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Bridging the "Space Divide": International Politics and Addressing Inequities in NGSO Satellite Governance for Developing Countries

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Bridging the “Space Divide”: International Politics and Addressing Inequities in NGSO Satellite Governance for Developing Countries

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Abstract

Generally, a hegemon refers to a country or a group of countries that possesses hegemony, exerting influence over others by promoting its norms or values and dominating the international system. Nonetheless, there appears to be no single actor with absolute dominance in the space domain. Therefore, this study focuses on regional hegemons: the U.S., China, and Europe. On one hand, the U.S. and China are clear examples of regional hegemons, the former a leading Western power, the latter a major Eastern power. According to ESPI, both are considered space powers due to their strong capabilities and autonomy in space activities. On the other hand, while Europe is classified by ESPI as a spacefaring nation, this study treats it as a regional hegemon because of its significant space presence and its ability to secure orbital resources.

Keywords: Space Divide, Hegemonic Stability, Asymmetry of Power, Space Governance, Developing Countries

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1. Introduction

Geopolitical competition, in both security and space presence, boosts technological advancement and intensifies rivalry over space resources, i.e. orbits and spectrum. This study examines the space competition among regional hegemonies, including the United States (U.S.), China, and Europe, focusing on the occupation of space orbits and spectrum. While the U.S. has been developing space technology and occupying a large share of space resources, China protects itself and its region from American influence and seeks to claim a prominent status in space, as its ambitions are reflected in the 2022 White Paper. As for Europe, it focuses on increasing regional autonomy by designating space as a strategic domain for security and defense, and by developing its own space technologies to reduce dependence on foreign systems.

The “First Come, First Served” (FCFS) approach for non-geostationary orbit (NGSO) assignment, adopted by the International Telecommunication Union (ITU), primarily benefits space powers, mostly developed countries, and justifies their actions to occupy a large share of resources, which could harm the space environment and its sustainability. To illustrate, NGSO orbits may become saturated due to satellite constellations launched by developed countries, which would hinder latecomers, mostly developing countries, from equitably accessing these resources. As a result, developing countries may be unfairly excluded from access, deepening the space divide — the growing disparity between nations with strong and those with limited space presence.

In the academic literature, despite discussions on issues regarding space resource allocation, governance, and the occupation of space resources by major powers, the underlying political drivers are rarely mentioned. Additionally, recommendations for revising the global mechanisms that perpetuate inequities remain limited. This study aims to fill this gap in the literature by identifying political drivers behind the current system, using Hegemonic Stability Theory (HST) to explain the barriers that hinder developing countries from gaining equitable access to space resources. The research question is: How do the actions of developed countries and the FCFS framework for NGSO resources lead to inequities for developing countries, and what alternative approaches could promote equity?

The study aims to illustrate that the FCFS approach and the actions of space powers, including the U.S., China, and Europe, cause developing countries to face challenges in accessing and using orbits and spectrum equitably. It also suggests identifying capacity limits and applying a reserve-based approach to allocate orbits and spectrum by considering the “Orbital Carrying Capacity.” This could ensure fair use, enhance the capacity of developing countries to utilize these resources, and promote sustainability in space.

This paper is organized as follows: section 2 reviews the literature on orbits and spectrum allocation, Hegemonic Stability Theory, and current space governance. Section 3 examines how developed countries create barriers for developing countries to equitably accessing NGSO orbits, from a Hegemonic Stability Theory perspective. Section 4 concludes the paper and recommends reforms for the global space approach, including defining NGSO capacity limits, and using a reserve-based approach for NGSO orbits for all nations as a primary framework, along with allocating the remaining resources under the FCFS framework.

2. Literature Review

This section reviews the related literature on space resource allocation, the perspective of hegemony, and space governance, which creates obstacles for developing countries as latecomers in equitably accessing space resources. It consists of the following subsections:

(2.1) Spectrum and Orbit Allocation, (2.2) Hegemonic Stability Theory, and (2.3) Current Space Governance

2.1 Spectrum and Orbit Allocation

Both orbits and spectrum are finite resources. Undseth, Jolly, and Olivari (2020) described them as resources that are accessible to many users with few restrictions, but the use by one party can naturally reduce the ability of others to use them. Their characteristic is also broadly acknowledged by the United Nations (UN), European Space Agency (ESA), as well as the ITU, as reflected in Article 44 of its Constitution and No. 0.3 of the Preamble to the Radio Regulations.

The World Radiocommunication Conferences (WRC) serve as the international arena for consideration of proposals regarding the use of the radio frequency spectrum, satellite orbits, and the review of related regulations. These proposals are submitted by subsectors under the ITU, such as the Radiocommunication Assembly, the Radio Regulations Board, and ITU member countries. The outcomes of the conferences are concluded in the Final Acts and result in revisions to the Radio Regulations, which are considered international law and are binding on member countries. At the recent WRC-23, many of the agenda items focused on the use of spectrum for NGSO satellites. The conference also included a suggestion to review the current rules on Equivalent Power Flux Density (EPFD), which could lead to regulatory changes in the future. Additionally, for the upcoming WRC-27, there are relevant agenda items, including agenda item 1.6, which addresses technical and regulatory considerations for high-frequency bands such as 37.5–42.5 GHz, 42.5–43.5 GHz, and 50.4–51.4 GHz, with the aim of creating equitable access to spectrum in accordance with Resolution 131. Agenda item 1.10 focuses on considerations regarding flux density and equivalent isotropically radiated power (EIRP) limits for inclusion in Article 21 of the Radio Regulations, to protect fixed and mobile services.

In the past, orbits and spectrum allocation were major debates, and geostationary orbit (GSO) was the main focus due to its special characteristics, its position above the equator, and its scarcity. This led to conflicts related to geopolitics, economics, and technological readiness among the Global North, the Global South, and Non-Aligned Countries (NACs). The FCFS approach was initially proposed for GSO allocation at the 1971 World Administrative Radio Conference (WARC) on Space Telecommunications; however, due to objections from NACs, it was rejected. Later, the Plenipotentiary Conference adopted the principles of equitable, effective, and economical use as the core of resource allocation and formally recognized orbits and spectrum as finite resources. During the mid-1970s, Less Developed Countries (LDCs) increased pressure by advocating for more equitable allocation and distribution of space resources. One crucial movement from the LDCs was the Bogota Declaration of 1976, proposed by eight equatorial countries; nonetheless, it was rejected due to objections from major countries. The main reason for the opposition was that orbits and spectrum are considered common property under the 1967 Outer Space Treaty (OST), which states that outer space shall be free from sovereignty claims.

Space resources allocation for GSO was also considered at WARC-79 through the Sixth Committee. The committee established an ad hoc working group to consider related proposals. Amidst the ongoing discussion, there was significant conflict between the Global North and the Global South. The NACs, led by India, suggested *a priori* planned allocation and pushed for a dedicated meeting on the issue. On the contrary, developed countries, led by the U.S. and the United Kingdom (U.K.), proposed an evolutionary, flexible approach. Eventually, after a

5-year delay caused by developed countries, the ad hoc working group decided to adopt *a priori* planned allocation in 1984.

Currently, spectrum allocation for GSO is defined in detail by regions in Appendix 30 of the Radio Regulations. These spectrum bands are designated for the GSO broadcasting-satellite service. Article 3.3 of the Radio Regulations states that spectrum band plan in Regions 1 and 3 is considered on the basis of national coverage in order to promote long-term flexibility and prevent monopolization of the planned bands and orbit by a small number of players.

