

Navigating the Legal Issues for Satellite Networks: A Comprehensive Analysis

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Abstract

This paper examines the legal issues associated with satellite networks, including data privacy, security, taxation, and copyright infringement. Satellite technology has revolutionized communication in many ways, enabling faster access to information, greater bandwidth, and expanded coverage of remote locations. However, these benefits come at a cost—legal risks may arise from inadequate oversight or insufficient enforcement of laws. This paper evaluates the extent to which current legal frameworks are addressing these risks at an international level. Furthermore, it presents potential strategies for improving the legal framework governing satellite networks, including strengthening existing laws and regulations, developing global standards for data protection, and increasing transparency in how companies use satellite technology. In conclusion, there is a need to balance the benefits of satellite technology with appropriate legal oversight to ensure that users are protected from potential risks associated with these networks. With appropriate legal governance, this technology can be used to benefit society without compromising user privacy or security.

Keywords: *Satellite Networks, Data Privacy, Security, Copyright, Taxation.*

1 Introduction

Satellite networks are an invaluable asset in the modern world, as they enable us to access information and communication faster than ever before. Since the 1957 launch of Sputnik 1, non-state organizations have been significant players in outer space operations [1] and satellite constellations increasing improving target spatial and temporal resolution [2]. However, these technologies also bring with them a unique set of legal challenges due to their complexity and global reach. The primary international laws and regulations governing satellite networks are contained in several treaties and conventions. The most important of these is likely the 1967 Outer Space Treaty, which outlines the basic principles concerning activity in outer space. Additionally, there are other international documents such as the International Telecommunications Union's Radio Regulations that set specific standards for allocating frequency spectrum used by satellites. An important consideration in the field of satellite communications is the potential for it to meet the telecommunications demands of developing nations [3]. However, the expansion of the industry to multiple nations brings new challenges, such as space mining, which raises complex legal questions. The existing body of international law that governs outer space activities is not fully equipped to handle the rapid technological advances that are driving this field forward, leaving many legal grey areas [4]. National governments also have

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their own laws related to satellite networks. These can include privacy, data storage, and copyright protection laws. As the number of satellites and associated debris continues to increase in outer space, and more countries are participating in space activities, the existing legal and normative system has failed to keep pace with these rapid developments [5].

Cybersecurity threats to satellite communications have emerged as a recent issue of great concern as they pose a significant threat to the sustainability of satellite systems, given their ability to exploit vulnerabilities and cause negative impacts [6]. With a substantial increase in the number and sophistication of communication satellites in Earth's orbit in the past decade, new legal questions have arisen concerning the hostile disruption of satellite transmissions [7]. Furthermore, data privacy and security are increasingly becoming an issue with regards to satellite communications, as access points can be vulnerable to cyberattacks from malicious actors. It is therefore necessary to have robust security measures in place to protect data from unauthorized access. Additionally, copyright infringement is a major concern with satellite networks, as content can easily be illegally shared or reproduced. It is necessary to develop methods for arbitrary checks and controls to prevent copyright infringement attempts [8]. Moreover, the geostationary orbit is a crucial position for the thousands of satellites that support the Earth's communication, media, and data industries. However, it can only accommodate around 1500 satellites [9], highlighting the need for knowledge in international law to provide protection beyond the physical boundaries of the Earth and into space [10].

To combat this problem, international treaties and national laws have been created to protect the rights of copyright holders. Taxation may also be an issue for satellite networks, depending on their usage and the location of those using them. International organizations such as the World Trade Organization may provide guidance on how taxes should be applied in different countries. Overall, WTO law indicates that economic theory and legal thought and legalization are complementary [11].

This article will explore some of the key legal issues surrounding satellite networks, focusing on topics such as international laws and regulations, data privacy and security, copyright infringement, and taxation. It opens with the regulation of satellite networks internationally (Section 3), followed by data privacy and security in satellite networks (Section 4). Copyright infringement is the subject of (Section 5). The impact of satellite networks on taxation laws is described in (Section 6). A presentation is then given on the regime developed in the context of the WTO in (Section 8). The article proposes some solutions and recommendations to regulate the legal issues of satellite networks (Section 10) and concludes by providing a few recommendations.

