-debris/>
- ^{xi} United Nations Office for Outer Space Affairs (2010). "[Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space](#)". *Inter-Agency Space Debris Coordination Committee (IADC)*. Retrieved 19 October 2021.
- ^{xii} Interview with the author November 2022.
- ^{xiii} [Space Threat Assessment 2020 \(researchgate.net\)](#), SEE ALSO, [Global Counterspace Capabilities Report | Secure World \(swfound.org\)](#), 2023.