For NGSO, the assignment follows Articles 9 and 11 of the Radio Regulations, under which the ITU applies a “Coordination Approach” or the FCFS framework to consider applications for satellites destined for NGSO orbits. Prior to launching a satellite system, NGSO operators are obligated to complete spectrum coordination with existing networks to prevent harmful interference.

Nonetheless, some scholars consider the FCFS approach to be a driving factor behind the rapid expansion of NGSO satellite systems in recent years, arguing that it benefits countries with technological readiness in space by allowing them to occupy space resources. Consequently, it leads to inequitable access to space resources among developed and developing countries. Giri and Hiebert (2024) argued that the formation of astropolitical blocs diminishes developing countries’ ability to access space, and the occupation of a large share of space resources by space powers is increasing orbit congestion and the risk of harmful interference. Thus, space governance should be revised and the FCFS approach should be abolished to ensure opportunities for developing countries in space.

Besides, there are related studies, such as Patton (2022), who adopts “2X2 Matrix of Rivalry and Excludability” to explain the characteristics of space resources (Figure 1) and finds that Low Earth Orbit (LEO), which is part of NGSO, and radio frequency are common pool resources, meaning they are non-excludable and accessible to all. Therefore, freely exploiting them could lead to the “Tragedy of the Commons,” a scenario in which no one can use the resources anymore because they are overused beyond their capacity. Exarchou (2022) states that the consequences of resource overconsumption affect everyone. The Tragedy of the Commons also relates to issues such as "unregulated access" and "abuse of state sovereignty privileges." Additionally, Chow and Weeden (2012) referred to Ostrom’s work, which proposes Adaptive Governance to resolve conflicts over space resources, which are common pool resources. Through Adaptive Governance, all rules, regulations, norms, and mechanisms are flexible and can be adjusted to fit the context and ensure the overall benefit of all.



Figure 1 Metrix comparing characteristics of spectrum and orbits¹

¹ Note. Adapted From “Is Space a Global Commons?,” by Patton, D., December 2022, Secure World Foundation.

2.2 Hegemonic Stability Theory

Hegemonic Stability Theory (HST) is associated with the concept of “Hegemony” and is used to explain international politics, focusing on the “state” as the main actor. In the international system, since all states possess sovereignty, there is no overarching authority. Therefore, the international system is described as anarchic. To protect themselves from potential external threats, such as invasion by more powerful states, all states seek hegemony by intensively gaining power through advancements in weaponry, military, and technology. However, only the most powerful state can achieve hegemony. Power can be classified into two types: (1) Hard Power or Coercive Power, such as military power and economic strength; and (2) Soft Power or Persuasive Power, which influences and guides others in decision-making or belief formation. The level of power is also related to the level of state capacity and resource concentration. In other words, the more resources a state possesses, the greater its capacity, and the more feasible it is to achieve hegemony (Keohane, 1989, as cited in Dirzauskaite and Ilinca, 2017). Still, to identify hegemony, Soft Power is more crucial than Hard Power because it is based on consent rather than coercion. For instance, hegemony arising from a community's need for security is more legitimate than hegemony imposed through military force (Brilmayer, 1994, as cited in Dirzauskaite and Ilinca, 2017). Nowadays, many states apply both Hard Power and Soft Power, which Hillary Clinton calls “Smart Power,” in their national strategy to enhance their power, as in the case of Turkey.²

The studies of Dirzauskaite and Ilinca (2017), and Walter (1996), demonstrate the concept of hegemony through the perspectives of neo-realism and neo-liberalism. Additionally, Dirzauskaite and Ilinca examine hegemony from a neo-Gramscian perspective, as stated below:

(1) Both neo-realism and neo-liberalism recognize the anarchic structure of the international system, meaning there is no central authority above states, leading to disorder and unequal power among them. The difference is that neo-realism views this as the reason for states to pursue security and defense in their own interests. From this perspective, a hegemon compels others to adapt to its needs. When the hegemon begins to lose power, the international system it established is likely to collapse as well. On the contrary, neo-liberalism argues that despite disorder, all states can cooperate through trust and systems, such as regulations, mechanisms, and organizations, to maintain peace and serve the interests of all. It is worth noting that whether the hegemon remains or not, these mechanisms and systems can continue to function. Furthermore, a hegemon is considered necessary for providing public goods, as it has the comparative capacity to bear their cost.

(2) Neo-Gramscianism highlights that relationships are built on consent, which is the basis of hegemony. It is a combination of Hard Power and Soft Power. Hegemony is not just about establishing a new world order, but also includes ideas, practices, culture, and structures that are widely accepted, such as social and political ideologies and economic systems (Cox, 1996, as cited in Dirzauskaite and Ilinca, 2017). The dynamics of power are illustrated in Cox's Three Forces Model, shown in Figure 2, which demonstrates three forces—social forces, forms of state, and world orders—that interact with one another and contribute power to the state. Among these, social forces are the most essential, as they are the source of consent arising from persuasion. From the neo-Gramscian perspective, imposing power without others' support cannot establish hegemony. Therefore, cultural leadership is no less

² See. **Sari, B., & Sula, I. E.** (2014, March). *An analysis on the concept of smart power: Its application on Turkish foreign policy*. Paper presented at the ISA Annual Convention, Toronto, Canada.
https://www.researchgate.net/publication/329103846_An_Analysis_on_the_Concept_of_Smart_Power_Its_Application_on_Turkish_Foreign_Policy

important than economic or military leadership. Moreover, states form organizations in order to set the rules and legitimize themselves.

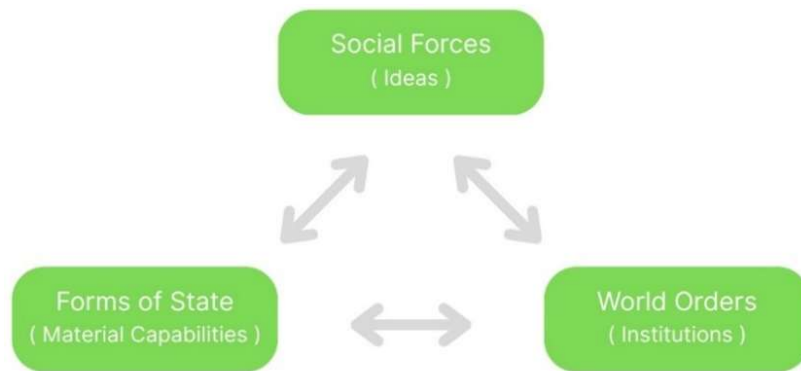


Figure 1 Cox's Three Forces Model³

There is an actor in the international community that has systematically and institutionally established systems, organizations, mechanisms, and regulations (Hansclever et al, 1997; Baldwin, 1993; Jackson and Sorensen, 2003, as cited in Talibu et al., 2023) to secure its status and prevent the system from irregularities (Grieco, 1993; Axelrod and Keohane, 1993, as cited in Talibu et al., 2023), as well as to control others' behavior in the system, including those who adjust to support the system (Baccini, Poast, and Urpelainen, 2011, as cited in Talibu et al., 2023). In other words, the actor is a hegemon that leverages the system and international bodies to demonstrate its power and influence. To identify hegemony, four factors may be considered: (1) economy, (2) population, (3) military prowess, and (4) social interaction, the last of which supports the other factors.

To summarize, the characteristics of a hegemon consist of three elements: (1) having superior power, (2) having the ability and willingness to set rules, as well as influence others' policymaking, and (3) being recognized by the international community, particularly by major powers. It is worth noting that a hegemon may collapse if it lacks legitimacy or the capability to function as a hegemon. However, the collapse of a hegemon does not necessarily lead to the collapse of the system.

