International Air and Space Law boundaries: A new frontier

by

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Abstract

On the 22nd of October 2021, a revolutionary new device called a Sub-orbital Accelerator was powered up for its first test launch in the desserts of New Mexico in the United States. The kinetic Sub-orbital launching system launches a rocket object into the atmosphere where rocket boosters ignite to propel the rocket object to reach lower Earth Orbit to deliver payloads such as satellites.

The rocket object launched from the system travels through airspace to reach lower earth orbit and beyond. The rocket object travels through airspace and into outer space. Airspace and outer space are governed by fundamentally different legal regimes. Under Air Law States have exclusive territorial jurisdiction over their airspace, whereas in Space Law which governs outer space - State sovereignty is prohibited, as outer space is subject to non-appropriation.

The differences between the legal regimes begs the question where delimitation may be found between airspace and outer space. The predominate theories regarding delimitation are the Spatialist and Functionalist approaches. Proponents of the Spatialist approach suggest various lines or boundaries based on different applicable standards. The Functionalist approach in the alternative places focus on the type of object in order to determine whether or not it operates in airspace or outer space.

Under the Functionalist approach, should the rocket object launched from the Sub-orbital Accelerator be made for atmospheric flight it would function within airspace and in the alternative should the rocket object be made for beyond atmospheric flight it could be considered a space object. Upon re-entry the rocket object remains classified as a space object.

Both the Functionalist and Spatialist approaches escape the general acceptance of States- although both theories are still primarily the sources that dominate the thinking of States and bodies such as the United Nations.

Contents

1. Introduction

i. Proposed title

International Air and Space Law boundaries: A new frontier.

ii. Introduction to concepts

This mini-dissertation concerns the delimitation of airspace and outer space. It seeks to investigate where a legal boundary may be found. This mini-dissertation will discuss and describe delimitation under the Spatialist approach and the Functionalist approach.[1] The research will further provide a brief discussion on the revolutionary SpinLaunch suborbital launching system in finding whether the system operates within airspace or outer space under the Spatialist and Functionalist approaches.[2]

On the 22nd of October 2021, a revolutionary new device called a Sub-orbital Accelerator manufactured by a commercial space company SpinLaunch was powered up for its first test launch in the desserts of New Mexico in the United States.[3] The Suborbital SpinLaunch system uses a vacuum-sealed centrifuge to spin a rocket object on a rotating arm which catapults it up to orbit at around 8000 kilometres per hour.[4] When the rocket object reaches an altitude of around 61 000 meters or 200 000 feet the rocket ignites its engines to reach lower Earth Orbit where it could deliver payloads such as satellites.[5] For its first test flight the Suborbital SpinLaunch system was powered up to 20 percent of its total capacity and launched a 3-meter projectile that reached a test altitude of tens of thousands of feet according to SpinLaunch's Chief Executive Officer Jonathan Yaney.[6]

The SpinLaunch company further plans to launch and recover in partnership with the National Aeronautics and Space Administration (NASA) its first NASA payload later

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1 Stephan Hobe, Geradine Meishan Goh & Julia Neumann, 'Space Tourism Activities - Emerging Challenges to Air and Space Law' (2007) 33 J Space L 359.

2 'Suborbital Accelerator' (SpinLaunch) https://www.spinlaunch.com/suborbital accessed 12 April 2022.

3 Matt Williams 'SpinLaunch Hurls a Test Vehicle Kilometres Into the air. Eventually, it'll Throw Them Almost all the way to Orbit' (Universe Today 18 November2021) https://www.universetoday.com/153342/spinlaunch-hurls-a-test-vehicle-kilometers-into-the-air eventually-itll-throw-them-almost-all-the-way-to-orbit/ accessed 14 April 2022.

4 Williams (n 3).

5 Ibid.

6 Ibid.

this year (2022).[7] The development of this new technology begs the question- where and when does the object launched by the Sub-orbital SpinLaunch system travel through airspace and/or outer space? Where an engineer or physicist might provide a theoretical or practical solution to this question- the answer remains unclear in the legal sense. As Freeland puts it, 'from a strictly legal perspective, there is as yet no clear definition of outer space – in other words it is unclear where (and how) airspace ends and outer space begins'.[8] The lack of a clear definition of where outer space begins and airspace ends forms the basis of this research. The delimitation of outer space and airspace is important as the legal regimes governing these areas have different core principles.

In Air Law which governs airspace, States have exclusive territorial jurisdiction over their airspace, whereas in Space Law which governs outer space, State sovereignty is prohibited, as outer space is subject to non-appropriation.[9] Under Air Law, liability for damages caused is imposed on the various Airline operators, whereas under Space Law liability is imposed upon States.[10] Furthermore, jurisdiction under Space Law is extended on the basis of registration.[11]

In light of the differences between Air Law and Space Law, potential hybrid systems such as the Sub-orbital SpinLaunch system may travel at various altitudes and across various distances – what regime of law is thus then applicable and where? Creating delimitation of airspace and outer space based on altitude for example in response to a hybrid vehicle is a task that leaves much to question and various grey areas. A view by a large number of States is that outer space is extended out from a theoretical line at an altitude of 100 kilometres – this line is known as the von Kármán line.[12] This approach introduces a Spatialist approach (one of many) to determine where outer space begins and thus where might Air Law and Space Law be applicable. Under the Spatialist approaches in finding where outer space begins, the central question is

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7 Liam Tung 'NASA will test this 'SpinLaunch' system that hurls satellites into space' (ZDNet 12 April 2022) https://www.zdnet.com/article/nasa-will-test-this-spinlaunch-system-that-hurls-satellites-into-space/ accessed 14 April 2022.

8 Steven Freeland, 'Up, up and. Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space' (2005) 6 Chi J Int'l L 6.

9 Hobe, Goh, Neumann (n 1) 361.

10 Ibid 361.

11 Ibid 361.

12 Hobe, Goh, Neumann (n 1) 363.

where the craft or object is positioned and operates.[13] Therefore, the Spatialist approaches aim to create specific delimitation between outer space and airspace such as the von Kármán line.[14]This mini-dissertation will discuss the Spatialist approaches.

In the alternative, the Functionalist approach places focus on the type of object itself in order to determine whether or not it operates in airspace or outer space.[15] The central question according to the functionalist approach is what is the objects' purpose and destination? If the object in question is characterised as an aircraft it will thus function in airspace and in the alternative for a space object it would function in outer space. This mini-dissertation will discuss the Functionalist approaches.

The ultimate aim of this mini-dissertation concerns the delimitation of airspace and outer space. It seeks to investigate where the boundary may be currently found between airspace and outer space. This requires a discussion of delimitation under the Spatialist approaches and the Functionalist approach.[16]

iii. The need for delimitation of airspace and outer space in the legal sense

Before attempting to analyse the concepts relating to the delimitation of airspace and outer space, it must be determined in greater detail why delimitation is of particular importance for the application of International Law. The legal regimes of Air Law and Space Law are inherently different and far removed from each other in the application of their legal principles.[17] Air Law embodies the notion of State sovereignty and is made up of established Customary International Law, numerous treaties and domestic legislation.[18] Space law on the other hand forms a basis on *res communis* or for the common benefit for humankind where outer space is subject to non-appropriation.[19] This basis of conflict is apparent and can be analysed in article 1 of the Chicago Convention [20] that forms part of Air Law and article II of the Outer Space Treaty[21] which forms part of Space Law.

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13 Dempsey PS and Manoli M, 'Suborbital Flights and the Delimitation of Airspace Vis-à-Vis Outer Space: Functionalism, Spatialism and State Sovereignty' (2017) 42 Annals of Air and Space Law 20.

14 Ibid.

15 Dempsey, Manoli (n 13) 11.

16 Hobe, Goh, Neumann (n 1) 359.

17 Hobe 361

18 Ibid.

19 Ibid.

20 Convention on International Civil Aviation (adopted 7 December 1944, entered into force 5 March 1947) 15 UNTS 295 (Chicago Convention) art 1.

21 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space

article 1 of the Chicago Convention states:

> The contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory.[22]

article II of the Outer Space Treaty states:

> Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.[23]

As both sources of Air Law and Space Law above form part of treaty law, the general interpretation method of treaties found in articles 31 and 32 of the Vienna Convention on the Law of Treaties (VCLT) may be employed as starting basis for the interpretation.[24] Article 31(1) of the VCLT establishes the general rule of interpretation in treaty law and determines that the ordinary meaning of specific words must be determined- article 31(1) states, 'A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose'.[25] The general rule of treaty interpretation contained in article 31(1) is based on a textual approach where the text under interpretation is presumed to be the authentic expression of the intentions of the parties.[26]

As per article 31 (1) of the VCLT the ordinary meaning of the words of Article 1 of the Chicago Convention are as follows – the definition of contracting is 'to make a legal agreement'.[27] The definition of State(s) is 'a country or its government'.[28] The definition of recognize is 'to accept that something is legal, true, or important:'.[29] The definition

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Including the Moon and Other Celestial Bodies (adopted 27 January 1967, entered into force 10 October 1967) 610 UNTS 205 (Outer Space Treaty) art II.

