Transcending the Legal and Political Uncertainty of the Delimitation Issue:

Baseline coordination on safety and traffic management for civil aerospace flights

by

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ABSTRACT

In recent years where both the international aviation and space industries have been growing apace, aerospace vehicles – mainly referred to as sub-orbital vehicles – have been seen as the next generation of transportation. However, various designs and functions of civil aerospace vehicles have complicated the issue of which current legal regime – air or space law – should apply. The debate on aerospace flights has largely remained stagnant, due to the fact that the international air and space law regime, under the 1944 Chicago Convention and the 1967 Outer Space Treaty, were both developed at a time when that futuristic concept of transportation means did not yet exist. While the issue has been extensively reviewed under the historical debate of delimitation or the vehicles' right of passage, those subjects have not been resolved since the beginning of space age and States have rather started to enact national regulations from their respective views on aerospace flights and airspace sovereignty.

This thesis submits that the legal and political gap has been widened where one cannot immediately resolve the delimitation issue, while aerospace flights will incomparably pose a significant risk of safety both in the air and on the ground. Thus, baseline coordination on global navigational rules – such as radio-communication and positioning aids – is crucial for ensuring the safety of aerospace flights. At the same time, such baseline coordination would alleviate the legal and political disagreement between States and would facilitate further cooperation between States in terms of aerospace traffic management. This thesis concludes that ICAO and ITU are the very actors to study the viability of standardizing radio communication of aerospace flights, and if feasible, to gather its over 190 member States to incorporate future aerospace navigation standards and means within their technical competencies.

RÉSUMÉ

Au cours de ces dernières années, alors que l'aviation internationale et l'industrie spatiale ont connu une croissance rapide, les véhicules aérospatiaux ont été considérés comme la prochaine génération de moyens de transport. Toutefois, les diverses conceptions et fonctions des véhicules aérospatiaux civils ont compliqué la question de savoir quel régime juridique actuel - droit aérien ou spatial - devrait s'appliquer. Le débat sur les vols aérospatiaux est resté en grande partie stagnant, du fait que le régime international du droit aérien et spatial, dans le cadre de la Convention de Chicago de 1944 et du Traité sur l'espace extra-atmosphérique de 1967, a été élaboré à une époque où ce concept futuriste des moyens de transport n'existait pas encore. Bien que la question ait fait l'objet d'un examen approfondi dans le cadre du débat historique sur la délimitation ou le droit de passage des véhicules, ces questions n'ont pas été résolues depuis le début de l'ère spatiale et les États ont plutôt commencé à adopter des réglementations nationales à partir de leurs vues respectives sur les vols aérospatiaux et la souveraineté de l'espace aérien.

Cette thèse soutient que le fossé juridique et politique s'est creusé là où l'on ne peut pas résoudre immédiatement le problème de la délimitation, alors que les vols aérospatiaux poseront un risque important et incomparable pour la sécurité tant dans les airs que sur terre. Par conséquent, la coordination de base des règles mondiales de navigation - telles que les radiocommunications et les aides au positionnement - est cruciale pour assurer la sécurité des vols aérospatiaux. Dans le même temps, une telle coordination de base atténuerait les désaccords juridiques et politiques entre les États et faciliterait la poursuite de la coopération entre les États en matière de gestion du trafic aérospatial. Cette thèse conclut que l'OACI et l'UIT sont les acteurs les plus appropriés pour étudier la viabilité de la normalisation des communications radio des vols aérospatiaux et, si possible, de réunir ses 190 Etats membres pour incorporer les futures normes et moyens de navigation aérospatiale dans leurs compétences techniques.

INTRODUCTION

In these recent years, both the international aviation and space industries have been growing apace. The aviation industry has shown dramatic growth throughout the last two decades with a net passenger increase of 1.5 to almost 4 billion worldwide and is still expected to double through enhancing passenger accessibility and increasing fuel efficiency.[1] The space sector, often lately referred to as the New Space,[2] is becoming an industry that is no longer driven by government-based projects but has evolved into a whole new business sector with new insurance challenges and cost-benefit considerations.[3]

Aerospace vehicles (e.g., SpaceShipTwo by Virgin Galactic, New Shepard by Blue Origin, Big Falcon Rocket by SpaceX), in this regard, are seen as the next generation of transportation means through air and space.[4] Having both aerodynamic and ballistic features, the industry

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[1] The International Air Transport Association (IATA) projected until 2037 a 3.5% rise on the Compound Annual Growth Rate based on global policy remaining as it has been during the period that led to this growth. To steadily achieve such number, airlines are ramping up to serve more passengers by modernizing their fleets and adding buying new generation aircraft that are more fuel-efficient. Also, the industry is also looking to simplify booking records and ticketing and, eliminate payment complications by introducing the One Order standard. See Marisa Garcia, "Air Travel Projected To Double In 20 Years, But Protectionism Poses Threat", *Forbes* (24 October 2018), online: <www.forbes.com> [perma.cc/VQ65-PAQ4].

[2] Although the exact definition is open to debate, the 'New Space' era describes an evolution from mere government contracting, government anchor tenancy, and government purchase of hardware to a cooperation between governments and private entities in purchasing services, funding and equity, and the exploitation of new commercial activities. It is an "entrepreneurial activity of private actors but working in concert with government under new partnerships and new business models." See Charles Stotler, "What is NewSpace?" (Presented at the 3rd Manfred Lachs International Conference on NewSpace Commercialization & the Law at Montreal, Canada, 16 March 2015) [unpublished].

[3] According to Morgan Stanley Research, the total revenue generated by the space industry in 2018 was $350 billion and has further estimated that this industry could generate more than $1 trillion by 2040. While most significant short and medium-term business opportunities currently come from satellite-based navigation and internet services, new frontiers including commercial space transportation, space mining, and property rights are expected to offer long-term profit to the global economy. See Morgan Staley Research, "Space: Investing in the Final Frontier", *Morgan Stanley* (2 July 2019), online: <www.morganstanley.com> [perma.cc/92LV-VMZV].

[4] UBS has predicted that in a decade, high speed travel via outer space will represent an annual market of at least $20 billion, and thus long-haul airplane flights that are more than 10 hours in duration would "be cannibalized"

initially attracts business interests with various use of those flights.[5] In turn, the fusion of the two technologies anticipates a paradigm shift in logistics and in the tourism industry. One even foresees a collaboration of this aerospace industry with the current aviation market. For instance, air carriers would be eager to extend their alliances in maximizing the carriage of those much faster traffic via utilizing aerospace ports as new hubs.[6]

Unfortunately, such varying designs and functions of civil aerospace vehicles have complicated the issue of which current legal regime – air or space law – should apply. Until now, the general perception towards civil aviation has always been that aircraft, no matter how they are designed, are subject to municipal regulations and international standards that are covered under the framework of the 1944 Convention on International Civil Aviation (1944 Chicago Convention). With the rise of various rocket designs and aerospace vehicles, however, a critical legal challenge has been brought to the air law regime as to the vertical limit of its application.[7]

The issue of distinguishing airspace from outer space has been discussed since the early space race. Yet, the international community has not even reached a consensus on whether the issue is urgent or not.[8] States, as subjects of the international law system, have not shown

by point-to-point flights on rockets. See Michael Sheetz, "Super fast travel using outer space could be $20 billion market, disrupting airlines, UBS predicts", *CNBC* (18 March 2019), online: <www.cnbc.com> [perma.cc/2APH-WBJS].

[5] See Chapter I.B.1, *below*, for details on the anticipated use of SpaceShipTwo, XCOR, High-Altitude Platform Systems (HAPS), Big Falcon Rockets, and newly proposed supersonic aircraft.

[6] See Ruwantissa I R Abeyratne, *Frontiers of Aerospace Law* (Routledge, 2017) at 23-26.

[7] See Carl Q Christol, "The aerospace plane: Its legal and political future" (1993) 9:1 Space Policy 35 at 35-36 [Christol, "The aerospace plane"].

[8] See Chapter III.B – D, *below*, for details on the debate concerning the issue of delimitation and aerospace flights in international meeting, mainly conducted by the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS) and International Civil Aviation Organization (ICAO).

critical urgency to instruct international organizations to establish a framework. Rather, municipal regulations and bilateral agreements are being introduced in the absence of an applicable global framework for aerospace flights.[9] Those diverse regulations, however, lead to a regulatory void in safety and navigation aspects, posing a critical risk of collision between aircraft, space objects, and aerospace vehicles.[10]

One should note that solving the delimitation issue is a premise for the establishment of a clear regulatory framework.[11] However, the current legal and political deadlock of the issue can push the debate no more substantively, whereas aerospace flights are posing relentless threats to the safety and security of foreign territories during ascent or descent. While diplomatic and legal concerns require scrutiny and rumination throughout time, the imminent problem of safety cannot simply be cast aside as it deals with innocent lives in the air and on the ground. The success of the 1944 Chicago Convention system has already shown that the demand for achieving interconnectivity and global safety could massively motivate its member States to harmonize technical standards and practices without the need to amend the Convention.[12] In this regard, one must again seek for baseline coordination for aerospace

[9] See Chapter III.E, *below*, for details on divergent State regulations on aerospace flights.

[10] For instance, several spaceflights by Space X have triggered policy concerns as to the inconsistent standards of segregating the airspace during space launch. Particularly, in February 2018, a 1,300-mile wide airspace over the Atlantic Ocean was closed to civil and State aircraft for three hours during the launch of the Falcon Heavy Rocket. To avoid the restricted area, a number of flights including Delta Flight 422 heading to the Latin American region had to bypass the original route, causing delays and additional fuel expenditure. Accordingly, the long closure of the international airway has exacerbated the fuel inefficiency problem, complicated the safety risk analysis, thereby causing economic loss to the aviation industry. See Chris Davenport et al, "Gridlock in the sky", *The Washington Post* (12 December 2018), online: <www.washingtonpost.com> [perma.cc/E43K-GJ99].

[11] See Andrea J Dipaolo, "The Definition and Delimitation of Outer Space: The Present Need to Determine Where Space Activities Begin" (2014) 39 Ann Air & Sp L 623 at 626.

[12] The success of the Chicago Convention system has long been attributed to its suitability as a general legal framework of harnessing international cooperation in civil aviation:

> "The flexible wording of the Convention enabled States, through ICAO, to deal with problems not specifically foreseen in the Convention… [Technical] assistance was integrated into the work programme of ICAO through a complex patchwork of UN General Assembly resolutions and ICAO Assembly resolutions… [T]he entire

flights from an operational perspective rather than waiting for a political consensus. Operational aspects, such as traffic management and safety risk analysis, have always been crucial for any kind of flight in establishing safety both on the surface and in the air.

This thesis consists of three main parts. First, it will proceed through an empirical analysis of the delimitation issue from both a legal and political perspective, mainly analyzing the different views of States and shared opinions of international organizations. The objective is to observe whether one of those various views could resolve the delimitation issue, balancing the interest between each State's exclusive sovereign right and the commercial demand for a new aerospace traffic system. This paper will particularly focus on the theories that directly concern the political, scientific, and legal complexity of aerospace flights: the aerodynamic lift theory, the lowest point of orbital flight theory, the von Karman line theory, the effective control theory, and the no present need theory.

Second, the thesis will analyze another historical debate concerning the right of passage in foreign airspace during the re-entry of a space object. Originally, the right of passage of aircraft has been accumulated throughout numerous State practices and international customs, codified into Article 5 of the 1944 Chicago Convention[13] and Articles 38 and 53 of the 1982 UN Convention on the Law of the Sea (UNCLOS).[14] On the other hand, the passage of space

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system of regional air navigation plans in conformity with the standards embodied in the 18 Annexes to the Chicago Convention, is a pragmatic creation not based on the text of the Convention."

Michael Milde, "Chicago Convention – 45 Years Later: A Note on Amendments" (1989) 14 Ann Air & Sp L 203 at 204.

[13] Article 5 of the 1944 Chicago Convention confirms that all non-scheduled aircraft shall have the right to make flights into or in transit non-stop across the territory of its member States and to make stops for non-traffic purposes without the necessity of obtaining prior permission. *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295 (entered into force 4 April 1947) at Art 5 [*1944 Chicago Convention*].

[14] According to the UN Convention on the Law of the Sea, "all ships and aircraft enjoy the right of transit passage, which shall not be impeded" between one part of the high seas or an exclusive economic zone and another part of the high seas or an exclusive economic zone. Also, aircraft enjoy "continuous and expeditious passage" through the airspace over an archipelagic State, in which that State may designate sea lanes and air routes thereabove.

objects has not been explicitly inhibited or allowed by adjacent or subjacent States.[15] Such inconsistency of State practice does not seem to clarify whether an international custom has been established. Here, the thesis will again conduct an empirical review on whether any State practices have been consistent in acknowledging such right, and whether State practices have been binding themselves as *opinio juris*. The thesis will then apply the overall analysis to civil aerospace vehicles, observing that there currently is no commonly agreed right of innocent passage of aerospace vehicles to freely traverse any airspace at any altitude without prior consultation or permission.

Finally, the thesis will sum up by concluding that the current international debate regarding delimitation has not reached any consensus in the present political deadlock. In that sense, one would now have to seek a shift of direction towards technical coordination, rather than continuing to linger over legal and political hypotheses. Perhaps the most important factor that we must take into consideration in the context of rapid vertical civil flights is the concept of 'safety'. In this regard, the International Civil Aviation Organization (ICAO)[16] and the International Telecommunication Union (ITU)[17] are the responsible bodies to foregather their member States to facilitate navigational aids and traffic management respectively in air and space. Hence, conducting a cooperative study between ITU and ICAO in terms of searching

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United Nations Convention on the Law of the Sea, 10 December 1982, 1833 UNTS 3 (entered into force 16 November 1994) at Art 38 & 53 [*UNCLOS*].

[15] See Chapter III.D, *below*, for more on this topic.

[16] The International Civil Aviation (ICAO) was established under the 1944 Chicago Convention, to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport. As of April 13, 2019, there are 193 Member States and invited international organizations in ICAO. See online: <icao.int/about-icao/Pages/member-states.aspx>.

[17] Originally established in 1865 to manage the first international telegraph network, the International Telecommunication Union (ITU) has evolved throughout over a century in the field of telecommunication. The current mandates of ITU are to allocate global radio spectrum and satellite orbits, develop the technical standards that ensure networks and technologies to seamlessly interconnect. Its current membership now includes 193 countries and over 800 private-sector entities and academic institutions. See online: <www.itu.int/en/about/Pages/default.aspx>.

for navigational aids and standards for aerospace vehicles, with the help of satellite-based positioning and radio communication, could facilitate a technical solution for accommodating point-to-point aerospace flights in a safe and harmonious manner. While this does not resolve the current legal and political deadlock of the delimitation issue, it will instead transcend the uncertainty of the issue and motivate the international organizations to proactively explore the viability of standardizing radio communication and navigation procedures for aerospace flights.

CHAPTER I. REVIEW OF *LEX LATA* AND THE ACCOMMODATION OF THE TERM "CIVIL AEROSPACE FLIGHTS"

A. The Conflict between the International Air Law and Space Law Regimes

As several argue, without deciding the applicable legal framework when a relevant legal issue is brought out, a potential regulatory void in safety and navigation is inevitable. This regulatory void, in turn, creates a risk of collision between different objects in the airspace (aircraft, space objects, and future aerospace vehicles) and continues to hinder investment and insurance in the private sector.[18] Therefore, before stepping into the debate of delimitation, it would first be important to observe the current legal frameworks that are applicable to aircraft and spacecraft and to review whether *lex lata* could encompass civil aerospace flights from both legal and technical perspectives.

Mainly, the 1944 Convention on International Civil Aviation (1944 Chicago Convention) was concluded with the purpose of promoting the development of international civil aviation in a "safe and orderly manner,"[19] while the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967 Outer Space Treaty) had been ratified with the desire to contribute to broad international cooperation in the scientific as well as the legal aspects of the "exploration and use of outer space for peaceful purposes."[20]

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[18] See Dipaolo, *supra* note 11; See also Ram S Jakhu, Tommaso Sgobba & Paul Stephen Dempsey, *The Need for an Integrated Regulatory Regime for Aviation and Space: ICAO for Space?*, Studies in Space Policy 7 (Vienna: Springer, 2012) at 62.

[19] *1944 Chicago Convention* at Preamble.

[20] *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, 610 UNTS 205 (entered into force 10 October 1967) at Preamble [*1967 Outer Space Treaty*].

1. Review of international air law regime

i. Exclusive and sovereign jurisdiction over national airspace under Article 1 of the 1944 Chicago Convention

Both the 1919 Paris Convention and the 1944 Chicago Convention, in its Article 1, "recognize" that every State/Power has complete and exclusive sovereignty over the airspace above its territory.[21] The use of the word 'recognize' refers to the fact that there has been State practice viewing sovereignty as extending over national airspace and States have been legally bound by those practices, forming international customary law. The International Court of Justice (ICJ), in its *Case concerning Military and Paramilitary Activities in and against Nicaragua*, also affirms that "[t]he principle of respect for territorial sovereignty is also directly infringed by the unauthorized overflight of [a] State's territory…."[22]

However, under the Chicago Convention, there is no definition as to where territorial airspace ends, and Article 2 seems to only mention the horizontal scope of State sovereignty. Since the Convention neither explains nor defines the term "airspace," there have been three possible interpretations regarding the limit of airspace sovereignty:

i) the logical-juridical interpretation: following the wording of the 1919 Paris Convention, each State is sovereign in those areas of space where sufficient gaseous atmosphere exists to lift and support any type of flight instrumentalities which could "derive support in the atmosphere from reactions of the air,"

ii) the effective control theory: mainly led by John C. Cooper, the territory of a State extends upward as far into space as it is physically and scientifically possible to control the regions above it, and

iii) the navigable airspace theory: argued by Oscar Schachter, the limit of

[21] See *1944 Chicago Convention* at Art 1.

[22] *Case concerning Military and Paramilitary Activities in and against Nicaragua (Nicaragua v United States of America)*, [1986] ICJ Rep 14 at 128 [*Nicaragua Case*].

sovereign control would be the point of the highest atmospheric "lift" a present manned aircraft could receive.[23]

ii. Definition of 'aircraft' under Annex 7 of the 1944 Chicago Convention

Under Annex 7, Chapter 2 of the Chicago Convention, there seems to be a general definition of an aircraft:

> "any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface."[24]

This definition was mainly aimed at excluding all air cushion type vehicles, not to mention vehicles deriving their energy from rocket propulsion. This is shown by the fact that the Council of ICAO, which is the core legislative and technical body under the Chicago Convention, accepted the amendment of the definition under Annex 7 in 1968 that the term should be redefined in a way that "all air cushion type vehicles such as hovercraft and ground effect machines should not be classified as aircraft."[25] Also, a Working Paper presented by the Secretary General of ICAO at the 175th Session of the Council shows the current position of ICAO on the distinction between aircraft and rocket-propelled vehicles. The paper concluded with the opinion that:

> "[v]ehicles which would [a]ffect earth-to-earth connections through sub-orbital space could incorporate the constitutive elements of aircraft and fly as such at least during [the] descending phase while gliding. However, rocket-propelled vehicles could be considered as not falling under the classification of aircraft."[26]

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[23] See Priyatna Abdurrasyid, "State's Sovereignty in Airspace" in Guido Rinaldi Bacelli, ed, *Liber amicorum honouring Nicolas Mateesco Matte: beyond boundaries* (Pedone, France: Istituto Universitario Navale di Napoli, 1989) 1 at 7-12.

