Annexure N

High Altitude Platform Stations (HAPS): The new Frontier at the intersection between Air and Space Law

by

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ABSTRACT

This mini-dissertation intends to explores the use of High-Altitude Platforms (HAPS) for broadband communication services in rural areas as an alternative to mobile networks, as half the world's population, most of whom live in rural areas, lacks internet access.

Finding ways to improve broadband access and telecommunication services, particularly in rural and underserved areas, is essential for closing the digital divide. The advantages that HAPS have over traditional terrestrial and satellite wireless networks are numerous. HAPS have the potential for wireless communication and are deployable stations that can operate at altitudes between 20 and 50 kilometres. However, their unproven nature prompts inquiries, especially into their legitimacy. Because they operate in the stratosphere, a previously uncharted zone, HAPS is not like other space-launched items in terms of design or purpose. As a result, there is still a lack of clarity regarding the rules and regulations that apply to HAPS operations.

Therefore, this paper intends to look at the different legal frameworks which might be applicable to HAPS. It seeks to analyse the current division between air law, which is licensed and operates within the national (Aviation Authorities) and international (International Civil Aviation Organisation (ICOA)) jurisdictions. The various space treaties which govern space activities and the role of the International Telecommunications Union (ITU) which identifies relevant radio frequencies for the use by HAPS.

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Chapter 1: Introduction to HAPS

1.1 Introduction

Over the past 20 years, internet connectivity has become more and more important to our daily life. It has become the foundation of the digital economy and supports many social and economic actions that people do every day, such as how they work, learn, shop, talk to each other, and do business. As the recent COVID-19 pandemic has demonstrated, social connections are crucial. With limits on movement and trade, connectivity has become a way for friends and family to stay in touch, for companies to run safely, and for governments to find new ways to provide public services like education and healthcare. In the world after the pandemic, people will depend on connectivity even more as governments try to speed up the economic rebound and businesses look for ways to make more production and efficiency gains. This makes it clear that people who aren't connected to the internet around the world run the risk of being left out of the digital economy.

The vast majority of internet users now access the internet from their mobile devices. In developing countries, mobile broadband is still the most common and sometimes only option for accessing the internet.[1] Mobile connectivity provides numerous socio-economic benefits, such as enhancing well-being[2], promoting socio-economic growth[3], alleviating poverty[4], and granting access to information and services that would otherwise be unavailable. Because of the benefits that these advantages bring to people's day-to-day lives, there is a positive impact on society as a whole as a result of these advantages.[5]

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[1] International Telecommunications Union (ITU), World Telecommunication ICT Indicators (WTI) Report, (2021) available at https://www.itu.int/pub/D-IND-WTID.OL-2021 (accessed 26 April 2023).

[2] Global System for Mobile Association (GSMA) Mobile Internet Use, Well-being and Gender: Understanding the Links report (2022); GSMA, The Impact of Mobile and Internet Technology on Women's Wellbeing Around the World (2019);

[3] ITU, How broadband, digitization and ICT regulation impact the global economy Report (2020), available at https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.BDR-2020-PDF-E.pdf , (accessed on 26 April 2023).; GSMA, The Mobile Gender Gap Report (2019), available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2022/06/Digital-Inclusion-Impact-Summary.pdf (accessed 26 April 2023).

[4] Bahia, K. et al., Mobile Broadband Internet, Poverty and Labour Outcomes in Tanzania, World Bank Group (2021).

[5] GSMA, The Mobile Gender Gap Report (2020), available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/05/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf (accessed 27 April 2023).

Despite the many recent advances, half the world still lacks internet connectivity and its numerous benefits.[6] They are mostly poor, have less education, are women, have disabilities, and live in rural areas. Most people (3.2 billion) live in places where mobile internet is available, but 400 million don't. Even though the number of people who have access to mobile internet is growing, Sub-Saharan Africa still has the largest coverage gap at 17%.[7] Due to high costs, profits can be lower, and logistics can be challenging, all of which contribute to the lack of mobile internet coverage in remote and rural areas.

Those who lack access to the internet typically reside in remote, rural locations with few inhabitants and challenging topography, where the high investment costs and low return on investment (ROI) pose significant challenges for network providers. New base stations can be up to twice as expensive to set up and three times as expensive to run in rural areas compared to metropolitan areas, with up to ten times lower profits.[8] Providing internet access to these outlying places is difficult enough, but doing so in a sustainable manner is an even greater problem.

The COVID-19 epidemic has highlighted the significance of the internet and the vital role of digital technologies, which is the major means by which most people access the internet. The internet accesses important information, services, and opportunities while also promoting economic growth. There is currently mobile internet connection available to almost half of the world's population. In spite of this, there is a lot more work that needs to be done to advance the cause of digital inclusion and make certain that nobody is left behind in an increasingly connected world.

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[6] GSMA, The State of Mobile Connectivity Report (2022), available at https://www.gsma.com/r/wp-content/uploads/2022/12/The-State-of-Mobile-Internet-Connectivity-Report-2022.pdf?utm_source=website&utm_medium=download-button&utm_campaign=somic22 (accessed 27 April 2023).

[7] Ibid

[8] GSMA, Enabling Rural Coverage: Regulatory and policy recommendations to foster mobile broadband coverage in developing countries Report, (2018), available at https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2018/02/Enabling_Rural_Coverage_English_February_2018.pdf (accessed 27 April 2023).

			Usage gap		Coverage gap		
	Adult population (m)	**Mobile internet subscribers (m)**	**Total (m)**	**Usage gap (% of population)**	**No coverage (m)**	**Edge of coverage (m)**	**Effective coverage gap (% of population)***
East Asia & the Pacific	2,126	1,786	278	13%	62	83	6.9%
Europe & Central Asia	729	657	46	6%	25	28	7.3%
Latin America & the Caribbean	575	435	131	23%	10	24	5.8%
Middle East & North Africa	453	307	132	29%	14	20	7.3%
North America	336	309	26	8%	0	13	4.1%
South Asia	1,682	933	682	41%	66	70	8.1%
Sub-Saharan Africa	888	415	408	46%	66	42	12.1%
Global	6,788	4,841	1,704	25%	243	279	7.7%

Table 1: Prediction of internet coverage gap by 2025. Source GSMA Intelligence – Satellite 2.0: Going direct to Device, March 2022

The demand for wireless technology is expected to increase across all sectors. This is because they are relying more on wireless technology to enhance and simplify their operations and services.[9] In response to this requirement, terrestrial and satellite wireless networks have been deployed much quicker. Both commercial and non-commercial players in the telecommunications industry are actively seeking solutions to address the perceived problem of insufficient capacity for future wireless applications and services and are exploring various approaches to tackle this challenge.[10]

High Altitude Platform Stations (HAPS), which can provide broadband wireless services from the stratosphere at altitudes of 20 to 50 km, are a promising new option for telecommunications companies that can combine the advantages of terrestrial and satellite networks. As such, this mini-dissertation intends to have a closer look at HAPS, its utilization and benefits for deploying this developing technology.

[9] Tseytlin M., ITU News, "High Altitude Platform Stations (HAPS) — bringing connectivity to all" (2019), available at https://news.itu.int/high-altitude-platform-stations-haps-bringing-connectivity-to-all/ (accessed 27 April 2023).
[10] Whitt R. and Maguire Y., ITU News, "Connecting the World from 20,000 meters" (2015), available at https://news.itu.int/connecting-world-20000-meters/ (accessed 1 May 2023).

1.2 Background

Due to its ability to function at high altitudes, HAPS can provide broadband services to customers and facilitate backhaul services that link a mobile connection to a core network.[11] These HAPS is crucial for areas which have no internet connectivity because of the difficulties in constructing mobile networks in those areas. These challenges may include difficult ground conditions, isolation, and high costs associated with providing services through terrestrial mobile networks.[12]

HAPS is airborne platforms that are positioned in the stratosphere at an altitude range of 20 to 50 kilometres above the surface of the Earth.[13] The ability to fly on demand means they can service a wide range of locations. In addition, HAPS can provide broadcasting capability, is much cheaper to construct then satellites, easy deployable and maintenance are cost effective.[14] This is just a few of the ways in which HAPS can be beneficial to ensure connectivity in rural areas at an affordable cost. However, there are a few limitations to the operation of HAPS, including the fact that they need to be refuelled or have their batteries replaced, and the fact that they might become unstable in the air and be a risk at either crashing to earth or worse, crashing into an aeroplane.

HAPS have a wide range of applications, such as broadcasting signals, providing broadband wireless connectivity, facilitating navigation services, monitoring traffic and environmental conditions, and facilitating emergency communications to name a few. Moreover, HAPS presents significant potential in consolidating their position in the fifth-generation (5G) services and subsequent generations by providing backhaul services to base stations, thereby

[11] ITU News, "WRC-19 identifies additional frequency bands for High Altitude Platform Station" (2019), available at https://news.itu.int/wrc-19-identifies-additional-frequency-bands-for-high-altitude-platform-station-systems/#:~:text=HAPS%20systems%20can%20be%20used,mountainous%2C%20coastal%20and%20desert%20areas. (accessed on 1 May 2023).

[12] Kaltenhäuser S. and Nikodem F., "Operation and operation approval of high altitude platforms (HAPS)", presented at the Deutscher Luft- und Raumfahrtkongress (2019), Darmstadt, available at https://elib.dlr.de/131061/ (accessed 2 May 2023).

[13] Karapantazis S. and Pavlidou F.N., Broadband communications via high altitude platforms (HAP) (2005); Djuknic, GM, Freidenfelds, F,and Okunev, Y, Establishing wireless communications services via high-altitude aeronautical platforms: A concept whose time has come?'' (1997).

[14] Araniti G., Iera A., and Molinaro B., The role of HAPS in supporting multimedia broadcast and multicast services in terrestrial-satellite integrated systems, (2005); Mohammed, A, Arnon, S, Grace, D, Mondin, M, and Muira, R, Advanced communication techniques and applications for high altitude platforms, (2008).

reducing the traffic load on the respective cellular systems' networks.[15] The argument is that by integrating terrestrial, HAPS, and satellite networks, the final goal can be attained to have those in rural and underserved areas being connected to the internet.

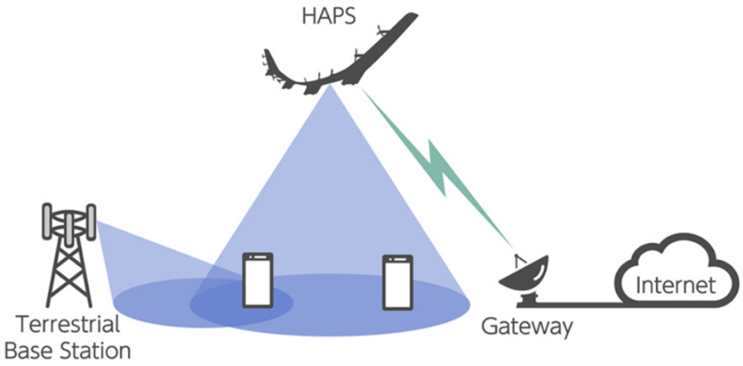

Figure 1: An illustration of HAPS technology – HAPS Alliance

As shall be illustrated, due to legal uncertainty which exist between HAPS developers and the jurisdiction within which they intend to operate, remains unclear. This uncertainty is compounded by concerns related to a country's sovereignty and security.[16]

Technological advancements have facilitated the introduction of new space objects, thereby altering the framework of international air and space law, and posing a challenge to the conventional understanding of spatial demarcation. The advancement of technology has expanded the boundaries of aviation, enabling the implementation of innovative systems in previously unexplored domains. The aforementioned activities serve to increasingly obscure the distinction between aviation and space.[17]

Consequently, the determination of applicable legal rules to these activities, particularly stratospheric operations like those conducted by HAPS, has become intricate and challenging.

[15] Evans B.G., and Baughan K., Visions of 4G, [Electron. Commun. Eng. J., vol. 12, (2000); Karapantazis, supra note 13
[16] Liu Hao and Tronchetti F., "The Exclusive Utilization Space: A New Approach to the Management and utilization of the Near Space", University of Pennsylvania Journal of International Law (2019).
[17] Hunter S., "Safe Operations Above FL600" (2015), available at https://commons.erau.edu/cgi/viewcontent.cgi?article=1065&context=stm (accessed 4 May 2023)

1.3 Overview of Air and Space Law:

There are substantial differences between the legal systems that regulate air law and space law respectively. Apart from established international law and bilateral air transport agreements between countries,[18] the regulations pertaining to aviation are subject to several significant multilateral Conventions.[19]

Agreements between independent states and established norms of international law are necessary for Space Law to function as a system of law, which includes resolutions promulgated by the United Nations, edicts issued by international organizations, domestic legal frameworks,[20] and court decisions. Additionally, there are five multilateral Conventions that govern this area:

- The Outer Space Treaty;[21]
- The Rescue Agreement;[22]
- The Liability Convention;[23]
- The Registration Convention;[24] and
- The Moon Agreement.[25]

According to the aforementioned multilateral conventions, States are required to follow the norms of international law, be responsible, liable regarding their space operations, oversee their citizens' behaviour in space, and both the public and the private sectors have an obligation to report and register their space objects.[26]

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[18] Article 38 (1) of the Statute of the International Court of Justice (became effective 24 October 1945), the Court, whose function is to decide in accordance with international law such disputes as are submitted to it.
[19] Amongst these Conventions are: Paris Convention of 1919; Warsaw Convention of 1929; Chicago Convention of 1944; the Tokyo Convention of 1963; Montreal Protocols of 1966; Montreal Convention of 1999; Cape Town Convention of 2001; and Beijing Convention and Protocol of 2010 to name a few;
[20] Dempsey P.S, "National Laws Governing Commercial Space Activities: Legislation, Regulation & Enforcement ", (2016).
[21] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967 (entered into force on 10 October 1967).
[22] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 22 April 1968 (entered into force 3 December 1968)
[23] Convention on International Liability for Damage Caused by Space Objects, 29 March 1972 (entered into force 1 September 1972)
[24] Convention on Registration of Objects Launched into Outer Space, 6 June 1975 (entered into force 15 September 1976)
[25] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 5 December 1979 (entered into force 11 July 1984)
[26] Hobe S. & Chen KW., "Legal Status of Outer Space and Celestial Bodies", (2017).