22 Chicago Convention (n 21) art 1.

23 Outer Space Treaty (n 21) art II.

24 Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 January 1980) 1155 UNTS 331

25 VCLT (n 24) art 31.

26 O. Dörr and K. Schmalenbach, in O. Dörr and K. Schmalenbach (eds) *Vienna Convention on the Law of Treaties* (Springer-Verlag 2018) 579-80.

27 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/contracting accessed 7 September 2022.

28 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/state?q=States accessed 7 September 2022.

29 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/recognize accessed 7 September 2022.

of every is 'used when referring to all the members of a group of three or more considered separately'.[30] The definition of complete is 'very great or to the largest degree possible'.[31]The definition of exclusive is 'limited to only one person, group of people, or organization'.[32]The definition of sovereignty is ' the power of a country to control its own government'.[33]The definition of airspace is 'the air or sky above a country that is considered to belong to that country'.[34]The definition of territory is 'an area of land, sea, or space, especially when it belongs to or is connected with a particular country, person, or animal'.[35]

Based on the ordinary meaning of the words of article 1 of the Chicago Convention the meaning can be deduced as a legal obligation created amongst States to accept the power and control of a particular country or government of the air or sky above the land or sea that belongs to that particular country or government. In furtherance of Interpretation, article 32 of the VCLT permits recourse to a supplementary means of interpretation which includes the preparatory works of a treaty and the circumstances of its conclusion - article 32 of the VCLT states:

> Recourse may be had to supplementary means of interpretation, including the preparatory work of the treaty and the circumstances of its conclusion, in order to confirm the meaning resulting from the application of article 31[36]

The sovereignty of airspace as adopted in article 1 of the Chicago Convention as a rule of international law extends as far back as the times of the Roman Empire where the *Corpus Juris Civilis* created by Emperor Justinian dealt with the removal of projections in airspace over places of burial.[37] This developed into the maxim of *Cujus est solum, ejus est usque ad coelom* which was entrenched as a right under ancient

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30 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/every accessed 7 September 2022.

31 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/complete accessed 7 September 2022.

32 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/exclusive accessed 7 September 2022.

33 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/sovereignty accessed 7 September 2022.

34 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/airspace accessed 7 September 2022.

35 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/territory accessed 8 September 2022.

36 VCLT (n 24) art 32.

37 Abeyratne R, 'Article 1 Sovereignty', *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 15.

Roman law.[38] This maxim confers that the right of land ownership brings with it the right of ownership of airspace above the land.[39] The rule was later adapted to mean that no nation acquired any domain in what was known as navigable airspace until such domain was needed to protect its territory.[40]

Prior to the Chicago Convention, the Convention Relating to the Regulation of Aerial Navigation signed at Paris in 1919 (Paris Convention) under article 1 included the right to State sovereignty of airspace in the western law and stated the following:

> The High Contracting Parties recognise that every Power has complete and exclusive sovereignty over the airspace above its territory [41]

The wording is very similar to the current wording of article 1 of the Chicago Convention which provides for the continuity of the International rule. The inclusion of the International rule of sovereignty over airspace in air law entrenched the International rule - commencing with inclusion in the prior 1919 Paris Convention to the inclusion of the current article 1 of the Chicago Convention.[42]The current implementation of article 1 of the Chicago Convention reinforces the notion of sovereignty and emphasises the International law rule from its formation in the time of the Roman Empire to in the current implementation.

As per article 31 (1) of the VCLT the ordinary meaning of the words of article II of the Outer Space Treaty are as follows - the definition of outer space is 'the universe beyond the earth's atmosphere'.[43] The definition of the moon is 'the object, similar to a planet, that moves through the sky, circling the earth once every 28 days, and which can often be seen clearly at night when it shines with the light coming from the sun'.[44]The definition of celestial is 'of or from the sky or outside this world'.[45]The definition of national is 'relating to or typical of a whole country and its people, rather

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38 Abeyratne (n 37) 15.
39 Ibid.
40 Abeyratne (n 37) 16.
41 Convention Relating to the Regulation of Aerial Navigation signed at Paris, 13 October 1919(super-seded by the 1944 Chicago Convention) art 1.
42 Abeyratne (n 36) 15.
43 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/outer-space accessed 8 September 2022.
44 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/moon accessed 8 September 2022.
45 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/celestial accessed 8 September 2022.

than to part of that country or to other countries'.[46] The definition of appropriation is 'the act of taking something for your own use, usually without permission'.[47] The definition of claim is 'to say that something is true or is a fact, although you cannot prove it and other people might not believe it'.[48] The definition of sovereignty is 'the power of a country to control its own government'.[49] The definition of use is 'to take advantage of a person or situation; to exploit'.[50] The definition of occupation is 'a situation in which an army or group of people moves into and takes control of a place'.[51] The definition of other is 'used at the end of a list to show that there are more things, without being exact about what they are'.[52] The definition of means is 'a method or way of doing something'.[53]

Based on the ordinary meaning of the words of Article II of the Outer Space Treaty the meaning can be deduced as the universe beyond the earth's atmosphere including the moon and bodies outside this world may not be taken for own use by a whole country or group of people, may not be subject to the power of a country or its control or government, may not be exploited, may not be the basis of a situation in which an army or group of people moves into and takes control, in addition to any other similar situations not being permitted.

Article 32 of the VCLT permits recourse to a supplementary means of Interpretation which includes the preparatory works of a treaty and the circumstances of its conclusion.[54] The Outer Space Treaty is the key stone source of Space Law.[55] The

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46 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/national accessed 8 September 2022.

47 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/appropriation accessed 8 September 2022.

48 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/claim accessed 8 September 2022.

49 Cambridge Dictionary (n 32).

50 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/use accessed 8 September 2022.

51 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/occupation accessed 8 September 2022.

52 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/other accessed 8 September 2022.

53 Cambridge Dictionary https://dictionary.cambridge.org/dictionary/english/means accessed 8 September 2022.

54 VCLT (n 24) art 32.

55 Brandon C. Gruner, 'A New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for the Colonization of Outer Space in the Twenty-First Century' (2004) 35 Seton Hall L Rev 2

non- appropriation concept flows from the idea that space is *res communis*.[56] Roman law developed that property being *res communis* meant that the property was not subject to dominion and control and therefore not legally property - an example being air.[57]

In the negotiation phase of the Outer Space Treaty both developed States and non-developed States agreed on the implementation of article II which embodies the concept of *res communis* and the non-appropriation of space.[58] The leading developed space nations at the time being the United States and the Soviet Union backed the notion of *res communis* on the basis that each of these two powers were engaged in a space race to the moon and wanted to prevent each other from gaining sovereignty over the moon on the basis of being the first nation to reach it and becoming the leading power in space by extensive property rights.[59] The inclusion of the notion *res communis* in the Outer Space Treaty which is the corner stone of Space Law indicates the ongoing application of the non-appropriation of Space.[60]

The interpretation of both article 1 of the Chicago Convention and article II of the Outer Space Treaty has brought forth the conflicting notions of the regulatory frameworks of airspace and outer space. The interpretation of these two treaty provisions rendered no clear insight on where these regulatory frameworks apply or end – only that the principle of arial sovereignty is applicable to a nations airspace and that outer space is subject to non-appropriation. The point at which sovereign airspace yields to the *res communis* of outer space is elusive.[61]

The Permanent Court of International Justice, when requested for a definition of "airspace" in the 1933 *Eastern Greenland's Case* was of the view that the natural meaning of the term was lay in the geographical meaning.[62] The most practical assumption according to Abeyratne is that the meaning of airspace can be found in the geographical sense.[63] This prescribes a possible spatialist solution but no answer

56 Gruner (n 54) 323.
57 Ibid.
58 Ibid.
59 Gruner (n 54) 324.
60 Ibid.
61 Vernon Nase, 'Delimitation and the Suborbital Passenger: Time to End Prevarication' (2012) 77 J Air L & Com 752.
62 *Legal Status of Eastern Greenland* (Denmark v Norway) PCIJ Series A/B, No. 53, at pp. 53
63 Abeyratne (n 36) 33.

is rendered to the delimitation issue. Where does outer space begin? This mini-dissertation will discuss the spatialist and functionalist approaches to a possible solution. Where no clarity is gained on this matter a possible grey area may arise in the application of Space Law and Air Law especially as noted above where an object may be subject to the principles of exclusive aerial sovereignty or non-appropriation.

iv. Research questions

3,1) What are the Spatialist approaches to the delimitation of airspace and outer space?

3,2) What is the Functionalist approach to the delimitation of airspace and outer space?