[24] *Annex 7 - Aircraft Nationality and Registration Marks*, ICAO, International Standards, 6th ed (2012) [*Annex 7*].

[25] *Ibid* at Table A.

[26] ICAO, *Working Paper presented by the Secretary General in the 175th Session of the Council: CONCEPT OF*

While ICAO acknowledged in the Working Paper that suborbital vehicles considered as civil aircraft crossing foreign airspace could be treated as engaging in international air navigation, the paper did not come to a conclusion as to what characteristics such vehicles had in nature.[27]

2. Review of international space law regime

i. The regime of commons under the 1967 Outer Space Treaty

On the other hand, the international space law regime basically guarantees the freedom of exploration and use of outer space, and further prohibits any national appropriation or otherwise subjecting of parts of outer space to the sovereignty of any State.[28]

It must be noted that the exploration and use of outer space are not subject to sovereignty under the 1967 Outer Space Treaty. According to Professor Ram Jakhu, the *obiter dictum* of the *Lotus case* held by the ICJ (i.e. "restrictions upon the independence of States cannot be presumed") does not automatically apply to the exploration and use of outer space.[29] Rather, the 1967 Outer Space Treaty coexists with international law, including the UN Charter, in the interest of "maintaining international peace and security and promoting international cooperation and

SUB-ORBITAL FLIGHTS, C-WP/12436 (2005) at para 6.1 [ICAO, "Concept of sub-orbital flights"].

[27] *Ibid*; See also Peter van Fenema, "Suborbital Flights and ICAO" (2005) 30:6 Air & Space L 396 at 401.

[28] See *1967 Outer Space Treaty* at Art. I, II, III.

[29] See Ram S Jakhu and Isabella Vasilogeorgi, "The Fundamental Principles of Space Law and the Relevance of International Law" (Paper delivered at "In Heaven as on Earth? The Interaction of Public International Law on the Legal Regulation of Outer Space," Institute of Air and Space Law, Cologne University, Germany, 1 June 2013) at 23, online (pdf): <www.ssrn.com/abstract=2801378>.

understanding" in carrying on space activities.[30] Therefore, notwithstanding the principles and rules of general international law, outer space is free for exploration and use and gives a clear restriction of State sovereignty in outer space.

However, the Outer Space Treaty, including the other four international space treaties, does not define where outer space starts.[31] Rather, the debate of the definition of outer space has mainly been dealt with in the ad-hoc discussion panel under the United Nations, in particular in the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS).[32]

ii. Definition of 'space object' under international space treaties

Moreover, the term 'space object' is neither defined under the 1972 Convention on International Liability for Damage Caused by Space Objects ("1972 Liability Convention") nor under the 1975 Convention on Registration of Objects Launched into Outer Space ("1975 Registration Convention"). Both conventions only stipulate that a space object includes its "component parts as well as the launch vehicle and parts thereof,"[33] giving too much ambiguity as to whether aerospace

[30] *Ibid*; See also *1967 Outer Space Treaty* at Art. III.

[31] The four other main treaties that have established the framework of international space law are the *1968 Rescue Agreement*, *1972 Liability Convention*, *1975 Registration Convention*, and the *1979 Moon Agreement*. See *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, 22 April 1968, 672 UNTS 119, 19 UST 7570, TIAS No 6599, 7 ILM 151 (entered into force 3 December 1968) [*1968 Rescue Agreement*]; See *Convention on International Liability for Damage Caused by Space Objects,* 29 March 1972, 961 UNTS 187, 24 UST 2389, 10 ILM 965 (1971) (entered into force 1 September 1972) [*1972 Liability Convention*]; See *Convention on Registration of Objects Launched into Outer Space*, 6 June 1975, 28 UST 695, 1023 UNTS 15 (entered into force 15 September 1976) [*1975 Registration Convention*]; See *Agreement governing the Activities of States on the Moon and Other Celestial Bodies*, 5 December 1979, 1363 UNTS 3 (entered into force 11 July 1984) [*1979 Moon Agreement*].

[32] See Chapter III.A – D, *below*, for more on this topic.

[33] *1972 Liability Convention* at Art I(d); *1975 Registration Convention* at Art I(b).

vehicles with a suborbital trajectory should be included as a space object.[34] While it is specified in the Registration Convention that a space object is to be registered by the 'launching State' and that the Secretary General of the United Nations will be duly informed thereof with a view to keeping an international register where pertinent information would be recorded, it does not regulate the requirements for the certification of space objects and its component parts.[35]

With these brief observations, one can conclude that the two *lex lata*, i.e., the international air and space law systems, are incompatible with each other and thus have failed to accommodate the advancing aerospace technology.

The reason for such inconsistency between the two legal regimes would be that in terms of the *mentalité* of State sovereignty, space law simply ignored the political and legal importance of Article 1 of the Chicago Convention. On the other hand, the 1968 amendments to the Annexes of the Chicago Convention clearly showed that, with the advent of the 1967 Outer Space Treaty, air law had vertically confined its air traffic management to conventional civil aircraft.[36] This did not seem to invoke legal and political complexity at that time when outer space activities were mostly regarded as State activities and outside the scope of the Chicago Convention. However, the technological advancement of civil aerospace flights has

[34] According to Frans von der Dunk, the term 'Earth orbit' and 'orbital' in the Outer Space Treaty essentially refer to an "operational/technical criterion instead of a geographic one." This means that earth orbit in its ordinary meaning would refer to the fact of having completed at least one full orbit around the earth or at least to the intention to achieve such orbit. See Frans von der Dunk, "Beyond What? Beyond Earth Orbit?...! The Applicability of the Registration Convention to Private Commercial Manned Sub-Orbital Spaceflight" (2013) 43:2 Cal W Int'l L J 269.

[35] See *1975 Registration Convention* at Art II, III.

[36] As Valérie Kayser observed the status quo, he reviewed that the inconsistencies between the two legal regimes "have not been artificially constructed." Rather, the different strategic importance of those two areas were heavily dependent upon political interests, and hence made little relevance to the development of different legal regimes. See Valérie Kayser, "From the Sky to the Stars: Air Lawyers' and Space Lawyers' Perspectives on Future Legal Issues and Legal Teaching" (1995) 20:1 Ann Air & Sp L 367 at 367-368.

increasingly complicated both of the legal regimes in terms of the exact boundary of airspace sovereignty.

In the end, it is the advent of aerospace technology that has made the two frameworks of *lex lata* inconsistent with each other and thus has caused a serious gap in the debate on delimitation and the issue of a right of free passage.

B. Legal and Technological Complexity of Scoping 'Suborbital Flights': Adopting the term 'Civil Aerospace Flights'

1. The technological complexity of currently featured aerospace vehicles

If one acknowledges that technological complexity has brought inconsistency between air and space law regimes, what are those kinds of aerospace technologies are we witnessing that has reignited the discussion of delimitation?

One could first assume the two-stage launch WhiteKnightTwo-SpaceShipTwo by Virgin Galactic as a representative concept of 'commercial suborbital flight'. This rocket-propelled spacecraft attached to a conventional aircraft can fly up to 80-100km and to low-earth orbit using a ballistic trajectory and returning back to its spaceport.[37] Virgin Galactic had recently succeeded in its test flight with one passenger on board, qualifying all three people on the flight for their commercial astronaut wings awarded by the US Federal Aviation Administration.[38]

[37] See Mike Wall, "Virgin Galactic Wants to Send People on Superfast Trips Across Earth", *Space.com* (13 November 2017), online: <www.space.com> [perma.cc/723J-NUBB]. After moving its spaceport to New Mexico by this year, Virgin Galactic is ready to fly its first paying customers. See Jackie Wattles, "Richard Branson's Virgin Galactic is finally moving to its space tourism headquarters", *CNN* (10 May 2019), online: <www.cnn.com> [perma.cc/Z7V7-5H4B].

[38] See Loren Grush, "Virgin Galactic spaceplane reaches space with first passenger on board", *The Verge* (22 February 2019), online: <www.theverge.com> [perma.cc/79UP-V4U5].

Next, the Lynx, designed by XCOR, is another viable technology in which a sporty spaceship with two seats takes off from a runway just like an aircraft and will climb just as high as SpaceShipTwo. Although the company had recently been bankrupt due to its high cost of manufacture, the design of a compact size vehicle clearly showed the benefit of not requiring a mother ship compared to the Virgin Galactic's WhiteKnightTwo, making it lighter and faster and thus allowing it to fly several times per day.[39]

If one could look up to the stratosphere, High Altitude Platform Systems (HAPS) serve as a platform between telecommunications satellites and the receivers on the ground, maximizing connections for broadcasting, crop monitoring, fire detection, telehealth services, education, policing or even defense-related services. A representative example of such vehicle would be the High-Altitude Pseudo Satellites (also called "HAPS") developed by the European Space Agency.[40] This platform is able to transmit vast information between satellites positioned in between 160-1000 km. On the other hand, Project Loon in Peru and Puerto Rico had succeeded in enabling wide-ranging internet connection through a tennis-court-sized balloon located above 20km in the stratosphere, receiving a transmission from satellites. The internet provided medical and rescue assistance to remote areas during devastating natural disasters. Now, Kenya expects to offer 4G connection to mountainous terrains by 2019, through a commercial agreement made between Loon and Telkom Kenya.[41]

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[39] See Erik Seedhouse, "SpaceShipTwo: VSS Enterprise" in Erik Seedhouse, ed, *Virgin Galactic: The First Ten Years,* Springer Praxis Books (Cham: Springer International Publishing, 2015) 65 at 81-84.

[40] The European Space Agency is currently reviewing its capability and its potential activities of HAPS throughout its meetings ("HAPS4ESA workshop") since 2017 and aims to mandate its specific missions at its next Council at Ministerial level in 2019. See "Home – HAPS4ESA 2019: State-of-the-Art and Future Perspective for High Altitude Pseudo-Satellites (HAPS) in Europe", online: *haps4esa 2019* <apti.eventsair.com/QuickEventWebsitePortal/haps4esa/website>.

[41] In the 13th Air Navigation Conference held at the International Civil Aviation Organization, both the

For the above designs such as the hybrid concept of rocket propulsion and aerodynamics, one cannot clearly specify the applicable law since those vehicles traverse both airspace and outer space at certain phases of their flight. Nevertheless, can one really guarantee that rockets are clearly distinguishable from aircraft, categorizing every long, cylinder-shaped rocket designs as space objects and instantly regulating them under space law? Conversely, should a vehicle with wings and engines that seems undoubtedly like an aircraft be exclusively regulated under air law? The answers would have not been questionable if one were in the early 1960s, observing a clear deviation of rocket from aircraft designs. However, the two recent examples of Neo-Concorde aircraft and SpaceX developments below suggest a steady but an incoming fusion of aerospace engineering.

Before its retirement after the tragedy in 2003, Concorde was deemed a commercially successful hypersonic aircraft. However, along with its maintenance cost problem, States including the United States had rejected its airworthiness due to the noise of the sonic boom that created havoc during its take-off and landing.[42] In such case, the mini-booms are thought to present a solution to such problem and thus the proposal of H2-O2 fueled hypersonic jet made by the Japanese space agency, JAXA, along with ESA-DLR of Germany and NASA of the United States, provides a new

representatives of Peru and Kenya expressed their view in their working papers that high airspace operations are increasing for testing purposes and will expand and grow in the near future, and that working cooperatively with these new products and services is in the interest of those States. Thus, they requested ICAO to provide guidance on the regulatory aspects of these operations. See ICAO, 13th Air Nav Conf, AN-Conf/13-WP/105 (2018); See also ICAO, 13th Air Nav Conf, AN-Conf/13-WP/136 (2018).

[42] Even if one could pull out the capital to revive the Concorde fleet, as one fairly argues, the relevant airline would again have to face the issue of fuel consumption, distinct maintenance techniques with high cost, and the noise of sonic boom where it will only be able to fly at supersonic speed over the unpopulated areas. See Karla Cripps, "Can plan to fly Concorde again get off the ground?", *CNN* (21 September 2015), online: <edition.cnn.com> [perma.cc/GBW6-NAP6].

generation of another intercontinental high-altitude hypersonic transportation.[43]

On the other hand, after the aborting of the Space Shuttle missions in 2012, the creation of Space X by Elon Musk and the development of reusable launch vehicles (RLVs) Falcon 1 and 9 have cemented the relevance and reach of private investments in space. By developing almost all of its rocket components in-house, and by operating on the lean model popularized by other technology start-ups, the company has been able to offer launches at a cost well below what the market has ever seen, while still making a profit.[44] The company has also announced new earth-to-earth transportation by vertical takeoff using its fully reusable launch vehicle to take passengers from Los Angeles to New York in less than 30 minutes.[45] Another company, Blue Origin, led by Jeff Bezos, will offer private citizens a ride to the "edge of space" using a reusable rocket and capsule.[46]

The abovementioned advancement of rockets and hypersonic aircraft clearly shows that technology is not only complicating the application of law but is also questioning the very purpose and nature of law. Air law had originally been enacted to facilitate civil flights in a safe and orderly manner; space law serves as a legal basis for making outer

[43] See Shinji Ono, "Across the Pacific in Two Hours: JAXA Sets Sights on Mach 5 Supersonic Aircraft", *JAPANForward* (25 February 2019), online: <japan-forward.com> [perma.cc/GP3B-K2YT]; See Jim Banke, "Shhhh! Keep It Down, Please", *NASA* (9 July 2009), online: <www.nasa.gov/topics/aeronautics/features/aircraft_noise.html>; See Adrian Giordani, "The challenges of building a hypersonic airliner – Could an airliner that flies anywhere in under three hours be in service by 2030?", *BBC* (15 September 2015), online: <www.bbc.com> [perma.cc/4P8X-KCKV].

[44] See Ram S Jakhu & Joseph N Pelton, *Global Space Governance: An International Study*, Space and Society (Cham: Springer International Publishing, 2017) at 253-256.

[45] See SpaceX, "SpaceX: Earth to Earth Transportation" (11 November 2018), online: *SpaceX* <www.spacex.com/mars>.

[46] See Michael Sheetz, "Blue Origin launches rocket designed to carry space tourists", *CNBC* (2 May 2019), online: <nbcnews.com> [perma.cc/3C8X-4G49].

space accessible for all States and strictly inhibiting appropriation of property by any State. But then, let us assume civil aircraft that fly safely to Moon for colonialization; imagine a fleet of rockets that fly low across continents without any communication to the air traffic controllers. Can we say that those flights are still respectively under the auspices of air and space law and cannot be regulated?

The advancement of aerospace vehicles does not completely dismiss the substance of those laws in determining any possible regulatory and liability issues. The question of the very purpose and nature of those laws, however, has put *lex lata* at a critical point where the existing 'social technologies' can no longer accommodate the development of 'physical technologies'.[47] At such point, one cannot establish a clear criteria in choosing among those laws to accommodate aerospace flights, nor can one clearly point to an appropriate organizational solution for those future flights. As Richard Nelson observes:

> "Today some of our most difficult problems involve discovering, inventing, and developing the social technologies [that are] needed to make new physical technologies effective…
>
> However, in many cases the adoption, or abandonment of a social technology requires collective action, as when certain patterns of action are required or forbidden by law, or where a government agency is a major actor. Thus… public policies, and how they change over time, will profoundly influence [, for instance,] how our medical care system will evolve, and what will happen regarding the way we organize telecommunications. And this makes the process of evolutionary improvement even more difficult."[48]

2. <u>Escaping from the legal and technical complexity of the term 'suborbital' by adopting the term 'civil aerospace flights'</u>

On the other hand, what does the term 'aerospace' mean from the terminology

[47] Richard Nelson, "Physical and Social Technologies, and Their Evolution" (2003) 2003/09 LEM Working Paper Series.

[48] *Ibid*.

perspective? First of all, the word ‘aerospace’ is a term that has not incited much controversy among legal scholars. Rather, the usage has been a matter of preference. The word in its dictionary meaning refers to the “branch of technology and industry concerned with aviation and space flight.”[49] Similarly, John C. Cooper in the early space age used the phrase ‘aerospace’ to indicate his belief that a single branch of law should govern all “man-made flight.”[50] On the other hand, Nicolas M. Matte referred to the term in both English (‘aerospace law’) and French (‘droit aérospatial’) language, simply denoting the urgency of a practical approach to space knowledge.[51] Nonetheless, most scholars including Carl Q. Christol, Stephen Gorove, and Paul S. Dempsey use the word to encompass both suborbital and future advancements and that defies any physical counterforce and aerodynamic reliance.[52]

However, the term ‘suborbital’ seemed to have invoked a range of opinions by various researchers, depending on the technicality or the regulatory perspective of the term. According to some technical experts, the definition is not decided under the criteria of at what altitude it should be considered as a space flight but is distinguished by whether it involves sending a vehicle into orbit. For example, Erik Seedhouse, a suborbital astronaut in Canada and a dedicated researcher of commercial space operations, has stated that a suborbital flight is defined as a flight to an altitude higher than 100 km that

[49] Catherine Soanes & Angus Stevenson eds, *Concise Oxford English Dictionary*, (Oxford, UK: Oxford University Press, 2008) sub verbo “aerospace”.

[50] See Ivan A Vlasic, ed, *Explorations in Aerospace Law: Selected Essays, 1946-1966* (Montreal: McGill-Queen’s University Press, 1968) at xii.

[51] See Nicolas Mateesco Matte, *Aerospace law: from scientific exploration to commercial utilization* (Toronto: Carswell Co., 1977) at 3.

[52] See Christol, “The aerospace plane”, *supra* note 7; See generally Stephen Gorove, “Aerospace Object - Legal and Policy Issues for Air and Space Law” (1997) 25 J Space L 101 at ; Paul Stephen Dempsey, *Public international air law*, 2nd ed (Montreal: William S. Hein & Co., Inc. for the Centre for Research of Air and Space Law, McGill University, 2017) at 741-764 [Dempsey, “Public International Air Law”].

does not involve sending a vehicle into orbit.[53] In his terms, the early V-2 rocket test operated by Germany in 1944 could also be considered as the first unmanned suborbital flight, even though it had known to have reached an altitude of 189 km.[54]

Other researchers including legal academics have looked into the issue of whether those flights are to be regulated under the existing legal regime or need an independent regulatory framework, thus focusing on the demarcation of airspace. For instance, Joseph N Pelton, another technical expert on the subject of commercial space operations and establishing relevant regulations, has turned to the concept of 'protozone' in between 21-100 km altitude; there, one might expect a distinct potential for business and regulatory applications for HAPS and suborbital spaceplanes.[55] In his view, suborbital vehicles such as X-15 or X-20 developed by the US Government for scientific and military purposes in the 1960s, although they have been regarded as suborbital vehicles when they reached 66 miles altitude, could also have been regarded as "manned, maneuverable, and recoverable rocket vehicles" with regard to its near-orbital velocity of 4159mph that could have nearly placed them in orbit.[56] Similarly, several scholars point out the need for a clear distinguished demarcation of airspace in which clarity provided by an established line of demarcation would promote the commercial development of space, while a failure to resolve ambiguity and the absence of uniformity

[53] See Seedhouse, *supra* note 39 at 3.