The legal frameworks that regulate airspace and outer space are separate and give rise to a unique conflict. Airspace is seen as a place where states can exercise their sovereignty, but outer space is not a place where sovereignty can be claimed. According to the Chicago Convention, each country has "full and exclusive" right to regulate its own airspace.[27] According to the Outer Space Treaty, no nation may lay claim to any area of space.[28]

In light of the abovementioned circumstances, this mini-dissertation aims to investigate the overarching research question of "**How can the activities of High Altitude Platform Stations (HAPS) be effectively regulated?".** The writer has posed additional sub-questions for consideration. The first sub-question pertains to the definition and characteristics of HAPS. The second part of the question is concerned with the boundaries between air and space, as well as the numerous theoretical models presented to explain how things work in these regions. Given recent technological advancements, it is worth considering whether the traditional categorization of airspace or outer space remains appropriate and what are the primary legal regulations that apply to HAPS in this particular context?

1.4 Methodology and Limitations:

Methodology: To address the various research question, a doctrinal methodology was employed, which entailed scrutinizing and critically evaluating academic works, reports, and explanatory materials from global organizations like the United Nations' International Telecommunications Union (ITU) and the International Civil Aviation Organization (ICAO).

Limitations: The scope of this mini-dissertation is constrained to a certain extent. The primary objective of this mini-dissertation is not to offer conclusive answers, but rather to present ideas for consideration. A further objective of this mini-dissertation is to highlight the existing ambiguity regarding the legal standing of HAPS operations and to encourage the establishing of a regulatory structure to oversee its operations. This mini-dissertation acknowledges the

[27] Article 1, Chicago Convention:
"The contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory." On State sovereignty in international aviation, see Truxal S., Economic and Environmental Regulation of International Aviation, (2017).
[28] Art. II, Outer Space Treaty:
"Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

contentious discourse surrounding the hypothetical demarcation of space and endeavours solely to present concepts that may serve as a basis for subsequent deliberation.

1.5 Chapter breakdown:

This study is broken up into five (5) chapters to provide a thorough overview of the topic at hand, and its primary emphasis of analysis is on the question of what constitutes "air" and "space" in the context of HAPS operations. Chapter 1 provides an overview of HAPS and its applications in order to understand its operational functions. To provide an overview of air and space law, their scope. It further identifies the research question and the purpose of the dissertation. It highlights the limitations and potential implications of the research and provides an outline of the dissertation. Chapter 2 intends to define HAPS, their key characteristics, discuss the types of HAPS and their possible use cases. Chapter 3 investigates the limits and differences that exist between air and space, as well as examines a number of different theoretical frameworks that have been presented to deal with this problem. Chapter 4 discusses the function of international organizations, such as ICAO[29] and the ITU,[30] in the regulation of HAPS. It further examines the challenges and opportunities associated with global coordination in the regulation of HAPS, including issues of safety, harmonization, standardization, and cooperation.

Because of the rise of wireless internet connections and digital transformation, there are an increase in competition of services to identify and allocate relevant spectrum frequency bands to roll out their services and guarantee against the risk of any harmful interference of adjacent services.[31] Chapter 5 suggests the possibility of creating an intermediary zone referred to as the "near space," which would be located between the airspace and outer space. Possible approaches to governing HAPS operations within the aforementioned framework are also being considered.

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[29] The International Civil Aviation Organization is a specialized agency of the United Nations that coordinates the principles and techniques of international air navigation, and fosters the planning and development of international air transport to ensure safe and orderly growth and was established on 7 December 1944;

[30] The International Telecommunication Union (ITU), is a specialized agency of the United Nations responsible for many matters related to information and communication technologies. It was established on 17 May 1865.

[31] ibid

Chapter 2: HAPS Technology and Applications

2.1 Introduction

Throughout the 1990's and 2000's, various global initiatives were launched to investigate the potential uses of HAPS in telecommunications and remote sensing.[32] HAPS is an aircraft positioned at altitudes exceeding 20 km within the stratosphere. These aircraft serve a range of purposes, including establishing telecommunications networks and conducting remote sensing activities for both civilian and military uses. These platforms come in various forms, such as airplanes, airships, or balloons, and can operate with or without a crew.[33] The stratosphere is a distinct atmospheric region characterised by a notable increase in temperature with increasing altitude.[34]

The ITU[35] hosts World Radio-communication Conference (WRC's) every 4 years, and the WRC in 2007, was pivotal in advancing the HAPS concept by allocating a radio frequency spectrum band to provide telecommunications services. The ITU serves as the regulatory body for radio frequency utilization worldwide and during WRC-97, the official designation of "High Altitude Platform Station" (HAPS) was established.[36] According to the defined parameters, HAPS is a telecommunication station positioned at altitudes ranging between 20 to 50 kilometres beyond the surface of the Earth, maintaining a fixed position relative to the planet.

Since wind speeds and the need for power to maintain a position are both lower at higher altitudes, HAPS operations will take place at an altitude of roughly 20 km.[37] Because of the calm weather, HAPS can effectively withstand wind and maintain its position.[38] HAPS operate

[32] Lee, YG., Kim, DM. & Yeom, CH. Development of Korean High Altitude Platform Systems, (2006). https://doi.org/10.1007/s10776-005-0018-6 (accessed 1 June 2023)
[33] Araripe d'Oliveira F., Cristovão Lourenço de Melo F. and Campos Devezas T., "High-Altitude Platforms—Present Situation and Technology Trends", (2016)
[34] Ehernberger L.J., "Stratospheric Turbulence Measurements and Models for Aerospace Plane Design", (December 1992), available at https://www.nasa.gov/centers/dryden/pdf/88279main_H-1865.pdf (accessed 1 June 2023).
[35] To ensure that radio frequencies are properly identified and allocated across the globe, the ITU was established as a specialised agency of the United Nation, available at https://www.itu.int/en/about/Pages/default.aspx (accessed 1 June 2023).
[36] Ibid
[37] Colozza A., "Initial feasibility assessment of a high altitude long endurance airship", (2003), available at https://ntrs.nasa.gov/api/citations/20040021326/downloads/20040021326.pdf , [accessed 2 June 2023].
[38] Tseytlin M., see note 9

in places where disasters like earthquakes, floods, and fires cannot reach.[39] HAPS can provide telecommunications services over a far wider area than commercial planes can at this height.[40] Furthermore, are also typically situated above normal commercial aircraft activity, with the height of restricted airspace varying from country to country.[41]

There are two primary types of HAPS, and they are known as aerostatic platforms and aerodynamic platforms.[42] Aerostatic platforms maintain their position in the air by utilizing buoyancy, while aerodynamic platforms rely on the dynamic forces generated as they move through the air. The term "lighter than air" is commonly used to describe aerostatic platforms, as they have a lower density than the surrounding air. Conversely, aerodynamic platforms are typically referred to as "heavier than air," as they possess a higher density compared to the air they navigate.[43]

Aerostatic platforms include airships and balloons, which float on gases like hydrogen and helium.[44] Balloons often don't have propulsion and require human pilots because of how difficult it is to regulate their flight. Airships, on the other hand, may fly for months without refuelling and don't require pilots.[45] Because of dynamic drag, this causes serious issues during take-off and landing.[46] However, the platform's vast surface area makes it ideal for installing solar panels to generate electricity, and it can carry larger cargoes.[47] Aerodynamic platforms, as contrast to aerostatic ones, need forward motion to stay afloat. So, they have to hover somewhere in the middle of the coverage area to stay somewhat still.[48] HAPS is widely recognized as a crucial bridge connecting terrestrial and satellites systems due to their unique characteristics and valuable attributes.[49] HAPS have the potential to either replace

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[39] Tozer T., Grace D., "High-Altitude Platforms for Wireless Communications", (2011)
[40] Araripe d'Oliveira et al, see note 33
[41] Widiawan AK., Tafazolli R., "High Altitude Platform Station (HAPS): a review of new infrastructure development for future wireless communications", (2006), available at https://doi.org/10.1007/s11277-006-9184-9 (accessed 2 June 2023)
[42] d'Oliveira F.A., Melo F.C.L.d., Devezas T.C., "High-altitude platforms—Present situation and technology trends" (2016)
[43] Grace D., Jiang T., Allsopp S., Reynaud L., Mohorcic M., "Aerial platform study", (2013).
[44] Gupta S.G., Ghonge M.M., Jawandhiya P., "Review of unmanned aircraft system (UAS)", (2013).
[45] Arjomandi M., Agostino S., Mammone M., Nelson M., Zhou T., "Classification of unmanned aerial vehicles", (2006)
[46] Watts A.C., Ambrosia V.G., Hinkley E.A., "Unmanned aircraft systems in remote sensing and scientific research: Classification and considerations of use", (2012).
[47] Ibid
[48] David G., Mohorcic M., "Broadband Communications Via High Altitude Platforms", (2010).
[49] Aziz M. and Iskandar. "Channel estimation for LTE downlink in high altitude platforms systems (HAPS)", (2013).

current communication infrastructure or complement existing wireless technologies, catering to diverse connectivity needs.[50]

HAPS represents an innovative solution that combines the best qualities of both terrestrial and satellite systems and avoiding the problems they may cause.[51] By occupying a place between Earth and space, HAPS is able to cut expenses, streamline operations, and improve communication.[52] HAPS operates at lower altitudes than geostationary (GEO) and low Earth orbit (LEO) satellites, enabling quick and almost immediate communication[53] and allowing for targeted coverage of specific regions of interest.[54] HAPS is in a prime location to meet the needs of 5G networks that demand ultra-low latencies.[55] In addition, HAPS is developed rapidly and can be quickly returned to the ground for servicing.[56] HAPS is more cost-effective than conventional satellites due to lower start-up and operating maintenance costs.[57] HAPS networks can function with far less communications infrastructure and much less ground-based equipment than terrestrial networks.[58] Coverage may be extended over larger areas with less disruption from obstructions as HAPS can have a faster deployment time than ground-based stations.[59]

2.2 Examples of HAPS Technology[60]

Because of the physical and technical limitations, as well as the fact that the technology was not readily available until recently, HAPS development has not been fully exploited in the

[50] Djuknic G., Freidenfelds J. and Okunev Y., "Establishing Wireless Communications Services via High Altitude Aeronautical Platforms: A Concept Whose Time Has Come?", (1997).
[51] Tozer T., see note 39
[52] Liu, X.; Liu, H.; Liu, C.; Luo, Y. "Time-Varying Communication Channel High Altitude Platform Station Link Budget and Channel Modeling", (2018) available at https://doi.org/10.3390/info9090210 (accessed 5 June 2023).
[53] Thales Alenia Space, "What is new with Stratobus", (2017), available at https://www.thalesgroup.com/en/worldwide/space/news/whats-stratobus (accessed 5 June 2023).
[54] Uniting Aviation, "High-altitude long-endurance aircraft are seeking new operational flight levels" (2019), available at https://www.unitingaviation.com/news/safety/high-fliers-high-altitude-long-endurance- aircraft-are-seeking-new-operational-flight-levels/ (accessed 5 June 2023).
[55] Ibid
[56] Tozer T., see note 39
[57] Araripe d'Oliveira et al, see note 33
[58] Grace D., Daly N.E., Tozer T.C., Burr A. and Pearce D.A.J, "Providing Multimedia Communications from High Altitude Platforms", (2001).
[59] David G., see note 48
[60] This is not a closed list of HAPS examples

past.[61] In recent decades, HAPS have improved in capability, and a few exciting and promising initiatives have emerged.[62]

Due to developments in aeronautic engineering, various HAPS research and development initiatives have been initiated over the past 20 years.[63] Prominent companies are currently in the process of developing and manufacturing HAPS, which are powered by solar energy and are either already commercially available or nearing that stage.[64]

2.2.1 The Zephyr – Airbus

Figure 2: Zephyr 7 UAV, QinetiQ, Airbus

In 2001, work began on what would become the Zephyr family of solar-powered, high-altitude unmanned aerial vehicles. The British firm QinetiQ's Zephyr 7, a two-propeller electric aircraft with a 23-meter wingspan, 55-kilogram mass, and 5-kilogram cargo capacity, developed in July 2010, marked a major milestone when it established a new record for flight endurance. Under the watchful eye of the United States Army, it flew nonstop for about 14 days at an altitude of around 18 km.[65] During the day, solar panels convert sunlight into electricity, and at night, it is operated by lithium batteries.[66] Airbus Defence and Space took over development of the Zephyr S variant after acquiring the project from QinetiQ in 2013. Although the payload capacity of 5 kg remains the same, the Zephyr S now boasts

Figure 3: Zephyr T and Zephyr S UAV's, Airbus

[61] Araripe d'Oliveira et al, see note 33.
[62] Preparations for WRC-19: "Understanding the issues at stake and the impact of decisions to be made", available at https://www.itu.int/en/ITU-D/Conferences/GSR/2019/Documents/Background_paper_Preparing%20for%20WRC19.pdf (accessed 5 June 2023).
[63] Djuknic G.M., Freidenfelds J., Okunev Y., "Establishing wireless communications services via high-altitude aeronautical platforms: A concept whose time has come?" (1997).
[64] "SoftBank Corp. Develops aircraft that delivers telecommunications connectivity from the stratosphere", 2019, Available at https://www.bloomberg.com/press-releases/2019-04-25/softbank-corp-develops-aircraft-that-delivers-telecommunications-connectivity-from-the-stratosphere (accessed on 6 June 2023).
[65] Amos J., "'Eternal plane' returns to Earth", (2010); available at http://bbc.co.uk/news/science-environment-10733998 (accessed 6 June 2023).
[66] Airbus, "Zephyr: Pioneering the Stratosphere", available at https://www.airbus.com/defence/uav/zephyr.html (accessed 6 June 2023).

enhanced autonomy, achieved through advancements in solar cells, batteries, and structural weight reduction.[67] The Zephyr T (twin-tail) was another upcoming variant and had the potential to carry 20 kilogrammes more cargo and had a wider wing span. The United Kingdom's Ministry of Defence granted Airbus a contract to manufacture and operate the Zephyr S in the amount of 13 million pounds in February 2016. This deal was historic since it was the first ever arrangement to provide a fully functional HAPS anywhere in the world.[68]