3,3) How and where does the Suborbital SpinLaunch system operate in terms of the Spatialist and Functionalist approaches?

v. Methodology

This research is desk and library based. The research will rely on a number of Textbooks, Journals, Academic articles and Internet sources. The field of International Air Law is well developed and five multilateral treaties govern the rights and duties of Space activities.[64] Despite this, it remains unclear where airspace ends and outer space begins. Therefore, although treaty law is referred to and interpreted in writing, the main source of International Law would be derived from scholarly writing as the debate remains theoretical and is not yet dealt with under treaty law.

vi. Delineations

The Spatialist approaches are noted to have a wide range of proposals based on numerous criteria. This research will only focus on the following theories: Demarcation based on the Division of Atmosphere into Layers, Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities (von Kármán line), and Demarcation according to the lowest altitude of an Orbiting Satellite.[65]

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64 Dempsey, Manoli (n 13) 4.

65 Marietta Benkö, Engelbert Plescher *Space Law – reconsidering the definition/delimitation question and the passage of spacecraft through foreign airspace* (Eleven International Publishing 2013) 31.

vii. Chapter outline

Chapter 1 of the mini-dissertation will introduce the topic of discussion.

Chapter 2 of the mini-dissertation will discuss what the Spatialist approach to the delimitation of airspace and outer space - with specific sub-headings: 'Demarcation based on the Division of Atmosphere into Layers', 'Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities (von Kármán line)', and 'Demarcation according to the lowest altitude of an Orbiting Satellite'.

Chapter 3 of the mini-dissertation will discuss what the Functionalist approach to the delimitation of airspace and outer space – with specific preliminary sub -headings; 'Definition of an aircraft', Definition of the space object', and 'Definition of a hybrid system'.

Chapter 4 of the mini-dissertation will discuss how the Spatialist and Functionalist approaches are applicable to the Suborbital SpinLaunch system.

Chapter 5 will conclude with an overview of the findings of Chapters 2 to 4.

2. The Spatialist approach

viii. Chapter Introduction

This chapter will discuss the Spatialist approach to the delimitation of airspace and outer space. According to the Spatialist approach the central question is where the craft or object is positioned or operates- the approach seeks to establish a lower boundary where outer space begins and airspace ends.[66] Proponents of the Spatialist approach suggest various lines or boundaries based on different applicable standards.[67]

The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) have identified several criteria to a possible Spatialist solution.[68] UNCOPUOS identified at least eight possible theories to a possible Spatialist solution. This mini-dissertation will only look at three of the identified theories namely: 'Demarcation based on the Division of Atmosphere into Layers', 'Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities (von Kármán line)', and 'Demarcation according to the lowest altitude of an Orbiting Satellite.[69]

Although the theories were identified in a paper dating back to 1977- the issue of the delimitation of airspace and outer space remains on the agenda of the UNCOPUOS Legal subcommittee in 2022 where the applicability of a possible Spatialist solution such as the application of the so called von Kármán line identified by the committee in 1977 was still discussed by the subcommittee.[70] Furthermore, the view was expressed by UNCOPUOS that the topic of the delimitation of airspace and outer space should remain under permanent discussion in the committee.[71] The discussion of the topic of delimitation in 2022 renders the argument that the theories identified in 1977 may very

66 Benkö, Plescher (n 65) 31.
67 Jinyuan Su, 'The Delineation Between Airspace and Outer Space and the Emergence of Aerospace Objects' (2013) 78 J Air L & Com 363.
68 The Question of the Definition and/or the Delimitation of Outer Space, Addendum (1977) UN Doc A/AC./C.217/Add.1
69 UNCOPUOS 1977 (68) pg. 2.
70 Report of the Legal Subcommittee on its sixty-first session, held in Vienna from 28 March to 8 April 2022 (2022) UN Doc A/AC.105/1260, at para 59.
71 UNCOPUOS 2022 (n 70) para 77.

well still be applicable in finding a possible solution to a topic that remains under permanent discussion in the committee.

ix. Demarcation based on the Division of Atmosphere into Layers

This approach applied in the 1977 UNCOPUOS paper is formulated on the premise that the Atmosphere is divided by the scientific community into a number of different layers.[72] The paper makes reference to the following atmospheric layers being the: troposphere, stratosphere, mesosphere and the ionosphere.[73] The scientific differences of each of these layers thus has the potential to form the basis of a Spatialist boundary on the basis of the different characteristics.[74]

Troposphere

According to the American Meteorological Society the troposphere is the layer of the Earth's atmosphere closest to the surface of the Earth where most weather formations occur- extending out from the surface of the Earth for about 10 to 20 km of the Earth's atmosphere.[75] The troposphere is characterized with temperature decreases with subsequent height increases.[76] At the top of the troposphere is a natural boundary known as the tropopause that acts as barrier and traps moisture associated with weather systems – this boundary varies with changes in latitude and\or seasonal changes.[77] The troposphere is the atmospheric layer where most conventional commercial and private aviation occurs.[78]

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72 UNCOPUOS 1977 (68) para 48.
73 Ibid.
74 Ibid.
75 American Meteorological Society, 'Definition of troposphere (*Glossary of Meteorology*, 2022) https://glossary.ametsoc.org/wiki/Troposphere accessed 29 April 2023.
76 American Meteorological Society (n 75).
77 Theory (FAA Federal Aviation Administration, ' Pilots Handbook of Aeronautical Knowledge- Chapter 12 -3 – Weather theory (*FAA,* 2016). https://www.faa.gov/sites/faa.gov/files/regulations_policies/handbooks_manuals/aviation/phak/14_phak_ch12.pdf
78 Benkö, Plescher (n 65) 68.

Stratosphere

Following the troposphere the next layer of the atmosphere is called the stratosphere. The stratosphere extends at altitudes of around 10 to 17 km to the base of the mesosphere in an area known as the stratopause at an altitude of roughly 50 km.[79] The stratosphere is characterized by increasing temperatures with increasing altitudes due to heating of ozone by ultraviolet radiation.[80] Only advanced aircraft and weather balloons operate within the stratosphere.[81]

Mesosphere

The mesosphere extends from stratopause at an altitude of about 50 km to the mesopause at 85 to 95 km.[82]The mesosphere is characterized by decreasing temperatures with increasing altitudes as the absorption of solar ultraviolet radiation by ozone is reduced.[83] The mesosphere is too high for balloon operations and too low for satellites to orbit.[84]

Ionosphere

The ionosphere is the atmospheric region that extends from a base altitude of 70 to 80 km to an indefinite altitude.[85] The ionosphere is characterized by containing significant concentrations of concentrations of ions and electrons.[86] The ionosphere is produced by the effect of solar radiation on the surrounding

79 American Meteorological Society, 'Definition of stratosphere (*Glossary of Meteorology*, 2022) https://glossary.ametsoc.org/wiki/Stratosphere accessed 29 April 2023.
80 American Meteorological society (n 80).
81 Benkö, Plescher (n 65) 68
82 American Meteorological Society, 'Definition of mesosphere (*Glossary of Meteorology*, 2022) https://glossary.ametsoc.org/wiki/Mesosphere accessed 29 April 2023.
83 American Meteorological Society (n 82).
84 Ibid.
85 American Meteorological Society, 'Definition of ionosphere (*Glossary of Meteorology*, 2022) https://glossary.ametsoc.org/wiki/Ionosphere accessed 29 April 2023.
86 American Meteorological Society (n 85).

> atmospheric make up.[87] Furthermore, the ionosphere contains an extremely low concentration of gas particles.[88]

Each of the abovementioned atmospheric layers have differences in their formations. There are several changes in temperature in the different layers. The chemical composition of the atmosphere is largely constant up to the mesopause.[89] According to McDowell:

> From a physical point of view, it is therefore reasonable to think of the atmosphere proper as including the troposphere and stratosphere and (with some qualification) the mesosphere, and identifying the thermosphere and exosphere with the common idea of 'outer space'.[90]

The argument may thus be made that the mesopause be considered a possible Spatialist boundary between airspace and outer space. In 1976 the idea for the mesosphere or 'mesospace' was introduced as the legal boundary or buffer zone for airspace and outer space.[91] Although, according to McDowell, the idea of the mesospace as a boundary or buffer zone has not yet gained acceptance among the International community.[92]

The difficulty in demarcating the atmosphere into layers and thus applying a boundary or buffer zone such as the mesospace is the lack of uniform and agreed upon political and scientific criteria for such a demarcation.[93] Delimitation based on the characteristics of the atmosphere would necessitate agreement on the physical attributes of the layer to be used as the demarcation.[94] According to Oduntan Scientists like layers will remain undecided on the scientific aspects.[95] Where hard won consensus may finally be reached – further difficulty may be found in that the

87 Ibid.
88 Benkö, Plescher (n 65) 68.
89 McDowell JC, ' The edge of space: Revisiting the Karman Line' (2018) 151 Acta Astronautica 668.
90 McDowell (89) 670.
91 Ibid.
92 Ibid.
93 Benkö, Plescher (n 65) 70.
94 Ibid.
95 Gbenga Oduntan *Sovereignty and Jurisdiction in the Airspace and Outer Space – Legal Criteria for Spatial Delimitation* (Routledge 2012) 310.