There are some works regarding power ranking. The first is the World Power Index, which applies the Power-Geostructure approach to describe power. It states that power has multiple aspects to consider, including economic, military, socio-institutional, and cultural dimensions, which are interconnected, and changes in these can cause power shifts. In addition, both government and non-state actors, as well as geopolitics, are also considered factors that can cause power change. It is worth noting that power is relative; in other words, it is measured in comparison to others. According to this work, the U.S. and China have been the most powerful countries in the world since 2017.

Next, U.S. News & World Report defines a hegemon as a country frequently mentioned in the news and recognized by other states due to its influence on policymaking and the global system, including politics and the economy. A hegemon also projects power on the international stage. In 2023, the U.S. and China are considered hegemons due to their respective GDPs of 27.4 trillion and 17.8 trillion USD.

³ Note. Adapted From "Understanding "Hegemony" in International Relations Theories," by Dirzauskaite, G., and Ilinca, N., May 2017, Aalborg University.

The last work regarding power in space is proposed by the European Space Policy Institution (ESPI). It applies the “Spacepower Index,” which is introduced in *Power, State and Space*. The Spacepower Index considers space power through 94 indicators, which are separated into two dimensions: (1) Capacity, meaning each state's ability to set its space strategy and utilize material assets to achieve economic, political, and social objectives; and (2) Autonomy, referring to the ability to set directions, policies, interests, and activities in space by applying its own resources. This work defines the U.S. and China as Space Powers, while Europe is categorized as a Spacefaring Nation, as shown in the space power map in Figure 3.

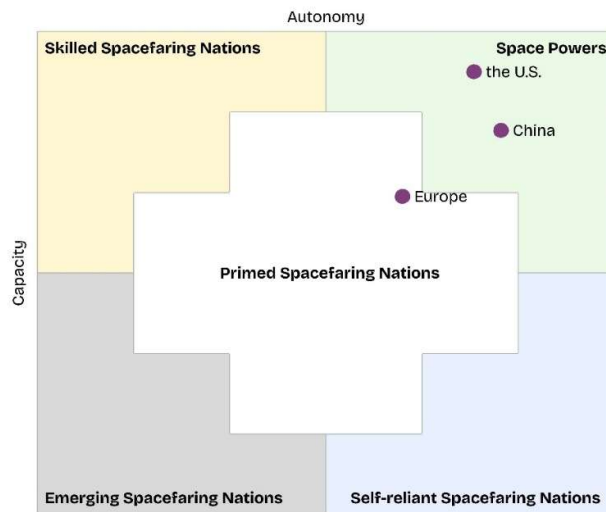


Figure 2 Positioning Space Actors in the space power map⁴

2.3 Current Space Governance

Satellite orbits are space resources subject to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty or OST). Articles 1, 2, and 4 state the boundaries and limitations on the use of space resources, and highlight the principles of equity and peaceful use in space.

The OST was introduced in the context of the Cold War, when the boundary of competition extended from Earth to the space domain between two major powers: the U.S. and the former Russia. The first signatories were led by the major powers of that period: the U.S., the U.K., and the former Russia, and it became effective on 10 October 1967. To date, 115 countries, including China, are bound by this treaty, with another 23 countries having only ratified it.⁵

However, the OST has been widely criticized. Firstly, its text is considered vague and outdated (Marshall, 2023), described as "neither exhaustive nor comprehensive," and viewed as a tool to limit the possible capacity of the space race winners (Ramirez, 2022). Specifically, the prohibition of using weapons of mass destruction in space, such as nuclear weapons, without mentioning other types of weapons, could allow for the deployment of other weapons in space under the justification of peaceful purposes (Secure World Foundation, 2023). Secondly, the OST turns space into a domain where anyone can freely access it without seeking

⁴ Note. Adapted From “*Europe as a Space Power*,” by Aliberti, M., October 2023, European Space Policy Institute.

⁵ See. **United Nations Office for Disarmament Affairs**. (n.d.). *Outer Space Treaty: Participants*. https://treaties.unoda.org/t/outer_space/participants

authorization (Ramirez, 2022). Lastly, its concept of the “Province of all Mankind” conflicts with the concept of the “Common Heritage of Mankind” in the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement or MA) which emphasizes ownership (Ramirez, 2022). Both Ramirez and the Secure World Foundation point out that the OST was designed based on the Antarctic Treaty, which was originally designed to manage no-man's land, but was not intended to regulate human or commercial activities in space. These loopholes have led to calls for regulatory revision by various experts and institutions, including Jonathan Lim (2018), Scott Atkins et al. (2022), Tim Marshall (2023) and the United Nations (2023).

Due to the continuous expansion in the use of satellite orbits since 2017, especially commercial satellites (Figure 4), negative impacts on space sustainability have emerged, such as orbital congestion. The works of Chen Chuan and Yang Wulin (2017), Hugh G. Lewis (2020), Christopher D. Johnson (2020), and Aaron C. Boley and Michael Byers (2021) argue that the expansion of satellite systems inevitably increases the risks to orbital environments. Furthermore, some studies indicate that space debris could negatively impact national economies. Marit Undseth, Claire Jolly, and Mattia Olivari (2020) state that the Kessler Syndrome, a phenomenon where in-orbit debris reaches a critical point and starts to create more debris continuously, causing serious problems for the space environment and future space use, could occur in highly concentrated orbits, such as those between 650 and 1,400 kilometers from Earth, which are primarily occupied by weather, Earth observation, and communication satellites, mostly for government and military purposes.

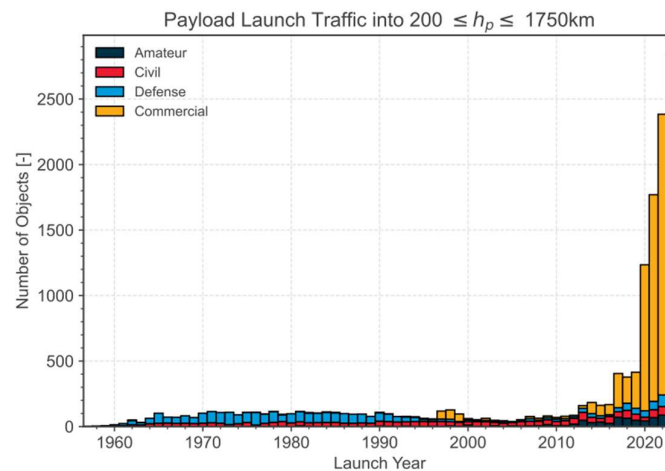


Figure 3 Numbers of payload launched to orbits⁶

To mitigate outer space problems, promoting mechanisms such as Space Situational Awareness (SSA), open-source platforms, and R&D programmes, along with stakeholder collaboration, is essential. Nodir Adilov et al. (2023) argue that due to the minimal financial losses from collision—only around \$86-103 million per year or 0.05% of the total value of commercial satellites—satellite operators have little incentive to resolve space environment problems. Most of these financial losses occur in LEO, particularly between 600-900 kilometers from Earth.

⁶ Note. From “ESA’s Annual Space Environment Report,” by ESA Space Debris Office, March 2025, The European Space Agency.