2.2.2 Project Loon – Google

Figure 4: Balloons of Project Loon, Google

In 2012, Google launched Project Loon, which aimed to address the lack of internet access in underserved areas by deploying a network of stratospheric balloons. The primary objective was to bring internet connectivity to regions with limited or no access to traditional communication infrastructure.[69] Each balloon could possibly stay in the air for up to 100 days thanks to its solar panels, and the average altitude of flight was 20 kilometres. The concept involves launching multiple balloons to form a ring at specific latitudes, creating a constellation.[70]

In February 2016, Google partnered with local telecommunications providers and the government of Sri Lanka to sign an agreement aimed at testing Project Loon balloons for internet connectivity in the country. This collaboration marked a significant step forward in utilizing the capabilities of Project Loon to provide connectivity.[71] In 2016, Project Loon accomplished another major milestone with the successful testing of an automated launching

[67] Airbus, Zephyr Solar High Altitude Pseudo-Satellite flies for longer than any other aircraft during its successful maiden flight, available at https://www.airbus.com/en/newsroom/press-releases/2018-08-airbus-zephyr-solar-high-altitude-pseudo-satellite-flies-for-longer (accessed 7 June 2023)
[68] Ibid
[69] Simonite T., "Project Loon", (2015), available at https://www.technologyreview.com/technology/project-loon/ (accessed 7 June 2023);
[70] Metz R., "Project Loon head details how the balloons interact", (2015), available at https://www.technologyreview.com/2015/06/01/167903/emtech-digital-project-loon-head-details-how-the-balloons-interact/ (accessed 7 June 2023)
[71] Tung L., "Google's Project Loon: now its Internet-beaming balloon tests take off in Sri Lanka" (2016), available at https://www.zdnet.com/article/googles-project-loon-now-its-internet-beaming-balloon-tests-take-off-in-sri-lanka/ (accessed 8 June 2023);

crane in Puerto Rico. This breakthrough sped up the deployment procedure by allowing a balloon to be launched in as little as 30 minutes.[72]

2.2.3 Sunglider – SoftBank

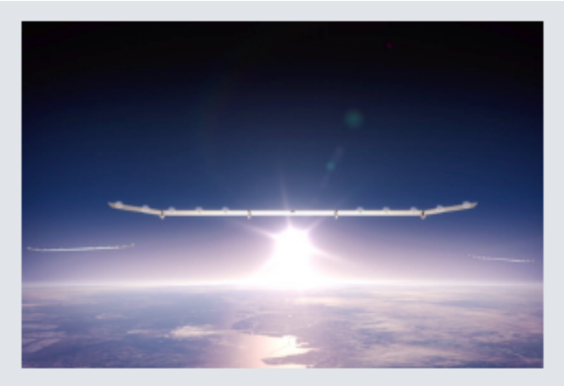

Figure 5: Sunglider, SoftBank

With the help of AeroVironment, Inc., SoftBank launched its HAPS project in 2017 and created a prototype aircraft called the "Sunglider".[73] The Sunglider successfully completed a test flight into the stratosphere in September 2020 at Spaceport America, and provided LTE connectivity from the stratosphere. This historic trip proved the feasibility of using the stratosphere as a communications hub.[74] SoftBank is currently working on constructing a replacement aircraft for the project based on these discoveries.[75]

2.3 Potential Use cases for HAPS

HAPS is flexible, thus are able to serve many purposes. The aircraft may be dispatched to cover a region quickly, and the capacity of a platform can be scaled to suit the demand. The HAPS system can be scaled up to connect an entire country or continent, or down to connect a single region or locality. HAPS capacity is adaptable, so it can be dispersed across a large region to offer blanket coverage or zeroed in on specific locations.[76]

HAPS can be easily integrated with pre-existing networks, which could lead to quicker and cheaper connectivity rollouts. HAPS is capable of providing LTE, 5G, and even the next generation of networks. Additionally, conventional smartphones can be used in place of

[72] Dent S., "Project Loon shows off auto launcher at work in Puerto Rico", (2016), available at https://www.engadget.com/2016-02-26-project-loon-autolauncher-peurto-rico.html (accessed 8 June 2023)
[73] SoftBank News, "HAPSMobile's Stratospheric Test Flight Opens A New Chapter for the Internet" (2020), available at https://www.softbank.jp/en/sbnews/entry/20201013_01 (accessed 8 June 2023)
[74] ibid
[75] Ibid
[76] The European Space Agency, "Could High-Altitude Pseudo-Satellites Transform the Space Industry? (2018), available at https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Could_High-Altitude_Pseudo-Satellites_Transform_the_Space_Industry (accessed 10 June 2023)

proprietary user equipment (UE) for any given radio network standard. Upgrading the system entails modifying the plane's airframe and installing a new antenna. During the time it takes to refuel, technicians can work from a central location to update and maintain the system.[77]

Because of their high altitude, HAPS is invisible to the naked eye. Therefore, they could be utilised to provide service in locations where people worry about the aesthetics of building terrestrial infrastructure.[78] HAPS is flexible enough to serve a number of purposes in both developed and emerging economies:[79]

a) Emergency communications and disaster recovery
b) The Internet of Things (IoT)
c) Connecting the unconnected

2.3.1 Emergency communications and disaster recovery


Figure 6: Floods in the Czech Republic

Natural disasters pose a hazard to the safety and coordination of response activities because of the potential disruption of terrestrial mobile networks and emergency communication services. HAPS can be life-saving because they provide a stable communication hub for coordinating rescue and search operations. The deployment of HAPS in disaster-stricken areas would not only enable effective communication among emergency personnel but also facilitate the restoration of critical infrastructures such as water, transportation, and energy supply. HAPS is well-suited for supporting disaster relief missions and can demonstrate resilience against localized disaster events and can be rapidly deployed to affected areas. A single aircraft operating as a HAPS can cover a significantly larger area compared to terrestrial emergency solutions. Moreover, the mobility of HAPS allows for efficient re-allocation to areas where their communication services are most needed during emergencies.[80]

[77] Ibid
[78] Ibid
[79] This is not a closed list of use cases
[80] Pavlidou F., Miura R. & Farserotu J., "Special Issue on "High Altitude Platform (HAP) Systems, Technologies and Applications", (2005).

In the case of a disaster, HAPS operations can be supported by deploying a portable ground station with its own power source, like a diesel generator, and backhaul connectivity via satellite. Previous catastrophes, such as those in Puerto Rico in 2017 and Peru in 2019, have proven the efficacy of the HAPS approach and can be valuable in supporting emergency response and recovery activities by providing critical communication services at critical times.[81]

2.3.2 The Internet of Things (IoT)

The interconnection of diverse mobile objects, including cars, machines, appliances, devices, and sensors, is what can be referred to as the "Internet of Things" (IoT).[82] This interconnected network enables the optimization of processes, cost reduction, and exploration of new business opportunities through data analysis. The primary function of the mobile network in the IoT is to transfer collected data to applications or other devices for further processing.[83] By meeting these essential requirements, the IoT can unlock the full potential of data-driven applications and enable innovative solutions across various industries.[84]

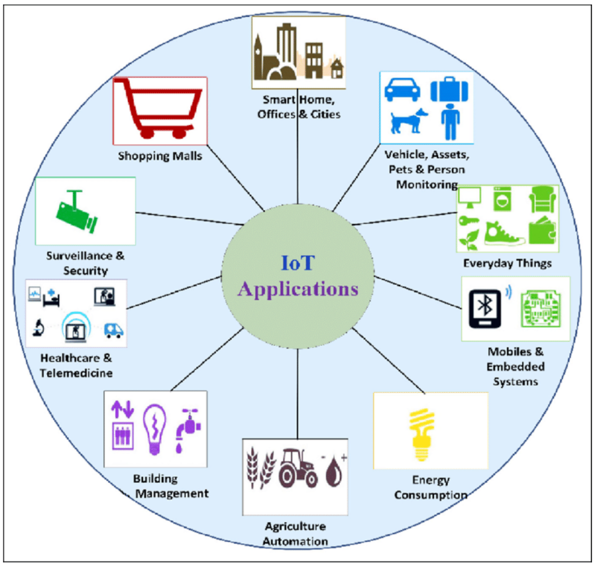

Figure 7: Examples of IoT applications

IoT plays a crucial role in various industries by leveraging data analysis and machine learning to enhance automation. Industrial IoT applications encompass a wide range of sectors, including smart grids, smart cities, smart manufacturing, and connected logistics. These applications enable predictive maintenance, smart energy management, and improved industrial safety with minimal human intervention.[85]

[81] ITU, "Emergency telecommunications (2021), available at https://www.itu.int/en/mediacentre/backgrounders/Pages/emergency-telecommunications.aspx (accessed 8 June 2023)
[82] Pavlidou F., see note 80
[83] Ibid
[84] Ibid
[85] Kaltenhäuser S., see note 12

Smart grids ensure efficient energy distribution, while smart cities integrate various systems for better urban management. Smart manufacturing enables automated and connected production lines, while connected logistics enhance supply chain visibility and efficiency. [86]

Moreover, IoT facilitates predictive maintenance, allowing businesses to identify potential equipment failures and perform timely repairs, reducing downtime and costs.[87] Overall, IoT empowers industries to harness the power of data and automation, leading to improved productivity, sustainability, and safety across various sectors.[88] Due to the low capacity needs of many IoT applications, a small fleet of aeroplanes with a large service area might be deployed to support widespread IoT rollouts.[89] To maximise network efficiency, HAPS can facilitate improved congestion prediction and control techniques.[90]

It's possible that HAPS might also facilitate two-way communications between vehicles and other modes of transportation, as well as networks, devices, and even pedestrians.[91] With the use of data analysis and vehicle collaboration, we can make roads safer, boost overall traffic efficiency (e.g., by reducing congestion), and provide significant energy savings.[92] HAPS has the potential to offer the global coverage required for this application.[93]

2.3.3 Connecting the unconnected

A significant portion of the world's population, exceeding 40%, still lacks internet access, particularly in remote regions where stable power infrastructure is scarce. In today's digital age, our world has become more interconnected and reliant on virtual connectivity.[94]

[86] David G., see note 48
[87] Kaltenhäuser S., see note 12
[88] Pavlidou F., see note 80
[89] Kaltenhäuser S., see note 12
[90] de Gouyon Matignon L., "Stratobus or the legal status of High Altitude Platform Stations", (2019), available at https://www.spacelegalissues.com/space-law-stratobus-or-the-legal-status-of- high-altitude-platform-stations/ (accessed 10 June 2023),
[91] Araripe d'Oliveira F., see note 33.
[92] David G., see note 48.
[93] de Gouyon Matignon L., see note 90.
[94] ITU, see note 81.

HAPS present a promising solution by offering internet connectivity to underserved locations that have limited or no access to traditional telecommunication networks. HAPS ensure continued communication capabilities, effectively bridging the digital divide. These platforms provide network latency comparable to terrestrial cellular towers while covering a wider geographical area, enabling access to a broader population.[95] By leveraging HAPS technology, the goal is to overcome the limitations of distance and infrastructure, thereby narrowing the gap in internet connectivity and fostering global digital inclusion.

2.4 Conclusion

While HAPS have several advantages, they also face several **challenges** that need to be addressed for their successful deployment and operation. Here are some of the key **challenges** associated with HAPS:

a) **Regulatory and Legal Issues:** The regulatory framework for HAPS operations, including airspace management and spectrum allocation, is still evolving. Clear guidelines and regulations need to be established to ensure safe and coordinated HAPS operations, address concerns about interference with existing systems, and facilitate international cooperation.

b) **Airspace Management and Collision Avoidance:** HAPS operate in the same airspace as manned aircrafts, unmanned aerial vehicles (UAV's), and other aerial platforms. Coordinating their operations to avoid collisions and ensure safety is a significant challenge. Robust airspace management systems and protocols need to be developed to integrate HAPS into existing air traffic management systems.

c) **Communication and Link Stability:** HAPS require stable and reliable communication links between the platform and the ground station to provide continuous services. Overcoming atmospheric conditions, signal degradation, and maintaining consistent connectivity pose technical challenges that need to be addressed.

d) **Power Supply and Endurance:** HAPS platforms need a continuous power supply to operate their communication systems, sensors, and other payloads. Ensuring sufficient power for extended periods while minimizing weight and energy consumption is a significant engineering challenge.

[95] Ibid.

e) **Maintenance and Durability:** HAPS platforms operate at high altitudes, subjecting them to harsh environmental conditions such as strong winds, temperature variations, and exposure to ultraviolet radiation. Ensuring their durability, reliability, and ease of maintenance becomes crucial for their long-term operation.

f) **Cost Considerations:** While HAPS can offer cost advantages compared to satellites, they still require significant investment in development, manufacturing, launch, and operational infrastructure. Achieving cost-effectiveness and viable business models for HAPS deployment remains a challenge.

These challenges require continued research, development, collaboration among stakeholders, and regulatory frameworks to be successfully addressed. Overcoming these hurdles can unlock the full potential of HAPS technology and enable their widespread deployment for global connectivity and observation purposes.

In addition, HAPS offer several **advantages** in comparison to other communication and observation platforms. Here are some of the key advantages of HAPS:

a) **Broad Coverage:** HAPS operate at high altitudes, allowing them to cover large areas on the ground. They can provide communication and observation services to remote, underserved, or inaccessible regions where traditional terrestrial infrastructure is difficult to deploy.

b) **Flexibility and Mobility:** HAPS can be quickly deployed and relocated to different locations as per the requirement. This flexibility enables them to respond to changing communication needs or to provide temporary services during emergencies or events.

c) **Cost-Effective:** HAPS can provide services at a lower cost compared to satellite-based solutions. The manufacturing, launch, and operational costs of satellites are typically much higher, whereas HAPS can be produced and operated at a relatively lower cost.

d) **Rapid Deployment and Redeployment:** HAPS can be quickly deployed to provide immediate communication and observation capabilities in emergency situations, natural disasters, or during temporary events. They can be positioned in the affected areas to assist with disaster management, search and rescue operations, or humanitarian efforts.

e) **Environmental Benefits:** Compared to satellite systems, HAPS have the potential for reduced environmental impact. They require less energy for deployment, do not contribute to space debris, and can be operated with renewable energy sources, making them a greener alternative.