physical attributes of the atmosphere are not of a uniform nature at all altitudes.[96] According to Oduntan an International Convention would ultimately be needed for the recommendation of a demarcation regime such as the mesospace.[97]

x. Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities (von Kármán line)

This approach notes that a Spatialist boundary may possibly be found at the theoretical line where aerodynamic lift is surpassed by centrifugal force.[98]The crux of this approach lies in the idea that where an altitude is reached that that all aerodynamic abilities that allow an ordinary aircraft to gain lift cease – demarcation may be found.[99] This demarcation is thus based on the lift characteristics of flight instrumentalities.[100] The von Kármán line is often represented as lying at 100 km above the Earths mean sea level.[101]

According to Gangale the von Kármán line has been extensively purposed in the argument for delimitation of airspace and outer space.[102] The von Kármán line was named after the aerodynamicist Theodore von Kármán.[103] According to McDowell, the 'von Karman line' appears to be what mathematicians refer to as a 'folk theorem' meaning that the theory was formed as part of a conference discussion but was never a formally published by von Kármán.[104] The theory was developed greatly by A.G Haley in 1963.[105] According to Benkö, Haley offered the following explanation of the theory:

> The aerodynamic lift decreases with altitude because of the decreasing density of the air and in order to maintain continuous flight beyond zero air lift, centrifugal force must take over. In the corridor of continuous flight when an object reaches 275 000 feet or

96 Benkö, Plescher (n 65) 71.
97 Oduntan (n 95) 311.
98 UNCOPUOS 1977 (68) para 56.
99 Oduntan (n 95) 298.
100 Oduntan (n 95) 298.
101 Thomas Gangale, 'The Non Karman Line: An Urban Legend of the Space Age' (2017) 41 J Space L 151
102 Gangale (n 101) 151.
103 Ibid.
104 McDowell (n 89) 673.
105 Ibid.

> 83 km and is travelling at 25 000 feet per second or 7 km per second the Kepler force takes over and aerodynamic lift is gone. This is the critical jurisdiction boundary.[106]

Haley thus places the distance of the von Kármán line at 83km.[107] The development of the von Kármán line as a distance of 100km is a recent theory.[108] The establishment of the von Kármán line at 100km is according to Gangale a misnomer or even comparable to an urban legend.[109] In 1963, delegates of the Fédération aéronautique internationale or FAI proposed a line of demarcation of 100km to coincide with the von Kármán line theory at 83km.[110] According to Gangale numerous sources thereafter have referred to the von Kármán line as being positioned at 100km.[111] Furthermore, Gangale concluded that the von Kármán line and the FAI line are two distinct theories that have been conflated.[112] Both the FAI line and the von Kármán line theory are based on two separate figures. McDowell conducted a mathematical analysis of the von Kármán line theory and stated that the typical lowest altitude at which gravity exceeds the Aerodynamic forces on a vehicle is between the 70km to 90km range and that 100km is too high.[113] This supports the positioning of the von Kármán line at an altitude of around 83km.[114] In addition to this Gangale concluded that numerous sources refer to the von Kármán line as being at 83km.[115]

Criticism of the von Kármán line theory may be found in human intuition. According to Benkö technological development may cause a shift in the positioning of the von Kármán line.[116] Where humans create aircraft that may reach higher altitudes the 93 km line may be blurred. Hybrid aircraft are example of such ongoing technological development –where elements of traditional aircraft and space craft are combined.[117] In 2004 such a hybrid space craft known as SpaceShipOne embarked on an experimental flight where it reached an altitude of more than 100km.[118] The hybrid

106 Benkö, Plescher (n 65) 74.
107 Ibid.
108 McDowell (n 89) 673.
109 Gangale (n 101) 162.
110 Gangale (n 101) 159.
111 Gangale (n 101) 162.
112 Gangale (n 101) 164.
113 McDowell (n 89) 676.
114 Benkö, Plescher (n 65) 74.
115 Gangale (n 101) 158.
116 Benkö, Plescher (n 65) 74.
117 Oduntan (n 95) 299.
118 Freeland (n 8) 1.

aircraft are thus not limited to the aerodynamic lift theory forming the basis of the von Kármán line. According to Oduntan, the theory of the von Kármán line cannot be separate from the theory of aerodynamic lift and the development of technology diminishes the usefulness of the von Kármán line as a boundary of delimitation.[119] Gangale concludes that the theoretical calculation underpinning the von Kármán line is based on the aerospace technology of the 1950's and has never had any influence of engineering.[120]

The abovementioned criticism attempts to render the implementation of the von Kármán line as pointless based on the assumption of ongoing technological innovation. The author of this dissertation marks the basis of the criticism but notes that the von Kármán line theory remains as other possible Spatialist theories remain on the agenda of UNCOPUOS in 2022 as a possible solution to the delimitation question:

> The view was expressed that considerations in determining the delimitation of outer space at between 100 and 110 km above sea level were based on comprehensive aspects, including scientific, technical and physical characteristics, namely, atmospheric layers, the altitude capacity of aircraft, the perigee of spacecraft and the Karman line.[121]

The continued reference to the von Kármán line in the delimitation question re-enforces the theoretical idea of the possible Spatialist solution. Consensus is required by the international community. Where no consensus is reached the von Kármán line remains nothing more than a theory for consideration.

xi. Demarcation according to the lowest altitude of an Orbiting Satellite

Demarcation according to the lowest altitude of an orbiting Satellite is based on the premise that at a certain altitude the Earth's atmosphere may be too dense for a Satellite to remain in orbit *inter alia* the lowest possible altitude to maintain a

119 Oduntan (n 95) 300.
120 Gangale (n 101) 177.
121 UNCOPUOS 2022 (n 70) para 59.

satellite.[122] Delimitation would thus be based on a calculation of the altitude required for the effective working of a satellite. According to Oduntan this point of altitude has been extensively put at an altitude of between 70km and 160km.[123]

In the 1977 UNCOPUOS paper the observation was noted that a satellite in its pedigree could burn up at an altitude of around 100km.[124] This view was further contrasted in the 1977 UNCOPUOS paper as it was stated that it would be possible to construct a Satellite to survive below an altitude of 90km.[125] Although, it was noted that such a satellite would be made from heavy metals to support the extreme mass to area ratio to prevent such a satellite from disintegrating in the Atmosphere- leaving construction of such a vehicle out of proportion based on the cost of such materials.[126]

Since 1962, when the first communications satellite was put into orbit – satellites have become smaller and far more advanced and less expensive.[127] Operators such as the Starlink program are on the forefront of technological innovation launching thousands of small satellites or Mega constellations into low earth orbit. . According to McDowell in his study of the Starlink satellite systems, the current Low Earth Orbit (LEO) extends from between 80km - 100km to 2000km where altitudes of 80km or lower render LEO satellites non-functional.[128] The creation of Mega constellations is indicative of an ever growing area of technological innovation in the area of satellite development. In the 1977 UNCOPUOS paper the observation was made that the theory of the lowest pedigree is largely based on physical concepts which are invariable and is only dependant on technological innovation to a slight degree.[129] With the constant development in satellite technology the degree of technological innovation may not remain at a slight degree as envisioned in 1977.

According to Benkö, the theory of Demarcation according to the lowest altitude of an Orbiting Satellite has an advantage as it would find support in the existing practices of

122 Benkö, Plescher (n 65) 75.
123 Oduntan (n 95) 306.
124 UNCOPUOS 1977 (68) para 62.
125 UNCOPUOS 1977 (68) para 64
126 Ibid.
127 Steven E. Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 Emory Int'l L Rev 101, 102.
128 McDowell JC, 'The low earth orbit satellite population and impacts of the SpaceX Starlink constellation' (2020) 892 The Astrophysical Journal Letters L 36, 1.
129 UNCOPUOS 1977 (68) para 64.

artificial satellites and the attitudes of states towards the launching of such satellites into orbit where some scholars have argued for the existence of a rule of International Customary Law - although this fact remains debatable.[130] Oduntan notes that the that the strengths and weakness of this theory are shared by the other Spatialist theories of demarcation based on scientific and technological criteria as the lowest pedigree theory is contrasted with the theory of Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities.[131] Therefore should the equally relevant theory of demarcation based on Aerodynamic Characteristics of Flight Instrumentalities be applied it would render disregard of the scientific advantages of the lowest pedigree theory.[132]

xii. Chapter conclusion

According to the Spatialist approaches the central question is where the craft or object is positioned or operates as the approach seeks to establish a lower boundary where outer space begins and airspace ends. What is clear from the analysis of the abovementioned theories is that they have produced no consensus. The one clear aspect conferred in UNCOPUOS is that the issue of a possible Spatialist solution must remain on the agenda for discussion. Scholars have referred to a number of distances based on numerical attitude dependant on a set of factors attributable to the theory in question – but what lacks in application of such a theory is consensus. Without consensus the Spatialist approaches will remain nothing more that theories on the agenda of UNCOPUOS requiring further endless discussion. The view has been expressed that for the implementation of a Spatialist theory an International instrument such as treaty would ultimately be needed as a basis for consensus amongst state parties.