Nowadays, prominent space actors such as the U.S., China, and Europe, are developing SSA systems to reduce the risk of collisions. Europe enforces Regulation (EU) 2021/696 of the European Parliament and of the Council of 28 April 2021, which establishes the Union Space Programme and the European Union Agency for the Space Programme. This regulation defines key elements of SSA, including: (1) the Space Surveillance and Tracking (SST) sub-component, which provides in-orbit object tracking information and services; (2) the Space Weather Events (SWE) sub-component, which monitors space weather; and (3) the Near-Earth Objects (NEO) sub-component, which monitors the risk of deorbiting objects. Moreover, the European Space Agency (ESA), a prominent European space actor, implements an SSA program designed to detect, predict, and assess risks that may arise from launches, collisions, in-orbit explosions, and deorbiting. It also monitors the potential impacts of near-Earth objects, and space weather on both terrestrial and space infrastructure. In addition, the U.S.'s SSA programme is under the Department of Defense and involves data sharing with its allies in both the public and private sectors. Meanwhile, China has been developing its own system, focusing on LEO satellite usage and implementing space-based technology, which is claimed to differ from the U.S.'s system.

Furthermore, there is Space Traffic Management (STM), which emphasizes policymaking and related regulations to set direction for preventing in-orbit collisions and promoting space sustainability. For example, the U.S.'s STM system is designed to support the expansion of the satellite market. It also invites stakeholders' comments, reduces the regulatory burden for smaller actors, and provides critical information to satellite operators to enhance accountability in space. The European system highlights collaboration among stakeholders across four clusters: (1) Civilian and Military STM requirements of space operators; (2) EU Industry and Start-ups Forum (EISF); (3) Regulatory aspects of STM; and (4) international dimension of STM. In contrast, China still lacks a clear policy regarding STM, even though it is mentioned in its white paper, *China's Space Program: A 2021 Perspective* (January 2022).

Apart from vague and outdated space law, lack of integration in frameworks, and insufficient international collaboration, there are additional challenges worth addressing that pose a significant burden to space sustainability. Undseth et al. (2020) point out space-related issues including low accuracy in space object detection—especially for objects smaller than 10 centimeters—challenges with unreliable warnings and big data processing, dependency on international collaboration and data sharing, and inefficiencies in regulations at both national and international levels. Meanwhile, according to an evaluation by the Secure World Foundation (2023), which applies Ostrom's eight design principles to assess the effectiveness of space governance, the study found that, in the space domain, institutional performance is fragile due to the lack of "graduated sanction," "recognition rights to organize," "conflict-resolution mechanism," and "nested units".

3. How do developed countries create barriers for developing countries in equitably accessing NGSO orbits? A Hegemonic Stability Theory perspective

To achieve hegemonic status, all states utilize their tools, resources, and capabilities to strengthen their advantages and protect themselves from threats that may arise from the anarchic structure of the international community. Although the current international framework for space resources allocation may reduce anarchy in the international system, it simultaneously disadvantages developing countries in accessing and occupying space resources, as higher-capability countries have already claimed large shares and pose risks to sustainable use.

Generally, a hegemon refers to a country or a group of countries that possesses hegemony, exerting influence over others by promoting its norms or values and dominating the international system. Nonetheless, there appears to be no single actor with absolute dominance in the space domain. Therefore, this study focuses on regional hegemons: the U.S., China, and Europe. On one hand, the U.S. and China are clear examples of regional hegemons, the former a leading Western power, the latter a major Eastern power. According to ESPI, both are considered space powers due to their strong capabilities and autonomy in space activities. On the other hand, while Europe is classified by ESPI as a spacefaring nation, this study treats it as a regional hegemon because of its significant space presence and its ability to secure orbital resources.

This section addresses the space activities of regional hegemons that enhance their advantages in accessing and occupying NGSO orbits. On one hand, the FCFS approach, as an institutional framework, legitimizes the occupation of large shares of space resources by hegemons and remains in use due to their consent. On the other hand, rivalry among hegemons, specifically between the U.S. and China, drives each to leverage their capabilities to gain greater advantages in space. Meanwhile, Europe has begun to recognize the importance of space for regional defense and security, aiming to reduce dependence on foreign technologies and position itself as a regional space power. These activities may strengthen stability for hegemons, but they also create risks for developing countries, as outlined below.

3.1 FCFS as an institutional framework that protects hegemons' advantages and legitimizes their claims over space resources.

(1) The relationship between the FCFS framework and hegemons

According to HST, hegemony is essential for setting and maintaining world order in the international system, helping to preserve peace and stability. In the context of space resources allocation, hegemons are among the main supporters of the FCFS framework for NGSO. This is because the framework naturally benefits the development and expansion of satellite and space technologies, providing significant advantages to spacefaring nations with advanced technological, political and economic capacities. These factors create strong incentives for them to support the current system, act as first movers in occupying orbital and spectrum resources, and expand their mega constellations under legitimate claims.

(2) Efforts to reform and rebalance

Despite calls for the reform of space resource governance for NGSO by some developing countries, aimed at making its use more equitable, as observed by Jennifer A. Manner, senior vice president of Regulatory Affairs at EchoStar Corporation, who attended WRC-23⁷ and were mentioned in Giri and Hiebert (2024), the FCFS framework remains in use due to the limited political power and lower technological capacity of developing countries, as well as a lack of support from major powers.

The ITU acknowledged that the FCFS approach may pose challenges for developing countries in accessing space resources in the future⁸ and recognized the obstacles they face in launching satellites. These concerns led to an increased emphasis on “sustainability” and “equitable access,” along with consideration of Resolution 80, *Due Diligence in Applying the Principles Embodied in the Constitution*. The aim is to reduce inequity in resource use, which

⁷ See. Jewett, R. (2023, July 24). Satellite issues take center-stage at WRC-23. *Via Satellite*. <https://interactive.satellitetoday.com/via/articles/satellite-issues-take-center-stage-at-wrc-23>

⁸ See. resolution 131 (WRC-23) and resolution 553 (REV. WRC-23)

is caused by a lack of resources and expertise in developing countries, especially in the coordination process, which often imposes the greatest burden. Additionally, the complexity and delays in the approval process, along with time limitations under No. 11.48 of Radio Regulations, can affect coordination and hinder the ability of developing countries to bring their systems into use. Moreover, Resolution 35, *A Milestone-Based Approach for the Implementation of Frequency Assignments to Space Stations in a Non-Geostationary-Satellite System in Specific Frequency Bands and Services*, aims to increase the efficiency of orbital and spectrum use, reflect actual use of resources, and seek a balanced approach to resource allocation. These two resolutions align with the ITU's values in Article 44 of the ITU Constitution and No. 0.3 of the Preamble to the Radio Regulations.

(3) Limitations

Although the ITU attempts to resolve all obstacles to increase developing countries' capability to equitably access space resources, the large share of occupation by hegemony still remains (Figure 5), and the launch rate of developing countries is lower because key problems, such as lack of resources and capabilities, have not been resolved. This suggests that current efforts are insufficient to prevent hegemony from continuing to dominate space resource allocation.

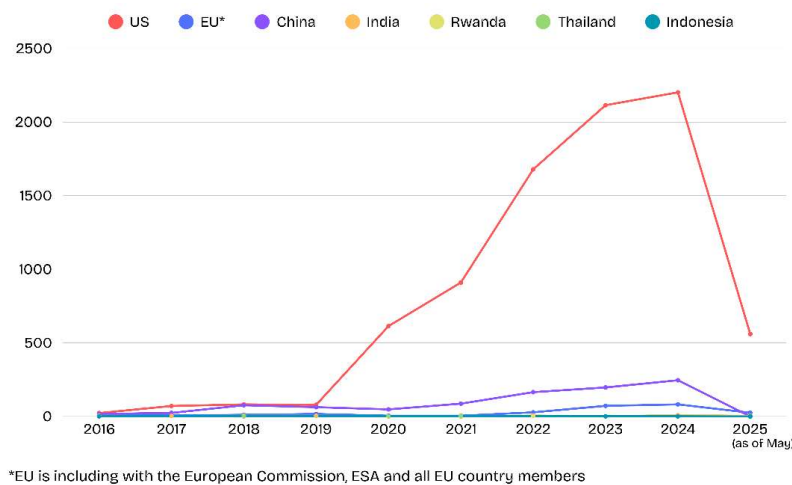


Figure 4 Chart showing the increase in launches from 2008 to 2024 by some countries (both developed and developing)⁹

3.2 Rivalry among hegemony

Technically, it is possible to have a sole hegemon in the world, whether in the form of an ordinary hegemon or a group hegemon. However, the current competition in space reflects a convergence of role in security and defense between state and non-state actors. While major states, as regional hegemony from both the West and the East, seek to gain advantages in traditional security and military domains, private actors and space agencies also play a significant role in developing space technologies and providing satellite-based services. Thus, these non-state actors can be considered as instruments for states to strengthen their capabilities and expand their influence in space. In other words, apart from state-led security and defense activities, the actions of non-state actors should be taken into account.