Overall, HAPS offer a versatile and cost-effective solution for bridging the digital divide, providing connectivity to remote areas, and supporting various communication and observation applications. Continued advancements in HAPS technology hold promise for improving global connectivity and enabling access to vital services in previously underserved areas.

Chapter 3: The applicability of Air and Space Law to HAPS

3.1 Introduction

It should be noted that when something new arises with the goal of establishing a stable legal and regulatory system, lawyers naturally look for applicable precedents. The same strategy is applicable to HAPS.[96] Therefore, before getting involved in the delimitation issue, it is vital to first analyse the existing legal frameworks that apply to aeroplanes and spacecrafts.[97]

To ensure that the growth of international air travel would be well-organized and safe, the Convention on International Civil Aviation of 1944 (the Chicago Convention) was created.[98] However, the Outer Space Treaty was signed to encourage people from all over the world to work together to "explore and use outer space," including in the legal and scientific communities".[99]

The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), discussed where exactly the line should be drawn between the atmosphere and space.[100] During these talks, the committee's participants were split into two camps, each representing a distinct point of view. One camp argued that the delimitation line should be set up in accordance with ideals like mutual benefit and non-interference in domestic issues as well as sovereignty, national independence, equality of rights, and non-discrimination. The second group, on the other hand, didn't think the problem was very pressing and of the view that the issue does not have to be solved right away.[101]

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[96] DiPaolo A.J., "The definition and delimitation of outer space: The present need to determine where "space activities" begins" , available at http://coe-cst.org/wp-content/uploads/2019/02/fielder-304-THE-DEFINITION-AND-DELIMITATION.pdf (accessed 8 August 2023)
[97] Jakhu, R.S, Sgobba, T., & Dempsey, P.S, The Need for an Integrated Regulatory Regime for Aviation and Space: ICAO for Space? (2012)
[98] International Civil Aviation Organization (ICAO), Convention on Civil Aviation ("Chicago Convention"), 7 December 1944, (1994) 15 U.N.T.S. 295, available at: https://www.refworld.org/docid/3ddca0dd4.html [accessed 1 July 2023]
[99] The Outer Space Treaty, see note 21.
[100] The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) is a United Nations committee whose main task is to review and foster international cooperation in the peaceful uses of outer space, as well as to consider legal issues arising from the exploration of outer space and was established on 12 December 1959.
[101] UNCOPUOS UN Doc A/AC.105/C.2/2016/DEF/L.1 (2016), Report of the Chair of the Working Group on the Definition and Delimitation of Outer Space – Annex II,

Representatives from UNCOPUOS, scientists, and academics have been arguing about how to define the border between air and space for almost 50 years.[102] The Legal Subcommittee, recognizing the seriousness of the situation, took decisive action by establishing a dedicated working group to study the issue of defining and delineating space.[103] This wasn't just a philosophical discussion; there were real legal and practical repercussions for air and space activities at stake.[104] The use of airspace and outer space is governed by different sets of rules and regulations under international law.[105]

At the moment, there is no legal description of the line between space and airspace, nor is there consensus on the exact altitude at which this line lies.[106] Although this topic has been debated for over fifty years, a definitive resolution has yet to emerge.[107] The Chicago Convention is arguably the foundation of aviation law; however, it is not in any space law treaty. None of these treaties define space's limits or vertical delineation.[108] As a result, there is no clear boundary between the two regions, and no one knows when the "legal limits of airspace expire, and the outer space regime of space law begins".[109]

It is crucial to do an investigation into this question of whether or not HAPS should be subject to air law or space law. There are two sectors in space, and each has its own laws and regulations. Given this, it is essential to study the differences between the two legal frameworks.

3.2 <u>The differences between Air and Space Law Regimes</u>

A set of rules known as "air law" governs the safe and legal use of airspace for the benefit of pilots, passengers, airlines, airports, and governments around the world.[110] The Paris

102 Abeyratne R., "Regulation of Commercial Space Transport: The Astrocizing of ICAO", (2015)
103 UNCOPUOS, see note 101
104 Ibid
105 Jinyuan S., "The delimitation between airspace and outer space and the emergence of aerospace objects (2013)
106 Hobe S., Space Law, CHBeck/Hart/Nomos (2019)
107 Ibid
108 Masson-Zwaan T. and Hofmann M., "Introduction to Space Law", (2019)
109 Jakhu R. et al, see note 97
110 Diedericks-Verschoor I-H., "An Introduction to Air Law", (1993).

Convention of 1919 was the first global agreement on air law.[111] Many of the contracting states lacked any sort of aviation-related legislation prior to this Convention, and it was essential in establishing the concepts of domestic air law for such states.[112] The International Commission for Air Navigation (ICAN) was established as a result of the Paris Convention, which acted as a multilateral agency charged with setting standards for aviation.[113]

Often considered the most important instrument in the field of air law, the Chicago Convention,[114] replaced the Paris Convention in 1944. This Treaty, often known as the "Constitution of international civil aviation", provided the groundwork for essential regulations that are used to control the aviation industry. These regulations cover major aspects of aviation, including sovereignty, navigation, airworthiness, and aircraft registration.[115]

The Chicago Convention led to the establishment of the International Civil Aviation Organisation (ICAO), an organisation that replaced ICAN. ICAO, is a specialised agency of that has been working to improve global civil aviation since its inception in October 1947. It does this through drafting international guidelines known as Standards and Recommended Practises (SARP's), to ensure governments operate and comply to the same requirements.[116]

In conjunction with the Chicago Convention, the air law framework encompasses various other specialised instruments which includes:

(a) the Warsaw Convention;[117]

(b) the Geneva Convention;[118]

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[111] The Paris Convention of 1919 (formally, the Convention Relating to the Regulation of Aerial Navigation) was the first international convention to address the political difficulties and intricacies involved in international air navigation and was signed in Paris on 13 October 1919, available at https://applications.icao.int/postalhistory/1919_the_paris_convention.htm#:~:text=This%20Paris%20Convention%20constitutes%20the,overlying%20its%20territories%20and%20waters (accessed on 2 July 2023)

[112] Ibid

[113] This agency was established in terms of article 34 of the Paris Convention

[114] Chicago Convention, see note 98

[115] Jakhu R. et al, see note 97

[116] Dempsey P., Public International Air Law, (2017).

[117] The Convention for the Unification of certain rules relating to international carriage by air, commonly known as the Warsaw Convention, originally signed in 1929 in Warsaw, it was amended in 1955 at The Hague, Netherlands, and in 1971 in Guatemala City, Guatemala. The Montreal Convention, signed in 1999, replaced the Warsaw Convention system in countries ratifying it.

[118] Convention on the International Recognition of Rights in Aircraft, signed at Geneva on 19 June 1948 (ICAO Doc 7620), available at https://www.icao.int/secretariat/legal/Administrative%20Packages/geneva_en.pdf (accessed 2 July 2023)

(c) the Rome Convention;[119] and

(d) the Montreal Convention.[120]

These instruments collectively constitute a comprehensive framework for the regulation of various facets of air transportation, with the overarching goal of protecting the lives of passengers, cargo, and their property.

However, "space law" governs how space can be used and explored by humans.[121] The majority of the substantive provisions of space law can be found in five key international multilateral treaties that make up the system of space law.[122] These agreements set the rules for what can and can't be done in, to, and from space.[123] These agreements also ensure that countries coordinate, collaborate and work together on their space projects.[124]

The legal framework that governs activities in space is its origin in the 1967 Outer Space Treaty.[125] The aforementioned foundational treaty is accompanied by a total of four additional treaties.[126] These agreements, taken as a whole, are the backbone of the system that regulates many different kinds of space-based activity and allows for the peaceful, collaborative, and responsible utilisation of outer space.

3.2.1 The principle of Sovereignty

Both air law and space law approach the idea of state sovereignty in distinctively different ways. Under international law, the power and jurisdiction of each nation over their country's airspace is of the utmost significance in preserving the sovereign status of any state within its

[119] The Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, is an international treaty, concluded at Rome on 7 October 1952 and entered into force on 4 February 1958
[120] The Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation (sometimes referred to as the Sabotage Convention or the Montreal Convention) is a multilateral treaty by which states agree to prohibit and punish behaviour which may threaten the safety of civil aviation, was adopted on 23 September 1971 and entered into force on 26 January 1973.
[121] Hobe S. and Chen K-W., "Legal status of outer space and celestial bodies", (2016).
[122] Steer C., "Sources and law-making processes relating to space activities", (2016).
[123] Ibid
[124] Masson-Zwaan T., see note 108.
[125] The Outer Space Treaty, see note 21.
[126] The Rescue Agreement, see note 22; The Liability Convention, see note 23; The Registration Convention, see note 24 and The Moon Agreement, see note 25

own borders.[127] However, space law departs from the concept of sovereignty, and recognises the furthest reaches of the galaxy as a realm beyond the jurisdiction of any one nation after a certain threshold is crossed. Instead, it emphasises the necessity of space travel and its applications for the benefit of humanity at large.[128]

As a direct consequence of this, the idea of sovereignty forms the foundation of air law. As such, "every State has complete and exclusive sovereignty over the airspace above its territory" was reaffirmed by the Chicago Convention. This was done because the Chicago Convention states that "every State has complete and exclusive sovereignty over the airspace above its territory".[129] Article 2 defines "territory" to include both land and surrounding territorial waters within a country's jurisdiction.[130]

Any object flying through a sovereign state's airspace must comply with that country's aviation regulations.[131] Therefore, states have the authority to regulate the airspace above their territory according to their own laws, subject to any reasonable restrictions and conditions they deem appropriate.[132] Not only that, but there is a clear delineation in international air law between regularly scheduled flights and irregular services.[133]

However, the Chicago Convention's Article 5 guarantees unscheduled flights the same degree of freedom and adaptability as scheduled flights. This rule allows recreational aircraft to travel across neighbouring countries without being interfered with.[134] Scheduled international aviation services require specific authorization from the relevant state under Article 6, which may be subject to limits specified by that state.[135] It is also illegal for unmanned aircraft to fly over a country's territory without permission.[136]

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[127] Truxal S., “Economic and Environmental Regulation of International Aviation”, (2017)
[128] Bittencourt Neto O., “Defining the Limits of Outer Space for Regulatory Purposes”, (2015)
[129] Article 1 Chicago Convention, see note 98
[130] Article 2 Chicago Convention, see note 98
[131] Haanappel P., “The Law and Policy of Airspace and Outer Space: A Comparative Approach”, (2003)
[132] Dempsey P., see note 116.
[133] See ICAO, Definition of a Schedules International Air Services, Doc. 7278-C/841 (28 March 1952)
[134] Article 5 Chicago Convention. However, the State may establish prohibited areas for reasons of military necessity or public safety and is supported by Article 9 Chicago Convention, see note 98
[135] Article 6 Chicago Convention, see note 98
[136] Article 8 Chicago Convention, see note 98

According to the rules of space law, no one has the right to claim the sky or the orbits of planets and other objects in space. The Moon is a global commons. It belongs to all of us, and no one has the right to claim ownership of it. We must cooperate to ensure that the Moon is explored for the common good. The term "non-appropriation principle" has come to be used more commonly to describe this concept.[137]

The Outer Space Treaty stipulates that everyone has something to gain by exploring the cosmos. In line with the "province of all humanity" idea, the treaty requires that nations must cooperate to explore space for the benefit of everyone.[138] Furthermore, it ensures that all countries are treated equally in their pursuit of space exploration and utilisation.[139] Liability in the event of damages is just one of many areas where air and space law differ significantly. In air law, the Warsaw Convention[140] and the Montreal Convention[141] place primary responsibility for damages on the airline and or its operator.[142]

Indeed, public law is the primary jurisdiction that governs issues pertaining to space.[143] This is why the launching state is made the primary entity responsible for liability under space law by both the Liability Convention and the Outer Space Treaty.[144] The launching State is the country that sends a space object into space.[145] Any damage caused by private activity in space may result in international liability because every country is liable for the acts of its residents anywhere they are, including in space.[146]

Space law is different from air law in several ways, including their registration. No launches may take place unless the spacecraft is first registered with a national government and then a notification is sent to the UN's Secretary-General to informed him. However, aircraft registration is a one-time process due to the requirements of aviation law.[147] Furthermore, a

[137] Ibid
[138] Gál G., Space Law, (1969)
[139] Ibid
[140] Warsaw Convention, see note 117
[141] Ibid
[142] Kaftal A., "The Problem of Liability for Damages Caused by Aircraft on the Surface", (1934)
[143] Masson- Zwaan T. and Mendes de Leon P (eds.)., Air and Space Law: De Lege Feranda. Essays in Honour of Henri A. Wassenbergh, (1992)
[144] Art. I (c) of the Liability Convention, see note 23
[145] ibid
[146] Article VI Outer Space Treaty, see note 21
[147] Masson-Zwaan T., see note 143

civil aircraft's legal status is established by its country of registration.[148] However, a space object is not technically assigned to a country at the time of registration.[149] Furthermore, the State of registration has important duties, such as providing proper airworthiness certification and personnel licencing, when an aircraft is registered there.[150]

However, only a few pieces of data, such the spacecraft's planned orbital trajectory, launch date, and general purpose, are required for registration.[151] The different registration requirements highlight the various ways in which air and space operations differ and have different legal repercussions.

3.3 The Functionalist theory to determine whether Air or Space law applies

There are two ways to go about determining which set of laws applies in a given situation. The first method looks at the object itself to see if it fits the definition of an "aircraft" or "space object". It might be considered a space object if its main purpose is to leave Earth's atmosphere and travel to another planet, e.g., an earth to space mission.[152] Yet, if its main objective is to transport individuals between different locations on Earth, it might not be classified as a spaceship.[153] This investigation is helpful in establishing the correct legal classification for the object in question.

The functionalists' main argument against the idea of a physical limit is that it is both arbitrary and impossible to carry out in practise. They argue that anything done in the sky or out in space is fundamentally different and should be subject to a different set of rules.[154] Functionalists argue that the law should be applied universally, regardless of where the activity takes place.[155]

148 Article 17 & 18 of the Chicago Convention, see note 98.
149 Article VIII Outer Space Treaty, see note 21 as well as Art. II Registration Convention, see note 24
150 Articles 31 and 32 of the Chicago Convention, see note 98
151 Article IV (1) of the Registration Convention, see note 98
152 Hobe S., see note 106
153 Jakhu R. et al, see note 97
154 Jinyuan S., "Near Space as a sui generis zone a tri-layer approach of delimitation", (2013).
155 Gorove K., "Delimitation of Outer Space and the Aerospace Object - Where Is the Law?", (2000).