2 Literature Review

A 2017 paper by Haas and Evangelio [12] examined spectrum allocation challenges for satellite networks, including inter-service interference and coordination mechanisms. It provided insights into international regulations and coordination efforts for efficient spectrum management.

Tekdal and Saudakhel's [13] 2018 paper examined satellite service problems and proposed some solutions. This paper took spectrum management as a case study.

A 2020 book by Pelton [14] provided a comprehensive overview of legal aspects in satellite communications, including spectrum allocation. The author explored national and international regulatory frameworks governing spectrum management and the challenges involved in ensuring fair allocation.

A 2015 paper by Oestreicher and Ikejiri [15] examined liability issues related to satellite damage, including third-party insurances, jurisdictional challenges, and legal remedies

available for affected parties. It analyzed international treaties and legal frameworks governing liability in satellite operations.

In a 2019 paper, Grewal and Bier [16] provided an economic perspective on liability for space debris, including satellite networks. They analyzed liability allocation models and the potential impact on satellite operators and governments. It also discusses the need for international cooperation to address liability issues.

Nonnenmacher and Janson [17] in a 2017 paper discussed the legal frameworks and technological measures required to ensure data privacy and security in satellite communications. They explored issues such as encryption, compliance with data protection laws, and cross-border data transfers.

A 2018 paper, Kugler and Barfield [18] focused on the legal aspects of cybersecurity in satellite networks. They examined the legal responsibilities, liabilities, and challenges faced by satellite operators and service providers in protecting satellites from cyber-attacks.

In a 2019 book, Kalantzis [19] provided a comprehensive analysis of data protection laws applicable to space activities, including satellite networks. The author explored legal frameworks, international agreements, and the challenges of ensuring data privacy and security in satellite communications.

Kim and Archibong [20] in a 2017 paper examined the impact of intellectual property rights on satellite communications, particularly in developing countries. They addressed issues related to patents, copyrights, and the access to satellite communication technologies required for socio-economic development.

Filbert and Zech [21] in a 2019 paper explored the implications of intellectual property rights in satellite services for markets and trade flows. They analyzed the legal frameworks and challenges related to patents, copyrights, and the protection of proprietary satellite technologies.

A 2020 book by Kulesza and Rzepecka [22] provided an in-depth analysis of intellectual property rights in the space sector, focusing on satellite networks and related technologies. They examined legal frameworks, case studies, and emerging challenges in protecting intellectual property rights in satellite communications.

3 Satellite Networks in the International Legal System

Satellite networks provide an invaluable service to a global population by transmitting signals for communication and navigation. International laws, regulations, and standards exist to ensure that satellite operations are conducted in a responsible manner and do not interfere with other activities in outer space or on earth. These regulations include The 1967 Outer Space Treaty (3.1), The 1972 Liability Convention (3.2), The 1975 Registration Convention (3.3) and The ITU Radio Regulations (3.4).

3.1 The 1967 Outer Space Treaty

Sputnik's 1957 launch demonstrated underscored the necessity for a strong space law benefiting all nations [23]. The 1967 Outer Space Treaty, formally known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, is a significant document in international space law [24]. It was first negotiated by the United Nations Committee on the Peaceful Uses of Outer Space and entered into force in October 1967. On 27 January 1967, Moscow, London, and Washington signed the Treaty simultaneously after the UN General Assembly overwhelmingly commended it on 19 December 1966 [25]. Changes in geopolitics, technology, and business interests in the intervening half-century have tested the limitations of the pact [26]. The treaty forms one of five treaties that make up