⁹ Note. Adapted From "Online Index of Objects Launched into Outer Space," by United Nations Office for Outer Space Affairs, Retrieved May 2025, United Nations Office for Outer Space Affairs.
<https://www.unoosa.org/oosa/osoindex/search-ng.jsp>

By applying HST, it can be implied that regional hegemons pursue national stability in order to gain advantages over others and protect themselves from external threats arising from the anarchic international system. Ultimately, their absolute objective is to become the global hegemon. Today, the main rivalry in space is between the U.S. from the West and China from the East. Meanwhile, Europe is recognized as a spacefaring nation. Although it does not expand its space influence aggressively compared to the U.S. and China, its activities regarding space still have implications for space sustainability. The specific details of each country are outlined below.

(1) The U.S.

To protect its status in space, expand its influence, and gain advantages over others, the U.S. plays a hegemonic role through both neo-realism and neo-Gramscian approaches. This includes enforcing law and order to create barriers, occupying strategic orbits, persuading through international platforms, and promoting space market competition through regulations, as discussed below.

Enforcing law and order to create barriers

Law and order is used by the U.S. government as a strategic instrument or form of hard power to limit others' capabilities and enhance U.S. strategic advantages, which reflects a neo-realist approach. For example, the U.S. strengthens its security and reduces the risk of technology transfer by enforcing Section 1340 of the Department of Defense and Full-Year Continuing Appropriations Act, 2011, commonly known as the Wolf Amendment. This measure is not only considered as a barrier to China's development of space technologies and a delay to its emergence as a space power, but also as a means for the U.S. to gain greater leverage in international negotiations. Although it was claimed that this law was intended to respond to China's human rights violations, its broader impact extends to Chinese strategic competition in space.

Additionally, the White House also instructed Maxar to restrict Ukrainian users' access to satellite imagery. This harms the strategic capabilities of Ukrainians during the war and weakens Ukraine's negotiating position.

Occupying strategic orbits

In today's context, the ability to occupy satellite orbits and spectrum, which are considered common pool resources, is essential. Jon Janka, Chief Officer of Global Government Affairs & Regulatory at Viasat, highlighted the critical importance of space resources and the national interests that arise from being a "first mover." As a first mover, the U.S. aggressively seeks to take over NGSO orbits, specifically, by investing in and deploying communication satellites that consume a large share of NGSO orbital resources to ensure reliable connectivity, primarily through private sector involvement, such as SpaceX's Starlink and Amazon's Kuiper. Additionally, the U.S. also submitted around 45 filings to the ITU between 2017 and 2022, ranking second after China, according to Falle et al. (2023). Both the overfiling and launching of mega-constellations help maintain the U.S.'s leading status in space.

According to the Union of Concerned Scientists, as of May 2023, the U.S. is the front-runner in the number of active NGSO satellites (Table 1), with over 80 percent owned by SpaceX. It is worth noting that this number continues to grow due to the expansion of satellite constellations such as Starlink or Kuiper, which serve purposes related to national communication security in addition to commercial applications.

Table 1 Number of the U.S. NGSO satellites (as of May 2023)

Category	Number of satellites
Existing Satellites ¹⁰	4,918
Number expected at completion ¹¹	>15,000*

*The expected number is based on 12,000 satellites for Starlink, with the potential to expand to 42,000 for the full system, plus 3,236 satellites for Kuiper.

Persuading through international platforms

At the World Radiocommunication Conference 2023 (WRC-23), the U.S. administration^{12,13} proposed a review of the rules regarding Equivalent Power Flux-Density (EPFD) limits, aiming to balance the increasing demand for satellite services, advancements in NGSO technology, and the need to protect GSO systems. This proposal was supported by a study report from the Alliance for Satellite Broadband, led by Amazon. This move can be interpreted through the lens of neo-Gramscianism, as the international conference served as a platform for the U.S. to assert its position and promote regulatory ideas to seek international support, or consent. Although WRC-27 is not expected to address this issue in regulatory terms, there is no guarantee that it will remain unchanged in the future. Additionally, this proposal aligns with the Federal Communications Commission (FCC)'s regulation, *Revising Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems*, which requests later-round systems not to cause harmful interference to earlier rounds; however, this protection lasts for only 10 years after the first system in the earlier round is approved.

Promoting space market competition through regulations

Apart from the *Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems* mentioned above, *Supplementary Coverage from Space (SCS)*, which allows cooperation between terrestrial and satellite operators to provide communication services from space, the accelerated authorization process for large satellite constellations initiated by the private sector, and the streamlining of the Federal Aviation Administration (FAA)'s launch licensing, can be considered through a neo-realism approach. Specifically, these actions boost competition in the U.S. satellite market, attract new players, drive innovation, and enhance the capability to expand systems on a large scale to meet increasing demand. Altogether, they support the U.S. in dominating space resources and reinforce its position as a global hegemon.

(2) China

To achieve great power status in space and to counter U.S. influence, China plays its great power role through a neo-realist approach. This includes occupying strategic orbits, building and developing satellite and space technologies, and improving space-related technology for military purposes to strengthen national security, as discussed below.

Occupying strategic orbits

As mentioned, due to the U.S. ban on space cooperation with China, it is inevitable for China to develop its own technologies. This has not significantly delayed China's technological

¹⁰ Note. Adapted From "UCS Satellite Database, [Data set]" by Union of Concerned Scientists, Retrieved February 2025, Union of Concerned Scientists. <https://www.ucs.org/resources/satellite-database>

¹¹ Note. Adapted From "Satellite Constellation Projects Ready for Takeoff," by Buchholz, K., Retrieved February 2025, Statista. <https://www.statista.com/chart/33246/satellite-constellation-projects/>

¹² See. Rainbow, J. (2024, January 23). *Orbital spectrum clash*. SpaceNews. <https://spacenews.com/orbital-spectrum-clash/>

¹³ See. Alliance for Satellite Broadband. (n.d.). *Alliance for Satellite Broadband*. Retrieved April 10, 2025, from <https://allianceforsatellitebroadband.org/>

progress but has instead greatly accelerated the advancement of Chinese space technology, strengthening China's ability to counter U.S. influence through Starlink, which affects its national security.

According to *China's Space Program: A 2021 Perspective* (2022, January) and The Ministry of Industry and Information Technology's 14th Five-year Plan, China is aware of the need to be a first mover and of the national interests it obtains from these resources, including a focus on the expansion of mega-constellations in NGSO. This leads to the occupation of NGSO orbits through overfiling between 2017 and 2022, with China accounting for the majority, around 65 filings, according to Falle et al. (2023). The satellite constellations include 532 LEO satellites, as shown in Table 2.