130 Benkö, Plescher (n 65) 75.
131 Oduntan (n 95) 308.
132 Ibid.

3. The Functionalist approach

xiii. Chapter introduction

This chapter will discuss what the Functionalist approach to the delimitation of airspace and outer space – with specific preliminary sub -headings; 'Definition of an aircraft', Definition of the space object or craft', and 'Definition of a hybrid system'. As discussed above the Spatialist approach focus on where a craft or object is positioned or operates and seeks to establish a lower boundary where outer space begins and airspace ends.[133]The Functionalist approach in the alternative places focus on the type of object in order to determine whether or not it operates in airspace or outer space. [134]

The central question according to the functionalist approach is what is the objects' purpose and destination? If the object in question is characterised as an aircraft the object is deemed to function in airspace – if the object is deemed a space craft it would then function in outer space. When applying a Functionalist approach one would have to determine whether the object is an aircraft, space craft or hybrid system.[135] Under a Functionalist approach, should the machine in question be made for atmospheric flight it could be an aircraft and in the alternative should the machine be made for beyond atmospheric flight it could be a space object.

xiv. What is an aircraft?

Since the dawn of modern human intelligence flight has been on the minds of human beings with a collective dream of flying within the heavenly realms of the birds.[136]Early human thinking of flight cantered around the imitation of birds as a possible means of flying. [137] Human beings left the surface of the Earth in 1783 when an early hot air

133 Benkö, Plescher (n 65) 31.
134 Dempsey, Manoli (n 13) 11.
135 Ibid.
136 Anderson JD and Bowden ML, *Introduction to flight*, Vol 582 (McGraw-Hill Higher Education New York 2005) 4.
137 Anderson, Bowden (n 137) 4.

balloon carrying two pilots rose up in to the air and drifted across the city of Paris.[138] On the 17th of December 1903 Wilbur and Orville Wright completed flight in a heavier than air machine called the *Wright Flyer I*– achieving what no one had done before them and heralding the birth of successful aviation engineering.[139] This birth of successful aviation has led to engineering marvels such as modern airliners.

Given the history of flight - when may legal scholars assume that a machine qualifies as an aircraft? The definition of an aircraft may primarily be found within Annex 7 of the Chicago Convention where an aircraft is defined as:

> 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.[140]

Therefore, an aircraft is a machine that operates from the 'reactions' of the air – where such reactions cannot be achieved at higher altitudes due to the reduced density.[141] Furthermore, Annex 7 in its amendment was aimed at excluding all air cushion type vehicles that derive reactions of the air against the earth's surface.[142] The definition of an aircraft may be read in conjunction with the definition of 'Aeroplane' provided in Annex 7 being:

> A power – driven heavier than air aircraft, delivering its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.[143]

The qualities that form the basis of defining an aircraft or aeroplane are that the machine derives lift from atmospheric or aerodynamic reactions. Therefore ICAO may in the correct circumstances exercise jurisdiction over civil machines designated as either an aircraft or an aeroplane. Rocket propelled vehicles on the other hand do not press against the atmosphere of the Earth to obtain a form of propulsion and can operate with in the vacuum of space.[144]

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138 Ibid.
139 Anderson, Bowden (n 137) 31.
140 Convention on International Civil Aviation (adopted 7 December 1944, entered into force 5 March 1947) 15 UNTS 295 (Chicago Convention), Annex 7 (2012).
141 Dempsey, Manoli (n 13) 13.
142 Benkö, Plescher (n 65) 112.
143 Chicago Convention (n 141) Annex 7.
144 Dempsey, Manoli (n 13) 13.

Rocket based vehicles during the ballistic portion of flight are not supported by so called reactions of the air- although some form of aerodynamic control may be present throughout the vehicles trajectory until it reaches the upper levels of the atmosphere where aerodynamic flight is no longer possible.[145] Therefore, rocket propelled vehicles do not form part of the definition of an aircraft or aeroplane. Being designed to operate within the vacuums of outer space could rocket based vehicles be defined as space objects?

xv. What is a space object?

In the 1977 UNCOPUOS paper discussing delimitation a definition of space object was provided for as being relevant to the paper and was defined as follows:

> Is any man-made object launched into space beyond atmospheric space.[146]

According to the brief definition provided a space object would thus be a man-made object launched beyond the atmosphere. This definition supports the definition of an aircraft as an machine that can derive support in the atmosphere from reactions of the air dependent on the atmosphere – where a space object is launched beyond the atmosphere and operates in space.[147]The two definitions provide for two distinctive areas of operation being that aircraft function within the atmosphere and space objects function beyond the atmosphere. Therefore under a Functionalist approach, should the machine in question be made for atmospheric flight it could be an aircraft and in the alternative should the machine be made for beyond atmospheric flight it could be a space object.

None of the five main space conventions define in precise terms what exactly a space object is.[148] The Convention on International Liability for Damage Caused by Space Objects (Liability Convention) offers a partial definition of a space object.[149]Article 1 (d) of the Liability convention states:

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145 Benkö, Plescher (n 65) 112.
146 UNCOPUOS 1977 (68) para 14.
147 Chicago Convention (n 141) Annex 7.
148 Dempsey, Manoli (n 13) 16.
149 The Convention on International Liability for Damage Caused by Space Objects (adopted 29 March 1972, entered into force 1 September 1972) 961 U.N.T.S. 187 (Liability Convention).

> The term "space object" includes component parts of a space object as well as its launch vehicle and parts thereof.[150]

Article 1 (d) forms party of treaty law – therefore in order to interpret the meaning of 'space object' the general method of treaty interpretation embodied in articles 31 and 32 of the VCLT may be employed as starting basis for the interpretation.[151] As per article 31 (1) of the VCLT the ordinary meaning of the words of Article 1(d) of the Liability Convention are as follows- the definition of space derived from (outer space) is 'space immediately outside the earth's atmosphere'.[152] The definition of object is 'something material that may be perceived by the senses'.[153] The definition of component is 'a constituent part'.[154]The definition of launch is 'to release, catapult, or send off'.[155] The definition of vehicle is 'a means of carrying or transporting something'.[156]

Based on the ordinary meaning of the words of Article 1 (d) of the Liability Convention the meaning of 'Space object' can be deuced as follows: material meant for the area immediately outside the earth's atmosphere -including constitutive parts thereof, send off transporting material and/or parts. In furtherance of Interpretation, article 32 of the VCLT permits recourse to a supplementary means of Interpretation which includes the preparatory works of a treaty and the circumstances of its conclusion.[157] In 1969 the United Nations General assembly identified the need for a convention intended to establish international rules and procedures relating to liability for damage caused by the launching of objects into outer space.[158]

During the negotiation phase of the Liability Convention one of the negotiators from the United States noted that it was considered that the convention covered injuries resulting from the "re-entry of fragments of a foreign man-made space payload or

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150 Liability Convention (n 150) art 1(d).
151 VCLT (n 24) art 31, art 32.
152 Merriam-Webster https://www.merriam-webster.com/dictionary/outer%20space accessed 18 June 2023.
153 Merriam-Webster https://www.merriam-webster.com/dictionary/object accessed 18 June 2023.
154 Merriam-Webster https://www.merriam-webster.com/dictionary/components accessed 18 June 2023.
155 Merriam-Webster https://www.merriam-webster.com/dictionary/launch accessed 18 June 2023.
156 Merriam-Webster https://www.merriam-webster.com/dictionary/vehicle accessed 18 June 2023.
157 VCLT (n 24) art 32.
158 Carl Christol, 'International Liability for Damage Caused by Space Objects' (1980) 74 Am J Int'l L 355.

launch vehicles''.[159] Commentators further noted that a space object included "even those parts which are not intended to go into orbit or beyond being all objects launched with the primary object or payload. [160] For the purposes of identifying a possible definition of 'space object' in terms of the preparatory works what can be deduced is that the Commentators intended the Liability Convention to be applicable to objects placed into orbit and that liability may be gained for activities relating space vehicles and parts thereof.

The interpretation method in terms of article 31 and 32 of the VCLT has rendered that a 'space object' in terms of Article 1 (d) of the Liability convention may be an object meant for space or to be placed in orbit immediately outside the earth's atmosphere which includes the constitutive parts of such a vehicle.

The definition of a space object as material or a vehicle bound for an area where atmospheric fight is limited or no longer possible relates to or lends credit to the Spatialist theory of Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities as discussed above- the crux of this approach lies in the idea that where an altitude is reached that that all aerodynamic abilities that allow an ordinary aircraft to gain lift cease delimitation may be found. The difference between the approaches is however that the Functional approach is based on the characteristics of the vehicle rather than a Spatialist theoretical set demarcation point within the atmosphere.[161]

Analysis of the term space object indicates that no concrete or clear definition has been implemented to denote what a space object is in the legal sense. What is clear is that a difference could be based on the aerodynamic characteristics of a vehicle as discussed above.

xvi. What is a hybrid vehicle?