the body of international space law. Its primary objectives were to prevent an arms race from developing in outer space, preserve freedom of exploration for all nations, and provide for equitable use of resources found there. Under the terms outlined by this treaty, signatories agree not to place nuclear weapons or other weapons of mass destruction in orbit, on the Moon or any other celestial body. They further commit to not station such weapons in outer space in any other manner and to not use them during the exploration of outer space. The treaty also contains provisions concerning the scientific investigation of outer space and its resources. All signatories are required to take measures to ensure that activities conducted by their nationals are in accordance with international law and that they do not harmfully interfere with others' peaceful use of outer space. This requirement extends beyond citizens of individual countries, as it also covers corporations and non-governmental entities established within a signatory state. Additionally, all parties must facilitate international cooperation for conducting research in outer space, exchanging information gathered from those investigations, and disseminating knowledge gained through these activities. Finally, the treaty sets out that all celestial bodies are not subject to national appropriation through claims of sovereignty, use or occupation. This prevents any single country from claiming a particular area of space as its own, and instead emphasizes the importance of collective exploration and utilization for the benefit of all humankind. The 1967 Outer Space Treaty remains an important component of international space law today and has been signed by over 100 countries worldwide. It serves as a foundation for more specific treaties such as the 1979 Moon Agreement that further expand on its principles and regulations. As humanity's presence in outer space continues to grow, this document will remain an integral part of regulating our activities there.

3.2 The 1972 Liability Convention

Rules authorizing the settlement of monetary damages for harm sustained by space objects and its constituent elements, such as the cargo, have been the subject of both international law and local law [27, 28]. The 1972 Liability Convention is an international treaty that was developed to allocate responsibility for any damage caused by space objects. Established on the basis of a United Nations General Assembly Resolution, it was signed in London, Moscow and Washington D.C. on 29th March 1972 by all major spacefaring countries. This document holds space activities accountable as nations must take full responsibility for their objects launched into outer space, regardless of fault or negligence. In particular, the convention governs liability for damages caused by spacecraft and payloads during launch and reentry operations, both accidental and intentional collisions with such objects in outer space, as well as unexpected malfunctions or hazardous incidents occurring within the Earth's atmosphere due to reentering spacecraft. The 1972 Liability Convention also provides a framework for states to seek compensation for damage caused by a launch, reentry, or operation of an object in outer space, as well as any scientific research conducted using the same. Few countries with space programs have passed national space legislation that detail how international duties will be implemented [29]. The benefits and objectives of space resource development must be shared by all nations, regardless of their level of economic or scientific advancement [30]. This includes damages incurred to people and property on Earth and other celestial bodies, as well as within their respective territories, exclusive economic zones and high seas areas. The convention further outlines the procedures that must be followed if a state wishes to bring a claim against another state or actor responsible for the loss or damage suffered due to its use of outer space.

3.3 The 1975 Registration Convention

The 1975 Registration Convention was a landmark treaty in international space law. The 1975 Registration Convention's overarching goal is to promote openness and accountability in space operations by the implementation of an obligatory registration system that will aid in the tracking of all objects launched into space [31]. Adopted by the

United Nations in that year, it is the only treaty of its kind to date and has been guiding space activity ever since. The purpose of this convention was to establish a system for nations to register objects they launch into orbit or beyond, providing other countries with information about them and protecting their own interests. By doing so, it also contributes to the prevention of collisions among satellites and the promotion of international cooperation in space activities. Under the Space Registration Convention, each state must provide details of any objects it plans to launch into Earth's orbit or beyond. This includes both civilian and military spacecrafts. These details include positional coordinates, as well as the planned orbit of the object. The State must also provide information on how it will use or operate the spacecraft and any objects it plans to deploy from its mission. Additionally, States are required to update this data each time a spacecraft changes its position or maneuvers in any way. Finally, all states are obligated to promptly notify other signatories when a registered space object is likely to become a hazard to navigation or poses a risk of collision with another space object. The Registration Convention has allowed countries to develop their own legal framework for regulating activities in outer space while adhering to an international regime of rules and regulations. It has been used by all major space-faring nations in order to ensure that they comply with international law and to protect their interests. In addition, it has provided a platform for the peaceful use of space by all states and is a cornerstone of modern international space law. The proper management of space requires that all objects in orbit be registered. While most countries acknowledge this and adhere to the Registration Convention and UN General Assembly Resolution, which were established to allow registration, they all handle and interpret registration differently [32]. Therefore, it should not be assumed that the application of the basic principles of international space law does not apply to certain types of exploration or usage of outer space just because there are no precise laws controlling every possible activity in space [33]. Through this convention, States have been able to ensure that their activities in outer space serve their own interests while respecting the rights of other countries. The 1975 Registration Convention has had an enormous impact on international space activity and continues to guide these activities today. It provides an invaluable framework for international cooperation and helps prevent potential conflicts from arising due to conflicting interests in outer space. As a result, it serves as an important milestone in both international space law and its application as we continue our exploration of the cosmos.