Table 2 Number of Chinese NGSO satellites (as of May 2023)

Category	Number of satellites
Existing Satellite ¹⁴	532
Number expected at completion ¹⁵	21,000*

*The expected number includes 15,000 satellites for Qianfan and 6,000 satellites for Geely Future Mobility. These figures do not include the additional expected 23,000 satellites from Guowang and Honghu-3.

Building and developing satellite and space technologies

The number of satellites mentioned above could potentially grow even more due to several national satellite projects such as *Guowang*, *Qianfan*, and *Honghu-3*, which serve purposes related to national communication security and military. In addition, China is also developing its rocket and launcher technologies, such as *Long March 9*, a super heavy reusable rocket, which could be a game-changer for China due to its sevenfold improvement in LEO satellite launch capacity at a lower cost compared to the currently operating *Long March 6A*. The *Long March 9* is also capable of competing with *SpaceX's Starship* in terms of payload capacity and launch cost.

These Chinese satellite constellations and related space programs are supported by Chinese government affiliations in terms of funding and government-led initiatives, along with private sector capabilities. Notable examples include the *Tengyun* spaceplane project and the VLEO communications and sensing integrated constellation project operated by the China Aerospace Science and Industry Corporation (CASIC), the *Long March* rocket project and the *Tiantong* satellite project for direct-to-device service operated by the China Aerospace Science and Technology Corporation (CASC), the *Qianfan* Constellation project operated by Shanghai Spacecom Satellite Technology (SSST), and the *Guowang* Constellation operated by China SatNet. The companies mentioned above are state-owned enterprises (SOEs).

Moreover, there are the *Jinwu-200* (JW-200) krypton propellant Hall thruster and *Honghu-3* Constellation project, operated by Shanghai Lanjian Hongqing Technology Company, a private company funded by government-sponsored investors. The collaboration between the government and enterprises provides China with an advantage in enhancing its space presence.

¹⁴ Note. Adapted From "UCS Satellite Database, [Data set]" by Union of Concerned Scientists, Retrieved February 2025, Union of Concerned Scientists. <https://www.ucs.org/resources/satellite-database>

¹⁵ Note. Adapted From "Satellite Constellation Projects Ready for Takeoff," by Buchholz, K., Retrieved February 2025, Statista. <https://www.statista.com/chart/33246/satellite-constellation-projects/>

Improving space-related technology for military purposes

To strengthen national security, not only satellite and space technologies, but also anti-satellite (ASAT) weapons are important. A report by the Center for Strategic and International Studies (CSIS) (2024) revealed that China is developing both kinetic and non-kinetic ASAT weapons, such as ground-based laser weapons, mobile high-powered microwave (HPM) weapons, high-altitude nuclear detonations (HAND), and direct-ascent anti-satellite (DA ASAT) systems. Satellite imagery¹⁶ provides evidence that a base for developing laser ASAT weapons has been built in the Asia-Pacific region. This weapon development is intended for targeting Western satellites. This can be viewed through a neo-realism lens as a means of increasing national security. The development and testing of these weapons demonstrate China's power and military strength, as well as the advancement of its space technology, aiming to intimidate rivals and prevent external threats. For example, China's ASAT test in 2007, which destroyed the inactive Fengyun-1C weather satellite in LEO, could be viewed as a power demonstration. Moreover, it generated a significant amount of space debris.

(3) Europe

To strengthen regional security and autonomy, Europe performs as a regional hegemon through neo-realist, neo-liberalist, and neo-Gramscian approaches. It does so by enhancing regional autonomy and protecting regional interests, occupying strategic orbits, providing open-source information from space, and introducing frameworks for regional space law and establishing a knowledge-sharing centre for space actors, as discussed below.

Enhancing regional autonomy and protecting regional interests

According to a European Space Policy Institute (ESPI) report, Europe has lower autonomy compared to the U.S. and China due to its dependency on foreign technologies. An example of this is the consideration of using SpaceX's satellite internet instead of local operators during the Russo-Ukraine war. Another example is Europe's lack of ability to make independent decisions on space policy because of geopolitical pressure, thus inevitably forming partnerships with others. This highlights the importance of strengthening regional security by developing space-based technology capabilities, aligning with a neo-realist approach.

Europe is pivoting toward a security and defense-oriented approach, aiming to position itself as a security provider and increase its autonomy by 2030. This shift is a significant driver in reducing Europe's dependency on foreign resources and building up European sovereignty. The 2022 Strategic Compass integrates space into defense and is structured around four pillars, *Act*, which involves immediately and intensively addressing emerging threats; *Invest*, which focuses on increasing defense spending to close gaps in technology and defense industry; *Partner*, which emphasizes forming and enhancing relationships with international bodies and countries that share common values with Europe; and *Secure*, which aims to strengthen Europe's ability to anticipate, defend against, and respond to threats.

In addition, to enhance communication security and military capabilities, Europe has developed its own satellite systems under the 2021 Regulation (EU) 2021/696. These systems include:

¹⁶ See. **Salerno-Garthwaite, A.** (2023, May 1). *Is China's Korla laser ASAT site hacking Western satellites?* *Army Technology*. <https://www.army-technology.com/features/is-chinas-korla-laser-asat-site-hacking-western-satellites/>

(1) The Union's Secure Connectivity Program (*IRIS²*), a collaboration between the European Commission and the SpaceRISE consortium, led by Eutelsat, Hispasat, and SES. It consists of 290 satellites using a multi-orbit model to ensure regional connectivity across domains and reduce reliance on SpaceX's Starlink.

(2) The Earth Observation program (*Copernicus*), operated by the European Commission and the European Space Agency (ESA). This program aims to collect and distribute imagery through an expected 20 Sentinel-family satellites, with full deployment anticipated by 2030.

(3) The Global Navigation Satellite System (*Galileo*), designed for civil use. It includes 24 satellites in MEO, the European Geostationary Navigation Overlay Service (*EGNOS*), and the Space Situational Awareness (SSA) component.

Occupying strategic orbits

The European satellite constellations mentioned earlier contribute to occupying NGSO orbits. Although the number of existing European satellites is relatively lower than that of space powers like the U.S. and China (Table 3), Europe employs overfiling as a strategy to secure orbital positions, as illustrated in the graph in Figure 6. One notable example is *Cinnamon-937*, a satellite constellation filing submitted by Rwanda but suspected to be linked to E-Space, a French satellite company. According to Falle et al. (2023), this filing includes 337,320 NGSO satellites, which is the largest submission ever received by the ITU between 2017 and 2022. Apart from *Cinnamon-937*, E-Space has submitted another filing through France involving hundreds of thousands of satellites for IoT applications. These can be seen through a lens of neo-realism as a means of gaining advantage in space in terms of resource occupation. If even one percent of these filings were approved, Europe could achieve orbital dominance alongside the U.S.

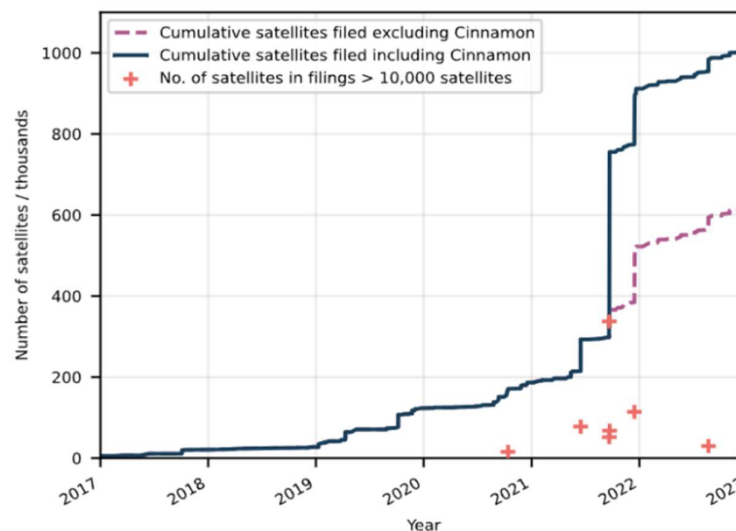


Figure 5 Statistic regarding satellite filings received by the ITU during 2017-2023¹⁷

¹⁷ Note. Adapted From “One million (paper) satellites,” [Accepted manuscript] by Falle, A., Wright, E., Boley, A., & Bye, TheScienceBreaker.