When applying a difference between an "aircraft" and a "space object" based on the atmospheric qualities of the vehicle- what would the position thus be if a vehicle utilizes

159 Christol (n 158) 357.
160 Ibid.
161 Dempsey, Manoli (n 13) 17.

lift within airspace when ascending or descending but also has the capability to ascend to outer space and function within that realm?

An example of such a hybrid or aerospace vehicle is the reusable launch vehicle "New Shepard" designed by Blue Origin an American aerospace and Exploration Company.[162] New Shepard is a reusable suborbital rocket system designed to take the astronauts on board beyond the realm of aerodynamic lift to the reaches of outer space.[163] When studying New Shepard in terms of the Functionalist approach it is noted that, the BE- 3 engine propels the rocket towards outer space and reignites for a controlled pinpoint landing.[164] The craft uses drag brakes, landing gear and ring and wedge fins for Aerodynamic flight.[165] New Shepard thus engages in Aerodynamic flight utilising lift to some extent during ascend but utilises Aerodynamic flight greatly during descent. Therefore the New Shepard suborbital rocket system may thus be both an aircraft and space object.

An aerospace vehicle such as the New Shepard sub-orbital rocket system operates within airspace and parts of outer space and therefore does not operate within a clearly defined area. Sub-orbital vehicles are particular crafts that have characteristics of both air craft and space objects.[166]

It is submitted by Hobe, Goh and Neumann that until the event of separation of the carrier craft the combined carrier craft and space craft forming the Hybrid vehicle operate with the qualities of an aircraft and thus be subject to Air law.[167]The carrier craft thus functions within airspace. Hobe, Goh and Neumann further submit that after the event of separation the space craft separated from the carrier vehicle and no longer derives atmospheric lift and could thus be considered a space object.[168]

Therefore, after the separation event the space craft would be deemed to operate within outer space. Upon re-entry Hobe, Goh and Neumann note that the space object remains classified as a space object being in line with the Convention on Registration

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162 'Suborbital Space Flight – Meet New Shepard' (Blue Origin) https://www.blueorigin.com/new-shepard accessed 25 June 2023.
163 Meet New Shepard' (n 163).
164 Ibid.
165 Ibid.
166 Dempsey, Manoli (n 13) 18.
167 Hobe, Goh, Neumann (n 1) 364.
168 Ibid.

of Objects launched into Outer Space,[169] where Space law will be applicable during re-entry and the landing of the aerospace vehicle.[170]

xvii. Issues with the Functionalist approach and chapter conclusion

Under the Functionalist approach should a vehicle be designed to operate within airspace it would be subject to the applicable Air Law governing airspace and in the alternative should a vehicle be designed to operate within outer space – it would be subject to the Space Law. Thus in Earth to Space transport the vehicle may be deemed to operate in outer space from launch to pay load disposal in orbit.

When applying the Functionalist approach to an aerospace vehicle the combined carrier craft and space craft operate with the qualities of an aircraft before separation and could be deemed an a vehicle operating within airspace. After separation and within descent including re-entry to landing the space craft could be considered a space object.

According to Vissepo, one basis for critique of the Functionalist approach lies in that the approach has no secure demarcation when it comes to aerospace vehicles and forms the basis for the application of a unitary regime.[171] Such a unitary regime may disrupt the harmonious application of law within airspace - particularity when it comes to sovereignty.[172]This view formulates that when declaring the purpose of a vehicle to be a space object a form of mutually accepted innocent passage is created - as such a vehicle would be deemed to function within outer space creating the assumption that the States have renounced the ability to object to the activities relating to vehicles with the characterisation of space object.[173]

Therefore, Space should not be thought of as the application of fictions legal regime within airspace and thus States have to avail themselves of the rights bestowed where such innocent passage might be contrary to the principles of International law.[174]

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169 Convention on Registration of Objects Launched into Outer Space (adopted 12 November 1974, entered into force 15 September 1976) 1023 U.N.T.S 15 (Registration Convention).
170 Hobe, Goh, Neumann (n 1) 364.
171 Varlin J. Vissepo, 'Legal Aspects of Reusable Launch Vehicles' (2005) 31 J Space L 175.
172 Vissepo (n 172) 175.
173 Benkö, Plescher (n 65) 104.
174 Benkö, Plescher (n 65) 104.

In an age of technological development and growth- the number of space missions is bound to grow exponentially. The concept of thus securing passage rights to states through innocent passage may be juxtaposed in that the passage itself may be a legal right derived from a right of universal free access to outer space bearing in mind that the activity should be conducted with caution and may not inflict damage.[175]

Despite additions to both the Functionalist and Spatialist approaches both these theories escape the general acceptance of States. Although what is evident is that both these two theories are still primarily the sources that dominate the thinking of States and bodies such as the United Nations .The topic of delimitation whether it be the Functionalist approach or the Spatialist approaches remains a constant source of debate evident by the issue being on the agenda of UNCOPUOS yearly.

4. How and where does the Suborbital SpinLaunch system operate in terms of the Spatialist and Functionalist approaches?

xviii. Chapter introduction

While researching the delimitation of airspace and outer space various rocket systems and aircraft are highlighted as natural examples of passage into outer space. This begs the question where will technology will evolve to and will mankind ever move away from the rocket propulsion systems as envisioned by the father of the rocket booster Wernher von Braun.

The answer may be found in ever expanding human intuition taking the form of a colossal Suborbital accelerator standing taller than the Statue of Liberty at 50.4 meters in length.[176] The SpinLaunch project started 2014 with the goal of making it cheaper and easier to launch satellites while reducing the need for traditional rocket boosters.[177] The Suborbital SpinLaunch system uses a vacuum-sealed centrifuge to spin a rocket object on a rotating arm and then catapults it up to orbit.[178] The rocket

175 Benkö, Plescher (n 65) 104.
176 'Suborbital Accelerator' (SpinLaunch) https://www.spinlaunch.com/suborbital accessed 30 July 2023.
177 Crane L, 'Boldly going where no one has gone before' (2022) 254 New Scientist 12.
178 Williams (n 3).

object accelerates to speeds of around 8000 kilometres per hour.[179] When the rocket object reaches an altitude of around 61 000 meters or 200 000 feet the rocket ignites its engines to reach lower Earth Orbit to deliver payloads such as satellites.[180]

When preparing for lunch the intended payload is enclosed within a carbon-fibre rocket object – the rocket object is then attached to a carbon-fibre tether.[181] The air within the centrifuge is then pumped out to avoid aerodynamic friction and excessive heating.[182] A counterweight is installed at the end the tether which houses the rocket object.[183]The tether spins within the Centrifuge- once the desired speed is reached the counter weight and rocket object are released from the tether - the rocket object then pierces the plastic sheet maintaining the centrifuge's seal and ejects out of a chute upwards towards the atmosphere. [184]The counterweight collides with a canister of earth where it is vaporised instantly.[185]

For its first test flight on the 22nd of October 2021 the Suborbital SpinLaunch system was powered up to 20 percent of its total capacity and launched a 3-meter rocket projectile tens of thousands of feet into the atmosphere.[186] The system was tested on only one-third of the size of SpinLaunch's planned orbital accelerator.[187] SpinLaunch aims to construct a large scale prototype which should be completed in 2025.[188] The large scale prototype should project a 10- metre rocket object with payloads of up to 200 kilograms into lower Earth orbit.[189]

Academic theory presents an idea that as proposed by Nejad, that the SpinLaunch system may be converted into an anti-hypersonic missile defence system or a system that can exert enough force by the incorporation of a railgun into the circular structure of the SpinLaunch system allowing further acceleration of the rocket object up to Mach 20 which would be enough to intercept present day hypersonic missiles.[190] The

179 Ibid.
180 Williams (n 3).
181 Crane Leah (n 178).
182 Ibid.
183 Ibid.
184 Ibid.
185 Ibid.
186 Williams (n 3).
187 Ibid.
188 Ibid.
189 Ibid.
190 Nejad AR 'A SpinLaunch-Circular Railgun Anti-Hypersonic Missile Defence System' Research Gate publication/360438405.

modified launching system indicates the increased speed and potential range of the SpinLaunch system within technological development.

Further motivation for the development of Kinetic launching systems such as the SpinLauch system have been described with regards to the effect of reducing harmful rocket emissions in the troposphere and the stratosphere including potential to eliminate emissions within the highest reaches of the atmosphere.[191]Although there is currently not enough data for a comparison between Kinetic launching systems and rocket emissions pertaining to their volumetric distribution throughout the atmosphere.[192]

The SpinLaunch Project has received extensive funding- where the company has raised around 55 million USD.[193] The use of the system as a weapon and the potential environmental benefits may provide a basis of extensive State or private funding which would allow for the further development of the technology. With further technological development the system may reach new heights.