As demonstrated above, after an object has been sent into orbit, it should no longer be governed by Air Law but rather by Space Law.[156] The risk of collisions between aeroplanes or spacecraft, depending on their operations location, is investigated by functionalists in order to answer this question.[157] The separation of air and space operations is central to the functionalist approach. In addition, knowing what characteristics distinguish an object as an aeroplane or a spaceship is of paramount importance to functionalists.

3.3.1 How is an aircraft defined?

As per the Chicago Convention, something is considered as an "aircraft" if it meets certain criteria for a "civil aircraft," then the laws pertaining to an aircraft in that context will apply.[158] Despite the fact that the phrase "aircraft" is used more than 100 times throughout the Chicago Convention, a clear definition of the term is unfortunately not provided.

After the Paris Convention was ratified and put into effect, ICAN had been established as part of the Convention, published a "Glossary of terms used in Aeronautical Technology". The Glossary entry for "aircraft" reads as follows: "a machine that can derive support in the atmosphere from reactions of the air". It should be noted that ICAN had formally resolved to update the Annexes with uniform definitions in 1930.[159]

Annexe 7 of the Chicago Convention was revised in 1967 when ICAO adopted a new description of an aircraft that differed from the one inherited from its predecessor. The fundamental objective of this revised definition was to remove all air- vehicles, such as a hovercraft from the definition of aircraft and, as a result, from the purview of ICAO.[160]

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156 The International Association for the Advancement of Space Safety (IAASS), "The Definition and Delimitation of Outer Space and the Safety of Aerospace Operations", (2016).
157 UNCOPUOS Report, see note 101.
158 Article 3 of the Chicago Convention, see note 98.
159 Refers to Annexes 6-8 of the Chicago Convention, see note 98.
160 ICAO, The Concept of Sub-Orbital Flights, Working Paper C-WP/12436 (2005).

3.3.2. How is a spacecraft defined?

If the vehicle meets the criteria for a spacecraft or any item in space, it will be governed by space law. However, it should be noted that neither "spacecraft" nor "space objects" are defined in terms of any of the five treaties that governs space law.[161] Efforts are made to define "space object" in both the Registration and Liability Conventions, that encompasses not only the complete object but also its constituent parts, launch vehicle, and related elements.[162] Some have argued that merely listing the parts that should be deemed a "space object" is not sufficient to provide a precise and thorough grasp of what makes up the term itself.[163]

The United Nations General Assembly first used the term "space objects" in a resolution in 1961 to refer to objects that had been launched by countries into outer space.[164] A "space object" is defined by a prominent scholar as any artificial object that has been launched or is scheduled for launch into space.[165] However, this definition prompts a discussion regarding where exactly the limit of space is and what is meant by the word "launch".[166] Whether on an orbital or suborbital route, a spacecraft should be able to function without the assistance of Earth's atmosphere and have a power source that doesn't require the constant supply of oxygen.[167]

3.3.3. Concerns with the Functionalist approach

The functionalist theory has been criticised for having theoretical and practical shortcomings. Problems arise, for example, when trying to decide what counts as an aeroplane or a spaceship. Because the Space Treaties do not provide a clear description of what is intended by the phrase "space object," according to the functionalist approach, the term "space object"

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161 Lee R.J, "The Liability Convention and Private Space Launch Services" (2006).
162 von der Dunk F., "The integrated approach - Regulating private human spaceflight as space activity, aircraft operation and high-risk adventure tourism", (2013).
163 Sundahl M., "Legal status of spacecraft", (2016).
164 UNGA Resolution 1721 (XVI) of 1962, "International cooperation in the peaceful uses of outer space".
165 Cheng B., Studies on International Space Law, (1998).
166 von der Dunk F., see note 163
167 Jakhu R. et al, see note 97.

cannot be used for classification purposes.[168] This raises concerns regarding the existence of space objects that may not meet the criteria, and the potential discrepancy between the terms "space objects" and "objects launched into space".[169]

The functionalist theory also necessitates identifying the specific characteristics of aerospace and aviation activities. As a result, individual states would be free to determine whether laws and regulations apply to the specific activities that are under their purview.[170] However, if the reason for doing anything is used as a criterion, that could lead to confusion and even legal problems between countries.[171]

3.4 The Spatialist theory to determine whether Air or Space law applies

A clear definition of where the sky ends and outer space begins is essential for establishing the correct legal framework.[172] For the past fifty years, legal experts have argued passionately over how to define and demarcate space, but no consensus has emerged.[173] Two main methods have developed throughout time to help pinpoint and define the limit between airspace and space.[174] The 1957 launch of Sputnik by the Soviet Union established the notion of freedom of space, which includes "access to and unimpeded passage through outer space for peaceful purposes".[175]

Unlike depending exclusively on scientific facts, which may lack accuracy in delineating, the spatialist theory calls for a distinct separation between air and outer space.[176] The spatialist theory suggests asking whether the object in question is in the atmosphere or the solar system to help narrow down possible locations for a solution.[177] Proponents of this view

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[168] DiPaolo A.J, see note 96.
[169] Cheng B, see note 166.
[170] Bittencourt, see note 128.
[171] Lyall F. and Larsen P., Space Law: A Treatise, (2009).
[172] Hobe S., see note 106.
[173] Cooper J.C., High Altitude Flight and National Sovereignty, (1951); Bittencourt, see note 128
[174] Cheng B., "Legal Regime of Airspace and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises", (1980).
[175] Cargill Hall, R., The Origins of U.S. Space Policy: Eisenhower, Open Skies, and Freedom of Space, available at http://www.dtic.mil/dtic/tr/fulltext/u2/a344697.pdf (accessed 5 July 2023).
[176] Oduntan G., Sovereignty and Jurisdiction in Airspace and Outer Space: Legal Criteria for Spatial Demarcation, (2012).
[177] Hobe S., see note 106.

believe that a clear boundary should be established, and they have suggested that 100 kilometres above the surface of the Earth is a suitable demarcation point.[178]

Theodore von Kármán developed the idea of the "von Kármán line" when he determined that at an altitude of about 100 km, it becomes unsafe for aeroplanes to fly and that an object flying at suborbital speed could not be supported solely by the earth's atmosphere.[179] Extreme atmospheric drag prevents aircraft wings from producing enough lift for sustained flight, and spacecraft from keeping their orbits.[180] Several countries have adopted the spatialist approach and demarcated their territories at 100 km.[181] In the eyes of the spatialists, everything below this imaginary line is safely functioning within the airspace, while everything above it is safely operating in outer space.[182]

3.4.1 The Airspace over National Territories

Both the Outer Space Treaty and the Chicago Convention set various criteria for determining who has authority over what in outer space and beyond.[183] The Chicago Convention establishes that each country has unfettered control over the airspace above its territory.[184] However, the Outer Space Treaty specifically rejects the idea that States have any sort of territorial sovereignty over space. In accordance with the norms that have been established in international law, every nation possesses full and unrestricted control over the airspace that is directly above its own territory.[185]

At the height of the Cold War, the Outer Space Treaty was ratified by countries in order to prevent the outbreak of a new global war over space.[186] Also indicative of foresight was the treaty's inclusion of provisions for the commercialization of space, which would emerge in the

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178 Oduntan G, see note 177.
179 Ibid; Reinhardt D., "The Vertical Limit of State Sovereignty", (2007).
180 UNCOPUOS, UN Doc A/AC.105/942, Report of the Legal Subcommittee on its forty-ninth session (2010).
181 IAASS, see note 157.
182 UNCOPUOS, see note 181.
183 Lachs M., The Law of Outer Space: An Experience in Contemporary Law-Making, (1972).
184 Article 1 of the Chicago Convention, see note 98.
185 Ibid; United Nations Convention on the Law of the Sea (UNCLOS), 10 December 1982, (entered into force 16 November 1994).
186 The Outer Space Treaty, see note 21.

decades following its ratification.[187] A dispute arose early on in the treaty-drafting process over what role commercial space operations should play legally.[188] The governments of the world compromised on this issue by agreeing to monitor the space activities of their citizens.[189] Therefore, any space activity by a non-governmental organisation must be approved by and regularly monitored by the relevant Treaty State.[190]

3.4.2 The lack of Sovereignty in Outer space

The universe is a collectively owned resource accessible to all nations on Earth for exploration and utilisation.[191] Some scientists believe that space begins at a theoretical limit called the von Kármán line, which is located roughly 100 km above Earth's surface.[192] At an altitude of 100 kilometres, as proposed by von Karman, a vehicle's control surfaces lose their aerodynamic control capability, requiring the use of alternative means such as the reaction control system (RCS).[193] The popular 100-kilometer threshold has been suggested, although other values between 40 and 160 kilometres have also been considered.[194]

When it comes to pinpointing where exactly air ends and space begins, has been the subject of significant discussion and analysis within the international space community for a long time.

3.4.3 Concerns with the Spatialist approach

As with the functionalist approach, the spatialist theory has its own set of problems. The fact that people can't seem to come to an agreement on where the boundary between the atmosphere and space ought to be is a significant issue. There are some countries that claim that there is no need for a delineated border because certain actions can only take place in

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[187] Ibid
[188] Ibid
[189] Article VI of the Outer Space Treaty, see note 21.
[190] Sgobba T. and & Chiesa S., "Toward an International Space Station Safety Authority", (2002).
[191] the Chicago Convention, see note 98; Outer Space Treaty, see note 21.
[192] Reinhardt D.N., "The Vertical Limit of State Sovereignty", (2007).
[193] NASA Armstrong Fact Sheet: X-15 Hypersonic Research Program, available at https://www.nasa.gov/centers/armstrong/news/FactSheets/FS-052-DFRC.html (accessed on 6 July 2023).
[194] UNCOPUOS, UN Doc. A/AC.105/1039/Add. 2. (2013).

space or in the air.[195] Due to the divergent nature of the two legal frameworks towards the question of sovereignty, some countries would rather take a less rigid approach and avoid establishing a clear boundary between their territory and the rest of space.[196]

Proponents of this view are further concerned that a barrier set at 100 km would severely limit the participation of smaller and landlocked states in space activities.[197] There is concern that a rigid boundary may restrict their ability to engage in aerial and space-based activities.[198] The spatialist approach is flawed because there is no universally accepted definition on where the boundary between air and outer space is located. [199]

A country's right to control its own airspace was recognised in the Paris Convention and the Chicago Convention. Neither treaty, however, outlined a maximum area that may be claimed. The Outer Space Treaty does not define the boundary of space, but rather prohibits states from laying claim to it.[200] This kind of limit, once set up, may be difficult to change, especially if there is a need to reduce it in the future.[201] There is worry about the consequences and restraints that could be imposed on space exploration and utilisation if an unrealistically high boundary is created and strictly enforced.[202]

The spatialist view characterises between aircraft, which fly at lower altitudes, and spacecraft, which travel at higher altitudes. Suborbital spacecraft present challenges since they operate primarily on Earth's surface yet briefly leave our atmosphere to undertake space missions.[203]

From a functionalist perspective, it could make more sense to regulate the entire transit of these vehicles under Air Law.[204] This strategy takes into account the operational realities of the vehicle and would apply a single legal regime uniformly across its entire path.[205] On the

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[195] Sundahl M., see note 164.
[196] Masson-Zwaan T., see note 108.
[197] UNCOPUOS, see note 181.
[198] Ibid
[199] Vissepo V., "Legal Aspects of Reusable Launch Vehicles", (2005).
[200] Zhao Y., "A Legal Regime for Space Tourism: Creating Legal Certainty in Outer Space", (2009).
[201] Goedhart R., "The Never-Ending Dispute: Delimitation of Air Space and Outer Space", (1996).
[202] Ibid
[203] Vissepo V, see note 200.
[204] Jinyuan S., see note 105.
[205] Gorove K., see note 156.

other hand, a spatialist perspective might call for two sets of laws to certify and govern these vehicles.[206] Travellers must abide by the Air Law regime established by the ICAO while in international airspace, and the Space Law regime established by whatever future space navigation body will be responsible for enforcing such laws while in space.[207]

In conclusion, the regulatory framework for suborbital space vehicles would depend on whether or not it is guided by the functionalist or spatialist approach. As opposed to the former, which provides a single legal regime based on the vehicle's total movement, the latter may require compliance with Air and Space Law due to the vehicle's potential to cross both the earth's atmosphere and space.

3.5 Why Space Law does not apply to HAPS

HAPS is a non-satellite object that performs satellite-like functions.[208] Services including as internet access, communication, and earth monitoring are offered by these stratospheric stations in a manner similar to that of orbiting satellites.[209] Given these features, one may make the case that space law applies here.

However, one can argue that space law does not apply to HAPS operations. This is because spatialists believe that only objects operating outside of earth's atmosphere, namely above the von Kármán Line, are subject to space law. Contrary to popular belief, HAPS do not leave Earth's atmosphere but rather travel between 20 and 50 km above ground. Therefore, it can be determined that HAPS is not subject to space law.

As functionalists would have it, HAPS also perform the same duties as conventional satellites in orbit. In terms of the vehicle's capabilities, however, HAPS do not meet the criteria to be identified as a space objects. They are not built for launch into space, cannot function without

[206] Haanappel P., see note 131.
[207] Ibid
[208] Hobe S., see note 106.
[209] Ibid

aerial support, and are incapable of space activities.[210] Therefore, space law has no bearing on this approach.

3.6 Why Air law does not apply to HAPS

Since HAPS is not subject to the regulations of space law, one must look to air law as the applicable framework for its operation. Spatialists argue that HAPS do not function in outer space but rather in the air above the designated outer space demarcation line. Therefore, it is contended that HAPS should be governed by the regulations established in terms of air law.

Functionalists, who view the world through a lens of object classification, would place HAPS under the category of an aircraft. HAPS is an unmanned aerial vehicle that rely on airborne reactions and atmospheric assistance for safe and efficient navigation. By harnessing atmospheric lift, either aerostatic for balloons[211] or aerodynamic for aircrafts.[212] Unlike spaceships, which use centrifugal force from orbital speed to keep them flying, HAPS is defined as air-supported vehicles in terms of the Chicago Convention's Annexes, it is arguable that aviation law should govern their flight operations.