Table 3 Number of NGSO In-Orbit Satellites (as of May 2023): A Comparison Between Europe, the U.S., and China.

Category	Europe	The U.S.	China
Existing Satellites ¹⁸	55	4,918	532
Number expected at completion	~250	>15,000	21,000

Providing open-source information from space

This may represent a significant hegemonic role for Europe, as it acts as a regional provider of resources through open-source information from its satellite systems, such as geographical data from *Copernicus*, positioning and navigating from *Galileo*, and space weather monitoring from EU Space Surveillance and Tracking (*EUSST*). This role aligns with neo-liberalism, which considers a hegemon responsible for providing public goods to other countries due to its inherent capacity.

Introducing frameworks for regional space law and establishing a knowledge-sharing centre for space actors

The Joint Communication to the European Parliament and the Council on the European Union Space Strategy for Security and Defence, signed on 10 March 2023 by the European Commission and the High Representative, is an initiative aimed at integrating space and defense, while ensuring long-term autonomous access and strengthening European autonomy. It introduced two key elements:

(1) European Space Law (*EUSL*), potentially Europe's first comprehensive space law, intended to set the direction for space sustainability;

(2) Information Sharing and Analysis Centre (*ISAC*), a platform for sharing knowledge and best practices among European public and private space actors.

This can be viewed through a neo-Gramscian lens, as the laws, knowledge, and guidelines introduced by *ISAC* may influence space governance and serve as benchmarks for latecomers in regulatory development. This approach not only highlights Europe's role as a front-runner in space regulation, but also reflects its efforts to shape and disseminate norms and values to gain consent and influence within the international space order.

Table 4 provides a comparative summary of the objectives and hegemonic roles of the countries discussed.

¹⁸ Note. Adapted From “*UCS Satellite Database*, [Data set]” by Union of Concerned Scientists, Retrieved February 2025, Union of Concerned Scientists. <https://www.ucs.org/resources/satellite-database>

Table 4 Summary of each country's objectives and hegemonic roles from the perspective of Hegemonic Stability Theory

Actor	Objectives	Hegemonic Roles
USA	<ul style="list-style-type: none"> - to protect its status in space - to expand influence and gain advantages over others 	<p>Playing a hegemonic role through both neo-realist and neo-Gramscian approaches, which includes:</p> <ol style="list-style-type: none"> 1) Enforcing law and order as instruments of hard power to hinder rivals from accessing and developing space technologies, while simultaneously enhancing strategic advantages. Examples include the Wolf Amendment, which restricts space cooperation with China, and a White House directive instructing Maxar to limit Ukraine's access to satellite imagery. 2) Occupying strategic orbits through overfiling and plans for mega satellite constellations as a means of expanding influence by providing space-based services. 3) Persuading through international platforms to drive regulatory change, exemplified by the proposal to review Equivalent Power Flux Density (EPFD) limits. This could affect GSO operators and developing countries in the future. 4) Promoting space market competition through regulations that drive U.S. space market expansion, such as Supplementary Coverage from Space and Spectrum Sharing Rules.
China	<ul style="list-style-type: none"> - to achieve great power status in space - to counter U.S. influence 	<p>Playing a hegemonic role through neo-realist approach, which includes:</p> <ol style="list-style-type: none"> 1) Occupying strategic orbits through overfiling and plans for mega satellite constellations as a means of strengthening national security. 2) Building and developing satellite and space technologies, such as broadband satellite constellations and launch capabilities, to strengthen national security and block external influence, especially from the U.S. 3) Improving space-related technology for military purposes, such as Anti-satellite (ASAT) weapons, to enhance national security.
Europe	To strengthen regional security and autonomy	<p>Recognising by ESPI as a spacefaring nation, it plays a hegemonic role through a mix of neo-realist, neo-liberalist, and neo-Gramscian approaches, which includes:</p> <ol style="list-style-type: none"> 1) Enhancing regional autonomy and protecting regional interests by setting strategic defence priorities and developing satellite systems to reduce dependency on foreign technology and increase the capability to respond to external threats. 2) Occupying strategic orbits through overfiling and planning mega-satellite constellations to ensure security and independence. 3) Providing open-source information from space as a means of demonstrating hegemony. 4) Introducing frameworks for regional space law and establishing a knowledge-sharing centre for space actors.

3.3 The consequences of the FCFS approach and rivalry among regional hegemony for developing countries

As mentioned above, the FCFS is an institutional framework that allows countries with higher readiness in space technologies to be first movers and legitimately exploit finite orbital and spectrum resources. Moreover, the rivalry among regional hegemony, namely the U.S., China, and Europe, aims to secure their national interests and achieve great power status. These political factors create inequities for developing countries: (1) the risk that no resources will remain available for developing countries, and (2) risks to national interests and sovereignty of developing countries.

(1) The risk that no resources will remain available for developing countries

As mentioned, the FCFS framework contributes to overfiling and the expansion of mega satellite constellations by first movers, who compete with each other in their efforts to claim orbital resources, which are considered common pool resources. In addition, the increasing number of satellite constellations approvals from the FCC and the enforcement of regulations, such as SCS and spectrum sharing potentially increase the number of satellite operators in the market and the number of constellations launched into orbit. This poses a risk of overcapacity and the Kessler Syndrome. In this context, there is no guarantee that developing countries, mostly latecomers, will be able to access and benefit from these resources safely and efficiently, which potentially violates Article 44 of the ITU Constitution.

Currently, the number of active and inactive satellites is rapidly increasing. According to the Union of Concerned Scientists, as of May 2023, there are 7,560 satellites in orbit; 89.52 percent are located in LEO orbit, and 89 percent of the satellites in LEO orbit are owned and operated by major powers, namely the U.S., the U.K. and China. The exponential growth in the number of satellites began during 2016-2017, with a fivefold increase between 2019 and 2020 due to the emergence of new players in the space economy and the expansion of the commercial satellite market, along with government infrastructure development plans. In addition to the Union of Concerned Scientists' data, the European Space Agency (ESA) also reported that over 2,000 inactive satellites have not yet begun the deorbiting process. Furthermore, more than 650 events of break-ups, explosions, collisions, and anomalies have been recorded, and over 131 million pieces of space debris have been detected, mostly ranging in size from 1 mm – 1 cm.¹⁹ These records reflect that, even though the orbital self-cleansing process and the FCC's five-year deorbit regulation exist, they have not kept pace with the rapid rate of satellite launches and system expansion.

It is also worth noting that Rwanda's Cinnamon-937 orbital filing may be reluctantly interpreted as a move to empower developing countries in terms of accessing and benefiting from space because the filing is tied to E-Space, a French company that has located its headquarters in Rwanda. However, the revenue generated from these services primarily goes to the French company, while actual access to space-based services for Rwandan population remains uncertain.