[54] *Ibid*. Meanwhile, Jonathan C McDowell, an astrophysicist at the Harvard-Smithsonian Center for Astrophysics, has also argued that orbiting objects can survive multiple perigees at altitudes around 80 to 90km and that this altitude range is also consistent with the highest physical boundary of the atmosphere. See generally Jonathan C McDowell, "The edge of space: Revisiting the Karman Line" (2018) 151 Acta Astronautica 668.

[55] See Joseph N Pelton, *The New Gold Rush: The Riches of Space Beckon!* (Springer, 2016) at 82-86 [Pelton, "The New Gold Rush"].

[56] *Ibid*.

will continue to hinder investment and insurance in the space sector.[57]

As George P. Sloup puts it, defining the term is complex due to the fact that the terminology is less likely based upon accepted scientific principles and is rather "devised by human policymakers to accomplish a policy objective."[58] Nonetheless, to properly indicate the rules of law that apply to physical technology, policymakers must put their best effort to accommodate the technological definition from a legal perspective.

In this sense, to mitigate the controversy that arises from both the technological complexity and the legal inconsistency of the current designs, the term 'aerospace' should be an all-encompassing term that particularly includes 'suborbital' flights. There are two reasons to support this idea. Firstly, it is important to stress the need for a civil regulatory regime that includes both point-to-point suborbital flights and other suborbital flights that make a round-trip to the same spaceport.[59] It would not be important to deal with the criteria of 'suborbital' itself that brings a lengthy discussion on whether the object has achieved at least one full orbit around the earth or at least to the intention to achieve such orbit. Rather, this thesis will confine the scope of the review to those flights that serve as a spaceport on Earth as the final destination of its flight itinerary.

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[57] See Jakhu, Sgobba & Dempsey, *supra* note 18 at 62; See also Dipaolo, *supra* note 11.

[58] George P Sloup, "The Aerospace Vehicle as a Legal Concept - On Final Approach Space Law" (1983) Ann Air & Sp L 433 at 435.

[59] A cooperation agreement has already been signed between US and Italy in 2016, mainly concerning a possible construction of a spaceport in Italy. Sweden already has its own spaceport in Kiruna, currently launching Zero-G aircraft flights and further aiming to attract Virgin Galactic and XCOR. See Research Italy, "A spaceport in Italy? Italy-USA cooperation agreement signed", *ResearchItaly* (7 August 2016), online: <www.researchitaly.it> [perma.cc/L3RW-T5Y7]; See also Miriam Kramer, "Spaceport Sweden Launches Aerial Northern Lights Tours, Aims for Space (Video)", *Space.com* (14 February 2014), online: <www.space.com> [perma.cc/TX2Q-J3TL].

Secondly, the term ‘aerospace’ is more of a concept that reflects the recent technological advancement of the vehicle which is purposefully designed to traverse airspace and outer space under full control of the manned-pilot or the unmanned-pilot and lands at a designated landing zone or a spaceport without any parts damaged or broken.[60] This kind of explanation distinguishes the term from satellites and return vehicles that re-enter the Earth in uncontrollable or partially controllable status.

To conclude this chapter, this thesis submits that the current air and space law regimes are inapplicable to different aerospace vehicle designs, and the legal and technical terminology of ‘suborbital’ further complicates the exact boundary to be drawn in between airspace and outer space.

While the discussion on ‘aerospace’ should be continued both in the scientific community and legal camps, resolving the issue of delimitation must therefore take precedence in order to decide the exact scope of the law. Even though this issue may be outdated and would bring disagreement among States that have different and unyielding interests in defining the limit of their airspace sovereignty, deciding the exact scope of law is essential in order to properly accommodate aerospace flights. Thus, through the rest of the two chapters this paper will review the delimitation issue, both from a legal and political perspective, and observe whether there has been a consensus as to the possible regulation of aerospace vehicles.

[60] The UNCOPUOS had also brought this subject into a questionnaire to circulate among member States, where many States had somewhat a common view that the term is not limited to the space-shuttle-type vehicle but also covers the aerospace plane which in light of expected commercial developments aims at a very fast, long-distance earth transportation, a whole range of issues must be examined so that appropriate policy evaluations and choices can be made with respect to the applicability or inapplicability of norms of air and space law in factual scenarios. See UNCOPUOS, *Note by the Secretariat: QUESTIONNAIRE ON POSSIBLE LEGAL ISSUES WITH REGARD TO AEROSPACE OBJECTS*, UN Doc A/AC.105/635 (1996) [UNCOPUOS, “Legal issues with regard to aerospace objects”].

CHAPTER II. CRITICAL REVIEW OF DELIMITATION THEORIES APPLICABLE TO AEROSPACE FLIGHTS – THEORETICAL DEADLOCK?

From the beginning of the space race in the 1950s, the two major space powers, the United States and the former USSR, did not put much effort into discussing the delimitation issue. Rather, the spacefaring nations were mostly concerned about their rival's missile capabilities and reconnaissance technologies that would potentially threaten their own national security in the midst of the Cold War. Thus, the ongoing political conversation was not about claiming sovereignty *usque ad coelum* but rather about acquiring an advantageous position in space.[61]

However, both powers felt the need to mitigate such rising competition in order to avoid any future armed conflict in outer space, especially after they had already armed themselves with nuclear weapons.[62] As a result, various international agreements including the 1967 Outer Space Treaty were put into place to relieve the tension and strike a deal on 'peaceful' uses of outer space.[63] Other European and Asian countries were also concerned about militarization in

[61] According to an analysis conducted by J. F. McMahon in the 1960s, Soviet Union at that time regarded its success of Sputnik I in outer space as an achievement not only of the Soviet people but of all mankind, reaffirming its support of the principle recommending that "outer space and celestial bodies are free for exploration and use by all States". Accordingly, he viewed that the government of the Soviet Union was unlikely to claim or acquiesce in claims to sovereignty in the airspace that would interfere with the right of a State to place a satellite in orbit. On the other hand, the proposition continuously expressed by the United States was that it did not wish to take a definite position on the interpretation of the word 'airspace' as used in the 1944 Chicago Convention, and that the boundary line between airspace and outer space was still undetermined. However, taking into account internal legal advices forwarded to the United States during the period, the general view, not challenged by any nation, regarded satellites so far placed in orbit as having been operated in outer space. In other words, the boundary line would be drawn below the height at which it was possible to place a satellite in orbit. See J F McMahon, "Legal Aspects of Outer Space" (1962) 38 Brit YB Int'l L 339 at 348-351.

[62] The relevant conversation during the space race did not include earth-to-earth defense capabilities such as ICBM weapons or nuclear arms control. Rather, a series of bilateral nuclear arms control negotiations have been made starting from the 1972 Strategic Arms Limitation Talks (*SALT I*) led by the Nixon Adminis tration. Accordingly, under the signed 1972 *Treaty on the Limitation on Anti-Ballistic Missile Systems* (*ABM Treaty*), both have agreed to limit anti-ballistic missile (ABM) systems and agree to monitor the arms status by using national technical means of verification.

[63] Although both sides had agreed that the activities in outer space be "peaceful" in character, the USSR and some states had interpreted peaceful to mean non-military, while the United States and others had interpreted peaceful to mean non-aggressive. Such difference would have been made due to technical difficulties that the two powers differently faced: Soviet position finds it hard to simply distinguish military from civilian activities, while the American position mainly finds it hard to assess the motives of decision-makers which could be construed as

outer space but were not so anxious about demarcating airspace.[64]

On the other hand, various legal experts and researchers paid a great deal of attention to the subject of delimitation. Even before the 1967 Outer Space Treaty, they were neatly divided into two camps, composed of those who are spatialists and those who are functionalists.[65]

A. Review of Spatialist Theory

According to a spatialist approach, one must draw a physical line between airspace and outer space to assess where the space object is located. Under this reasoning, an aerospace vehicle might be an aircraft when it is in the airspace, while it might be a spacecraft when it is in outer space. This argument is based on the differences between the two legal regimes.[66]

Article 1 of the 1944 Chicago Convention reaffirms Article 1 of the Paris Convention of 1919 by recognizing the pre-existing rule of customary international law that "every State has complete and exclusive sovereignty over the airspace above its territory."[67] On the other hand, the 1967 Outer Space Treaty provides that the "exploration and use of outer space… shall be the province of all mankind," declares that outer space shall be used freely "for

aggressive. See William H Schauer, *The politics of space: a comparison of the Soviet and American space programs* (New York: Holmes & Meier Publishers, 1976) at 246-247.

[64] There is a sharp contrast to the mentality of space development between Europe and Asia. Europe, where leading nations cooperate extensively through a jointly gathered European Space Agency (ESA), share consensus views on space security, the need for collective approaches to problem solving, and reliance on legal remedies instead of warfare. On the other hand, Asia's space rivalry is more like a long-duration cross-country race, with many runners and many different objectives. Such hostile dyads as India-China, China-Japan, India-Pakistan, Japan-South Korea, and North Korea-South Korea indicate that Asian countries see space largely as an extension of other competitive realms and are carefully watching regional rivals, attempting to match or at least to check their capabilities, influence, and power. See James Clay Moltz, *Asia's New Presence in Space* (Columbia University Press, 2011) at 1-10.

[65] See Bin Cheng, "The Legal Regime of Airspace and Outer Space: The Boundary Problem Functionalism versus Spatialism: The Major Premises" (1980) 5 Ann Air & Sp L 323 at 324.

[66] See Dempsey, "Public International Air Law", *supra* note 52 at 933-962.

[67] *1944 Chicago Convention* at Art 1.

exploration and use by all States," and shall not be subjected to national appropriation or otherwise shall not be subjected to the sovereignty of any State.[68] Thus, the 1944 Chicago Convention assures complete and exclusive sovereignty over national airspace, whereas the 1967 Outer Space Treaty explicitly denies territorial sovereignty over outer space and stipulates that it is free for exploration and use by all States.

From a legal point of view, there is unanimity among scholars that exclusive national sovereignty is the supreme principle in international law, where State jurisdiction must be fully respected within the physical demarcation of airspace.[69] The general problem with this approach, however, is that there is no consensus as to where and on what basis to draw the line: gravitational effect, effective control, theoretical and actual lowest perigee of orbiting satellites, the von Karman line, limit of air drag, limit of air flight, the atmosphere and its various layers, an absolutely arbitrary height, and so forth.[70] Another problem specific to aerospace flights is that those flights may enter suborbital space for only a short time, while its primary activity and mission are in the airspace.[71]

When we turn to a political point of view, the historic debate between the US and former USSR clearly shows how the matter of delimitation is tangled with power relations and sovereignty issues, resulting in the absence of consensus.[72] In this regard, some academics

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[68] See *1967 Outer Space Treaty* at Art I, II, III.

[69] For instance, McNair notes that 'sovereignty in the superincumbent airspace reigns supreme'. Bin Cheng sees the principle as 'a well-recognised rule of international customary law'. For William J. Hughes the principle is now a fundamental tenet of international law. This universal principle underlies other numerous bilateral and multilateral conventions particularly the 1944 Chicago Convention. See Gbenga Oduntan, "The Never Ending Dispute: Legal Theories on the Spatial Demarcation Boundary Plane between Airspace and Outer Space" (2003) 1 Hertfordshire L J 64 at 64-65.

[70] See Cheng, *supra* note 65 at 324-325.

[71] See Dempsey, "Public International Air Law", *supra* note 52 at 933-962.

[72] See Chapter III.B, *below*, for more on this topic.

have advocated the theory of establishing a buffer zone between airspace and outer space, primarily on the ground of mitigating the political and legal risk between States (specifically between adjacent States).[73]

B. Review of Functionalist Theory

Compared to spatialist theory, the functionalist approach puts less emphasis on the location of the line to be drawn and instead pays more attention to the character of activities in outer space and the objectives.[74] Mainly led by Myers S. McDougal, Harold D. Lasswell, and Ivan A. Vlasic, the group of functionalists argues that drawing a physical line would be premature and arbitrary and that the applicable law should be determined by the nature and purpose of activities.[75] This has led to the suggestions for the establishment of different frontiers for different types of activity, rendering them conditional on the degree of tolerance accorded to them by the subjacent States. Representative implications of those schools are well stipulated by Gbenga Oduntan:

> "(a) [S]pace law covers among others the area of transport through airspace; therefore, space law should be applicable to all transport from the earth to any point in space; (b) noting the definition of 'aircraft' that exists in Annex 7 of the 1944 Chicago Convention, all other vehicles passing through and beyond the atmosphere should be classified as 'spacecraft'; (c) airspace extends to the maximum altitude attainable for aircraft, while outer space starts at the lowest point where spacecraft can orbit the Earth… (e) given the absence of a demarcation line in the [Outer] Space Treaty and the lack of definition of 'spacecraft' in other space treaties, then the [Outer] Space Treaty is by nature a functional treaty."[76]

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[73] See Chapter II.D, *below*, for details on the proposal for an intermediate zone/buffer zone.

[74] See Manfred Lachs, *The law of outer space: an experience in contemporary law-making*, Tanja L. Masson-Zwaan & Stephan Hobe, eds. (Leiden: Martinus Nijhoff Publishers, 2010) at 53-54.

[75] See Katherine M Gorove, "Delimitation of Outerspace and the Aerospace Object - Where is the Law" (2000) 28 J Space L 11 at 16.

[76] Oduntan, *supra* note 69 at 70.

In terms of geopolitical interest, many States which have deemed to take the functionalist approach have acknowledged the need to observe some principles and rules of the spatialist legal regime if they were to move through another State's airspace.[77]

However, as one may fairly argue, the approach itself may over-enthusiastically include too many considerations in its development, as the precise definitions of 'aircraft' and 'spacecraft' are just as obscure as similar definitions of air law and space law.[78] Another reality to which one should pay close attention is that different States apply their own municipal legal regulations to aerospace vehicles, making it difficult to accommodate all at an international level. For example, according to the European Aviation Safety Agency (EASA) under the single European Union system, suborbital vehicles are deemed to be classified as aircraft.[79] On the other hand, the United States authorities have issued a launch license to Scaled Composites for their SpaceShipOne flight under the US Commercial Space Launch Act in 2004, categorizing it as a spacecraft.[80] Such divergent regulations would not only make it difficult to determine liability in case of any damage, injury or death caused during transportation via suborbital flights but would also create a danger of collision unless

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[77] From the 'Questionnaire on Possible Legal Issues with Regard to Aerospace Objects' conducted by the Secretary General of the UNCOPUOS in 1995, Jiyuan Su reviewed as such:

> "For instance, some functionalist states, such as Czech Republic, Germany and Mexico, maintain that the application of space law to aerospace objects does not exclude the application of certain provisions of air law, in particular those relating to authorization of passage and air traffic when aerospace objects move through another state's airspace. A few states mentioned the possibility of establishing a *sui generis* regime. As argued by Argentina and Turkey, the special characteristics of aerospace objects and future technological developments in this field may necessitate the establishment of a special regime that accounts for situations not provided for under current international air and space law."

Jinyuan Su, "The Delineation Between Airspace and Outer Space and the Emergence of Aerospace Objects" (2013) 78 J Air L & Com 355 at 367-368; See also UNCOPUOS, "Legal issues with regard to aerospace objects", *supra* note 60.

[78] See Oduntan, *supra* note 69 at 70.

[79] See Chapter III.E, *below*, for more on this topic.

[80] *Ibid*.

those vehicles are regulated under a unified international standard.[81]

C. Critical Analysis of Various Theories Applicable to Aerospace Flights

So far, we have reviewed two mainstream perspectives on the delimitation issue, in which at the exterior it seems simple to understand the concept but throughout the discussion, there really is no neat line that distinguishes one from another. While such theoretical differentiation would not be of much practical concern for the regulators, the complexity of aerospace flights with mixed technological principles raises the need to probe deeper into various theories under the two mainstream views.

The purpose of this subchapter is to explore these theories that include either scientific, legal, or political considerations that are more detailed and compatible with aerospace flights. While those theories seem to be acceptable to a certain degree according to their originally suggested bases, new scientific discoveries, developing technologies, and particularly the temporal factor that has supported the wait-and-see approach now reject or contradict those proposals. Again, as this paper considers in the next Chapter, such theoretical deadlock can also be seen in various international meetings, where States advocate or reject any of those various assertions and fail in reaching a consensus in establishing an international framework for aerospace flights.

1. Review of Aerodynamic Lift theory

Before discussing the legal aspects of the aerodynamic lift theory, it is essential to

[81] See Ram S Jakhu, "Legal Aspects of Suborbital Personal Flight," in Angie Bukley and Walter Peeters, ed, *Private Access to Space Volume 1: Suborbital Flights* (Paris, France: International Academy of Astronautics, 2013) 71 at 71-80; See also Dempsey, "Public International Air Law", *supra* note 52 at 933-962.

first introduce basic science for a better understanding. When ascending, the altitude increases and the density of air, as well as the upward pressure of air, decreases.[82] Beyond an estimated elevation of 83 km, the air buoyancy would altogether disappear and only the centrifugal force would remain, keeping an aircraft in flight if it can travel at a certain speed. To move above 83 km would now require a circular velocity of +/- 7,900 m/s, which is the conventional capacity limit of an aircraft.[83]

According to a general assertion which had also been agreed by Robert F. A. Goedhart, airspace ends where an aircraft will no longer find sufficient aerodynamic lift to sustain a flight.[84] This theory is backed up by Article 1 of the 1944 Chicago Convention that the sovereignty of the air relates to the regulation of aircraft which obviously requires an aerodynamic lift. Thus, once a point is reached where there is a vacuum and all the aerodynamic features disappear, claims of sovereignty and jurisdiction would also cease to exist.[85]

However, the existing legal frameworks do not give a concrete understanding as to when those vehicles should be under their scope of application. First of all, Annex 7 of the 1994 Chicago Convention does not give a clear standard as to whether a spacecraft

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[82] Aerodynamics is the way objects move through the air, using four forces of flight: lift, weight, thrust and drag. The amount of each force compared to its opposing force determines how an object moves through the air. See NASA, "What is Aerodynamics?" (1 March 2017), online: *NASA Knows: Aeronautics (Grades 5-8)* < www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-aerodynamics-58.html>.

[83] See Oduntan, *supra* note 69 at 72.

[84] *Ibid*.

[85] Goedhart writes that "the air buoyancy is a feature of the atmosphere that may well serve as a means of distinguishing aircraft from spacecraft. In the context of treaty law the aerodynamic yardstick means that 'the complete and exclusive sovereignty' of a State over the airspace above its territory is confined to the uppermost height at which aircraft are capable of flying." See Robert F A Goedhart, *The Never Ending Dispute: Delimitation of Air Space and Outer Space*, Forum for air and space law 4 (Gif-sur-Yvette, France: Editions Frontières, 1996) at 60.

re-entering the Earth with aerodynamics to land safely is also considered as an aircraft at the descending phase.[86] Another ambiguous aspect has been expressed by the Working Paper presented by the Secretary General of ICAO at its 175th Session of the Council Meeting, where it stated that while the 1944 Chicago Convention applies to international air navigation, current commercial activities envisage sub-orbital flights departing from and landing at the same place, which may not entail the crossing of foreign airspaces.[87]

Moreover, several sources indicate that the dichotomy of aeronautics/air-breathing engines versus ballistic missile technology has already been blurred. For example, one source in the Russian military has recorded a scramjet test on 12 February 1998, which was related to the development of a maneuverable ICBM warhead.[88] In the United States, scramjet development achieved a milestone with the 1 May 2013 flight of the Boeing X-51 at Mach 5.1 (3,400 statute miles per hour; 5,400 kilometers per hour).[89] Thus, as Thomas Gangale argues:

> "If there is a separation, either in speed or altitude, of the "territory of air-breathing vehicles from that of rocket vehicles," it has yet to be determined, therefore no proposed line can have a "practical application"."[90]

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[86] See *Annex 7*.