The concept of a new class of aircraft, such as HAPS and other stratospheric vehicles, has been addressed at a number of international forums in recent years. They operate at an altitude of around 20 kilometres, well above the 9–12 kilometres used by most commercial airlines and private planes.[213] HAPS operations, including take-off and landing, occur in a controlled airspace, hence it can be argued that the legal frameworks in place, does not find application to HAPS operations.[214]

Their frameworks have been characterised as "somewhat unconventional and very lightweight".[215] In addition, the Chicago Convention, does not adequately cover HAPS

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210 See 3.3.2 – How is a spacecraft defined.
211 As defined in the Annexes of the Chicago Convention, see note 98.
212 Ibid
213 Uniting Aviation, see note 54
214 David G., see note 48.
215 Uniting Aviation, see note 54

activities, which are fundamentally different from typical air activities.[216] As a result, one could contend that HAPS's goals are misaligned with the kinds of aviation activities generally covered by existing air law restrictions.

HAPS is very distinct from traditional aircrafts and comparing HAPS operations to those involving commercial aeroplanes transporting humans, safety considerations are also drastically different.[217] It is important to emphasise that the legislation governing HAPS operations should not rely on the outdated models of aviation regulations.[218] This mini-dissertation finds that the current air law criteria are not applicable to HAPS operations because of these distinguishing features.

3.7 Conclusion

When governments first started getting involved in air and space activities, questions about space delimitation and definition naturally arose. The problem of delineating space has become increasingly more complicated as technology keeps changing as well as the growing presence of the private sector.[219] In view of these changing situations, it is now required to conduct a re-evaluation of the restrictions that are placed on air and space law.[220] HAPS is just one illustration of how progress in technology might threaten the criteria used to categorise air and space activities.

There are currently two major instruments that need to be considered whenever a vehicle is launched into space. Air law is the branch of law that regulates both airspace and aeroplanes, as defined by the Chicago Convention. The Outer Space Treaty, expands the application of terrestrial legal frameworks by including the "outer space" and a "space object". But the author argues that the classification and interpretation are no longer relevant as a result of recent developments in technology. HAPS operations, as we've established, occur in a

[216] Mendes de Leon P., Introduction to Air Law, (2017)
[217] Uniting Aviation, "ANC Talks: Loon and Airbus Zephyr take aviation to new heights" (May 2020), available at https://www.unitingaviation.com/news/safety/anc-talks-loon-and-zephyr-take-aviation-to-new-heights/ (accessed 10 July 2023).
[218] Ibid
[219] Reed R., "Shaping a Liability Regime for the Future of Space Tourism", (2009).
[220] Hobe S., see note 106

previously unused zone that blurs the boundaries between air and space.[221] Because of its singular status, the traditional categorization of air and space activities must be re-evaluated.

HAPS is not a spacecraft and is not designed to operate in space. Adding more complexity to our current knowledge of space, the appearance of these vehicles poses a challenge to the researched spatialist and functionalist approaches. It has already been shown that HAPS operations are not covered by either space law or air law because of their distinct nature.

In light of these findings, this mini-dissertation recommends an alternative strategy. In particular, it is proposed that a new intermediate zone be created between the atmosphere and outer space. Due to its location, this area could be called the "in-between space". As a direct result of this, the establishment of an agency, brand-new laws and guidelines to control the activities that take place within this particular location, would be necessary.

[221] Ibid

Chapter 4: International Coordination of HAPS

4.1 Introduction:

The legal frameworks governing the use of objects in airspace and space are distinct. Airspace is governed by air law, while space is governed by space law.[222] The creation of different stratospheric phenomena, increased commercial sector interest in this field, and the constantly changing technical environment increase the need to research new solutions.[223] In the past, human activities have either taken place on Earth's surface or well beyond its atmosphere, in outer space.[224] Technological progress has allowed for the rise of new types of commercial activity, most notably HAPS, which occupy the grey area between these two clearly defined limits and force us to rethink our understanding of what space is.

HAPS can be used in wireless communications, however there are several rules governing their use. Civil aviation agencies on both a global and national level are often responsible for enforcing aviation laws. However, the Radio Regulations, which are overseen by the Radiocommunication Sector (ITU-R) of the ITU, govern the allotment of spectrum for HAPS:[225]

a) **Aviation laws:** Different countries have different aviation regulations, and following those standards is essential for the successful launch of any given type of Aerial Platform (AP).[226] A licence from the Civil Aviation Authority (CAA) of the country in which operations are to take place is usually required of operators of unmanned aircraft, regardless of the size of the aircraft.[227] Maintaining compliance with safety, security, and personal data protection laws is a top priority for CAA's.[228] HAPS is the subject of continuous global discussions, although no particular legal framework controlling their

[222] DiPaolo A.J, see note 96.
[223] Jinyuan S., see note 155
[224] Liu Hao and Tronchetti F., The "EUS", see note 16
[225] The ITU-R plays a pivotal role in the global regulation of the radio frequency spectrum and satellite orbits, both of which are limited resources that are in increasingly high demand due to the proliferation of different types of services. Among these are meteorology, global positioning systems, environmental monitoring, telecommunications in times of emergency, broadcasting, amateur radio, space research, and fixed and mobile communication. These organisations work together to ensure people are protected on land, at sea, and in the air, available at https://www.itu.int/en/ITU-R/information/Pages/default.aspx , (accessed 8 August 2023).
[226] Yuniarti D., "Regulatory challenges of broadband communication services from high altitude platforms (HAPS)", 2018
[227] Feikert-Ahalt C., "Regulation of drones: United Kingdom," available at https://www.loc.gov/law/help/regulation-of-drones/unitedkingdom.php , (accessed 8 August 2023)
[228] Ibid

operation has yet been established.[229] The lack of oversight is slowing down the development and rollout of these systems.[230] The "Exclusive Utilisation Space" (EUS) is a new classification introduced for the near space region, which includes the distances between 18 and 100 km.[231] It can be argued that the near space should be decoupled from the sovereignty of the underlying nations so that it can be governed by a separate set of legislation tailored to maximise profits and sustainability.[232] Nonetheless, proponents of the idea stress the importance of safeguarding the inherent states' sovereign rights.[233] They will be given the authority to regulate and enforce safety and security matters inside their territories, including setting usage limitations and negotiating compliance requirements for other businesses.[234]

b) **Radio Regulations:** Broadband communication from HAPS relies on a certain spectrum allotment that is subject to worldwide regulation by the ITU-R.[235] According to the ITU, a HAPS station is an object that is 20-50 kilometres above ground and at a certain, predetermined location with respect to the Earth.[236] Generally speaking, the operational height of a HAPS is between 17 and 22 km.[237] The ITU-R has designated a number of bands of millimetre-wave (mm-Wave) and International Mobile Telecommunications (IMT) spectrum for HAPS use in a variety of regions throughout the past two decades.[238] During the most recent World Radiocommunications Conference 2019 (WRC-19), the ITU-R announced new rules for a number of technical requirements[239] for operations within the designated HAPS spectrum bands.[240] It is crucial to establish appropriate laws governing the creation, deployment, and operation of HAPS to ensure their smooth

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229 Adurogboye S., "Nigeria:- NCAA issues safety guidelines for drone operators", 2016, available at https://www.suasnews.com/2016/05/43512/ (accessed 8 August 2023).
230 Liu Hao and Tronchetti F., The "EUS", see note 16
231 Ibid
232 Ibid
233 Ibid
234 Ibid
235 Mohammed A., Mehmood A., Pavlidou F.N., and Mohorcic M., "The role of high-altitude platforms (HAPS) in the global wireless connectivity," (2011).
236 ITU, "Radio Regulations, Section IV – Article 1.66A, Radio Stations and Systems, definition: High Altitude Platform Station," (2016).
237 Grace D., Tozer T., and Daly N., "Communications from High Altitude Platforms a complementary or disruptive technology?" (2000).
238 Ibid
239 ITU, "Provisional Final Acts," in World Radiocommunication Conference 2019, ITU Publications, 2019, available at: https://www.itu.int/en/ITU-R/conferences/wrc/2019/Documents/PFA-WRC19-E.pdf (accessed 9 August 2023.
240 Ibid

integration into the global communication infrastructure. HAPS is subject to aeronautical laws during the take-off and landing phases of their operations in the stratosphere.[241] There are currently certain regulatory hurdles in the way of the development of HAPS for wireless communication, which include the spectrum band allocation and the various aeronautical restrictions encountered in different jurisdictions.[242]

Due to the historical underutilization of the near space and the ambiguity surrounding the demarcation between air and outer space, there is a lack of regulation in regards to safety and navigation.[243] Because of this disparity, a collision between two planes is always a possibility.[244] Surprisingly, there isn't a well-established, internationally-recognized regulatory body with clear responsibilities to regulate HAPS operations or the use of the EUS.[245]

The resolution of this issue, is vital for future considerations due to the significance of a country's security and the necessity for legal certainty. This is particularly crucial for businesses seeking to negotiate the regulatory frameworks of both sectors, which are governed by conflicting regulations. A workable strategy for reducing the risks associated with an unregulated fleet would involve working together to address navigational and safety concerns within the current frameworks of the ICAO and ITU.

The ITU and the ICAO have assumed crucial responsibilities in coordinating communication between flights and air traffic systems to avoid collisions and harmful interference between aircraft and satellites. This mini-dissertation seeks to understand how these two organisations collaborate on flight navigation system integration, which is critical for preventing crashes and harmful interference among air, spacecraft and future aerospace vehicles.

[241] Mohammed A. et al, see note 236.
[242] Ibid
[243] DiPaolo A.J, see note 96.
[244] Ibid
[245] Pelton J., "Urgent Security Concerns in the Proto-zone", 2016, available at https://www.researchgate.net/publication/301922145_Urgent_Security_Concerns_in_the_Protozone (accessed 10 August 2023).

4.2 The role of ICAO in regulating HAPS:

4.2.1 Introduction

Harmonisation of international rules is crucial to the aviation industry's success since it ensures its continued safe and efficient operation. The ICAO was established as a result of the Chicago Convention to regulate such activities.[246] ICAO's principal goals include enhancing safety and systematically expanding civil aviation around the world.[247] It is, therefore, ICAO's responsibility to promulgate legal frameworks, protocols, and principles that guarantee a "secure, structured, and sustainable aviation sector".[248]

The Chicago Convention gives ICAO the ability to develop SARP's as Annexes in order to meet these responsibilities.[249] The safety and efficacy of air travel are guaranteed by these SARP's because they cover every aspect of civil aviation, both technically and operationally. HAPS fly at higher altitudes than commercial planes, however they do share the airspace with these planes for a limited time. At the absolute least, HAPS must be included into the global air navigation system[250] because they cross the standard air routes during ascension and descent.

To maintain a safe and sustainable global air transportation sector, it is clear that standardisation is essential.[251] All users of a given airspace should adhere to the same safety and navigation standards. When multiple types of aircraft share the same airspace, it is more crucial than ever to have a consistent system of air safety for everyone's protection.[252] Therefore, it is reasonable to propose that ICAO address concerns connected to HAPS to some extent: adopting different procedures or practises for HAPS and other aircraft could potentially produce conflicts and undermine safety.[253]

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[246] See Article 43 of the Chicago Convention, see note 98
[247] See Article 44 of the Chicago Convention, see note 98
[248] The Outer Space Treaty, see note 21.
[249] Article 37 of the Chicago Convention, see note 98
[250] Uniting Aviation, see note 218.
[251] Jakhu R. et al, see note 97.
[252] Ibid
[253] Milde M., "International Air Law and ICAO", (2008).

A number of issues pertaining to HAPS operations have already been under investigation by the ICAO Secretariat. A good example is the "Operations above flight level 600", where a Working Paper was introduced by the Secretariat at the 13th Air Navigation Conference.[254] The importance of ICAO to HAPS activities was highlighted, and the case was made for ICAO to help regulatory bodies adapt to new aircraft types, especially HAPS, while still adhering to established international norms and standards.[255]

4.2.2 What approach would ICAO take to regulate HAPS:

According to the Working Paper, ICAO will use existing procedures that include relevant expert groups to address all aspects of HAPS development and advancement, notably in relation to global aviation safety and navigation.[256] ICAO could consider to add an additional Annex, as a means to resolve safety concerns related to HAPS operations, to the Chicago Convention.[257] As such, Article 37 provides a sufficiently thorough framework for ICAO to propose a new Annex that directly tackles concerns particular to HAPS, which were not initially considered when the Chicago Convention was first formulated.[258]

To this end, it is important to evaluate ICAO's current technical capabilities in the areas of air navigation and safety, as well as the possibility of expanding this function to include standards and guidelines for near space flight navigation. Some experts argue that ICAO must keep an eye on any new uses of airspace that may change the way it manages traffic throughout the world.[259] Article 44 of the Chicago Convention outlines ICAO's goals in terms of safety and air navigation.[260]

With the primary goal of establishing safe and synchronised worldwide air navigation, Air traffic management (ATM) is a part of the Communication, Navigation, and Surveillance (CNS) programme that ICAO has put into place. The incorporation of the Global Navigation Satellite System (GNSS) air navigation concept has significantly improved this programme. Since

[254] International Civil Aviation Organisation Working Paper AN-Conf/13-WP/16
[255] Ibid
[256] Ibid
[257] Article 37 of the Chicago Convention, see note 98
[258] Ibid
[259] Van Fenema P., "Suborbital Flights and ICAO", (2005)
[260] Article 44 of the Chicago Convention, see note 98

utilising cutting-edge technology is central to this GNSS-based CNS/ATM initiative, the benefits of such a sophisticated air navigation system for aerospace aircraft will be investigated as well.[261]

The Chicago Convention's Annex 10 lays down the groundwork for the complex field of aviation, covering such topics as communication, surveillance, and navigation.[262] It's vital to keep in mind, though, that this system is still in its infancy, having acquired global acceptance as a programme only in 1991,[263] and that the nuances of aeronautical telecommunications specified in the Annex are extremely technical and are mostly used by specialised users.[264]