In addition to the multilateral treaties overseen by international organizations, there are several bilateral agreements between countries concerning satellite communications rights that may include regulations governing ownership, access rights, traffic routing protocols, frequency coordination requirements or any other terms and conditions. Satellite networks are increasingly becoming a crucial part of the global communications infrastructure, so it is important for nations to abide by international laws and regulations to ensure that their operations do not interfere with those of other countries. By adhering to these standards, satellite networks can continue to provide efficient services while avoiding disruptions due to technical or legal issues. Furthermore, respecting the laws and regulations set forth by international organizations ensures that all nations benefit from peaceful exploration and use of outer space. All in all, satellite networks offer immense opportunities for communication, navigation, data transfer and other activities; however, they must be regulated properly to maximize their potential while minimizing any possible risks associated with their use.

3.4 The ITU Radio Regulations (RR)

The International Telecommunication Union (ITU) is a pivotal force in the regulation of global radiocommunication services [34]. Its core document, the ITU Radio Regulations (RR), serves as the cornerstone of these efforts, impacting the utilization of radio frequencies and radiocommunication services on an international scale [35].

The primary function of the ITU RR is to establish a regulatory framework for the use of radio frequencies and orbital slots. This is an immensely significant role as frequencies and slots are finite resources that must be managed meticulously to avoid interference and ensure efficient usage. In this context, the ITU RR serves as the international agreement that defines the terms of access to this spectrum [35].

The ITU, via the RR, aims to create a balanced and equitable distribution of these resources among nations. This is accomplished through frequency coordination regulations, which ensure that all countries have fair access to the radio spectrum and orbital slots, preventing monopolization by a few countries or organizations.

The ITU's role extends beyond mere regulation, serving as a forum for negotiation and coordination among nations. Through coordination meetings and world radiocommunication conferences, the ITU facilitates dialogue and collaboration, enabling nations to make collective decisions on spectrum management.

Moreover, the ITU RR promotes technological innovation. By defining the legal framework for radio frequency usage, it fosters an environment conducive to the development and deployment of new technologies. These advancements, ranging from 5G cellular networks to satellite navigation systems, rely on the standardized and coordinated global spectrum management ensured by the ITU [35].

Despite technological advancements and the evolving nature of the telecom industry, the ITU RR remains a relevant and necessary tool. By managing radio frequencies and orbital slots, the ITU through the RR is helping to shape the future of global communications, ensuring that all of humanity can benefit from the opportunities provided by these resources.

The ITU RR plays an indispensable role in managing the global telecommunications landscape. Its mandate for frequency coordination and equitable spectrum access underpins the growth and sustainability of global radiocommunication services, ensuring that the finite resources of radio frequencies and orbital slots are used for the benefit of all mankind [35].

4. Satellite Networks, Data Privacy and Security

With the growing complexity of satellite networks and their integration into terrestrial infrastructures comes the challenge of data privacy and security. Satellite technology has enabled a wide range of services such as emergency response systems, mobile communications, GPS navigation, and broadband applications. As these technologies become increasingly used for mission critical operations, it is essential that adequate steps are taken to ensure data privacy and security. The primary concern regarding data privacy centers on the ability of parties other than the intended recipient to potentially intercept or access transmissions made via satellite communications systems. Data encryption techniques have been used to protect satellite communications from unauthorized access, but in recent years encryption has become increasingly vulnerable as cybercriminals have developed sophisticated methods for breaking into networks. Another concern is the potential for malicious actors to hijack satellite transmissions and redirect them to another location. This poses a significant risk to both individuals and organizations that rely on secure and reliable communications via satellite networks. Additional security measures must be taken such as authentication of data transmissions and encryption of sensitive data prior to transmission over the network. Furthermore, it is important to ensure that adequate physical security measures are implemented at all sites associated with the satellite network, including ground stations and other remote locations where links are established between satellites and terrestrial systems. Finally, it is essential that appropriate policies and procedures are in place to ensure that the confidentiality, integrity, and availability of the data transmitted over satellite networks is maintained.