[87] See ICAO, "Concept of sub-orbital flights", *supra* note 26 at para 6.3. In turn, this might mean that when foreign airspace is traversed by those vehicles and such vehicles are eventually determined to be subject to international air law, pertinent Annexes to the Chicago Convention would be applicable.

[88] See Thomas Gangale, *How high the sky?: the definition and delimitation of outer space and territorial airspace in international law*, Studies in space law 13 (Leiden; Brill Nijhoff, 2018) at 130-135.

[89] According to Kevin G. Bowcutt, a leading expert on aerospace engineering and the designer for the Boeing X-51, scramjets use airbreathing engines that utilizes shockwaves instead of turbofans for combustion, enabling high fuel efficiency and at the same time rendering hypervelocity to transit intercontinental distances across oceans if a boost-glide approach is used. See Kevin G Bowcutt, "Physics Drivers of Hypersonic Vehicle Design" (Presented at the 22nd AIAA International Space Planes and Hypersonics Systems and Technologies Conference at Orlando, United States, 15 September 2018).

[90] See Gangale, *supra* note 88 at 130-135.

The recent advancements of Space X and Blue Origin utilizing suborbital trajectories proves that this theory no longer holds. While it is normally accepted that the density of the atmosphere and the drag will make spacecraft unstable as they get lower to the Earth, the two companies' plans of transporting passengers and cargos from point-to-point using suborbital trajectories do not correspond with the logic of the theory. Therefore, this scientific theory is outdated and does not hold strongly even from a scientific perspective. Rather, the above technological advancements necessitate a policy consideration for integrated traffic control, where point-to-point flights are safely managed within a designated trajectory as opposed to moving through airspace without any guidance.

2. Review of Lowest Perigee of Orbiting Satellites theory

The lowest point of orbital flight, also known as the lowest perigee, is also used as another criterion for drawing a line between airspace and outer space. It states that sovereignty should extend to the lowest height at which an object requires to enter into orbit and circle the Earth.[91] Scientific and technological grounds mainly support this view in that orbiting satellites do not have a long life span at an altitude of 90 km or less, or else they would be severely damaged or destroyed by enormous frictional heat.[92]

While the arms race in between those two major space powers during the Cold War led to the development of nuclear and ballistic missiles system, reconnaissance satellites played an important role at the same time in order to keep watch on each other's

[91] See Oduntan, *supra* note 69 at 79.

[92] See Goedhart, *supra* note 85 at 47.

armament status.[93] Accordingly, States distinguished space objects including earth satellites and objects in deep space as the subject for further discussions before international fora, while excluding surface-to-surface missiles such as ICBMs for national defense and for future negotiation such as bilateral arms control agreements.[94]

Professor Bin Cheng observed that:

> "A careful scrutiny of the discussion on outer space in the United Nations reveals that States appear to be in general agreement that orbiting satellites in their orbits never enter airspace and, therefore, the problem of the right of passage through foreign airspace does not arise, except possibly during launching and re-entry."[95]

The International Law Association also took action in 1968, from the draft resolution proposed by D. Goedhuis in 1966, to unanimously adopt a resolution stating that the term "outer space" in the 1967 Outer Space Treaty should be interpreted so as to include all space at and above the lowest perigee. The resolution, however, also left room for the question of whether it may or may not later be determined to include any part of space below such perigee.[96]

When also applying this theory to the modern technology, the premises of the theory would argue that because suborbital flights include both aerodynamics and ballistic features and blur the classification between aircraft and orbiting satellites, sovereignty should simply extend to the lowest perigee of satellites. As Goedhart writes, there appears to be practice by the spacefaring nations to launch most artificial satellites into orbits near 100 km or above, and such practice could often be seen as an international

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[93] See McMahon, *supra* note 61.

[94] See Schauer, *supra* note 63 at 246-247.

[95] Cheng, *supra* note 65 at 352.

[96] See International Law Association, *Resolutions on the fifty-third Conference*, ILA, 1968 at xxii.

custom.[97]

However, like the aerodynamic lift theory, this theory has also failed to reflect the discoveries that blur the exact boundary. First, the minimum perigee required for orbital flight has not been exactly determined, except that the range ranges between 70-160 km above the Earth's territory.[98] Second, while the atmospheric composition changes gradually in altitude there still is a maximum height between 30-40 km to the aerodynamic lift of aircraft, where such altitude is twice lower than the minimum perigee of the satellite. Thus, accepting this theory without any second thought would create a huge legal vacuum in between the altitude of 40-70 km, possibly rejecting both the standards and aviation regulations under the 1944 Chicago Convention and the principles under the 1967 Outer Space Treaty.[99]

3. Review of von Karman Line theory

To briefly conclude the two theories explained above, the aerodynamic lift theory and the lowest point of orbital flight theory technically contradict one another concerning the application between air law and space law regime to aerospace flights. Between these theories is where the von Karman line stands based on the scientific concept of compensation.

The von Karman line, named after Theodore von Karman who was a German-Hungarian expert on aerodynamics, explains that the compensation of an aircraft's

[97] See Goedhart, *supra* note 85 at 51.

[98] See Oduntan, *supra* note 69 at 79-80.

[99] *Ibid*.

weight by the centrifugal force takes place at nearly 100 km above the Earth.[100]

Political debates on whether the 100 km is viable to be drawn have also appeared after the USSR proposed either 100km or 110 km for the delimitation at the UNCOPUOS in 1979.[101] Since then, several jurisdictions or even non-governmental entities have also from time to time regarded 100 km as a legitimate boundary. For instance, the 1988 Australia Space Activities Act,[102] the Republic of Kazakhstan's Outer Space Act,[103] and the Danish Outer Space Act declare outer space as above 100 km.[104] Also, the Fédération Aéronautique Internationale (FAI), which ratifies world records and organizes international aeronautical and astronautical competitions, has approved the rule under its Sporting Code in that a flight could only be considered an astronautical flight when that flight goes beyond 100 km.[105]

Recently, renowned Harvard astrophysicist Jonathan C. McDowell advanced the theory that historical orbital data for actual artificial satellites confirm the survival of those objects at around 80-90 km, concluding that the effective Karman line is close to 80 km independent of solar and atmospheric conditions.[106] Accordingly, the two non-

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[100] See Goedhart, *supra* note 85 at 63.

[101] See Chapter III.B, *below*, for the proposals made by USSR.

[102] See *Space Activities Act 1988* (Cth), 1988/123, s 8. It must be noted that Australia positioned itself that the altitude of 100km represents a practical clarification and is not an attempt to define or delimit "outer space." See UNCOPUOS, *Note by the Secretariat: Summary of information on national practices and legislation of States with regards to the definition and delimitation of outer space*, UN Doc A/AC.105/C.2/2014/CRP.27 (2014).

[103] See *Law of the Republic of Kazakhstan on Space Activities*, 6 January 2012, no. 528-IV, art 1(6).

[104] See *Danish Outer Space Act*, 11 May 2016, no. 409, s 4(4).

[105] Under Section 8 of its Sporting Code, all flights must exceed an altitude of 100 km in order to qualify for records. Moreover, a mission is sub-orbital if each of its arcs of trajectory above an altitude of 100 km has a length of less than 40,000 km (in the non-rotating geocentric set of axes). See *Section 8 - Astronautics*, FAI, FAI Sporting Code (2009) at subchapter 2.18.1 & 2.18.6.

[106] See McDowell, *supra* note 54.

governmental organizations, FAI and the International Astronautical Federation (IAF), have also put forward this recent theory of reducing the altitude limit and have expected to explore this issue with the participation from the astrodynamics and astronautical community.[107]

The problem of this seemingly straightforward proposal is that while the 80-100 km altitude is well-utilized to separate the fields of aeronautics and astronautics, setting the boundary of territorial air space that high would also create a high wall to many smaller and landlocked States.[108] Also, if we consider the von Karman line as a stringent rule for classifying the regime between air space and outer space, those two regimes would have to apply every time a single-vehicle traverses in two spaces, causing a relentless shift of the application of the law.[109]

Lastly, the premise of the theory itself needs to be questioned at the very beginning. To be clear, Andrew G. Haley coined the term "von Kármán line" in 1957, referring to a soft number of 275,000 feet (52.08 statute miles, 83.81 kilometers) which may be changed significantly.[110] Moreover, his theory did not properly distinguish the scientific

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[107] See "Statement About The Karman Line" (30 November 2018), online: *Fédération Aéronautique Internationale* <www.fai.org/news/statement-about-karman-line?type=term&id=1443>.

[108] See Oduntan, *supra* note 69 at 82; See also Paul Stephen Dempsey & Maria Manoli, "Suborbital Flights and the Delimitation of Air Space vis-a-vis Outer Space: Functionalism, Spatialism and State Sovereignty" (2017) 42 Ann Air & Sp L 209 at 234.

[109] As Dempsey and Manoli argues:

> "[However,] what should the approach be for those suborbital aerospace vehicles that principally operate within the air and remain in space for less than a few minutes before re-entering the Earth's atmosphere? Under a functionalist approach, it might be more appropriate to apply Air Law to the entire movement. A spatialist approach might require that vehicles be certified under, and regulated by, two separate legal regimes… Duplicative regulation might create costs and inefficiencies that chill private investment."

Ibid.

[110] See Gangale, *supra* note 88 at 130-135.

rationale between aerothermodynamics and aerodynamics, and this would have seemingly caused confusion for several researchers and practitioners in stating the exact scientific basis for arguing such number.[111] Haley himself was even inconsistent in his references to the von Karman line, where he referred to an agreement between delegates to the FAI from the United States and the Soviet Union regarding a 100-kilometer line (62.13 statute miles, 328,083 feet) as a determination of space flight records as "this coincides with the Karman line theory."[112]

4. Review of Effective Control theory

Article 1 of the 1949 Chicago Convention clearly states that every State has complete and exclusive authority over the airspace above its territory, meaning that airspace is an integral part of State territory. According to Goedhart, this arrangement between States seemed to have reflected the principle of effective control, perhaps as a default proposition that States would make for the sake of national sovereignty.[113]

Cooper, as a representative advocate of this theory, opined that every State, no matter how small or how weak, as a State of equal sovereignty with every other State, has and should be admitted to have territorial rights upwards above its surface territories as high as the rights of every other State no matter how powerful.[114] Goedhart further stresses some conditions to make this theory plausible: that there should be (1) "an actual display of any sovereign power by an underlying State in its own airspace as a prerequisite", and/or (2) "the actual display of any sovereign power by an underlying State for

[111] *Ibid*.

[112] *Ibid*.

[113] See Goedhart, *supra* note 85 at 97.

[114] See John Cobb Cooper, "High Altitude and National Sovereignty" in Vlasic ed., *supra* note 50 at 263-264.

establishing claims to national airspace in accordance with international law."[115]

Whatever capabilities States might possess to observe flying objects or carry out physical inspections, however, this theory is critically outdated as part of a legal discussion of the delimitation issue. Firstly, the theory itself in the present conception of international law does not necessarily imply in any way a State being all-present and all-perceiving.[116] Second, even if there is a potential expansion of control *usque ad coelum* in case one argues that it must have the ability to do so, the 1967 Outer Space Treaty clearly prohibits national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.[117] This, in turn, would once again raise the issue of a spatial limit and would ask in all seriousness whether the principle of effective control can ever be pertinent to outer space.

5. Review of No Present Need theory

Not only space-faring nations but also because of States who have yet to achieve such capability and also expect to have a future interest in space exploration, demarcating airspace would seem to impede the right of these States to potential economic sovereignty. Also, it is more presumable that the fear of passing one's territory on ascent or descent may be more imaginary than real since the general tendency towards the passage of space objects is not to unreasonably veto spaceflights during ascent or descent.[118] Therefore, as Jessup and Taubenfeld express their opinion where in due course practical international necessities will lead to a definition, it may be better not to

[115] Goedhart, *supra* note 85 at 99.

[116] See Goedhart, *supra* note 85 at 100.

[117] See *1967 Outer Space Treaty* at Art II.

[118] See Oduntan, *supra* note 69 at 66-69.

grant sovereignty over the airspace at all than to grant it without specifying precisely where it ends.[119] When reviewing the continued international debates, Jinyuan Su concluded with an observation that:

> "The emergence of aerospace objects, which combine the functional characteristics of aircraft and space objects, poses a challenge to, but does not seem to justify, the urgency of delimitation."[120]

From a political point of view, the United States, having shared its opinion with some other States including Canada, Sweden, and the United Kingdom, has persistently argued that it is not a priority to draw a definite line that would restrict space activities.[121] Throughout ICAO meetings and UNCOPUOS, the US has argued that it would seem arbitrary to attempt to draw a line at this point, where the space industry could be intimidated and such stringent application of different rules across an artificial border would bar future discoveries and technological advances.[122]

However, the temporal element of the above wait-and-see approach cannot be considered valid forever, especially taking into account that the new industries are already in place and waiting for policy countermeasures. As Thomas Gangale argues, the whole time consideration cannot depend upon whether the experience has ripened from the time the position was taken.[123] Rather, those who take such position should really ask themselves "whether future experience might be substantially different," and

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[119] *Ibid*.

[120] Su, *supra* note 77 at 377-378.

[121] Gangale, *supra* note 88 at 51-52; See UNCOPUOS, *Background paper prepared by the Secretariat: THE QUESTION OF THE DEFINITION AND/OR THE DELIMITATION OF OUTER SPACE*, UN Doc A/AC.105/C.2/7/Add.1 (1977).

[122] See Chapter III.B, *below*, for details on the proposition of the US.

[123] Gangale, *supra* note 88 at 51-52.

this will remain "unanswerable in a definitive way since the future is unwritten."[124] Also, the debate might be considered already too late, even if one gives credence to the temporal element, since the advent of new technologies, including high-altitude platforms, space tourism, and suborbital flights, have already increased the political awareness of the debate of delimitation.[125]

Moreover, diverse and distinct national regulations generate even more uncertainty regarding an understanding of the issue.[126] While the "no present need" theory seems to well reflect the political reluctance by States to come up with a consensus of drawing a bright line, clarity provided by an established line of demarcation would promote the commercial development of space, while a lack of demarcation would result in ambiguity and the absence of uniformity will continue to hinder investment and insurance in the space sector.[127]

D. Suggestion for an Intermediate Zone Absent Solution for Legal and Political Complexity of the Delimitation Issue

There are also other theories that have been revised or newly suggested. A suggestion for an intermediate zone is a representative example of this: it is not a new one that has been recently discussed in academia but was suggested quite a long time ago in different ways by different scholars. Mainly starting from Cooper to Goedhart, Oduntan, Dempsey, and Jakhu, those academics advocate the theory of establishing a mediating zone between airspace and

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[124] *Ibid*.

[125] See Dipaolo, *supra* note 11; See Chapter III.E, *below*, for diverse national regulations on aerospace flights.

[126] See Dipaolo, *supra* note 11.

[127] *Ibid*; See also Jakhu, Sgobba & Dempsey, *supra* note 18 at 62.

outer space, mainly on the ground of mitigating the political and legal risk between States.[128] Some have even suggested a designated name for that zone, such as 'buffer zone,' 'protozone,' or 'near space.'[129]

At first glance, such dialectic reasoning or interpreting either air or space law *de lege ferenda* could be regarded as ideal by those who advocate a harmonized or integrated approach. For instance, Cooper, by arguing that the legal status of territorial airspace and international outer space is diametrically opposed, suggests a contiguous zone that gives the subjacent State full sovereignty over that part of airspace but at the same time provides for a right of transit for non-military or civil aerospace flights.[130] On the other hand, Professor Jakhu, Dempsey, and Tomaaso Sgobba opine that in order to apply ICAO regulations and mechanisms to space flights, one approach would be to interpret Article 37 of the Chicago Convention in a way that gives ICAO jurisdiction over everything that has an impact on the safety, regularity, and efficiency of international air navigation.[131]

However, those suggestions for an intermediate zone do not hold the key to unraveling the existing legal and political disagreement between States. Not only does resolving the issue

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[128] See John Cobb Cooper, "The Boundary Between Territorial Airspace and International Outer Space" in Vlasic ed., *supra* note 50 at 298; See also Jakhu, Sgobba & Dempsey, *supra* note 18; See also Oduntan, *supra* note 69 at 81-84.

[129] Oduntan suggests the concept of "buffer zone" in between 88.5-160.9 km (55-100 miles), where it can mainly accommodate further scientific researches and function as a bargaining chip and negotiating weapon for States in their international relations. Jakhu, Dempsey, and Pelton also argues that a flight between an intermediate region between 50-120 km, also called as "near space," should be compliant with international norms presumably by ICAO and that overflights for military purposes should be undertaken only if authorized by the overflown country. Pelton personally turns to the concept of 'protozone', where in between 21-100 km altitude there is a distinct potential for business and regulatory applications for HAPS and suborbital spaceplanes. See Oduntan, *supra* note 69 at 82-83; See also Dempsey & Manoli, *supra* note 108 at 249; See also Jakhu, Sgobba & Dempsey, *supra* note 18; See also Pelton, "The New Gold Rush", *supra* note 55 at 82-86.

[130] See John Cobb Cooper, "The Boundary Between Territorial Airspace and International Outer Space" in Vlasic ed., *supra* note 50 at 303.

[131] See Jakhu, Sgobba & Dempsey, *supra* note 18 at 138-139.

of delimitation depend upon the willingness of States, but also invoking the issue as a lively debate is also up to those States, even if one argues that there may be an acquiescence in freedom to move "into" outer space through such an intermediate zone.[132] This is especially true when compared to the past cases concerning the demarcation of the seas, and indeed, there has not been a single bilateral treaty negotiation or a judicial case concerning the delimitation of airspace.[133]

If one were to suggest a solution to a legal problem, there is simply no way of getting out of the hard part of solving that legal question. Unfortunately, such a mediating suggestion seems to be situated far from political reality. As the next Chapter shows, decades of international debates show that States are reluctant to reach compromise and call for a unified regulatory framework for the delimitation issue.

[132] Oduntan stresses that even though such arbitral line would be workable equally as to what States have agreed upon the sea, "what concerns all must be approved by all." (by borrowing the Latin phrase *caveat humana dominandi, quod omnes tangit ab omnes approbatur*) Oduntan, *supra* note 69 at 83.

[133] In this regard, the suggestion of Exclusive Utilization Space (EUS), modeling from the Exclusive Economic Zone (EEZ) from the seas, may also not be the best idea for the time being. Whether or not the object is a civil one, the nature of aerospace involves inherently haphazard safety risk of the subjacent State and the current air navigation system does not support the range of situation awareness above 80km. See critically Hao Liu & Fabio Tronchetti, "Regulating Near-Space Activities: Using the Precedent of the Exclusive Economic Zone as a Model?" (2019) Ocean Development & International Law 1.