Standard radio navigational tools are the primary focus of Volume I of Annex 10. Very High Frequency (VHF) ground-based omnidirectional radio range (VOR) is used by air traffic controllers to communicate with aircraft on very short overland routes.[265] Ground-based guidance systems, on the other hand, can't send signals far enough when they are used to get around on the open sea.[266] So, a device called an Inertial Navigation System (INS) is needed that can work on its own. This instrument measures not only the velocity of an aircraft but also transmits its location, navigation data, steering instructions, and angle data including pitch, roll, and heading.[267]

When it comes to surveillance systems, however, the rules and advice tools are presented in Volume IV of Annex 10. This is made possible by radars and systems that keep planes from colliding.[268] Air traffic management relies heavily on this form of surveillance since it allows humans or systems to always know where aircrafts are and where they'll be going in the future. The Automatic Dependent Surveillance (ADS)[269] system and radio/digital-based radar equipment is the backbone of this network's surveillance capabilities. Utilising aircraft

[261] Dempsey P.S., see note 116.
[262] Ibid
[263] Galotti V.P, "The Future of Air Navigation System", (1997).
[264] Ibid
[265] Galotti, see note 264.
[266] Oduntan G., "The Never-Ending Dispute: Legal Theories on the Spatial Demarcation Boundary Plane between Airspace and Outer Space", (2003).
[267] Ibid
[268] Annex 10 of the Chicago Convention, see note 98.
[269] By observing the radar, an air traffic controller can see exactly where a plane is on a screen.

navigation systems with sufficient accuracy and dependability, the ADS system provides a seamless data connection between the air and the ground.[270]

The prior communication and surveillance system's range limits have highlighted the need for a more all-encompassing and holistic solution that can improve air navigation over oceans and hilly terrains.[271] As a result of this requirement, the GNSS was created as a satellite-system to help in aerial navigation by precisely detecting a plane's location, velocity, and other critical flight data.[272] It cannot be overstated how crucial it is to have access to an abundant and suitably protected radio spectrum. Because of the high standards for reliability and availability associated with aviation safety systems, this spectrum is important.[273]

One of the main problems with regional air traffic control is that different countries have different safety and security standards for their airports and use different air traffic protocols. The current air transportation system may be able to handle this without issue because states can keep tabs on the number of flights taking off and landing within their Flight Information Region (FIR).[274] However, because of the ballistic trajectories and high velocities typical of aerospace travel, the danger zone surrounding these flights is significantly larger than that surrounding commercial planes. A complete system to assure the safety of all flights at different altitudes is thus necessary for the management of air traffic.[275]

How, though, should the current ICAO technical expertise be factored into discussions on radiocommunication and navigational procedures for future aerospace journeys?[276] It is true that ICAO is prohibited from interfering with how individual countries handle air traffic control, but it is also true that the organisation is obligated to address all safety and navigational issues that affect civilian aviation.[277] Notably, ICAO has successfully moved

[270] Galotti, see note 264.
[271] UNCOPUOS, UN Doc A/AC.105/635 (1996)
[272] Abeyratne R.I.R., Frontiers of Aerospace Law (2017).
[273] ICAO's Position to the International Telecommunication Union (ITU) in preparation of the World Radiocommunication Conference 2019 (WRC-19).
[274] Luchkova T., Kaltenhaeuser S. and Morlang F., "Air Traffic Impact Analysis Design for a Suborbital Point-to-Point Passenger Transport Concept" (2016), available at: https://commons.erau.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1128&context=stm (accessed 11 August 2023)
[275] Ibid
[276] Ibid
[277] Hunter S., see note 17.

international involvement from a reactive position to a proactive strategy regarding security and safety, and its scope is continually expanding to include anticipatory global risk management.[278] Whenever the safety of civil aviation is in jeopardy, regardless of vehicle height, ICAO can investigate aerospace navigation systems and encourage countries to establish fundamental navigation standards and procedures.[279] Because of this, ICAO has the responsibility and the ability to investigate and develop flight navigation safety standards.

4.3 The role of ITU in regulating HAPS:

4.3.1 Introduction

The ITU is an international organisation charged with managing the allotment of spectrum frequencies and the orbital positions for satellites. In particular, the ITU:

a) coordinates the usage of Geostationary Space Orbit (GSO) and orbital corridors.

b) allot portions of the radio frequency spectrum for use by various technology services.

c) maintains the Master International Frequency Register (MIFR), a database of radio frequency allocations, and

d) defines global norms for the administration of radio frequencies and orbital slots.[280]

International oversight of the radio-frequency spectrum and satellite orbits falls to the ITU Radiocommunication Sector (ITU-R).[281] Demand for these limited resources is rising as a result of the rise in popularity of services including fixed and mobile communications, broadcasting, amateur radio, space exploration, emergency communications, meteorology, global positioning systems, environmental monitoring, and communication.[282] These services safeguard land, sea, and air life.

According to the Radio Regulations, the ITU has divided the globe into three regions in order to make it easier to coordinate the use of the radio spectrum worldwide.[283] The major

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[278] ICAO, "An outcomes-based approach to sustainable aviation security measures", HLCAS-WP/33 (2012), available at https://www.icao.int/safety/SafetyManagement/Pages/default.aspx (accessed 12 August 2023).
[279] Hunter S., see note 17.
[280] Allison A.L, "The ITU and Managing Satellite Orbital and Spectrum Resources in the 21st Century" (2014)
[281] ITU's Radiocommunication Sector (ITU-R), available at: https://www.itu.int/en/ITU-R/information/Pages/default.aspx, (accessed 13 August 2023).
[282] Ibid
[283] The radio-frequency spectrum and geostationary satellite orbits are natural resources that can be accessed and used fairly and sensibly thanks to the ITU Radio Regulations. Also, they contribute in preventing and resolving instances of harmful interference between radio services of different governments, and they ensure that emergency and safety-related frequencies remain accessible. There is a need for these rules to oversee innovative uses of radio technology, but

motivation for dividing the world up into regions was to assign different frequencies to each one:[284]

a) Region 1: Europe, Africa, the Middle East west of the Persian Gulf including Iraq, Russia and Mongolia;

b) Region 2: Americas, Greenland and some of the eastern Pacific Islands;

c) Region 3: Asia, east of and including Iran, and most of Oceania

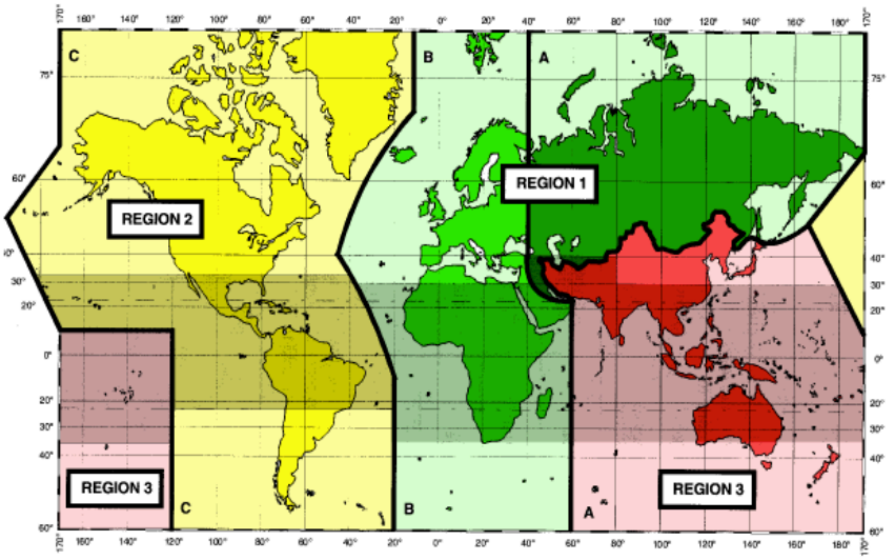

Figure 8: Source: ITU Regions

When the safety of civilian aviation throughout the world was threatened by issues like harmful interference to GNSS, the ITU and ICAO signed a Memorandum of Cooperation (MoC) in 2012.[285]

4.3.2 What approach would the ITU take to regulate HAPS

ITU is unique in that it welcomes organisations from the business sector to become members and participate in its programmes as "Sector Members",[286] as long as they receive approval from their respective governments. The ITU-R is made up of both member states and large

otherwise they facilitate the efficient and effective operation of all radiocommunication services, available at https://www.itu.int/hub/publication/r-reg-rr-2020/ (accessed 13 August 2023)

[284] ITU, "Radio Spectrum Management for a Converging World", (2004) available at https://www.itu.int/pub/S-POL-NIP.RSM-2004 (accessed 13 August 2023)

[285] Memorandum of Cooperation between the ITU and ICAO for Enhanced Cooperation related to the Protection of Global Navigation Satellite Systems from Harmful Interference impacting on Aviation Safety (effective December 2012) available at https://www.itu.int/dms_pub/itu-r/oth/0a/0e/R0A0E0000A40001PDFE.pdf (accessed 13 August 2023)

[286] Constitution and of the International Telecommunication Union, December 1992, (entered into force 1 July 1994)

technology companies. [287] They have the right to take part in the industry's affairs, provided that they adhere to the guidelines set forth in the Constitution and the Convention.[288]

Sector members have a unique opportunity to create the rules that would apply to them. This allows them to make use of the spectrum efficiently, while shielding themselves from harmful interference from other services.[289] As a result, national authorities would enforce the internationally accepted norms and use them as a basis for domestic licencing. This gives non-government organisations a sense of security and legal certainty.[290]

With private sector and government working together, radio frequencies for HAPS have been successfully allocated. For HAPS operations, which would involve gateway and ubiquitous terminal applications,[291] ITU has assigned certain radio frequencies as of 2007. In addition to using the same radio frequencies as International Mobile Telecommunications (IMT) base stations, the ITU has also authorized HAPS to use specific radio frequencies that have been allocated to IMT services. More importantly, the ITU has mandated that fundamental details like the station's identity, administrative authority, and location be disclosed.[292]

ITU has always been careful and decisive about preventing interference with radio transmission or radio navigation services that could be harmful. The ITU Constitution states that, "all stations, no matter what they are used for, must be set up and run in a way that doesn't interfere with the radio services or communications of other Member States or recognised operating agencies".[293] The Constitution further emphasises "the imperative of implementing all feasible measures to prevent electrical apparatus and installations of every kind from generating harmful interference to radio services or communications..." to avoid this kind of harmful interference.[294]

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[287] Big technology companies such as Google, Meta, Boeing, Airbus, SpaceX, etc.
[288] Updated list of sector members, available at: https://www.itu.int/online/mm/scripts/gensel11 , (accessed 13 August 2023)
[289] Allison A.L., see note 281.
[290] Ibid
[291] ITU Radio Regulations, Resolution 122 (Rev.WRC-07), Resolution 145 (Rev.WRC-12), Resolution 221 (Rev.WRC-15).
[292] Ibid.
[293] Article 45(1) of the ITU Constitution.
[294] Article 45(3) of the ITU Constitution.

Due to the limits of radio technology, the ITU has only been able to organise efforts by states and businesses to stop harmful interference between these services. It hasn't gone as far as controlling all the knock-on effects, such the trouble with aircraft navigation caused by GNSS jamming.[295]

North Korea, for example, was responsible for a string of radio jamming incidents between 2010 and 2012 that caused GPS systems to malfunction, affecting over a thousand planes and ships operating in and around Incheon airport and other locations.[296] When ICAO deals with threats to air travel, the ITU could only concede that "harmful interference" existed between satellites and ground stations infrastructure.[297]

As a result, ITU and ICAO formed a joint study committee to find a complete solution to the GNSS security issues and associated safety concerns. In 2012, ICAO and ITU succeeded in their efforts to collaborate by signing a Memorandum of Cooperation (MoC).[298] The fundamental motivation for this MoC was to create a methodical strategy for dealing with problems associated with harmful interference to GNSS that could compromise the security of international civil aviation.[299] The two organisations have agreed to work together under the MoC to avoid duplication of effort and take advantage of synergies that arise naturally from their separate but complementary areas of expertise.[300]

4.4 Conclusion:

In spite of the fact that the parties to this MoC are under no legal obligation to alter or expand their respective powers, it lays a crucial groundwork for future collaboration in areas where the participation of both organisations is necessary. Based on what has been said so far, it's not out of the question that these two organisations might work together on something as broad as the coordination of aerospace missions. This gives confidence that possible challenges connected to the assignment of stratospheric objects and communication with

295 Allison A.L., see note 281.
296 Mizokami K., "North Korea Is Jamming GPS Signals", (2016), available at https://perma.cc/B68P-GESE (accessed 14 August 2023).
297 Savage J.G, "The Politics of International Telecommunications Regulation" (2019)
298 ITU-ICAO MoC, see note 285.
299 Ibid
300 Ibid

flight controllers, may be overcome given the current level of collaboration between these groups.[301] In anticipation of the World Radiocommunication Conference 2019, on the question of assigning more radio spectrum for aerospace aircrafts, ICAO supported any efforts made to answer technical and legal questions, including those that might call for "new allocations" of radio frequencies.[302]

While the allotment of specific radio frequencies for these innovative flights was discussed during the WRC-19, no immediate conclusion was reached in the Final Acts.[303] The resolution directs the ITU-R to undertake feasibility studies of sub-orbital vehicles “to determine the technical and regulatory conditions to allow some stations on board sub-orbital vehicles to operate under the aeronautical regulation and to be considered as earth stations or terrestrial stations even if a part of the flight occurs in space”, and “to facilitate radiocommunications that support aviation to safely integrate sub-orbital vehicles into the airspace and be interoperable with international civil aviation”.[304]

The work under the current study cycle in preparation for WRC-23, agenda item 1.4, in accordance with Resolution 247 (WRC-19), includes sharing and compatibility studies in the frequency bands 694-960 MHz, 1 710-1 885 MHz and 2 500-2 690 MHz, as well as studies for modifications to the existing RR No. 5.388A and associated Resolution 221 (Rev.WRC-07).[305] The aim of these studies are to provide more flexibility on the use of such frequency bands by HAPS, including the use of the most recent radio interface technologies of IMT. This would allow HAPS to protect the viability of current primary services in the same and adjacent frequency bands while also giving people in rural and remote areas who don't have access to internet connectivity.[306] The ITU-R and other regional organisations are conducting preliminary research at the moment.