This includes implementing robust access control mechanisms to limit who can access sensitive data and enacting stringent authentication protocols for users accessing the system.

5. Satellite Networks and Copyright Infringement

Copyright infringement is a major concern when it comes to satellite networks. As the world has become increasingly interconnected and dependent on digital technologies, so too have intellectual property rights come under threat. Satellites offer a variety of ways for individuals to access content without going through traditional channels. This can include downloading movies and music illegally or streaming live TV channels that are not available in their region. In response to this problem, international organizations such as the World Intellectual Property Organization (WIPO) have taken steps to protect copyright holders from these kinds of activities. For example, WIPO has negotiated agreements with several major satellite operators that require them to take specific steps in order to prevent illegal activity on their networks. These measures include monitoring for illegal downloads and transmissions, as well as utilizing technological solutions such as encryption and digital rights management (DRM) systems. Additionally, some countries have adopted laws that allow copyright holders to pursue legal action against satellite operators that fail to adequately protect their intellectual property. For example, the U.S. Digital Millennium Copyright Act allows copyright holders to sue satellite providers who knowingly transmit content without permission or who do not take reasonable steps to prevent piracy on their networks. These kinds of laws help ensure that satellite networks abide by international standards of copyright protection while still allowing consumers access to a wide range of content.

6. The Role of Satellite Communications in Global Trade

The role of satellite communications in global trade is becoming increasingly important in the 21st century. The ability to communicate instantaneously and securely over long distances has allowed businesses to expand their operations around the world and increase profits. In addition, satellite communications enable companies to keep track of goods that are being shipped across borders, reduce costs associated with international shipments, and monitor customer service levels around the globe. With this technology, businesses can more easily connect with customers in other countries, open new markets for their products, and get a better understanding of market dynamics outside their home country.

Satellite communications have enabled businesses to become more efficient by allowing them to operate in real time. By providing access to up-to-date data regarding supply chain logistics, companies can make decisions that are informed and well-timed. This can dramatically reduce their costs, as they no longer must wait for information to arrive manually. In addition, satellite communications enable businesses to track the progress of shipments in real time and act when delays occur.

Another benefit of satellite communications is that it allows businesses to remain competitive in the global marketplace by providing access to timely pricing information. By quickly responding to market changes, companies can maximize their profits while minimizing risks associated with changing exchange rates or commodity prices. This also helps them protect their customers from price shocks caused by unexpected events or fluctuations in the markets worldwide.

Overall, satellite communications play a vital role in facilitating global trade and helping businesses succeed in the digital age. By providing access to up-to-date information, businesses can make more informed decisions and respond quickly to market changes. In

addition, satellite communications enable businesses to operate in real time and reduce costs associated with international shipments. Finally, this technology helps protect customers from price shocks caused by unexpected events or fluctuations in markets worldwide. With these benefits, it is no wonder that satellite communications are becoming ever more important for global trade in the 21st century.

7 The Impact of Satellite Networks on Taxation Laws

The development of satellite communication networks has had a profound impact on the way people access information. This technology has revolutionized how businesses, government agencies and individuals communicate, connect and collaborate with each other. Unfortunately, this technological advancement also affects taxation policies in many ways. To understand how satellite networks affect taxation laws, it is important to first define what constitutes these types of networks and the associated terms. Indeed, it is the most recent effort to control the fledgling space mining sector, and it includes a number of clauses that, to a significant degree, question the conventional wisdom of fundamental principles of international space law [36]. A satellite network is an electronic communication system that uses an orbiting object to relay signals from one point on earth to another typically by radio waves or microwaves. It consists of transponders which receive incoming signals from ground stations or other satellites, amplifies them and then retransmits the signals back to earth. The taxation implications of satellite networks are varied and can be complex. One way in which these systems affect taxes is through the use of Depreciation Expense for tax purposes when using tangible assets such as satellites and ground stations. Depreciation is an expense used by companies to recover their costs associated with capital investments over time, allowing them to spread out the cost of an asset over its useful life on their income statement rather than having to include it all in one year's income. This allows businesses to receive a tax deduction for those expenses, reducing their taxable income and ultimately reducing the amount of taxes they have to pay. Additionally, many countries have implemented Value Added Tax (VAT) or Sales Tax on satellite services, which can significantly impact the cost of communication services. Lastly, taxation policies may also play a role in how far apart two points must be for a person or company to connect with one another using a satellite network. This is because governments often require companies to pay taxes on their income earned from customers located within their borders, so companies may only choose to offer service to locations where they will not have to pay extra taxes. Satellite networks are an integral part of today's communication infrastructure, and it is important for both companies and individuals to understand how taxation policies can affect these types of systems. It is also important for governments and legislators to continue evaluating tax implications associated with satellite networks as technology advances in order to ensure that businesses and individuals are not placed at an unfair disadvantage in the market.