CHAPTER III. REVIEW OF THE PAST AND PRESENT INTERNATIONAL DEBATE – POLITICAL DEADLOCK?

A. Importance of Considering Past and Present Political Debate for Future Commercialization of Civil Aerospace Flights

If one were to plead that either the functionalist or spatialist theories could resolve the delimitation issue, why has the international community not been able to reach consensus on this crucial matter?

For that question, Thomas Gangale observed that:

> "[T]here has been a failure to diffuse scientific and technical knowledge to the legal community… Much argumentation on the issue of legally defining and delimiting outer space is based on some tidbits of scientific facts without much understanding of to what degree such facts are relevant, or whether they are relevant at all."[134]

However, Gbenga Oduntan reviewed the matter from a different angle:

> "Political resolution normally would have to take place before or at least contemporaneously with legal codification… It might, however, be suggested that the reason why the indecision over the issue has been allowed to fester so long is because the absence of a precise boundary is advantageous to the dominant interests in international space exploration."[135]

Adding to those two observations, this paper also observes that the primary reason for States failing to reach consensus on one of those theories is that the principle of territorial integrity codified under the Charter of the United Nations was and still is a crucial element for States to preserve their exclusive sovereignty from any threat or use of force.[136]

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[134] Gangale, *supra* note 88 at 8-9.

[135] Oduntan, *supra* note 69 at 66-69.

[136] Article 2, paragraph 4 of the *Charter of the United Nations* provides that "[a]ll Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations." See *Charter of the United Nations*, 26 June 1945, Can TS 1945 No 7, 59 Stat 1031, 145 UKTS 805, 24 UST 2225, TIAS No 7739 (entered into force 24 October 1945) at Art 2.4.

At the same time, it is also important to note that States would always leave room for any potential coordination and agreements with other States for its potential economic growth.[137] This means that aerospace flights could become a topic not only primarily of airspace sovereignty but also of economic interest followed by rapid commercialization. As Wolfgang Friedmann writes:

> "There is a relativity in the concept of "national interest" which gives it a flexible relationship to any specific value of ideology of international life… it is as consistent at one time with the pursuit of absolute national sovereignty as it is at another time with the organization of a regional union, an effective international order force, or even a world federation."[138]

The issue of regulating aerospace flights, therefore, is a subject in which one can see the affiliation between a State's territorial integrity and a private/public business opportunity; States are refraining from political conflict and at the same time are willing to negotiate for their economic interest at a certain phase. Therefore, it is important to review from such a perspective of what States have asserted before the international community on behalf of their national interest, projecting a certain viewpoint on the possible regulation of aerospace vehicles.

This thesis will analyze the political dynamics that have changed along with the advancement of aerospace technology, observing whether there have been consistent State

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[137] As Henri Wassenbergh analyzed different regulatory approaches of States, he observed that States do not base their legal and political perspectives solely on the determination of the applicable law. Rather, they carefully choose their approach by determining (i) the balance of interests struck upon an exchange of sovereign State rights (reciprocity), (ii) the reasonableness and fairness of trade between States, and (iii) the potential benefits from acting or favoring other interests for the sake of other States or the international community as a whole. See generally Henri Wassenbergh, "The Art of Regulating International Air and Space Transportation: An Exercise in Regulatory Approaches to Analyzing Air and Space Transportation" (1998) 23 Ann Air & Sp L 201 at 206-210.

[138] He strongly criticized the majority of international legal academics who still regard "national interest" as a primary value, oppose it to the values of the international order and view the problems of peace, humanitarianism, international economic development from such position. Such naive identification of "national interest" with "national security" would greatly curtail the flexibility of interpretation. Wolfgang Friedmann, *The Changing Structure of International Law* (New York, US: Columbia University Press, 1964) at 45-48.

practices over the decades on the issue of delimitation and the flight of aerospace vehicles. However, as this Chapter introduces numerous international debates and State regulations, the dispersion of legal and political views cannot resolve either the delimitation issue or the issue of regulating aerospace flights by establishing an international law framework. Rather, as the final Chapter suggests, this thesis will observe whether the legal and political uncertainty of the delimitation issue could be transcended by the introduction of aerospace navigational and communication aids for the safety of aerospace flights.

B. Political History of Outer Space Activities and Suborbital Flights

Under UN General Assembly Resolution 2222 (XXI) adopting the Outer Space Treaty, the Assembly requested the UNCOPUOS to study the questions relative to the definition of outer space and the utilization of outer space and celestial bodies.[139] Since then, the Legal Sub-Committee has taken the role of providing a point for discussion where States are more or less obliged to express a view on the subject.[140]

1. Review of the 1979 UNCOPUOS meeting on the delimitation issue

The heated debate on delimitation began in 1979 where the former USSR introduced a working paper on "Approach to the solution of the problems of the delimitation of airspace and outer space."[141] It argued that the region above 100(110) km altitude from

[139] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, GA Res 2222 (XXI), UNGAOR, 21st Sess, Supp No 30, UN Doc A/Res/21/2222 (1966) at Preamble.

[140] See Cheng, *supra* note 65 at 325.

[141] See UNCOPUOS, *Working paper submitted by the Union of Soviet Socialist Republics: Approach to the solution of the problems of the delimitation of air space and outer space*, UN Doc A/AC.105/L.121 (1979) [UNCOPUOS, "1979 Working Paper by the USSR"].

the sea level is outer space, and that space objects of States shall retain the right to fly over the territory of other States at altitudes lower than 100 (110) km above sea level for the purpose of reaching orbit or returning to earth in the territory of the launching State.[142]

On the contrary, the United States, along with the UK and Germany, continued to position itself against any immediate need for a boundary between airspace and outer space. The US has argued for the lack of adequate examination of the relevant scientific, legal, technical and political factors, and the possible inhibiting and even stifling effect of such a boundary on future efforts to explore and use outer space.[143]

2. Review of the 1995 UNCOPUOS Questionnaire on Possible Legal Issues with regard to Aerospace Objects

In the early 1990s, many States had started to take into consideration some advancements in aerospace objects, and the Legal Sub-Committee thus had taken account of the subject of aerospace objects in its circulation of the questionnaire. It is interesting to note that Russia had insisted that State practice had been established whereby a space object launched by a State may, when being in orbit, pass without hindrance over the territory of other States at virtually any altitude.[144] It also saw prior notifications as voluntary and prompted by considerations of international courtesy.[145]

Based on Russia's further proposal on the problems of the legal regime for aerospace

[142] *Ibid*.

[143] See UNCOPUOS, UN Doc A/AC.105/C.2/SR.316 (1979) at 2, cited in Cheng, *supra* note 65 at 327.

[144] See UNCOPUOS, *Working paper submitted by the Russian Federation: Questions concerning the legal regime for aerospace objects*, UN Doc A/AC.105/C.2/L.189 (1992) [UNCOPUOS, "1992 Working Paper by Russia"].

[145] *Ibid*.

objects, the Legal Sub-Committee in 1995 circulated another questionnaire specific to the relation between delimitation and emerging aerospace objects. While all the respondents agreed that no special procedures for aerospace objects exist,[146] many respondents stated that aerospace objects, for purposes of safety and air navigation, should follow national and international air traffic rules.[147] However, those respondents refrained from dealing with any political or legal issues, making it clear that such proposal of incorporating air and space traffic rules would not mean that those rules will conclusively govern the flight of aerospace objects.[148] Moreover, the United States has not made any statements regarding the issue of delimitation nor the issue of aerospace flights, repeating its concern that if the Legal Sub-Committee acknowledges a specific line above which is presumed to be outer space, a number of States would claim that the area below that point is also presumed to be outer space.[149]

C. Continuing Controversies and Suggestions on a Certain Spatial Limit

The continued replies by States concerning the Legal Sub-Committee's circulation of questionnaires show rather inactive progress in considering State practices on the delimitation issue. Two typical approaches – the spatial and functional approaches – seem to have gone nowhere for the last decades.

It is relatively noteworthy that the discussion itself started to shift from mere hypothetical

[146] See UNCOPUOS, *Note by the Secretariat: Comprehensive analysis of the replies to the questionnaire on possible legal issues with regard to aerospace objects*, UN Doc A/AC.105/C.2/L.204 (1997) at para 35.

[147] *Ibid* at para 43.

[148] *Ibid*.

[149] See K Gorove, *supra* note 75 at 14-15.

concerns; it took some practical considerations regarding the right of innocent passage of aerospace objects through foreign airspace. For instance, some States advocating the functional approach stated that the air law regime would apply to craft used for Earth-to-Earth transport of material or persons, whereas the space law regime would apply to objects where its main mission is the exploration of outer space.[150]

While the issue of delimitation has still been unsettled, some States have argued that customary international law has been formed in a way that perceives 100km as a spatial limit. For example, Russia has been a long advocate for demarcating airspace up to 100km above sea level.[151] Germany also alluded to the entry below 100 km in altitude as "re-entry into the Earth's atmosphere."[152] Other states, such as Australia, Kazakhstan, and Denmark, have shown State practices through their national legislation.[153]

The UNCOPUOS also expressed its official position that it supports a 100km altitude above sea level as a delimitation.[154] The Committee stated that this proposal should be codified through an international instrument providing for regulation of passage rights for space objects during launching and re-entry, so long as those space activities are peaceful, are conducted in accordance with international law, and respect the sovereign interests of the

[150] See UNCOPUOS, *Note by the Secretariat: Analytical summary of the replies to the questionnaire on possible legal issues with regard to aerospace objects*, UN Doc A/AC.105/C.2/L.249 (2004) at para 20 [UNCOPUOS, "2004 Analytical Summary"].

[151] See UNCOPUOS, "1979 Working Paper by the USSR", *supra* note 141.

[152] See UNCOPUOS, "Legal issues with regard to aerospace objects", *supra* note 60.

[153] See Chapter II.C.3, *above*, for more on this topic.

[154] See UNCOPUOS, *Working paper prepared by the Chair of the Working Group on the Definition and Delimitation of Outer Space of the Legal Subcommittee: Promoting the discussion of the matters relating to the definition and delimitation of outer space with a view to elaborating a common position of States members of the Committee on the Peaceful Uses of Outer Space*, UN Doc A/AC.105/C.2/L.302 (2017) at para 19-21 [UNCOPUOS, "2017 Working Paper by the Delimitation Working Group"].

applicable territorial State.[155]

However, a number of States are also persistent objectors in opposing such an idea, and some delegations even expressed the view that by defining outer space, the Working Group of the UNCOPUOS would also define airspace, which of course raises the issue of whether the Working Group had been mandated to do so.[156] Also, the United States as a space-faring nation has not taken part in sharing any of its views through the Legal Sub-Committee and persistently argues, through its domestic practice and other international forums, that "any attempts to impose an established aviation regulatory regime could unduly influence the technology trajectory of legacy systems on commercial spaceflight industries, further hindering developments."[157]

D. Critical Issue on the Right of Innocent Passage (IPR)

1. Discussions on State acquiescence on the brief passage of 'space objects' through foreign airspace

Historically, the right of innocent passage evolved at a time when special zones of jurisdiction were not clearly distinguished from zones of sovereignty and the maritime

[155] *Ibid*.

[156] See UNCOPUOS, *Report of the Chair of the Working Group on the Definition and Delimitation of Outer Space – Annex II*, UN Doc A/AC.105/C.2/2016/DEF/L.1 (2016) at para 9.

[157] According to its working paper presented at the 13th Air Navigation Conference in ICAO, United States provided their position with reference to its municipal traffic management system. Since the US Federal Aviation Administration does not currently attempt to harmonize high-level technical standards for suborbital vehicles and concepts with all types of airspace operations at an international level, the Office of Commercial Space Transportation coordinates launch and re-entry activities with the Air Traffic Organization within the FAA. Air traffic controllers manage aviation operations and the airspace when suborbital launch and re-entries take place. Therefore, current US suborbital activity is contained in segregated airspace or other controlled airspace, without any significant safety impact to domestic and international flights. ICAO, *Working Paper presented by the United States: INTEGRATING PUBLIC SAFETY STANDARDS FOR COMMERCIAL SPACE AND AVIATION*, 13th Air Nav Conf, AN-Conf/13-WP/205 (2018).

belt was considered to be the high seas but with restrictions in favor of the coastal State.[158] The judgement from the *Schooner Exchange* case confirms this principle whereby "[a]ll sovereigns have consented to a relaxation in practice, in cases under certain peculiar circumstances, of that absolute and complete jurisdiction within their respective territories which sovereignty confers."[159]

Turning to space objects, the issue was now challenged three-dimensionally as to whether they were allowed of passage through foreign airspace during ascent and/or descent. Some academics in the early space age (1950-70) had suggested that the right of passage of space objects should not be inhibited in order to permit reciprocity and convenience between space-faring States, and for the further advance of technology.[160]

Others have argued that any State practice or relevant precedents of passage through foreign airspace might prove customary international law itself to also confer a right of passage for aerospace objects. Manfred Lachs, one of the most highly qualified publicists (as a former judge to the ICJ), argued that:

> "…[T]he first instruments that man sent into outer space traversed the airspace of States and circled above them in outer space, yet the launching States sought no permission, nor did the other States protest. This is how the freedom of movement

[158] See James Crawford & Ian Brownlie, *Brownlie's principles of public international law*, eighth edition. ed (Oxford, United Kingdom: Oxford University Press, 2012) at 317.

[159] Judge Marshall had carefully delivered through the Court that "the full and absolute territorial jurisdiction… would not seem to contemplate foreign sovereigns nor their sovereign rights as its objects." The Court thus stated that "[o]ne sovereign being… can be supposed to enter a foreign territory only under an express licence, or in the confidence that the immunities belonging to his independent sovereign station, though not expressly stipulated, are reserved by implication, and will be extended to him." *Schooner Exchange v McFaddon*, 11 US (7 Cranch) 116 (1812) at 137.

[160] Christol argued that innocent passage through national air space need not be prohibited solely for reasons of security, and therefore the exercise or non-exercise by the subjacent State in its airspace should be made to depend on convenience, economy, and the need for order and for mobility. Cheng also did not refute that among space powers or near-space powers, the passage right in the expectation of reciprocity may be easily granted. See Carl Q Christol, "Innocent Passage in the International Law of Outer Space Symposium on the Law of Outer Space" (1965) 7 USAF JAG L Rev 22 at 29; See also Cheng, *supra* note 65 at 357.

into outer space, and in it, came to be established and recognized as law within a remarkably short period of time."[161]

However, the adoption of the 1944 Chicago Convention clearly cuts off the passage issue in sovereign foreign airspace (Article 1). Moreover, the principles of freedom of exploration and use of outer space, which had been primarily adopted by the *UN Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*[162] (*UNGA Resolution 1962 (XVIII)*) nowhere indicates that the rule of national and exclusive airspace sovereignty had been waived or modified.[163]

2. Discussions on the extended passage of 'aerospace objects' through foreign airspace and the rejection of forming any customary rule

As the UNCOPUOS failed to receive enough support by States on the delimitation issue, the committee also extended the debate as to whether there were precedents for the passage of aerospace objects after re-entry into the Earth's atmosphere and whether international customary law existed with respect to such rights of passage.[164]

For instance, the UNCOPUOS Analytical Summary Paper in 2004 has stated that some States provided precedents with respect to the passage of aerospace objects during

[161] *Case concerning North Sea Continental Shelf (Germany v Denmark; Germany v Netherlands)*, [1969] ICJ Rep 3 at 230 (dissenting opinion of Judge Lachs).

[162] *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*, GA Res 1962 (XVIII), UNGAOR, 18th Sess, UN Doc A/Res/18/1962 (1963).

[163] See John Cobb Cooper, "Legal Problems of Spacecraft in Airspace" in Vlasic ed., *supra* note 50 at 312. Moreover, since provisions concerning the right of innocent passage does not exist for spacecraft in any relevant treaties, it would be risky to simply draw analogy from international customs in territorial waters. See Su, *supra* note 77 at 375.

[164] Such discussion on passage rights by way of questionnaire was originally proposed by the Russian Federation in 1992, submitting a working paper entitled "Questions concerning the legal regime for aerospace objects." From there, Russia had stated that a practice has been established whereby a space object launched by a State may, when being in orbit, pass without hindrance over the territory of other States a virtually any altitude. It has also seen prior notifications as voluntary and prompted by considerations of international courtesy. See UNCOPUOS, "1992 Working Paper by Russia", *supra* note 144; See also Andrei D Terekhov, "Passage of Space Objects through Foreign Airspace: International Custom?" (1997) 25 J Space L 1 at 2.

take-off and/or re-entry into Earth's atmosphere: (1) a closed communication between the US and former USSR concerning the final flight stage of Atlantis Space Shuttle in 1990; (2) the Agreement between Russia and Kazakhstan on the Main Principles and Conditions for Utilization of the Baikonour Launch Site in 1994; (3) the re-entry of the USSR Space Shuttle Buran through Turkish airspace without prior consent in 1988; (4) the de-orbiting of Russia's orbital space station MIR in 2001; and (5) the falling of US Space Station Skylab's fragments in 2011.[165]

The other States were of the view that there were no precedents with respect to the passage of an aerospace object after re-entry.[166] Some States even referred to whether the specific design of the US Space Shuttle had retained the right of passage, but some argued that it could not be regarded as an aerospace object since it was not strictly capable of moving through the airspace.[167]

From the above analysis, it is true that since the beginning of the space era there have been no protests against defunct satellites entering the upper layers of the atmosphere over foreign States after the end of their active life, and either burning up completely or even having some of the debris reaching the surface.[168] To such extent, Stephen Gorove has even argued that a limited international custom seems to have emerged.[169] By that analogy, as long as the object's primary function is to operate as a spacecraft, its safe

[165] See UNCOPUOS, "2004 Analytical Summary", *supra* note 150 at para 56-58.

[166] *Ibid*.

[167] Russia had also stated that the agreement between US concerning the passage of Atlantis Space Shuttle in 1990 was established in a way not to be deemed to set a precedent. Nonetheless, Russia had viewed this as suggesting broad lines of the procedures to be followed in notifying States. *Ibid* at para 59.

[168] See Terekhov, *supra* note 164 at 14.

[169] See S Gorove, *supra* note 52 at 109-111.

passage to and from outer space could also attain the status of international customary law.

However, the fact that there have been no explicit protests as to the re-entry of space objects does not instantly lead to the conclusion that an international custom has been established.[170] Any international custom, especially concerning territorial sovereignty, must accompany 'actual' State practice to confirm *erga omnes* of the non-intervention principle. According to Judge Read in the *Fisheries Case between the United Kingdom and Norway*:

> "Customary international law is the generalization of the practice of States. This cannot be established by citing cases where coastal States have made extensive claims, but have not maintained their claims by the **actual assertion** of sovereignty over trespassing foreign ships."[171] (emphasis added)

Moreover, to further confirm any incoherency of the custom, other State practices that seem inconsistent with the rule should not be regarded as a recognition of a new rule but "should generally have been treated as [a] breach of that rule."[172] In this regard, there seems to be no superior and general State practice concerning passage rights of aerospace vehicles that would regard any other practices as a breach of the majority.