Additionally, a significant event that contributed to the space debris problem was China's 2007 ASAT weapon test, which destroyed the inactive Fengyun-1C weather satellite. As a result, it created a massive debris cloud, with 3,037 pieces of trackable debris detected. Following this ASAT test, Weeden (2010) cited expert estimates that over 32,000 additional untrackable fragments were produced, further intensifying orbital congestion and raising global

¹⁹ See. European Space Agency. (n.d.). Space debris by the numbers. Retrieved February 25, 2025, from https://www.esa.int/Space_Safety/Space_Debris/Space_debris_by_the_numbers

concerns over space environmental degradation. Johnson et al. (2008) cited an analysis from the U.S. Space Surveillance Network (SSN), which indicates that a significant portion of the debris resides in long-lived orbits. In 2010, the U.S. SSN reported that debris from the Fengyun-1C incident remained in orbit and posed ongoing hazards. For instance, the International Space Station (ISS), which also operates in LEO, had to adjust its orbit to avoid collision. According to Lambert (2018), citing SSN data, 2,392 pieces of the debris remained in orbit, suggesting that only 21 percent had deorbited after eight years. The persistence of such debris increases risks for developing countries seeking to access outer space safely.

(2) Risks to national interests and sovereignty of developing countries

Technically, NGSO satellites are not stationary relative to the Earth; thus, they continuously move across its surface and share radio frequency spectrum with other terrestrial and satellite services. Specifically, communication satellites are deployed in large constellations that occupy a significant portion of orbital space. This space is protected under the OST (1967), which states that space is not subject to national sovereignty and shall benefit all countries. Nonetheless, satellites in orbit are subject to the national regulations of the country where the satellite operators provide services. These three points, the characteristics of NGSO satellites, the principle that space shall not be subject to national sovereignty and shall benefit all, and the fact that NGSO satellites in orbit are subject to national regulations, present the problem of dominance in space through internal regulations.

Currently, the hegemon, namely the U.S., holds the majority share of in-orbit NGSO satellites and has made significant shifts in national regulations. Specifically, the U.S. aims to boost satellite market expansion through regulations like *Revising Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems* and *Supplemental Coverage from Space*, thereby compelling new players and promoting competition in the market. These internal regulations could create inequities for developing countries in both processes and outcomes. Regarding processes, developing countries are excluded from the legislative or regulatory processes of the hegemon due to the principles of sovereignty and jurisdiction, and they cannot directly oppose this influence due to their limited power. At best, they can refuse to license such operators within their own jurisdictions. In terms of outcomes, the internal regulations focus primarily on the hegemon's national interests, which do not necessarily represent those of other nations or of humankind.

Another point that highlights the U.S. dominance in space regulation, or the influence of a powerful minority, is the WRC's acceptance of the proposal to review the ITU's EPFD limit regulation, assigning it for technical study. This proposal is based on the arguments that the current regulation is outdated and does not align with the current technological context. However, this proposal mainly focuses on serving the national interests of the U.S., which possesses advanced technological capabilities, while potentially causing harmful interference to GSO satellites, which are predominantly used by developing countries. This ultimately leads to inequitable access to and use of space resources, endangering the interests of developing countries.

In addition, when satellites operate under the regulations of hegemons, who are early entrants in the market, conflicts may arise when satellite operators enter foreign markets in developing countries with regulatory conditions that differ from those of the hegemon states. In such cases, satellite operators may resist complying with the regulations of developing countries, claiming adherence to the rules of their home jurisdictions. This can potentially lead to regulatory non-compliance and undermine the national sovereignty of developing countries.

4. Conclusion and Recommendations

Both of satellite orbits and spectrum are finite common pool resources. Despite the fact that the ITU promotes equitable access and long-term sustainable use of space, the current mechanism and framework disproportionately benefit hegemonies who are first movers in space allowing them to occupy a large share of these resources. Meanwhile, rivalry in space among hegemonies, which focuses on their interests, also reduces the chances of latecomers accessing and using space resources. These two issues hinder developing countries from efficiently and safely accessing orbits and spectrum. To promote the responsible use of resources, we propose recommendations to address some of these issues, which are not presented as definitive solutions but require further study, as follows.

(1) Defining NGSO orbital capacity limits

Although space for NGSO orbits is wider than GSO orbits and is suggested to have the capacity to carry over tens of billions of satellites, as publicly stated by Elon Musk, SpaceX's chief executive officer, the rapid increase in launch rates and the escalating space debris problem may pose risks of interference and collision to NGSO satellites. To increase efficiency in the use of resources and promote sustainability in space, defining NGSO orbital capacity limits may be necessary.

Miles Lifson and Richard Linares (2022; 2023) reflect the idea of resource overconsumption through their online articles. They argue that the framework of sustainability in space has not yet been pushed into policymaking, and current regulations are insufficient to create sustainability in space. They also suggested assigning orbit by using a deterministic approach to calculate horizontal and vertical spacing to find appropriate orbital capacity per slot. This can help increase the efficiency in orbit use and the effectiveness of regulation.

Moreover, Lifson and Linares also proposed models for finding LEO orbit capacity through their research. First, their 2022 research with Andrea D'Ambrosio utilized a MOCAT-3 Source-Sink model, one of the MIT Orbital Capacity Assessment Tool (MOCAT). This model was subsequently developed into the MOCAT-4S model, which they used in their 2022 research with D'Ambrosio and David Arnas, taking all Anthropogenic Space Object (ASOs) into account. However, in MOCAT-3, which categorized ASOs by active satellites, derelict satellites and debris, the result showed that within the 200-900 kilometer range in LEO orbit, with a 7 percent failure rate, the maximum capacity was 12.6 million satellites, or a launch rate of 2.7 million satellites per year, mostly concentrated at low altitudes. In contrast, MOCAT-4S, which more specifically divides active satellites into slotted and unslotted, estimated a maximum launch rate of 1.8 million satellites per year over 200 years.

On one hand, assigning NGSO orbital capacity limits may be viewed as a barrier to space technology advancement. On the other hand, the huge growth in technology should not be a reason to legitimize overconsumption by space actors, specifically regional hegemonies who utilize common pool resources to secure their national interests and pursue great power in space by occupying a large share of resources. Therefore, failure to consider NGSO orbital capacity limits could lead to dominance in space and create an obstacle for developing countries to equitably access space.

(2) Reserving part of NGSO orbits for all nations as a primary framework, and allocating the remaining under the "First come, first served" framework

A number of developing countries are calling for a revision of the FCFS framework, citing two reasons: first, their limited capability to compete against hegemonies, who possess

the advanced ability to design systems and secure orbital positions for satellites, due to lack of resources in terms of financial, technical and expertise in satellite field; and second, the disproportionate benefit the current system provides to space powers and spacefaring nations, mostly developed countries, who enjoy a large share, while developing countries struggle to fairly access the resources. The ITU, responsible for orbital allocation, should review the system by adopting a hybrid approach. This approach would use a reserve method to set aside some orbital shells for latecomer by calculating orbital capacity limits for each orbit and defining a maximum ratio between reserved and unreserved areas. For unreserved areas, they would continue be allocated by the FCFS approach. Implementing this approach will ensure the equitable access for developing countries and mitigate the tragedy of the commons in space.

Despite seemingly going against the OST principle of the use of outer space for the benefit and in the interests of all countries, leveraging outer space in the current context disproportionately benefits first movers, predominantly developed countries, at the expense of developing countries. Moreover, the benefits that first movers obtain from space result in their own national security, political prowess, military strength, as well as private sectors' economic interests, which do not represent humankind's interests. Thus, international bodies must consider a new approach to manage orbital space to ensure more truly equitable access for all nations.

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