8 The Regime Developed in the Context of the WTO

In 1947, the General Agreement on Tariffs and Trade (GATT) was established to create a framework for reducing trade barriers between nations. The treaty had potential for global application, including the reduction of import tariffs and quotas. Although it was not an intergovernmental organization, a secretariat in Geneva began operation as an institutional platform to support endeavors towards liberalizing international trade. The General Agreement on Tariffs and Trade (GATT) talks over the last half century have resulted in a significant multilateral decrease in tariff barriers. As tariffs have been lowered, focus has switched to other domestic measures that might serve as secondary trade obstacles [37]. The rapid expansion of international commerce, however, suggests that the total degree of protection has declined over time [38]. Stricter regulations on safeguards and the use of antidumping duties are also needed to ensure that these

measures are not substituted for those eliminated [39]. These endeavors involved applying the GATT rules and obligations to particular sets or categories of goods as agreed upon during long international negotiations known as Rounds. Through this process, barriers were progressively lowered across countries. In the early 1990s, the success of GATT prompted a desire to expand trade liberalization. This resulted in 1994 with the General Agreement on Trade in Services (GATS) - an agreement to create a similar framework for trading services alongside goods. Additionally, another measure was taken to support and institutionalize all existing trade liberalization efforts by forming the World Trade Organization (WTO).

Under the WTO Agreement, which serves as the overarching legal framework, Multilateral Trade Agreements and Plurilateral Trade Agreements bring numerous specific agreements to form the bulk of substantive trade regulations. These agreements are achieved following deliberations held at Ministerial Conferences or various 'Rounds' previously discussed, applying general trade liberalization policies to certain issues or sectors. However, a two-pillar framework in which the WTO regulates with its 1994 rules and mega-regional agreements set the new standards for production chains is the most likely outcome for international trade regulation [40].

9 Liability and Responsibility

Satellite communications is an activity primarily located in outer space, and so States are held responsible for the actions of their citizens, whether they are part of a public organization or private commercial entity. This responsibility is outlined in Article VI of the Outer Space Treaty. Furthermore, Article VII of the same treaty states that States must be accountable for any damage happened from space activities.

States have taken steps to make sure that they follow Article VI of the Outer Space Treaty by enacting domestic legislation and licensing schemes. The economic and technical prospects and the ideals that have guided international space law must be balanced [41] and a paradigm change can be achieved by setting space-based goals [42]. These measures have several advantages for the State in question. Firstly, it guarantees that relevant information concerning space or satellite operations is provided to the regulatory body. Secondly, it allows for license renewal, which facilitates ongoing oversight of space activities as mandated by Article VI of the Outer Space Treaty. Thirdly, it establishes a framework on which liability can be distributed or shared between the government and entity involved.

When a space activity causes harm, the 1971 Liability Convention prescribes two different forms of liability for launching States: absolute responsibility for damages inflicted on the surface of Earth or to aircraft in flight; and fault liability for damage caused elsewhere than the ground. In both cases, the term 'damage' refers to personal injury or damage to property that can be either natural or juridical.

It is noteworthy that the Liability Convention applies not just to States, but also to Member States of international organizations who have accepted its rights and obligations. Furthermore, the Convention does not apply to nationals of the launching State or to foreign nationals of participating States. The only three categories of claimants allowed by it are the State of nationality, the State of the territory in which damage occurred and the State whose permanent residents have suffered damage.