With the available funds and the technological achievements made by SpinLaunch since the company's founding in 2014 it can be said that the Sub-orbital accelerator may be extensive and viable technology in the near future. The payload capabilities of the Suborbital system and the ability of the system to reach lower earth orbit for satellite delivery once again extends the delimitation argument to the system. The delimitation of outer space and airspace remains important as the legal regimes governing these areas have different core principles.

xix. Delimitation and the Suborbital Spinlaunch system

The development and use of the SpinLaunch Suborbital accelerator fails to escape the ever debated delimitation question. Where an engineer or physicist may focus on the potential drawbacks related to a mechanical question a lawyer would of course extend the debate to what law would be applicable to such a novel concept.

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191 Gaston JK, 'Environmental impacts of increasing numbers of artificial space objects' (2023) 21 Frontiers in Ecology and the Environment 289.

192 Gaston (n 192) 291.

193 Niederstrasser C, 'Small Launchers in a Pandemic World-2021 Edition of the Annual Industry Survey' (2021) 7 SSC21 9.

As noted the delimitation of airspace and outer space remained on the agenda of the UNCOPUS Legal subcommittee in 2022 where the applicability of a possible Functionalist or Spatialist solution such as the application of the so called von Kármán line identified by the committee in 1977 was still discussed by the subcommittee.[194] Therefore, the rocket type object launched by the Suborbital accelerator does not escape this legal challenge.

The potential of rocket objects launched by the Suborbital accelerator to reach altitudes of around 61 000 meters or 200 000 and with booster assistance lower Earth Orbit - proposes that the rocket objects function within airspace and outer space. The height gained by the kinetic potential of the rocket object alone surpasses two major atmospheric layers namely the troposphere[195] and stratosphere[196]. With the assistance of rocket boosters the rocket object may extend well into the ionosphere.[197]Therefore, the rocket object launched by the Suborbital accelerator surpasses several atmospheric layers.

Should a Spatialist boundary be determined at either one of these atmospheric layers the rocket object would be function in airspace below the boundary and in outer space above. At present the difficulty in demarcating the atmosphere into layers and thus applying a boundary or buffer zone such as the mesospace is the lack of uniform and agreed upon political and scientific criteria for such a demarcation.[198] Should a theoretical line be applied where aerodynamic lift is surpassed by centrifugal force such as the von Kármán line the rocket object will once again only be deemed to operate with in outer space should it surpass the theoretical line.[199]

Should the equally relevant theory of Demarcation according to the lowest altitude of an Orbiting Satellite be utilised the rocket object will only be deemed to operate within outer space should this area be surpassed.[200] Given that the intended purpose of the Spinlaunch Suborbital accelerator is to be a cheaper and easier way to launch satellites into outer space – the payload delivery would at least take place in lower

194 UNCOPUOS 2022 (n 70) para 59.
195 American Meteorological Society (n 75).
196 American Meteorological Society (n 79).
197 American Meteorological Society (n 85).
198 Benkö, Plescher (n 65) 70.
199 UNCOPUOS 1977 (68) para 56.
200 Benkö, Plescher (n 65).

orbit to release the satellite within in relevant functional parameters [201]Therefore, should the rocket object reach lower earth orbit for payload delivery the rocket object would function within outer space. The Spatialist approach establishing the lowest boundary of an orbiting satellite could be applied.[202] The dependency on technological advancement and lack of state consensus has rendered the Spatialist boundary undefined but should a boundary be applied the rocket object would function in outer space once lower Earth orbit is reached.

Under the Functionalist approach, should the rocket object be made for atmospheric flight it could be an aircraft and function within airspace and in the alternative should the rocket object be made for beyond atmospheric flight it could be a space object[203] The rocket object launched from the Suborbital accelerator finds purpose in payload delivery such as satellites into lower orbit – the rocket object reaches the intended destination through the use of kinetic energy and rocket boosters. [204]

Due to the potential and intended design of the rocket object in reaching lower earth orbit it can be said to be a space object. According to the functionalist approach the object would function within outer space. [205] Upon re-entry the rocket object remains classified as a space object being in line with the Convention on Registration of Objects launched into Outer Space.[206]

xx. Chapter conclusion

From the first test flight on the 22nd of October 2021 the Suborbital SpinLaunch system has displayed the potential of the technology as a cheaper alternative to payload delivery within outer space. The development and use of the SpinLaunch Sub-orbital accelerator fails to escape the ever debated delimitation question. The delimitation of airspace and outer space remains on the agenda of the UNCOPUOS Legal subcommittee where the applicability of a possible Functionalist or Spatialist

201 Crane Leah (n 178).
202 Grotch (n 127) 102.
203 Dempsey, Manoli (n 13) 11
204 Crane Leah (n 178).
205 Dempsey, Manoli (n 13) 11
206 Hobe, Goh, Neumann (n 1) 364.

solution such as the application of the so called von Kármán line identified by the committee in 1977 is still discussed- therefore both Functionalist and Spatialist theory may be applied to the SpinLaunch system as the debate currently lacks State consensus.

In conclusion, should a discussed Spatialist line be applied the SpinLaunch rocket object will be dependent on the area of operation in order to determine whether it functions within airspace or outer space. Under the Functionalist approach, should the rocket object be made for atmospheric flight it would function within airspace and in the alternative should the rocket object be made for beyond atmospheric flight it could be considered a space object. Upon re-entry the rocket object remains classified as a space object.

5. Conclusion

The aim of this research was to embark on a brief study of the delimitation of airspace and outer space. The central question of the research was to investigate where a boundary may be found. This research discussed delimitation under the Spatialist approach and the Functionalist approach. The research further provided a brief discussion on the revolutionary SpinLaunch suborbital launching system in in application of the Spatialist and Functionalist approaches to the system.

xxi. Spatialist approaches

According to the Spatialist approach the central question is where the craft or object is positioned as the relevant theories attempt to establish a theoretical lower boundary where outer space begins and airspace ends. What has become clear from the analysis of the theories of Demarcation based on the Division of Atmosphere into Layers, Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities (von Kármán line), and Demarcation according to the lowest altitude of an Orbiting Satellite is that they have produced no State consensus.

The difficulty in demarcating the atmosphere into layers and thus applying a boundary or buffer zone such as the mesospace is the lack of uniform and agreed upon political and scientific criteria for such a demarcation.[207] The physical attributes of the atmosphere are not of a uniform nature at all altitudes thus difficulty may be found in applying a set boundary. [208] An International Convention would ultimately be needed for demarcation regime such as the mesospace.[209]

The continued reference to the von Kármán line in the delimitation debate lays the foundation for the von Kármán line as a possible Spatialist solution. What is once again lacking is consensus which is required by the international community.

The theory of Demarcation according to the lowest altitude of an Orbiting Satellite has an advantage as it would find support in the existing practices of artificial satellites and the attitudes of states towards the launching of such satellites into orbit where some

207 Benkö, Plescher (n 65) 70.
208 Benkö, Plescher (n 65) 71.
209 Oduntan (n 95) 311.

scholars have argued for the existence of a rule of International Customary Law.[210] The applicability of this theory in in terms of weaknesses are shared by the other Spatialist theories of demarcation based on scientific and technological criteria as the lowest pedigree theory is contrasted with the theory of Demarcation based on Aerodynamic Characteristics of Flight Instrumentalities.[211]

Without consensus the Spatialist approaches will remain nothing more than theories on the agenda of UNCOPUOS. The view has been expressed that for the implementation of a Spatialist theory an International instrument such as treaty would ultimately be needed as a basis for consensus amongst state parties.

xxii. Functionalist approach

When applying a perspective from the Functionalist approach should a vehicle be designed to operate within airspace it would be deemed to operate within airspace and in the alternative should a vehicle be designed to operate within outer space –it will be deemed to be function within outer space. In Space launch the vehicle may be deemed to operate in outer space from launch to pay load disposal in orbit.

When applying the Functionalist approach to an aerospace vehicle the combined carrier craft and space craft operate with the qualities of an aircraft before separation and could be deemed an a vehicle operating within airspace. After separation and within descent including re-entry to landing the space craft could be considered a space object.

xxiii. Chapter conclusion

In conclusion, both the Functionalist and Spatialist escape the general acceptance of States. Although what is evident through research is that both these two theories are still primarily the sources that dominate the thinking of States and bodies such as the United Nations. The solution to the delimitation question lies in State consensus. Indecision by State parties has rendered finding a solution such as the application of a singular regime to objects such as the rocket object launched from the SpinLaunch Suborbital accelerator unclear.

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210 Benkö, Plescher (n 65) 75.

211 Oduntan (n 95) 308

The delimitation debate has not rendered the work of States and Space corporations impossible- as corporations such as SpinLaunch and SpaceX continue their work under the current regulatory regimes. Although, indecision remains the biggest hurdle to the delimitation debate for legal certainty. The writer of this research found it apt to let the late Statesmen Theodore Roosevelt have the final word on indecision: 'In any moment of decision, the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing you can do is nothing.'[212]

212 'Theodore Roosevelt Quotes' (Theodore Roosevelt Centre) https://www.theodorerooseveltcenter.org accessed 3 September 2023.