Clearly, SpaceShipOne of Virgin Galactic or reusable launch vehicles of Space X and Blue Origin, both of which are intended to traverse between airspace and outer space and arrive at a point of destination, shows another aspect of this ambiguity of strictly deciding the issue of passage rights. One could (at first glance) consider such a flight as

[170] See Terekhov, *supra* note 164 at 14-15.

[171] *Fisheries Case (United Kingdom v Norway)*, [1951] ICJ Rep 116 at 191 (dissenting opinion of Judge Read).

[172] *Nicaragua Case*, *supra* note 22 at 98.

extended cabotage, which is primarily regulated under national provisions.[173] However, it is important to note that other emergent space States, especially those States that are geographically land-locked, are very much concerned as to whether those particular objects are allowed passage through their airspace during flight. For instance, Israel has launched most of its satellites westward over the Mediterranean Sea to avoid launching over enemy countries in the region. This action has forfeited the benefits of launching in the direction of the Earth's rotation and therefore has resulted in a retrograde orbit that exacts heavy performance penalties which have caused a loss of up to 40 percent of the rocket's lift capacity.[174]

E. Divergence of State Implementations and the Prevailing Principle of State Sovereignty

The above cumulative summary of replies from the UNCOPUOS questionnaires has shown that States have failed to reach consensus and do not have an urgent need to call for an international agreement regarding the issue of delimitation or the right of innocent passage. To that extent, the Legal Sub-Committee expressed its concern on the absence of consensus, observing that without proper delimitation of the frontier between airspace and outer space, the principle of territorial integrity cannot be fully exercised and the potential for conflicts

[173] Those that make it a round-trip to its original place of departure are even more difficult to be debated under the international regime since its itinerary might be an international flight or a cabotage. In this sense, it would also seem plausible that a 'tenth freedom' of the air – to depart from and return to the same launch site in another country - would lawfully allow a suborbital space flight like SpaceShipOne designed by Virgin Galactic, or else, it would be possibly seen as an unlawful 'cabotage' that traverses third State's airspace. See Brian F Havel & Gabriel S Sanchez, *The principles and practice of international aviation law* (New York, US: Cambridge University Press, 2014) at 55, 76.

[174] See Barbara Opall-Rome, "Israel Eyes Overseas Launch of Next Ofeq Spy Satellite", *Spacenews* (9 May 2011), online: <www.spacenews.com> [perma.cc/UL6Y-P4R3].

of jurisdiction could increase dramatically.[175]

On the other hand, the present legal and political deadlock of the delimitation has neglected a growing number of national regulations on aerospace flights. UNCOPUOS, throughout its decades of studies and summaries, has projected that "the vertical limit of State sovereignty, wherever it has been established at the national level, tends toward local and national interests."[176]

In this sense, this subchapter will review different State legislations and policies concerning the authorization and navigation of aerospace flights and possibly demonstrate each view towards the delimitation issue and the flight of aerospace vehicles. Below are some of the selected States – US, EU, and New Zealand – that have their own municipal laws or regulatory bodies, or at least certain policy views on aerospace flights.

1. United States – Commercial Space Launch Amendments Act 2004 (CSLAA)

The view of suborbital flights as space activities is essentially the approach that is most prominently followed and particularly important in view of the US leadership in the sector. Originally enacted in 1984, the Commercial Space Launch Amendments Act 2004 (CSLAA) introduced a legal regime for private spaceflight.[177] The Act is significant for commercial space venture companies in two aspects: (1) the Act exempts the certification of the vehicles and instead relies on the licensing process under the Federal Aviation Administration (FAA),[178] and (2) the operator for a suborbital vehicle

[175] See UNCOPUOS, "2017 Working Paper by the Delimitation Working Group", *supra* note 154 at para 11.

[176] *Ibid* at para 16-17.

[177] See *Commercial Space Launch Amendments Act*, 51 USC § 50904 (2004) [*CSLAA*].

[178] See *CSLAA*, § 50904–50906.

must notify its potential crewmembers that the US government has not certified the vehicle as "safe" and advise of each known hazard and risk that may result in serious injury, death, etc., for which in return passengers provide their signed and dated "informed consent."[179]

For the general licensing process, the FAA Office of Commercial Space Transportation focuses mostly on the safety of public and property not involved in the flights.[180] In addition, the Office can also issue an alternative license called an "experimental permit," with the aim of facilitating the development of new types of reusable suborbital vehicles.[181] In this regard, SpaceShipTwo vehicles undertaking flights from the US were registered by the Federal Aviation Administration (FAA) as spacecraft, although they were technically categorized as an aviation-reminiscent mode under the number N348MS (categorization of flights capable of reaching around 400,000 feet as the intended maximum altitude).[182]

Safety is one of the stringent requirements the CSLAA addresses in relation to the people on board or on the ground. By initially differentiating the term "crew" and "space flight participant,"[183] the Act requires the crew to have adequate training and to

[179] See *CSLAA*, 49 USC § 70105 (2010).

[180] See *CSLAA*, § 50904.

[181] See *CSLAA*, § 50906. See also Rafael Moro-Aguilar, "National Regulation of Private Suborbital Flights: A Fresh View" (2015) 10:2 FIU Law Review 679 at 687-688.

[182] See US, Federal Aviation Administration, Commercial Space Transportation License – License Number: LRLO 16-092 (Rev 2) (26 July 2018), online: <www.faa.gov> [perma.cc/W6WH-BP7Z]; See also US, Federal Aviation Administration, FAA Registry – Aircraft – N-Number Inquiry: N348MS (20 February 2019), online: <www.faa.gov> [perma.cc/L2F2-AEQM].

[183] FAA, in this regard, qualified all three people on the flight of SpaceShipTwo as "crew", one of those riders including the first test passenger which will be responsible for training other potential space flight participants. See Loren Grush, "Virgin Galactic spaceplane reaches space with first passenger on board", *The Verge* (22 February 2019), online: <www.theverge.com> [perma.cc/79UP-V4U5].

demonstrate an ability to withstand the stresses of flight, as well as a capacity to conduct any aborting or emergency procedures.[184] The Act also requires the crew to have an FAA pilot certificate and sufficient experience in operating one or more aircraft with similar characteristics to safely carry out their duties so that the vehicle will not harm the public.[185]

Regarding traffic management, most of the States, including the US itself, has adhered to a rigid type of traffic control policy for aerospace activities: completely segregating its airspace or other US-controlled airspaces, without any significant safety impact to a domestic and international flight. However, since many civil aircraft have been affected by the increasing number of space launches and aerospace flight tests,[186] the FAA has planned to change the way that the US Air Traffic Organization (ATO) manages air traffic in the vicinity of a launch or re-entry operation.[187]

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[184] See *CSLAA*, § 70105. According to the Draft Guidelines for Commercial Suborbital Reusable Launch Vehicle Operations with Flight Crew, published by the FAA in 2005, human factors should be considered in a manner so that the flight crew can withstand physical stress factors such as acceleration, vibration, and noise. The guideline draws the analogy from the "Man-Systems Integration Standards" (NASA-STD-3000) published by NASA, in which it provides guidance on some physical stress factor limits. See FAA, "Draft Guidelines for Commercial Suborbital Reusable Launch Vehicle Operations with Flight Crew" Version 1.0 (11 Feb 2005), online: <www.faa.gov> [perma.cc/A32N-MS2G] [FAA, "Draft Guidelines for Suborbital Vehicle Operations"].

[185] See *CSLAA*, § 70105. For instance, the pilot of a Reusable Launch Vehicle that will operate in the National Airspace System (NAS) should possess a valid FAA pilot certificate, should hold ratings to operate one or more aircraft with similar characteristics for as many phases of the mission as practicable, and should possess a valid FAA 2nd-class medical certificate. See FAA, "Draft Guidelines for Suborbital Vehicle Operations", *supra* note 184.

[186] See Davenport, *supra* note 10.

[187] According to the Working Paper distributed at the 13th Air Navigation Conference of ICAO in 2018, there are two general considerations that US has taken into account when incorporating suborbital flights into the existing air traffic system: (1) merely increasing the amount of airspace segregated during launch or re-entry could be extremely detrimental to the efficiency and capacity of the current airspace system, and (2) the Air Navigation Service Provider providing air traffic services to different types of operators at different levels of public safety risk could be problematic. See ICAO, *Working Paper presented by the United States: UNITED STATES SUBORBITAL REGIME AS IT RELATES TO THE USE OF CIVIL AVIATION AIRSPACE*, 13th Air Nav Conf, AN-Conf/13-WP/272 (2018); ICAO, *Working Paper presented by the United States: INTEGRATING PUBLIC SAFETY STANDARDS FOR COMMERCIAL SPACE AND AVIATION*, 13th Air Nav Conf, AN-Conf/13-WP/205 (2018) [ICAO, "2018 Working Paper by the United States on Safety Standards"].

For example, it has introduced future regulatory plans for safety risk analysis, as well as for integrated traffic management to prevent possible collisions between aircraft, ships, and spacecraft, including surface damage. These changes incorporate three main elements: the application of an intermediate adjustment in individual risk, operational restrictions, and a new collective risk limit. The new collective risk limit, in this case, is to cap the number of exposed aircraft in space launch and re-entry operations in a rolling 12-month period.[188] By adopting such a new acceptable level of risk (ALR) approach, the FAA expects a higher level of safety during launch and re-entry operations without drastic increases to the size of segregated airspace and the associated impacts these increases would have on airspace systems and capacity.[189]

2. European Union – European Aviation Safety Agency (EASA) and the concept of Sub-orbital Aeroplanes (SoAs)

On the other hand, the European Union is inactive in regulating suborbital flights and leaves the implementation on that subject to each Member State's internal procedures for the time being. This is because the general statutory framework concerning air and space activities, provided under Article 4 and 6 of the Treaty on the Functioning on the European Union (TFEU), does not transfer the competency to the EU for regulating space activities.

Article 4 of the TFEU mainly deals with transport, including aviation. However, space is not included within the listing in the paragraph that allows the EU to adopt binding regulations or directives, and is dealt with in a separate paragraph stating that "[i]n the

[188] To ensure that no fatal accidents occur in the average person's lifetime of 80 years, the FAA set the collective risk limit to no more than 6,412 exposed aircraft in a rolling 12-month period. See ICAO, "2018 Working Paper by the United States on Safety Standards", *supra* note 187.

[189] *Ibid*.

areas of research, technological development and space, … the exercise of that competence shall not result in the Member States being prevented from exercising theirs."[190] According to Masson-Zwaan, the competency of the EU and of the Member States "co-exist[s]" in this part, meaning that Member States do not have to wait for the EU's decision.[191] For this reason, the space sector is sometimes referred to as a 'parallel competence.'[192]

While there is no regulatory body to cover suborbital flights, there seems to be an approach to viewing those flights as part of the aviation system through the work of the European Union Aviation Safety Agency (EASA). In a draft working paper presented at the 2008 International Association for the Advancement of Space Safety (IAASS) Conference, the EASA representatives expressed some ideas for a regulatory approach to suborbital space tourism: limited to winged aircraft, they proposed a framework of certifying rocket-powered airplanes using the concept of vertical take-off, calling them 'Sub-orbital Aeroplanes' (SoAs).[193]

Moreover, the representatives suggested an independent certification system for authorizing those SoAs: different from the FAA's licensing procedure, EASA's certification process would require more steps equivalent to certifying current

[190] *Treaty on the Functioning of the European Union*, 13 December 2007, OJ 2008/C 115/47 at Art 4.2, 4.3, 6 [*TFEU*].

[191] Article 6 also concerns education, culture, and tourism, in which there seems to be a potential inclusiveness for the commercial space sector. Nonetheless, Article 6 does not transfer the competency to the EU but is interpreted as a mere 'support' competency. See Tanja Masson-Zwaan, "The future regulation of suborbital flight in Europe" (2014) 30:2 Space Policy 263 at 268.

[192] *Ibid*.

[193] The representatives considered that EASA would have regulatory competence over SoAs and would treat them as aircraft in a similar way as Unmanned Aerial Systems (UAS) by complementing existing rules to capture their specific features. However, the paper presented at the Conference did not represent the official position of EASA. *Ibid* at 266-267.

commercial aircraft.[194] While the certification process for SoAs would be relatively lengthy and costly, it would allocate the risk not only to the operator – which is the case of the US licensing system for suborbital flights – but would also entail the responsibility of the relevant authority, influencing the extent of involvement of EASA.[195]

However, as one observer points out, the certification process is lengthy and costly, thus not suitable *ab initio* for such experimental, rocket-powered vehicles.[196] Moreover, the attention to commercial suborbital flights within the Union has lessened recently (possibly because of a heavy regulatory focus on unmanned aircraft systems) and EASA has thus regarded the subject as a low priority task. The relevant European Commissioner's *cabinet* has even shown a regression from its original policy trend, re-directing EASA to investigate the subject with a light hand that is similar to the FAA's "Launch Licensing".[197]

3. New Zealand – Outer Space and High-Altitude Activities Act 2017

New Zealand's newly enacted Outer Space Act provides a legal framework for commercial space launches and for high-altitude activities above 18 km (60,000 ft, which is also referred to as 'FL600').

Firstly, regarding the spatial scope of its application, the Act covers high altitude activities above FL600 and covers outer space activities that are higher than the upper

194 *Ibid* at 266-267.

195 *Ibid* at 266-267.

196 See Moro-Aguilar, *supra* note 181 at 695.

197 In this regard, the Suborbital Working Group has subsequently drafted possible amendments to accommodate for this lighter approach. However, some stakeholders had confirmed their demand for full certification, and in 2014 activities on the subject have been stopped until budget is available. See EASA, *Annex A - EASp Status Report 2014*, [2015] online: <www.easa.europa.eu> [perma.cc/5G4P-ZBAQ].

limit of controlled airspace under the Civil Aviation Act 1990.[198] Therefore, the Act makes a distinction between (i) controlled airspace under the Civil Aviation Act 1990, (ii) high altitude under both the Civil Aviation Act 1990 and the Outer Space Act 2017, and (iii) outer space under the Outer Space Act 2017. However, the law does not clearly define the altitude of the boundary between high altitude and outer space.

Secondly, regarding functional scope, the Act extends its application to the launch of high-altitude vehicles including an aircraft or any other vehicle that travels, or is intended to travel, or is capable of traveling to high altitudes.[199] However, under its regulations, simple radiosonde balloons, balloons for educational purposes, or meteorological balloons that solely measure pressure, temperature, humidity, etc. are not considered as high-altitude vehicles.[200] Moreover, model rockets that are launched by a registered member of the New Zealand Rocketry Association, non-guided rockets that are simply equipped with basic propulsion functions, or rockets that have no payload are also not considered as high-altitude rockets.[201] These limitations of the definition entail that the purpose of the Act is to regulate certain high-altitude activities for the development of the space industry, but not to cover all kinds of activities that fly to high altitudes.[202]

Lastly, the Act requires a license for high-altitude activities, which is separate from a

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[198] See *Outer Space and High-altitude Activities Act 2017* (NZ), 2017/29 at section 4 under 'high altitude' [*New Zealand Outer Space and High-altitude Activities Act*].

[199] *Ibid*.

[200] See *Outer Space and High-altitude Activities (Definition of High-altitude Vehicle) Regulations 2017* (NZ), 2017/251 at regulation 5.

[201] *Ibid* at regulation 6.

[202] See *New Zealand Outer Space and High-altitude Activities Act* at section 3.

space launch license.[203] To be granted a high-altitude launch license, the applicant (i) should be technically capable of conducting a safe launch, (ii) should have taken, and will continue to take, all reasonable steps to manage risks to public safety, and (iii) should act consistently with New Zealand's international obligations.[204] The Act then continues to distinguish the high-altitude launch license for aircraft types: for those aircraft that travel, or are intended to travel, or are capable of traveling to high altitude, there should be an additional confirmation under the Civil Aviation Act 1990 that the aircraft, or where relevant the operator of the aircraft, should have the appropriate permits, certificates or other documents.[205] At this point, it is interesting to note that the definition of aircraft under the Civil Aviation Act 1990 is exactly the same phrase from Annex 7 of the 1944 Chicago Convention, also leaving room for interpretation for aerospace vehicles that utilizes both the aerodynamics and ballistic trajectory at the same time.[206]

This thesis has explored various municipal regulations which imply different State views as to the delimitation issue and the right of passage of aerospace vehicles. While the legislative purpose and policy considerations may vary, it can be well observed that current State policies and regulations are clearly divergent in terms of (i) the definition and scope of aerospace flights

[203] *Ibid* at section 45.

[204] *Ibid* at section 47(1)(a).

[205] *Ibid* at section 47(1)(b).

[206] Under the Civil Aviation Act 1990, aircraft means "any machine that can derive support in the atmosphere from the reactions of the air otherwise than by the reactions of the air against the surface of the earth." Under Annex 7 of the Chicago Convention, aircraft means "any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface." See *Civil Aviation Act 1990* (NZ), 1990/98 at section 2 under 'aircraft'; See also *Annex 7*.

and (ii) the capability of air traffic control over its own national airspace. In any case, such localization of law is widening the political and legal gap in the issue of delimitation and rights of passage, while delimitation and the right of passage dyad are still being dealt with in the working group under UNCOPUOS, not showing a consensus in the form of a resolution or even a declaration.[207]

Nonetheless, as Pelton observes, different vehicles with different velocities in so-called 'near space' is a huge concern, given that there is no one responsible for international traffic control and management of this "Wild West in the skies."[208] Moreover, different traffic management standards would eventually cause regulatory conflict in the safety and navigational systems of international aerospace flights. In such a case, one can imagine frustrating if not devastating scenarios, where frequently scheduled aerospace vehicles could cause surface damage to or collision with conventional aircraft. Meanwhile, there would be no authority to assign blame under the chain of responsibility concerning civil aerospace flights since there would be no proper allocation of risk under the current international legal framework.[209]

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[207] The UNCOPUOS meeting in 2019 has shown some progress in taking into regard practical concerns regarding the management of HAPS. Since they function as aircraft as defined by the Convention on International Civil Aviation but at the same time could deliver the services of space objects, the Acting Chair of the Legal Subcommittee expressed the view that this body could take "a more practical approach, irrespective of theoretical considerations regarding the territorial scope of space law and the delimitation of outer space, although such considerations were certainly important in their own right." UNCOPUOS, *Report of the Acting Chair of the Working Group on the Definition and Delimitation of Outer Space*, UN Doc A/AC.105/C.2/2019/DEF/L.1 (2019).

[208] Pelton argues that there are a wide range of systems to be concerned in this area including frequency allocations, global atmospheric pollution, health standards, and that a classification of various vehicles is needed while national and international entities assist each other in identifying where regulatory oversight, standards or new technology is required or useful. See Joseph N Pelton, "Inclusiveness In the New Space & Protozone Transportation Services" (Presented at the 2015 ICAO-UNOOSA AeroSPACE Symposium on the Access and Equity to Aerospace Transportation at Montreal, Canada, on 19 March 2015) [unpublished]; See also Pelton, "The New Gold Rush", *supra* note 55 at 85.