Any claims should be made within one year of when the damage or liable State is identified by diplomatic channels, another state, or the UN Secretary General. Additionally, there's no need to exhaust local remedies before filing a claim. If a settlement is not reached, the Convention provides for the formation of a Claims Commission.

10 Potential Strategies for Improving the Legal Framework Governing Satellite Networks

Potential strategies for improving the legal framework governing satellite networks can include strengthening existing laws and regulations (10.1), developing global standards for data protection (10.2), increasing transparency in how companies use satellite technology (10.3), strengthening the role of international organisations (10.4).

10.1 Strengthening Existing Laws and Regulations

The development of effective strategies will require collaboration between public and private sector stakeholders to ensure that any laws or regulations are effectively enforced. Space commercialization is growing [43]. To reinforce these laws, public–private partnership (PPP), Space Act Agreements, and government privatization projects must be accommodated [44].

There is no doubt that the Artemis Accords have played a significant role in redefining the landscape of space exploration, particularly in fostering effective Private-Public Partnerships (PPP). These Accords, led by NASA, provide a framework for a harmonious and sustainable exploration of space, encouraging international and commercial participation [45]. The Accords have thus accelerated the development of PPP, offering private entities an opportunity to contribute to space exploration and related activities. The policy clarity provided by the Artemis Accords encourages private sector investment and innovation in space technologies, leading to cost-effective solutions and expediting the pace of space exploration. Hence, the Artemis Accords are instrumental in stimulating the development of robust PPP, facilitating the sustainable and collaborative exploration of space [45].

Strengthening existing laws and regulations is a key step in creating an effective legal framework for satellite networks. This involves evaluating current regulations to identify any gaps or weaknesses, then amending or replacing them if necessary.

Existing laws and institutions, including the United Nations (UN), often fall short in effectively regulating the intricate legal issues surrounding satellite networks. One primary obstacle is the unenforceability of international treaties. These agreements, albeit crucial for establishing global norms, often lack stringent enforcement mechanisms, turning them into mere statements of intent rather than binding rules. Furthermore, questions arise concerning the jurisdictional scope of bodies like the UN, World Intellectual Property Organization (WIPO), and World Trade Organization (WTO). The blurred lines of authority often result in a regulatory gap, undermining the efficacy of these institutions. Additionally, the merits of initiatives taken by individual countries or blocs, such as the Artemis Accords, are contentious [46]. While they may fill the regulatory void to some extent, their legitimacy remains questionable due to their unilateral or geographically limited nature, potentially exacerbating disparities in space exploration and usage. The current scenario calls for a comprehensive, enforceable, and globally accepted legal framework to regulate satellite networks.

Another emerging challenge includes space debris, asteroid mining, space tourism, lunar colonization, Martian exploration, potential territorial claims by nations, and the escalating risk of space becoming a new theater for warfare, including the use of anti-satellite weapons [47]. The latter issue exacerbates the already significant space debris problem, as anti-satellite weapon testing can generate a high volume of debris [48]. It is imperative that international legal instruments adapt to address these evolving realities, ensuring that outer space remains a realm of peaceful exploration and cooperation [48].

The development of new laws and regulations should be informed by best practices in other countries, as well as the views of experts in the field.

10.2 Developing Global Standards for Data Protection

As satellite technology continues to evolve and become more widely used, there is a need for greater global standards regarding data protection. It is essential that these standards are implemented across all countries in order to ensure that individuals' privacy is respected, and their personal information is secure from unauthorized access. This could involve the introduction of data protection laws, or the development of an international code of conduct that is agreed upon by all relevant stakeholders and enforced accordingly.

10.3 Increasing Transparency in How Companies Use Satellite Technology

Users may benefit from increased mobility, adaptability, responsiveness, power, and efficiency thanks to space-based satellite communications systems, more powerful processors, new encoding capabilities, and new user terminal capabilities [49]. One issue with satellite technology is that it can be used for a variety of purposes, some of which may be unethical or otherwise not in keeping with the values and beliefs of certain individuals. To ensure that companies are not misusing satellite technology, there should be increased transparency in how companies use this technology and what data they collect. This can involve greater public disclosure requirements as well as measures to ensure that personal data is not shared without consent. Ultimately, it is important to remember that the development of an effective legal framework for satellite networks requires collaboration between all stakeholders, including governments, industry and civil society. By working together, it is possible to create a set of laws and regulations that will protect individuals' privacy and ensure that companies are properly regulated when using satellite technology. This will help to ensure that this technology is used responsibly, for the benefit of all.