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[301] ICAO’s WRC19 position, see note 274.
[302] Ibid
[303] The 2nd ITU’s Conference Preparatory Report of 2023, in preparation for the World Radiocommunication Conference for 2023, available at: https://www.itu.int/dms_pub/itu-r/md/19/cpm23.2/r/R19-CPM23.2-R-0001!!PDF-E.pdf (accessed 15 August 2023).
[304] Ibid
[305] Ibid
[306] Ibid

Through collaboration, ICAO and ITU can advance aerospace flight navigation. However, creating a separate organisation for stratospheric navigation and safety explorations may be beneficial. This separate organisation may assist in preventing border conflicts between states and help define technical phases for these vehicles throughout their flight path. The evaluation and establishment of basic navigation requirements for aerospace flights may potentially introduce a customised legal framework for HAPS and other stratospheric objects' safety and liability issues.

Chapter 5: The Future of Regulating HAPS

5.1 Introduction:

Neither the economic nor technological possibility of HAPS operations were taken into account when the current air and space legal frameworks were drafted.[307] As a result, there was a period of time during which no aviation-related activities took place. Nowadays, innovative crafts like HAPS is sent into the stratosphere, where they operate above normal airspace but below outer space.[308] This situation raises questions about proper vehicle classification and the scope of applicable laws and regulations.

The scientific term for the area between Earth's atmosphere and the furthest reaches of space is the "near space".[309] The current upper limit for conventional aeroplanes is between 18 and 20 kilometres above sea level.[310] Any flight beyond this altitude "holds minimal potential for human survival without a complete pressure suit in case of aircraft system malfunctions".[311] As air density continues to drop beyond this 18–20 km range, so does the efficiency of aircraft engines. This decrease will continue until either the wings or the engines can no longer provide enough lift or force.[312]

The von Kármán line, which occurs at an altitude of roughly 100 kilometres, is the point at which "the velocity needed to generate aerodynamic lift exceeds the speed required to attain orbital velocity".[313] This transformation marks the beginning of space travel as the aeroplane becomes a space object.[314]

In this chapter, we discuss the possibility of expanding our understanding of space beyond the simplistic dichotomy between the atmosphere and the rest of the cosmos. In between the

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[307] UNCOPUOS, Dempsey P. and Manoli M., "Suborbital flights and the delimitation of airspace vis-à-vis outer space: functionalism, spatialism and state sovereignty", (2018).
[308] Jinyuan S., see note 155.
[309] Ibid
[310] Hunter S., see note 17.
[311] Ibid
[312] King M., "Sovereignty's Grey Area: The Delimitation of Air and Space in the Context of Aerospace Vehicles and the Use of Force", (2016).
[313] Hunter S., see note 17.
[314] Gorove K., see note 156.

minimum orbit level reachable by a space object and the altitudes typically used by commercial aviation lies a transitional zone known as the "near space".[315] There's a fascinating ambiguity where aeronautics and space exploration might meet in this area. HAPS is one popular use for the expanding market of near space.[316]

However, because near space has not been used before, its legal status is unclear. There are no existing international legal frameworks that are specific to near space, so there is a lack of clarity regarding "the regulations overseeing activities within this domain".[317] The author argues that the uncertainty about the legality of some activities or the details of their implementation, has a negative effect on HAPS-related services in this new territory.[318]

The goal of this chapter is to look into the burgeoning field of near space and investigate how HAPS operations can be included into this sector. The goal of this chapter is to create specialised legislation for the near space by defining it in a way that is separate from air and outer space. This chapter will investigate some paths and ideas that could be considered to build governance over near space utilisation in the absence of a comprehensive current framework.

Scholars have pointed out that there is substantial debate over where near space stands legally.[319] The lack of clear international regulations for the near space has created a legal "grey area" within the scope of international law, making its status unclear and up for debate.[320]

HAPS initiatives, which commonly involve an entity flying above a foreign territory, are complicated by this fact because of their worldwide scope.[321] There are many questions because there is a lack of clarity caused by the absence of internationally accepted regulations. What regulations govern travel to and activities in suborbital space? Which kinds

[315] Bittencourt, see note 128.
[316] Pelton J., see note 246.
[317] Liu Hao and Tronchetti F., "Regulating Near-Space Activities: Using the Precedent of the Exclusive Economic Zone as a Model?", (2019).
[318] Ibid
[319] Liu Hao and Tronchetti F., The "EUS", see note 16
[320] Ibid
[321] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317

of assistance are acceptable? How long is an international station allowed to stay in one place? What precautions can a country take to ensure the safety of its citizens?[322]

The uncertainty of the near space can be clarified by establishing a new legal framework that is designed to oversee activities within this area. The result would be a level playing field for businesses, which would spur innovation and the development of HAPS.[323]

5.2 A legal framework for regulating operations in the "near space":

The Exclusive Economic Zone (EEZ) is defined by the United Nations Convention on the Law of the Sea (UNCLOS), which could serve as a potential model.[324] The EEZ is defined as "a zone beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by the relevant provisions of the Convention".[325] It is generally agreed that the EEZ is a special area with its own set of rules that incorporates features of both territorial waters and the open ocean.[326] It's also worth noting that, like the EEZ, near space extends beyond state borders and lacks any sort of universally recognised legal status.[327]

In addition, developments in these areas provide difficulties and raise safety and security concerns, especially when dealing with international companies.[328] Similar considerations could be given to the EEZ's regulatory regime to determine whether or not it has any bearing on the near space. Although the EEZ's regulations shouldn't be taken at face value, some useful lessons might be learned from it.[329]

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[322] Ibid
[323] Ibid
[324] The United Nations Convention on the Law of the Sea (UNCLOS), also called the Law of the Sea Convention or the Law of the Sea Treaty, is an international agreement that establishes a legal framework for all marine and maritime activities, signed in December 1982 and effective in November 1994, available at https://treaties.un.org/doc/publication/CTC/Ch_XXI_6_english_p.pdf (accessed 28 August 2023).
[325] Article 55 of UNCLOS, see note 328.
[326] Kwiatkowska B., "The 200 miles exclusive economic zone in the new law of the sea", (1990).
[327] Quince Ch., The Exclusive Economic Zone, (2019).
[328] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.
[329] Pelton J., see note 246.

5.2.1 The underlying States sovereign rights and territorial scope:

In the same way that a coastal state's EEZ is not part of its territory, the near space falls within the category.[330] The idea behind this is to increase international cooperation by removing potential roadblocks for HAPS operations, should the underlying States retain full sovereignty over the near space.[331] If the underlying states have full sovereignty, they can put restrictions on HAPS by limiting access, activities, or service provision.[332]

Creating a near-space zone would not interfere with a country's right to control its airspace. The underlying state would be able to legislate, govern, and monitor operations taking place anywhere inside its territory, up to an altitude of 18 kilometres.[333]

Following the model of the EEZ, the underlaying states would have primary control over the use and management of the immediate vicinity.[334] Countries that are flown over, should have control over their immediate airspace.[335] Therefore, the launching state would continue to have control over HAPS operations and make sure they adhere to their license terms and conditions, before any work is undertaken.[336]

5.2.2 HAPS deployment:

National authorization is required prior to a HAPS deployment into the near space. Given that HAPS will inevitably pass through the airspace of multiple countries, it is logical for each country to have a say in how these systems are operated.[337] A possible solution is to require the HAPS operator to file an application for a launch licence in the jurisdiction where the object is to be launched. For HAPS deployment to go smoothly, all parties need work together to develop a set of ground rules.[338]

[330] Quince Ch., see note 331.
[331] Meira Mattos A., Direito Internacional Público, (2002).
[332] Mateesco Matte N., Aerospace Law, Carswell (1969).
[333] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.
[334] Quince Ch., see note 331.
[335] UNCOPUOS (2018), see note 307.
[336] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.
[337] Pelton J., see note 246.
[338] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.

HAPS is a semi-mobile platform, operating at high altitudes. Since State A may launch a HAPS that will operate over State C, State B's airspace may be traversed by the HAPS at some point. For this reason, the HAPS operator would have to either obtain permission from or formally inform State B of its intention to fly across State B's airspace.[339] There should be no way for states to block the free passage of an object through their territory.[340] However, countries should still be informed of flights that will be going through the near space, even though it is not technically within their territory. This requirement must be met before the object is put into operation.[341]

5.2.3 Exercising control over HAPS operations:

Before beginning operations, the HAPS operator must, as was previously noted, apply for a licence to operate. The HAPS operator and the underlying State should work together to establish clearly defined requirements that apply to HAPS operations and activities.[342] By working together, the underlying State can determine whether the proposed initiative jeopardises national security, serves national interests, or benefits the well-being of its population.[343] The owner must provide a comprehensive plan outlining the specifics of the activities, including their scope, duration, and outcomes, in order to facilitate risk assessment.[344] After considering this proposal, the underlying State would either approve or withhold permission to begin operations.

Each country would be free to "determine how to structure the process" in terms of its own authorization and coordination needs.[345] If the object is deployed and operated in the same country, one licence may be sufficient if both takes place in the same country.[346] The HAPS operators will have to apply for two licences if the object is launched and operated in different countries: one from the "launching country" and another from the country over which the HAPS will be operating.[347]

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[339] Ibid
[340] Mateesco Matte N., see note 336.
[341] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.
[342] UNCOPUOS (2018), see note 307.
[343] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317
[344] Ibid
[345] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.
[346] Ibid
[347] Ibid

If these conditions are not met, it is a violation of the rights of the State which granted permission to operate and may compromise the security of that State.[348] The underlying state would be within its rights to take any necessary steps to stop the illegal behaviour. Such measures may include, but are not limited to, terminating, amending or suspending the licence or agreement.[349]

5.3 Conclusion:

HAPS's main goal is to make communication and the internet more accessible, but it's also crucial to recognise that other technologies, including satellites and terrestrial stations, serve the same purpose. Therefore, it is crucial that HAPS do not cause interference with already established services.[350] In addition, it is imperative that HAPS operations be coordinated in a way that does not increase the danger to civilians, property, or other aircrafts, both manned and unmanned, that are in the area.[351]

As a result, the underlying states would be legally permitted to impose strict security regulations.[352] To undertake HAPS operations of the near space under State sovereignty, HAPS operators must comply with the State's regulations.[353] If the required safety and security measures are not met, operations may be temporarily halted, altered, or cancelled.[354] However, in order to keep things on a level playing field, "the underlying State would be required to convey the rationale behind its rejection and provide the foreign entity with a chance to mitigate any concerns".[355]

In conclusion, the ideas discussed above provide a basis for the regulation of HAPS activities. To encourage HAPS operators to pursue near space initiatives and "provide services to interested customers globally," and so allow efficient use of the near space.[356] Furthermore, the near space would continue to be legally and administratively independent from the

[348] Ibid
[349] Ibid
[350] Pelton J., see note 246.
[351] David G., see note 48
[352] Pelton J., see note 246.
[353] Liu Hao and Tronchetti F., "Regulating Near-Space Activities", see note 317.
[354] Ibid
[355] Ibid
[356] Ibid

underlying State's territory while still retaining some measure of sovereignty for use and control.[357] In addition, HAPS organisations would have to meet the requirements and standards established by the State, which would call for the submission of a detailed activity plan before any stations could be put into operation.

[357] Ibid

CONCLUSION:

There is a “new” emerging technology that shows promise in operating within the stratosphere, namely at altitudes spanning from 20 to 50 kilometres above the Earth's surface and it’s called High-Altitude Platform Stations (HAPS). Among the cutting-edge wireless services that could be provided by such systems are earth observation and monitoring, as well as communication and access to internet connectivity to rural and underserved areas.

Until recently, aviation mostly focused on transporting people and cargo. Today's developments have created new objects that operate beyond normal airspace, providing new features and functions. This technical advancement, which allows such objects to operate, challenges and expands the aviation industry. Additionally, these technological advancements also challenge legal practitioners' and the law's ability to adapt to new and unusual conditions.

At present, there are two main areas of space that is recognised: airspace and outer space. As technology has advanced, "specific instances that pertain to the enduring discourse about defining and delineating space" have emerged.[358] The study and implementation of the spatialist and functionalist theories, have led to a more nuanced classification of space than only "airspace" and "outer space". The existing international legal frameworks for air law and space law are important, but they are not enough to deal with the new activities that are emerging in the stratosphere.

HAPS is a hybrid machine that perform space-related duties by combining characteristics of conventional aircraft with unique designs. As a result, these objects blur the lines between the aviation and space industries, defying easy classification. Because of these differences, a transitional zone called the near space must be created to accommodate HAPS operations. This industry would cover new businesses between 18 and 100 km above sea level and new rules, specifically designed for items operating in this vicinity, should be considered.

[358] Hunter S., see note 17.

The near space is a new kind of strategic battlefield for testing out futuristic vehicles and the ambiguity of this space's legal status is the key worry in legal circles. The regulatory framework in this region is uncertain since international agreements governing it are lacking. Since the line separating airspace from space is often unclear, there may be a gap in safety and navigation regulations. Given that HAPS malfunctions or failures could have grave consequences for those on the ground, this chasm represents a real threat of collision with aeroplanes. Because of their similarity to aeroplanes, HAPS must be governed by the same aviation safety regulations and standards that apply to planes which are developed by ICAO.

The author attempted to suggest a system for controlling the nearby space, modelling it after the Law of the Sea Convention, which makes reference to the EEZ. To put it succinctly, the idea proposes that the States situated over which HAPS is operating, should have control over the commercial use of the near space. The State may not directly control the jurisdiction of the near space, but it does impact its use and management. Before deploying a station, the HAPS operator must get the necessary licences and submit detailed plans for their planned activities. The underlying states would be the ones with the authority to determine the standards that HAPS providers must meet.

The HAPS initiatives are only getting started. Even though the current volume of operations is relatively limited, there is an expected growth in the years ahead. When it comes to HAPS operations, it's important to have a holistic, multi-stakeholder strategy as only with cooperation between States and HAPS operators, and the active engagement of international and regional organisations, can the advancement of HAPS activities be made in a way that is effective, secure, and lawful.

Given the current state of technology, expanding HAPS infrastructure will benefit not only the States and the industry involved in its operation and management, but also, the people who live in rural and underserved areas by giving them access to the internet.

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