[209] To date, it has not been decided whether the liability regime for civil aerospace vehicles should be subordinated to the 1929 Warsaw-1999 Montreal Convention system (private international air law regime) or the *1972 Liability Convention* system (for outer space activities). Hence, only under certain conditions the conduct of private actors can be attributed to the State, thereby constituting an act of the State. For instance, according to Articles 5 and 8 of the *Draft Articles of Responsibility of States for Internationally Wrongful Acts*, State responsibility is generally confined to private activities that are substantially on behalf of the State or *de facto*

Therefore, as this thesis reviews in the following and final Chapter, baseline coordination on global navigational systems – such as radio-communication and positioning aids – is needed to ensure the safety of aerospace flights. In terms of navigation and traffic management, such a technical and apolitical approach would alleviate and indeed transcend the legal and political disagreement between States. States, accordingly, would be less reluctant to share their regional information concerning ideas for aerospace navigation systems. In the view of this author, ICAO and ITU would be the appropriate actors to proactively study the viability of standardizing radio communication of aerospace flights and if it were feasible, to gather their over 190 member States to consider applying their existing standards for managing future aerospace flights.

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under the direction and control of the State:

> "Article 5. *Conduct of persons or entities exercising elements of governmental authority*
>
> The conduct of a person or entity which is not an organ of the State under article 4 but which is empowered by the law of that State to exercise elements of the governmental authority shall be considered an act of the State under international law, provided the person or entity is acting in that capacity in the particular instance.
>
> Article 8. *Conduct directed or controlled by a State*
>
> The conduct of a person or group of persons shall be considered an act of a State under international law if the person or group of persons is in fact acting on the instructions of, or under the direction or control of, that State in carrying out the conduct."

ILC, *Draft Articles on Responsibility of States for Internationally Wrongful Acts*, 53 UN GAOR Supp (No. 10) at 43, UN Doc A/56/83 (2001) at Art 5 & 8.

CHAPTER IV. TRANSCENDING THE LEGAL AND POLITICAL DEADLOCK OF THE DELIMITATION ISSUE THROUGH BASELINE COORDINATION OF SAFETY AND TRAFFIC MANAGEMENT

To begin with what is evident under the existing international legal regime, the 1944 Chicago Convention unequivocally proclaims the principle of airspace sovereignty. This has always been the *raison d'etre* of that instrument. Because this reliance on sovereignty began with a military background, it has served as a tool to safeguard national airspace and security. Thus, there is no transfer of national competencies in the economic field to ICAO or any other international organization.[210] According to Mendes de Leon:

> "Because of the need of a unified framework for the **technical side** of air transport operations, national competencies have been transferred to ICAO in the areas of safety, security, immigration, facilitation,… However, contracting States are free to decide whether or not, and, if so, how they implement ICAO standards in their national laws… Moreover, ICAO has no enforcement or sanction mechanism at its disposal… In other words, ICAO has very limited supranational legislative powers."[211]

In this sense, a civil aerospace vehicle cannot fly above a State's territory without any prior permission or consultation, nor can ICAO govern all aerospace vehicles and devise a regulatory regime that overrides national legislative powers.

However, this superiority of national airspace sovereignty does not in any way extend *usque ad coelum*. This is particularly irrefutable since the adoption of the 1967 Outer Space Treaty, the fundamental principle of which is the freedom of exploration and use of outer space. Therefore, it is naive to say that the vertical limit of sovereignty has not been decided – there is exclusive sovereignty over airspace, while no one can claim sovereignty further over outer space.

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[210] See Pablo Mendes de Leon, "The Dynamics of Sovereignty and Jurisdiction in International Aviation Law" in Gerard Kreijen et al, eds, *State, Sovereignty, and International Governance* (Oxford, UK: Oxford University Press, 2002) 483 at 484-485.

[211] *Ibid*.

The issue of delimitation, even though it is a political conundrum, should eventually be resolved in the future for the sake of national security and legal certainty for the actors who wish to traverse both spaces that are regulated under principles that are at odds with each other. Unfortunately, this issue does not seem to be resolved – or resolvable – in the here-and-now. Rather, what one can do in order to solve the potential safety risks of such an uncontrolled fleet would be to transcend the legal and political uncertainty of the delimitation issue through baseline coordination on navigational and safety aspects under ICAO and ITU's existing frameworks.

In terms of safety, ICAO and ITU have been the central players in harmonizing flight communication and traffic management systems to prevent collision and harmful interference between aircraft or between space objects. In this sense, this thesis proposes that a cooperative study between the two bodies in terms of incorporating aerospace flight navigation systems would be necessary to prevent further collision and harmful interference between aircraft, space objects, and future aerospace vehicles. By studying and possibly commencing baseline navigation standards and aids for aerospace flights within their technical competencies, the process itself will transcend the disagreement of States on the delimitation issue and could further direct its member States as to what legal regime could best fit for future safety and liability issues.

Through the rest of the chapter, therefore, this thesis will explore current regulations concerning communication and navigation systems, respectively flowing from the Chicago Convention and the ITU Constitution. Then, it will observe whether ICAO and ITU could take their proactive role in contriving aerospace flight navigation standards within their current technical competences.

A. Extending ICAO's Envelope to Civil Aerospace Flights

It can be stipulated initially that municipal regulations and active measures, such as the creation of 'no-fly' zones in the area of planned space launches and descents, would convince ICAO to not concern itself with aerospace flights and to focus only on the safety of international air transport through measures directed at the primary users of airspace. After all, as Professor Brian F. Havel comments on ICAO's past and present achievements:

> "[ICAO] certainly faces the need to reflect its member States' interests and cannot often push beyond that structural limitation. On the other hand, keeping "equipoise" among [193] member States' interests is a task that would not necessarily be eased by giving ICAO a more aggressive and intrusive legal or political role in international aeropolitical affairs."[212]

Moreover, it is true that most States can oversee the density of the air traffic within their Flight Information Region (FIR) via their air traffic control systems. Also, as this thesis reviews in this Chapter, States implement different navigation rules and procedures in their national airspace. However, the ballistic trajectory of aerospace flights brings those vehicles to an incomparably high speed in terms of entering and exiting national airspace, creating a much shorter time of surveillance and larger zone of risk than those of commercial aircraft.

In this sense, it is important to review the current technicalities of ICAO on safety and air navigation and to observe whether this role can further incorporate standards and aids for aerospace flight navigation. As Dr. Peter van Fenema opines, ICAO is responsible for monitoring any potential uses of airspace that touch upon its global air traffic management mandate.[213]

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[212] Brian F Havel & John Q Mulligan, "International Aviation's Living Constitution: A Commentary on the Chicago Convention's Past, Present, and Future Commentary" (2015) 15 Issues Aviation L & Pol'y 7 at 26.

[213] See Fenema, *supra* note 27 at 402.

ICAO's objectives concerning safety and air navigation are stipulated in Article 44 of the Chicago Convention:

> "[to] *Ensure* the safe and orderly growth of international civil aviation throughout the world;…
> [to] *Meet* the needs of the people of the world for safe, regular, efficient and economical air transport;…
> [to] *Promote* safety of flight in international air navigation;…"[214]

Primarily, ICAO has promulgated the Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM) program to achieve safe and harmonious global air navigation. This program has further been advanced by the proposal of Global Navigation Satellite System (GNSS)-based air navigation, in which the US is already promulgating the Next Generation Air Transport System (NextGen) for the global positioning of civil aircraft. Since this GNSS-based CNS/ATM program is optimized to utilize advanced digital and satellite-based technologies, this thesis will also look into whether aerospace flights could be aided by such a future air navigation system.

1. Review of Annex 10 on Communication, Navigation, Surveillance / Air Traffic Management program (CNS/ATM)

To begin with, Annex 10 of the Chicago Convention deals with the most essential and technical parts of aviation: communications, navigation, and surveillance.[215] Although

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[214] *1944 Chicago Convention* at Art 44

[215] Annex 10 is consisted as below:

- Volume I – Radio Navigation Aids
- Volume II – Communication Procedures including those with Procedures for Air Navigation Services (PANS)
- Volume III – Communication Systems
- Volume IV – Surveillance Radar and Collision Avoidance Systems
- Volume V – Aeronautical Radio Frequency Spectrum Utilization

See Dempsey, "Public International Air Law", *supra* note 52 at 279.

the specifics of the aeronautical telecommunications under the Annex is highly technical and are deployed mainly by technical users (air traffic controllers, air navigation service providers, pilots, etc.), one must note that this system is relatively young since it has only been endorsed as a global program since 1991 (at the 10th Air Navigation Commission[216]). And yet, as we will discuss later, the program is continuously being updated along with the technological advancement of satellite-based navigation aids.

Volume I of Annex 10 mainly deals with standard radio navigation aids.[217] For short routes of areas over land, ground-based Very High Frequency (VHF) would be used within Omni-Directional Radio Range (VOR) for radio communications between the air traffic controller and the aircraft commander.[218] For navigational guidance over the high seas, ground-based navigation systems would not be enough to cover the range for signal transmission.[219] Thus, a piece of totally self-contained equipment, which is called the Inertial Navigation Systems (INS), would be required for additionally sensing aircraft accelerations and conversely transmitting accurate position, navigation data, steering commands and angular pitch, roll, and heading information.[220]

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[216] The 10th Air Navigation Conference took place on September 5, 1991, to mainly review the works of the special group called the Future Air Navigation System Committee (FANS Committee). Based on the work of the FANS Committee, the final report of the Conference included a number of universally agreed recommendations covering the full spectrum of CNS/ATM activities, and the conference took into regard the already use of satellites for navigation and communication on maritime transport, stressing out that satellite-based CNS systems will be the key to worldwide improvements. See Werner Guldimann & Stefan Kaiser, *Future air navigation systems: legal and institutional aspects*, Utrecht studies in air and space law 13 (Dordrecht: M. Nijhoff, 1993) at 78-90; Vincent P Galotti, *The Future Air Navigation System* (New York, US: Routledge, 1997) at 8-9.

[217] See *Annex 10 (Aeronautical Telecommunications) – Volume I: Radio Navigation Aids*, ICAO, International Standards and Recommended Practices, 7th ed (2018).

[218] Galotti, *supra* note 216 at 97.

[219] To be specific, the disadvantage of VOR is that it is subject to the "operational coverage and reception limitations of the selected facilities and any other errors in the system." *Ibid* at 98.

[220] *Ibid* at 99.

However, the overall air navigation over the high seas at the end needs an integral approach, where the equipment operates by automatically determining aircraft position from one or more of a variety of inputs, even including satellite-based measurements.[221] In such a way, an aircraft can conduct its flight along any track without the need to fly directly over ground-based navigation instruments with the limited scope of VOR.

On the other hand, Volume IV of Annex 10 contains standards and guidance materials for surveillance systems provided by aircraft collision avoidance systems and surveillance radars. The surveillance system is crucial for air traffic management, where people or systems on the ground must know the position of aircraft on a continuous basis and be able to estimate their future position. Mainly, the system relies upon radio/data-based radar systems and the Automatic Dependent Surveillance (ADS) system.[222] The ADS system is an integral system of air-ground data links with sufficiently accurate and reliable aircraft navigation systems, which also provides surveillance services in areas that lack these services in the infrastructure.[223]

2. Review of the Global Navigation Satellite Service (GNSS)-based CNS/ATM

Meanwhile, there have been a lot of shortcomings with respect to the traditional

[221] This system is called Area Navigation (RNAV), where ground based long-range navigation systems, self-contained navigation aids, and satellite-based measurements all compute distances along and across track to provide the estimated time to a selected point together with a continuous indication of steering guidance. *Ibid* at 97.

[222] Radar allows the position of an aircraft to be presented on a radar display, where an air traffic controller provides radar control. The system is mainly composed of Primary Surveillance Radar (PSR) that utilizes the traditional echo of the radar, and Secondary Surveillance Radar (SSR) that requires the equipment of a ground interrogator and airborne transponder. While the mostly used type of mode for transmission or interrogation is Mode S radar, the altitude code structure employed in Mode S surveillance replies provides the capability for reporting altitude in 25 ft. increments.

[223] The ADS concept "is based on the use of digital data link communications and encompasses the transfer of the aircraft-derived position information to the controller in near real-time. This is accomplished automatically without the need for direct pilot or controller involvement." Galotti, *supra* note 216 at 149.

CNS/ATM system, especially when one considers it to be applicable to aerospace flights. Firstly, none of the current CNS systems is able to cover up to 70,000 feet altitude on a global basis.[224] The common altimetry is provided by barometric devices with inaccuracies particularly at high altitudes and requiring continuous adjustment due to meteorologically caused pressure changes.[225] Thus, the insufficient accuracy results in a need for "larger vertical separation and less efficient use of airspace at high altitudes."[226]

Secondly, the standard voice communication via Very High Frequency (VHF) and radio navigation systems and all radar stations have an electromagnetic propagation that only allows line of sight contacts, limiting the range of communication to the vicinity of aerodromes.[227] Although mobile high frequency (HF) communication allows "over-the-horizon" contacts, its transmission quality is poor, and the overall communication system lacks air-ground data exchange systems.[228]

Therefore, the short-range limit of the past communication and surveillance system has brought the need for a more systematic and integral approach that would complement air navigation in the high seas and mountainous areas. In this regard, the Global Navigation Satellite System (GNSS) was introduced as a satellite-based system that could be applied to air navigation in terms of determining the position, velocity, and

[224] Guldimann & Kaiser, *supra* note 216 at 152.

[225] *Ibid*.

[226] *Ibid*.

[227] *Ibid* at 151.

[228] *Ibid* at 152.

components of an aircraft in flight.[229] While above 5.486 km a barometric altitude is again computed using a standard atmospheric model, satellite-based stand-alone inertial navigation would meet the oceanic en route requirements and would also provide a solution with the altitude measurement.[230] One must note at this point that the current and future CNS/ATM systems are "highly dependent upon the availability of a sufficient, suitably protected radio spectrum that can support the high integrity and availability requirements associated with aeronautical safety systems."[231]

However, States have the discretionary authority to implement various CNS/ATM systems or the enhanced GNSS-based air navigation system.[232] Furthermore, States apply different standards as to the control of their airspace in terms of the density of their airspace. Therefore, such different implementations of CNS/ATM systems in national airspace would also be the case for future aerospace flights, since States would adopt different air traffic control methods and navigational systems during those flights.

3. Considering the proactive role of ICAO in studying and setting basic navigation standards and aids for aerospace flights

The current problem of regional air traffic control is that States primarily rely on their

[229] See Abeyratne, *supra* note 6 at 43.

[230] Paul D Groves, *Principles of GNSS, inertial, and multisensor integrated navigation systems*, 2nd ed, GNSS technology and application series (Boston: Artech House, 2013) at 731-732.

[231] ICAO, *ICAO Position for the International Telecommunication Union (ITU) World Radiocommunication Conference 2019 (WRC-19)* at para 3.2 [ICAO, "ICAO Position for ITU WRC"].

[232] Through the consensus that has been reached at the CNS/ATM Systems Implementation Conference held in Rio de Janeiro in 1998, the ICAO Assembly passed the Charter on the Rights and Obligations of States Relating to GNSS Services, declaring that "[e]very State and aircraft of all States shall have access, on a non-discriminatory basis under uniform conditions, to the use of GNSS services, including regional augmentation systems for aeronautical use within the area of coverage of such systems." However, the Charter explicitly stated that the implementation and operation of GNSS "shall neither infringe nor impose restrictions upon States' sovereignty, authority or responsibility in the control of air navigation and the promulgation and enforcement of safety regulations." See *Charter on the Rights and Obligations of States Relating to GNSS Services*, ICAO, Assembly Res A32-19, 32nd Sess, A32-19 (1998) at 64-65.

own air traffic procedures and manage their aerodromes under their respective safety and security provisions. While this may not be an issue when it comes to the current air transport system, where States are capable of overseeing the density of the air traffic within their FIR, aerospace flights are swift and their natural ballistic trajectory creates a larger zone of risk than those of commercial aircraft. Therefore, when it comes to aerospace traffic management, an integral system must be put in place in order to oversee the holistic safety of all flights at every altitude. The following section will show some of the suggested forms of integral traffic control systems and will review whether ICAO can and should consider studying and coming up with some basic standards and aids for aerospace flight navigation.

According to the European Air Traffic Impact Analysis Design conducted by the German Aerospace Center (DLR), the hazard areas are assumed to be active during the complete timeframe of the spacecraft flying through European airspace plus an additional 30 minutes of buffer time, meaning a large portion of European airspace will be "affected" for about 60 minutes and the amount of traffic that will be affected would be 350-400 aircraft for the peak hour operations.[233] However, the design had suggested that this prolonged time of flight delays could be reduced depending on the acceptance of different safety risk analysis. For instance, reducing the remaining effects of airspace closures for parts of the space vehicle trajectory within lower altitudes might be possible with more advanced concepts for calculating and handling hazard areas.[234]

[233] See Tanja Luchkova, Sven Kaltenhaeuser & Frank Morlang, "Air Traffic Impact Analysis Design for a Suborbital Point-to-Point Passenger Transport Concept" (Presented at the 3rd Annual Space Traffic Management Conference "Emerging Dynamics", Embry-Riddle, Daytona Beach, 16-18 November 2016) online (pdf): <commons.erau.edu/cgi/viewcontent.cgi?article=1128&context=stm>.

[234] *Ibid*. For such an advanced approach, the agency has also stressed the importance of restructuring the space traffic information data into one single pool, in order to integrate space operations into the Single European Sky.

The US has also reviewed its former regulations and amended them to standardize the safety risk for aircraft and ships during launch and re-entry of a spacecraft. The FAA had proposed to amend 14 CFR § 417.107(b)(3) and (4) to clarify the requirements for hazard areas for ships and aircraft, respectively, by removing references to an ‘‘equivalent level of safety to that provided by [ship or aircraft] hazard areas implemented for launch from a Federal range’’ and replacing them with a specific numeric limit on the probability of impact with debris capable of causing a casualty.[235]

Moreover, the utilization of the GNSS-based traffic navigation system adds to the setting of the cornerstones for future aerospace traffic management. For instance, the Next Generation Air Transportation System (NextGen) spearheaded by the FAA proposes to transform its national airspace from a ground-based navigation system to a satellite-based system. According to Stephen K. Hunter, a satellite-based navigation system does not require the service volume limitation of VORs and “opens up the possibility of redefining the top of Class A airspace (18,000-60,000 ft) and potentially defining the top of the U.S. National Airspace System as, potentially, the Kármán line,” which is often classified as Class E airspace (60,000 ft ~).[236]

See Sven Kaltenhaeuser, Frank Morlang, Jens Hampe & Dirk-Roger Schmitt “Air Traffic Management and Space Transportation: System Wide Information Management and Integration into European Airspace” (Presented at the ICAO-UNOOSA AeroSPACE Symposium, Montreal, Canada, 18-20 March 2015) [unpublished].

[235] Under 14 CFR § 417.107(b)(4), a hazard area for aircraft will satisfy part 417 if the probability of impact with debris capable of causing a casualty on any potential aircraft within that hazard area does not exceed 0.000001 (1×10^{-6}). See US, Department of Transportation, *Changing the Collective Risk Limits for Launches and Reentries and Clarifying the Risk Limit Used To Establish Hazard Areas for Ships and Aircraft* (Washington, D.C.: Office of the Federal Register, 2016), online: US Office of the Federal Register < www.federalregister.gov/documents/2016/07/20/2016-17083/changing-the-collective-risk-limits-for-launches-and-reentries-and-clarifying-the-risk-limit-used-to> at 47021.