10.4 Strengthening the Role of International Organisations

The International Telecommunication Union (ITU) plays a pivotal role in formulating global standards and policies that govern the increasingly complex world of telecommunications. The organization has been investing substantial resources in cybersecurity, recognizing its critical importance in ensuring secure and reliable satellite communications. Recent efforts include establishing international cybersecurity frameworks and promoting co-operation among nations to combat cyber threats [50]. However, there are ongoing debates concerning the extent of ITU's authority for this scope of work. It is argued that, while the ITU is doing commendable work in developing standards and fostering dialogue, the sheer complexity and cross-border nature of cybersecurity issues might demand a more robust and globally coordinated response [51]. As technology continues to evolve, the ITU's role in this space remains vital but also prompts questions about its capacity and jurisdiction in dealing with such intricate challenges.

Additionally, the ITU is also regularly involved in resolving disputes between states over spectrum allocation and jurisdiction. With modern communication tools becoming more essential for everyday life, it is not uncommon for countries to find overlapping claims over certain frequency bands. The ITU's arbitration process provides a platform for affected parties to come together and discuss mutually agreeable solutions in such cases. In recent years, the organization has seen a surge in dispute resolution cases as more countries look to secure their share of frequency bands for telecommunication services. The same could be said for the ITU's role as an arbitrator for disputes between states concerning the siting of communication-related facilities and infrastructure. As the demand for satellite networks continues to grow, so does the need for timely and effective dispute resolution. Thus, the ITU remains at the forefront of providing a platform for international dialogue on such matters [52].

The ITU also works to promote access to communication technology across different parts of the world. This is achieved through a number of initiatives including technical

capacity building programs, global awareness campaigns, and support for local telecommunications infrastructure development projects. In particular, the ITU has recently been involved in providing support and assistance for countries looking to bridge the digital divide among their citizens. From increasing access to education in remote areas through satellite connections to supporting communities with limited access to modern communication tools, the ITU's work is helping to improve lives in some of the most underserved parts of the world [53].

Overall, the ITU is committed to making the world a better place through communication technology. This includes their stated aim of providing equitable access to the Radio Frequency Spectrum, improving global connectivity, and reinforcing the power of digitalization for social good. From developing specifications for emerging technologies to ensuring cross-border cooperation on matters related to communications, the ITU's work provides both economic and social benefits to countries around the globe.

11 Conclusions

In order to make efficient and ethical use of space-based technology, a solid legal framework must be in place to regulate satellite networks. Possible approaches to this goal include strengthening current rules and regulations, creating worldwide standards for data security, and enhancing openness in how businesses utilize satellite technology. Successful implementation requires cooperation between public and private sector parties. Keep in mind that governments, businesses, and the public all need to work together for a lawful framework to operate. This will guarantee the safe and beneficial use of satellite technology. Several options exist for enhancing the legislative framework that regulates satellite networks.

First, any loopholes or other flaws in the current set of rules and regulations need to be closed. To guarantee that any rules or regulations are really implemented, collaboration between public and private sector parties is essential. Furthermore, while crafting new rules and regulations, it is important to consider both international best practices and the opinions of subject matter experts. Partnerships between the public and commercial sectors may be quite useful in this regard, since they encourage creativity and make better use of available resources.

Second, improved worldwide data security standards are essential. It is possible to preserve people's privacy and prevent unlawful access to their personal information via the implementation of data protection legislation or the creation of an international code of conduct. For these guidelines to be successful, they will need to be implemented internationally.

Finally, it is critical that businesses be more open about their satellite technology use. Assuring that satellite technology is not abused requires public disclosure regulations and procedures to prohibit the transfer of personal data without authorization. Governments, businesses, and civil society may work together to craft privacy-protecting rules and regulations for the commercial use of satellite technology.

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