6. Bibliography

xxiv. Textbooks

Abeyratne R, 'Article 1 Sovereignty', *Convention on International Civil Aviation: Commentary* (Springer International Publishing 2014).

Anderson JD and Bowden ML, *Introduction to flight*, Vol 582 (McGraw-Hill Higher Education New York 2005).

Gbenga Oduntan *Sovereignty and Jurisdiction in the Airspace and Outer Space – Legal Criteria for Spatial Delimitation* (Routledge 2012).

J Dugard, Max du Plessis, Tiyanjana Maluwa and Dire Tladi (eds), Dugard's International Law: *A South African Perspective* (JUTA 2018).

M. Benkö, Engelbert Plescher *Space Law – reconsidering the definition/delimitation question and the passage of spacecraft through foreign airspace* (Eleven International Publishing 2013).

O. Dörr and K. Schmalenbach, in O. Dörr and K. Schmalenbach (eds) *Vienna Convention on the Law of Treaties* (Springer-Verlag 2018).

S. Hobe, *Space Law* (Nomos Verlagsgesellschaft, Baden-Baden 2019).

Theory (FAA Federal Aviation Administration, 'Pilots Handbook of Aeronautical Knowledge- Chapter 12 -3 – Weather theory (*FAA* 2016).

xxv. Journal articles

Brandon C. Gruner, 'A New Hope for International Space Law: Incorporating Nineteenth Century First Possession Principles into the 1967 Space Treaty for the Colonization of Outer Space in the Twenty-First Century' (2004) 35 Seton Hall L Rev 2.

Carl Christol, 'International Liability for Damage Caused by Space Objects' (1980) 74 Am J Int'l L 355.

Crane L, 'Boldly going where no one has gone before' (2022) 254 New Scientist 12.

Dempsey PS and Manoli M, 'Suborbital Flights and the Delimitation of Airspace Vis-à-Vis Outer Space: Functionalism, Spatialism and State Sovereignty' (2017) 42 Annals of Air and Space Law 20.

Gaston JK, 'Environmental impacts of increasing numbers of artificial space objects' (2023) 21 Frontiers in Ecology and the Environment 289.

Jinyuan Su, 'The Delineation Between Airspace and Outer Space and the Emergence of Aerospace Objects' (2013) 78 J Air L & Com 363.

McDowell JC, ' The edge of space: Revisiting the Karman Line' (2018) 151 Acta Astronautica 668.

McDowell JC, 'The low earth orbit satellite population and impacts of the SpaceX Starlink constellation' (2020) 892 The Astrophysical Journal Letters L 36, 1.

Nejad AR 'A SpinLaunch-Circular Railgun Anti-Hypersonic Missile Defence System' Research Gate publication/360438405.

Niederstrasser C, 'Small Launchers in a Pandemic World-2021 Edition of the Annual Industry Survey' (2021) 7 SSC21 9.

Stephan Hobe, Geradine Meishan Goh & Julia Neumann, 'Space Tourism Activities - Emerging Challenges to Air and Space Law' (2007) 33 J Space L 359.

Steven E. Grotch, 'Mega-Constellations: Disrupting the Space Legal Order' (2022) 37 Emory Int'l L Rev 101, 102.

Steven Freeland, 'Up, up and. Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space' (2005) 6 Chi J Int'l L 6.

Thomas Gangale, 'The Non Karman Line: An Urban Legend of the Space Age' (2017) 41 J Space L 151.

Varlin J. Vissepo, 'Legal Aspects of Reusable Launch Vehicles' (2005) 31 J Space L 175.

Vernon Nase, 'Delimitation and the Suborbital Passenger: Time to End Prevarication' (2012) 77 J Air L & Com 752.

xxvi. Treaties

Convention on International Civil Aviation (adopted 7 December 1944, entered into force 5 March 1947) 15 UNTS 295 (Chicago Convention).

Convention relating to the Regulation of Aerial Navigation signed at Paris, 13 October 1919 (superseded by the 1944 Chicago Convention).

Convention on Registration of Objects Launched into Outer Space (adopted 12 November 1974, entered into force 15 September 1976) 1023 UNTS 15 (Registration Convention).

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies (adopted 27 January 1967, entered into force 10 October 1967) 610 UNTS 205 (Outer Space Treaty).

The Convention on International Liability for Damage Caused by Space Objects (adopted 29 March 1972, entered into force 1 September 1972) 961 UNTS. 187 (Liability Convention).

Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 January 1980) 1155 UNTS 331 (VCLT).

xxvii. Caselaw

Legal Status of Eastern Greenland (Denmark v Norway) PCIJ Series A/B, No. 53

xxviii. UN Documentation

The Question of the Definition and/or the Delimitation of Outer Space, Addendum (1977) UN Doc A/AC./C.217/Add.1

Report of the Legal Subcommittee on its sixty-first session, held in Vienna from 28 March to 8 April 2022 (2022) UN Doc A/AC.105/1260.

xxix. Electronic sources

AMS (*Glossary of Meteorology*, 2022) https://www.ametsoc.org/index.cfm/ams/ accessed 29 April 2023.

Cambridge Online Dictionary (Cambridge Online Dictionary) https://dictionary.cambridge.org/ Accessed 13 September 2022.

Liam Tung 'NASA will test this 'SpinLaunch' system that hurls satellites into space' (ZDNet 12 April 2022) https://www.zdnet.com/article/nasa-will-test-this-spinlaunch-system-that-hurls-satellites-into-space/ accessed 14 April 2022

Merriam Webster Dictionary (Merriam Webster Online Dictionary) https://www.merriam-webster.com/ accessed 18 June 2023

Matt Williams 'SpinLaunch Hurls a Test Vehicle Kilometres Into the air. Eventually, it'll Throw Them Almost all the way to Orbit' (Universe Today 18 November 2021) https://www.universetoday.com/153342/spinlaunch-hurls-a-test-vehicle-kilometers-into-the-air eventually-itll-throw-them-almost-all-the-way-to-orbit/ Accessed 14 April 2022

Suborbital Space Flight – Meet New Shepard' (Blue Origin https://www.blueorigin.com/new-shepard accessed 25 June 2023.

'Suborbital Accelerator' (SpinLaunch) https://www.spinlaunch.com/suborbital accessed 30 July 2023

'Theodore Roosevelt Quotes' (Theodore Roosevelt Centre) https://www.theodorerooseveltcenter.org accessed 3 September 2023.

7. Glossary of terms

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.[213]

Functionalist approach to delimitation: The Functionalist approach in the alternative places focus on the type or characteristics of object in order to determine whether or not it operates in airspace or outer space.[214]

Hybrid vehicles or sub-orbital vehicles: Sub-orbital vehicles are particular crafts that have characteristics of both air craft and space objects.[215]

Space object: Is any man-made object launched into space beyond atmospheric space.[216]

Spatialist approach to delimitation: According to the Spatialist approach the central question is where the craft or object is positioned or operates- the approach seeks to establish a lower boundary where outer space begins and airspace ends.[217]

Spatialist theory of demarcation according to the lowest altitude of an orbiting Satellite: Demarcation according to the lowest altitude of an orbiting Satellite is based on the premise that at a certain altitude the Earth's atmosphere may be too dense for a Satellite to remain in orbit inter alia the lowest possible altitude to maintain a satellite**.**[218]

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213 Convention on International Civil Aviation (adopted 7 December 1944, entered into force 5 March 1947) 15 UNTS 295 (Chicago Convention), Annex 7 (2012).

214 Dempsey PS and Manoli M, 'Suborbital Flights and the Delimitation of Airspace Vis-à-Vis Outer Space: Functionalism, Spatialism and State Sovereignty' (2017) 42 Annals of Air and Space Law 11.

215 Dempsey, Manoli (n 218) 18.

216 UNCOPUOS 1977 (n 214) para 14.

217 Marietta Benkö, Engelbert Plescher *Space Law – reconsidering the definition/delimitation question and the passage of spacecraft through foreign airspace* (Eleven International Publishing 2013) 31.

218 Benkö, Plescher (n 65) 75.

Spatialist theory of demarcation based on Aerodynamic characteristics of flight instrumentalities (von Kármán line): This approach notes that a Spatialist boundary may possibly be found at the theoretical line where aerodynamic lift is surpassed by centrifugal force.[219] The crux of this approach lies in the idea that where an altitude is reached that that all aerodynamic abilities that allow an ordinary aircraft to gain lift cease – demarcation may be found.[220]

Spatialist theory of demarcation based on the division of atmosphere into layers: This approach applied in the 1977 UNCOPUOS paper is formulated on the premise that the Atmosphere is divided by the scientific community into a number of different layers -the paper makes reference to the following atmospheric layers being the: troposphere, stratosphere, mesosphere and the ionosphere.[221]

219 UNCOPUOS 1977 (n 214) para 56.
220 Oduntan (n 95) 298.
221 The Question of the Definition and/or the Delimitation of Outer Space, Addendum (1977) UN Doc A/AC./C.217/Add.1, para 48.