[236] See Stephen K Hunter, “Safe Operations Above FL600” (Presented at the 2nd Annual Space Traffic Management Conference "The Evolving Landscape", Embry-Riddle, Daytona Beach, 12 November 2015) online (pdf): <commons.erau.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1065&context=stm> at 13-14.

But then, how does the current technical competency of ICAO fit in the process of considering radiocommunication and navigation means for future aerospace flights? While it is the reality that ICAO cannot touch upon the matter of States' national implementation of air traffic control, it certainly has its responsibility to take into regard all safety and navigational issues that are related to civil aviation. In particular, ICAO has succeeded in shifting States' level of international participation from reactive to proactive measures concerning security and safety,[237] and it is continuing to expand its mandate of performing global risk management on a predictive basis.

A central role has already been devolved to ICAO when an immediate reaction was needed to the tragedy of Malaysia Airlines 370 flight. Michael Lawson, former US Ambassador to the ICAO, stated his observation on ICAO's key technical role regarding the tragedy in the US Congressional Hearings:

> "Weeks after the MH370 disappearance, ICAO convened a special multi-disciplinary meeting to study issues related to global airline flight tracking. The meeting concluded that there was a need to accelerate the existing time table to track aircraft effectively and globally, and that the solution would have to involve more than the introduction of technology. A comprehensive approach that involves the coordination of airline industry practices, air traffic control procedures, search and rescue capabilities, and accident investigation processes would be required…
>
> For the United States, FAA regulations already require some level of centralized tracking, and U.S. airlines have fairly sophisticated operational control centers capable of meeting this challenge. However, other regions of the world may find this standard more challenging. For this reason, ICAO will conduct a normal aircraft

[237] In terms of security, ICAO has already shifted to an 'outcomes-based approach' to achieve a more concrete goal in implementing security measures. The Aviation Security Panel has outlined that this approach allows States to "exercise flexibility and determine for themselves the security measures that are the best possible and practicable to achieve the outcome." In terms of safety, performance-based Global Aviation Safety Plan (GASP) and the Global Air Navigation Plan (GANP) set out a reference to all States to implement safety programs and navigation plans, and at the same time, aiming for a harmonized system in the future. See ICAO, *Working Paper presented by New Zealand and Singapore: AN OUTCOMES-BASED APPROACH TO SUSTAINABLE AVIATION SECURITY MEASURES*, High-Level Conference on Aviation Security (HLCAS), HLCAS-WP/33 (2012) at 3.1; See ICAO, "Safety Management", online: *ICAO – Safety* <www.icao.int/safety/SafetyManagement/Pages/default.aspx>.

> tracking initiative in Asia later this year. The initiative is designed to assist in identifying challenges with technology and procedures, and help the industry gain operational experience…
>
> However, during the recent high-level safety conference, industry and regulators from around the world urged ICAO to draft performance-based standards that would leave the door open to other emerging technologies such as streaming data, which may be easier and possibly quicker to implement."[238]

This proves that no matter how States have developed their own air traffic control procedures, the issue of safety or navigation standards would eventually implicate the key leadership of ICAO in convening States to enhance international standards and to lower the safety risk of civil aviation.

Whether a vehicle is in a higher altitude does not necessarily prevent ICAO from studying the possible means for aerospace navigation and convening the member States to adopt basic navigation standards and procedures when it finds that the matter is seriously risking the safety of civil aviation. In concluding the viability of integrated US space traffic management, Stephen K. Hunter emphasized that:

> "… any attempt to fully address [space traffic management] would need to include, at some later stage of development, at least the [193] member States to the ICAO convention. Just as the 22 Air Route Traffic Control Centers across the U.S help sustain safe air operations above the United States, several regional centers would be needed around the world for any routine point-to-point high-altitude operations as well."[239]

To conclude, this thesis submits that ICAO can and should explore the possible navigation standards and aids for aerospace flights. The general trends are already shifting at the local level toward integrating air and space traffic management. At this pace, the US and the EU

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[238] US, *Preventing Another MH370: Setting International Standards for Airline Flight Tracking: Hearing Before the Subcommittee on Transportation and Public Assets of the Committee on Oversight and Government Reform*, *House of Representatives*, 114th Cong (Washington, DC: United States Government Printing Office, 2015) at 7-8 (Michael A Lawson).

[239] See Hunter, *supra* note 236 at 14.

would most likely be the leading actors. However, without a closely-woven collaboration at the international level via ICAO, those point-to-point aerospace flights cannot be regarded as a safe operation for other subjacent States.

B. Possible Cooperation with ITU Concerning Radio Communications of Aerospace Flights

As a specialized agency of the UN, the ITU is responsible for coordinating the allocation of radio spectrums and orbital slots of satellites. To be specific, the organization i) manages access to the Geostationary Orbit (GSO) and other orbits, ii) allocates radio frequency spectrum to radio services, iii) maintains the registry of radio frequency through its Master International Frequency Register (MIFR), and iv) develops global standards as to the management of radio frequency and orbital slots.[240]

But then, to what extent can ITU cooperate with ICAO in terms of studying and proposing possible standards and aids for the navigation of aerospace flights? As this paper will discuss later, the importance of satellite-based communication on the internet, positioning, and navigation have made ITU interconnect with other organizations in their respective fields of interest to prevent harmful interference with radio frequencies and satellite communication. For instance, in 2012, ICAO and ITU signed a Memorandum of Cooperation (MoC), in order to establish a framework in matters related to harmful interference to GNSS with a potential impact on the safety of international civil aviation.[241]

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[240] Audrey L Allison, *The ITU and Managing Satellite Orbital and Spectrum Resources in the 21st Century*, Springer Briefs in Space Development (Springer International Publishing, 2014) at 9.

[241] ITU, *MEMORANDUM OF COOPERATION between the International Civil Aviation Organization and the International Telecommunication Union for PROVIDING A FRAMEWORK FOR ENHANCED COOPERATION REGARDING THE PROTECTION OF THE GLOBAL NAVIGATION SATELLITE SYSTEM FROM HARMFUL INTERFERENCE WITH A POTENTIAL IMPACT ON AVIATION SAFETY* (entered into force 17 December 2012),

This thesis observes that such a cooperative relationship could also expand – and already has started to expand[242] – to the management of radio communication between air traffic controllers and aerospace vehicles.

1. Review of the extended participation of private actors as 'Sector Members'

One of the unique characteristics of ITU is that private sector companies, with each State government's approval, are encouraged to join as members and to actively participate in the organization's activities as "Sector Members."[243] For instance, Google, Facebook, Airbus, Boeing, SpaceX, and Loon LLC[244] are all involved in the radio communication sector (ITU-R) within the organization, and entitled to participate fully in the activities of the Sector of which they are members subject to relevant provisions of the Constitution and the Convention.[245]

Why would many private actors including commercial satellite operators consider it worthwhile to invest in a membership in a UN body in which they do not even have a vote? Audrey Allison, Boeing's representative to the ITU, observed that private actors have the opportunity to essentially draft the regulations that will be applied to their operations "to allow for the maximum extent of operations in their spectrum while also

online (pdf): ITU <www.itu.int/dms_pub/itu-r/oth/0a/0e/R0A0E0000A40001PDFE.pdf> at para 1.1 [*ICAO-ITU MoC*].

[242] See Chapter IV.B.2, *below*, for details on the studies of aerospace flights by ICAO and ITU.

[243] Sector Members are entitled under the ITU Constitution to take part in the adoption of Questions and Recommendations and in decisions relating to the working methods and procedures of the Sector concerned. See *Constitution and of the International Telecommunication Union*, 22 December 1992, 28 ATS 1994, 24 BTS 1996 (entered into force 1 July 1994) at Art 3.3 [*ITU Constitution*].

[244] See Chapter I.B.1, *above*, for general information on Boeing, SpaceX, and Loon LLC.

[245] *ITU Constitution* at Art 3.3. For the whole list of Sector Members of the ITU, see online: <www.itu.int/online/mm/scripts/gensel11>.

preventing harmful interference from other services."[246] In turn, those international standards that are adopted would be implemented by State authorities and serve as a basis for national licensing, providing private actors with legal predictability and certainty.

An achievement that has already flowed from coordination between the industry and State authorities is the allocation of radio frequencies for High Altitude Platform Stations (HAPS). According to ITU Resolutions that were adopted in 2007, ITU has decided to allow specific radio frequencies which are expected to be required for HAPS operations for both gateway and ubiquitous terminal applications.[247] Concerning HAPS that serves as an International Mobile Telecommunications (IMT) base station, ITU has decided to allow certain radio frequencies and has asked general characteristics such as its identity, administrative authority, and position information to be provided for the station.[248]

2. Cooperation of ICAO and ITU in resolving the issue of 'harmful interference' of GNSS-based navigation system for civil aircraft and future aerospace vehicles

On the other hand, ITU has been always alert and assertive in preventing any harmful interference with radio communication or radio navigation services. According to Article 45 of the ITU Constitution, "[a]ll stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States or of recognized operating

[246] Allison, *supra* note 240 at 13.

[247] See *Radio Regulations of the International Telecommunication*, International Telecommunications Union (ITU, 2016) at Resolution 122 (Rev.WRC-07), Resolution 145 (Rev.WRC-12), Resolution 221 (Rev.WRC-07) [*ITU Radio Regulations*].

[248] See *ITU Radio Regulations* at Resolution 122 (Rev.WRC-07), Resolution 145 (Rev.WRC-12), Resolution 221 (Rev.WRC-07).

agencies…"[249] In order to prevent such harmful interference, the Constitution further states "the necessity of taking all practicable steps to prevent the operation of electrical apparatus and installations of all kinds from causing harmful interference to the radio services or communications…"[250]

However, the ITU has only been capable of managing State and industry coordination for preventing harmful interference of radio services or communications between radio stations. It has not been able to manage all subsidiary effects derived from the interference, such as the positioning problem of aircraft derived from the jamming of the GNSS system.

For example, four rounds of radio jamming by North Korea from 2010-2012 caused failure to the GPS systems affecting over 1,000 airplanes and ships near Incheon airport and in several other regions.[251] While ICAO had reacted to such an occurrence risking the safety of civil aviation,[252] ITU, on the other hand, was limited to stating 'harmful interference' caused to the radio communication system between satellites and the ground stations.[253]

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[249] *ITU Constitution* at Art 45.1.

[250] *ITU Constitution* at Art 45.3.

[251] See Kyle Mizokami, "North Korea Is Jamming GPS Signals", *Popular Mechanics* (5 April 2016), online: <www.popularmechanics.com> [perma.cc/B68P-GESE].

[252] Concerning North Korea's GPS jamming, the ICAO Council decided under the full support of all Council members to take the following measures: "expressing deep concern over the possible recurrence of North Korea's GPS jamming; urging North Korea to prevent the recurrence of similar incidents; conducting a joint research by the ICAO Secretariat and ITU on the effect of GPS jamming on international civil aviation…" Republic of Korea Ministry of Foreign Affairs (MOFA), Press Release, "International Civil Aviation Organization (ICAO) Responds Actively to North Korea's GPS Jamming" (6 July 2012), online: Ministry of Foreign Affairs Press Releases <www.mofa.go.kr/eng/brd/m_5676/view.do?seq=311296&srchFr=&srchTo=&srchWord=&srchTp=&multi_itm_seq=0&itm_seq_1=0&itm_seq_2=0&company_cd=&company_nm=>.

[253] Another speculation to ITU's inactiveness to harmful interference issues would be that the Union, as it has been focusing on coordination of pure telecommunication issues, has been relatively reluctant to delve into intentional interference issues. As James Savage wrote, "[w]here telecommunications are involved the issue enters

Therefore, such a need for an interconnected solution for the GNSS vulnerability and the collateral safety problem led to a joint study group between ITU and ICAO. In 2012, ICAO and ITU signed a Memorandum of Cooperation (MoC), in order to establish a framework in matters related to harmful interference to GNSS with a potential impact on international civil aviation safety.[254] Moreover, the MoC aims to prevent the duplication of efforts and to benefit from potential synergies between the parties acting in their respective fields of responsibility.[255]

While this memorandum does not directly bind those two parties in terms of modifying or expanding their responsibility, it would be the key to any future cooperation in any other field where the two organizations would have to be involved in terms of radio communication. One could even envisage from the above that within the umbrella of those two bodies, managing aerospace flights could also be one of those fields of cooperation.

This thesis concludes, therefore, with the proposition that the current cooperative status between those two bodies implies hope for resolving any future obstacles to satellite-based positioning of aerospace vehicles and extended radio communication with air traffic controllers. Below is the position of ICAO before the World Radio Communication Conference in 2019 on

ITU jurisdiction. It will be seen that the ITU has nonetheless been loath to actively involve itself in the resolution of the jamming of broadcasts, the specter of deliberate interference against satellite television, or restrictions against the free flow of news and information. The issue is seen as purely political and thus beyond ITU competence." James G Savage, *The Politics Of International Telecommunications Regulation* (Westview Press: San Francisco, 2019) at 23-24.

[254] *ICAO-ITU MoC* at para 1.1.

[255] *Ibid*.

the matter of additional radio spectral capacity for aerospace flights:

> "Studies have shown that in principle from a technical perspective, current ICAO systems should have the capability to provide radio links for suborbital vehicles to operate safely… However, from a terrestrial frequency planning perspective, the additional height and velocity of sub-orbital vehicles would require current planning criteria to be amended with an associated adverse impact on system capacity which is unlikely to be acceptable and hence additional spectral capacity is likely to be required."[256]

ICAO evidently supported any proposals for resolving the technical and legal questions, including as necessary "any new allocations" of the radio frequency.[257]

The following Provisional Final Acts of 2019 World Radiocommunication Conference, unfortunately, did not come to an instant conclusion in terms of allocating specific radio frequencies to those new flights. Nonetheless, ITU has recognized that the requirements for communication, navigation, and surveillance of aerospace vehicles are different from those of conventional spacecraft and those of civil aircraft.[258] In this sense, the resolution has stated the invitation of ITU Radiocommunication Sector (ITU-R) to study the possibility of accommodating 'stations on board sub-orbital vehicles', with the following objectives:

> "*to* determine the status of stations on sub-orbital vehicles, and study corresponding regulatory provisions to determine which existing radiocommunication services can be used by stations on sub-orbital vehicles, if necessary;
>
> *to* determine the technical and regulatory conditions to allow some stations on board sub-

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[256] ICAO, "ICAO Position for ITU WRC", *supra* note 231 at A-28.

[257] *Ibid* at A-28.

[258] "*recognizing*,…

> *d*) that the current regulatory provisions and procedures for terrestrial and space services may not be adequate for international use of relevant frequency assignments by stations on board sub-orbital vehicles;
> *e*) that Annex 10 to the Convention on International Civil Aviation contains Standards and Recommended Practices for aeronautical radionavigation and radiocommunication systems used by international civil aviation;…
> *h*) that conventional space launcher systems currently have a radiocommunication regulatory framework that may differ from the future radiocommunication framework of sub-orbital vehicles,"

ITU, *Consideration of regulatory provisions to facilitate the introduction of sub-orbital vehicles* (2019) RESOLUTION COM6/5 (WRC-19).

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;

to facilitate radiocommunications that support aviation to safely integrate sub-orbital vehicles into the airspace and be interoperable with international civil aviation;…"[259]

These objectives, as this thesis submits, will be the cornerstone to facilitate cooperation between ICAO and ITU on future navigation for aerospace flights. Furthermore, focusing on the matter of navigation and safety will avert the disagreement of States on the delimitation issue and help conceive different technical phases of those vehicles when traversing airspace. In turn, the process itself of studying and commencing baseline navigation standards of aerospace flights could also provide some clues as to what legal regime could conclusively be applied best for the safety and liability issues.

[259] *Ibid*.

CONCLUSION

It is evident that commercial aerospace flights are on the verge of marketisation. While an initially high ticket price would be expected especially in the case of Virgin Galactic and its SpaceShipTwoflight, the rival case of Space X clearly proves that further technological enhancement and the overall increase of supply will eventually lower the cost.[260]

However, the imminent problem of commercial aerospace flights focuses on the safety issue: not only is there an inherent risk posed to the subjacent people and infrastructure when those vehicles traverse airspace and outer space, the increasing number of flights will also threaten the safety of civil aircraft that generally fly at an altitude of 20-30 km.[261] Moreover, passengers who are on board aerospace flights will experience white-knuckle rides with enormous speed, G-force, and zero gravity.[262] This will, on the one hand, necessitate complicated medical certificates and safety protocols to successfully operate scheduled flights.

On the other hand, the development of aerospace technologies has diversified the designs and functions of civil aerospace vehicles, whose flights have complicated the matter of which law should apply. Unfortunately, the delimitation issue has also not yet reached a consensus due to the political and legal dynamics that have begun in the early space age. Moreover, States

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[260] See Derek Webber, "Point-to-point people with purpose—Exploring the possibility of a commercial traveler market for point-to-point suborbital space transportation" (2013) 92:2 Acta Astronautica 193. However, Christensen, the founder and chief executive officer of the consulting firm Bryce Space and Technology, stated that the company "has dropped launch prices by something around 25 percent," saving customers as much as $10 million to $20 million and putting pressure on rivals. See Andre Tartar & Yue Qiu, "The New Rockets Racing to Make Space Affordable", *Bloomberg Businessweek* (26 July 2018), online: <www.bloomberg.com> [perma.cc/JZU3-MK3K].

[261] "Richard Branson's Virgin Galactic space flights criticized as 'dangerous, dead-end tech'", *The Guardian* (17 December 2018), online: <www.theguardian.com> [perma.cc/6NTJ-HE3B].

[262] Andrew J Hawkins, "Elon Musk's idea for commercial rocket travel on Earth would be a logistical nightmare", *The Verge* (29 September 2017), online: <www.theverge.com> [https://perma.cc/6UFD-BLZK]. See Chapter III.E.1, *above*, for more on this topic.

have started to enact government policies or even legislation from the perspective of their own national views on aerospace flights, and such diversified regulation would degrade the very essence of what characterizes aerospace flights, namely, interconnectivity and globalization.

Whichever cause one might point out in this endless loop without a breakthrough, this thesis submits that the technological and legal complexity of aerospace flights has already widened the legal and political gap, where one cannot immediately resolve the issue of delimitation. Rather, to ensure the safety of aerospace flights, it would be necessary to consider baseline coordination on safety and navigation matters, by way of examining local regulations on aerospace flights and studying the standardization of navigation and radio communication systems. While technical considerations cannot unravel the legal and political issues that are intrinsically tied to national sovereignty, global technical standards regarding aerospace flights will function as a pivotal regulatory effect for the sake of safety and security to subjacent States and would transcend the legal and political deadlock of the delimitation issue.

The key roles of ICAO and ITU are essential in the discussion of aerospace flight navigation. ICAO is responsible for contriving air navigation guidelines since its core mandate is to consider matters that are related to the safety of civil aviation. ITU, on the other hand, is an interconnected body with ICAO when it comes to satellite-based communication of flights and is responsible for managing the allocation of radio frequencies and preventing any harmful interference with radio connection. Therefore, this thesis concludes that ICAO and ITU are the appropriate actors to study the viability of navigational aids and standards for aerospace flights, and if feasible, to consult among their over 190 member States to consider standardizing navigational rules for future aerospace traffic management.

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