# Suborbital Point-to-Point Flights —Applicability of Air Navigation Law and Aviation Criminal Law


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## Abstract

Development in suborbital point-to-point transportation has progressed rapidly over the past couple of years. What was once considered only an element of science fiction has become a reality. Companies, such as Virgin Galactic and SpaceX, are developing and testing new types of vehicles that can be used to reach suborbital heights. While these flights are presently only meant to be a tourist attraction for the wealthy passenger, the development will eventually enable commercial and routine suborbital point-to-point transportation. These suborbital vehicles pose quite a challenge from a legal point of view. Both – air law and space law – were created at a time when the possibility of suborbital flights seemed to be a mere figment of imagination.

The hybrid nature of these types of vehicles, that is their ability to utilise airspace and outer space, causes ambiguity as to which legal regime should apply to them. Neither is there an internationally accepted demarcation line between air space and outer space, nor is it clear whether these vehicles should be considered aircraft or space object. A solution to this problem must be found before suborbital point-to-point transportation becomes mainstream. The safety of civil aviation demands no less!

The aim of this thesis is to discuss how current Aviation Criminal Law and Air Traffic Management can be applied to suborbital flights and to deliver a small contribution to the scientific literature that supports the applicability of air law to suborbital flights.

## Resumé

L’essor du transport suborbital point-à-point a progressé rapidement durant ces dernières années, et ce qui fût autrefois considéré comme un élément de science-fiction est aujourd’hui devenu une réalité. En effet, des entreprises, telles que Virgin Galactic et SpaceX, développent et testent de nouveaux types de véhicules pouvant atteindre les altitudes suborbitales. Bien que ces vols soient actuellement consacrés à une clientèle fortunée en tant qu’attraction touristique, leur évolution contribuera à terme à l’émergence d’un mode de transport suborbital commercial et routinier effectuant du point-à-point.

Toutefois, du côté juridique, ces véhicules suborbitaux posent un défi majeur, puisque tant le droit aérien que le droit spatial furent conçus à une époque où la possibilité de réaliser des vols suborbitaux semblait être le fruit de l'imagination. D’autant plus que la nature hybride des véhicules suborbitaux, capable d’utiliser à la fois l'espace aérien et l'espace extra-atmosphérique, crée une ambiguïté quant au régime juridique qui devrait leur être appliqué.

Par ailleurs, il n’existe pas à ce jour une ligne de démarcation internationalement acceptée séparant l'espace aérien de l'espace extra-atmosphérique, sachant qu’il n'est pas clair non plus si ces véhicules doivent être considérés comme des aéronefs ou des objets spatiaux. C’est pourquoi une solution à ce problème doit être trouvée avant que le transport suborbital de point-à-point ne se généralise, et la sécurité de l'aviation civile n'en exige pas moins !

Cette thèse aura donc pour objectif de discuter de la manière dont le droit pénal aérien et le droit de la circulation aérienne actuels peuvent être appliqués aux vols suborbitaux et fournir ainsi une petite contribution à la littérature scientifique qui soutient l'applicabilité du droit aérien aux vols suborbitaux.

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Deo gratias!

# Introduction

## 1. Introductory Note

Since the beginning of humankind, people have dreamed to reach the skies and with the industrial revolution of the 19th and 20th Century this dream became a reality. What started out as a small leap of 37 meters for the Wright Brothers at the beginning of the 20th Century, went on to develop into a multi-billion-dollar industry, connecting the farthest corners of the planet. Aircraft became bigger, greater and faster – the peak of this development was undoubtedly the Concorde. Concorde was the result of a treaty between France and the United Kingdom that ultimately made faster than sound travel possible for the first time in human history.[1] The travel-time from New York to London was significantly reduced to approximately 3 hours total travel time.[2] An already interconnected world became even more connected.

When the Concorde was eventually retired in 2003 – the fuel costs, high ticket prices, declining passenger numbers as a result of accidents and raising maintenance costs making the service unsustainable – the search for an alternative began.[3] To this day it remained without success. Although not yet operational, technological developments, particularly in

[1] See Lewis Johnman & Frances M.B. Lynch, "The Road to Concorde: Franco-British Relations and the Supersonic Project" (2002) 11:2 Contemporary European History 229 at 229; Lewis Johnman & Frances M.B. Lynch, "A Treaty too Far? Britain, France, and Concorde, 1961–1964" (2002) 13:3 Twentieth Century British History 253 at 253. See also Stephen de Sausmarez, "1962 Concorde Treaty" (last visited 24 June 2021), online: *Heritage Concord* <www.heritageconcorde.com/1962-concorde-treaty>.

[2] Concorde currently holds the transatlantic commercial flight record for traveling from New York to London in 2 hours and 52 minutes. See Michael Sheetz, "Virgin Galactic's supersonic jet would go from NYC to London in 2 hours, shattering Concorde record" (03 August 2020), online: *CNBC* <www.cnbc.com/2020/08/03/virgin-galactics-supersonic-jet-would-go-nyc-to-london-in-2-hours.html>.

[3] See e.g. Howard Slutsken, "What it was really like to fly on Concorde" (02 March 2019), online: *CNN Travel* <www.cnn.com/travel/article/concorde-flying-what-was-it-like/index.html>; Alan Cowell, "British and French to Halt Concorde Flights" (10 April 2003), online: *New York Times* <www.nytimes.com/2003/04/10/business/worldbusiness/british-and-french-to-halt-concorde-flights.html>.

the space sector, have brought the possibility not just of subsonic but sub-orbital flight within reach.

Over the past 15 years companies, such as Virgin Galactic, have been developing and testing vehicles capable of reaching a suborbital altitude.[4] Virgin's concept consists of two vehicles – WhiteKnightTwo and SpaceShipTwo. WhiteKnightTwo carries SpaceShipTwo to an altitude of approximately 50.000ft where it detaches and carries the passengers further up to suborbital height. It stays at this altitude for a couple of minutes, during which the passengers can enjoy zero gravity, before returning to Earth.[5]

While these flights are primarily intended to be a tourist attraction for the wealthy individual – tickets initially sold at a price of 250.000,- USD [6] - this technology can lead to the development of suborbital vehicles that offer commercial point-to-point transportation on Earth of passengers and cargo. Companies like SpaceX, Virgin Galactic and Blue Origin want to make such transcontinental suborbital point-to-point a reality.[7] Consequently, such vehicles are already under development and are currently being tested.[8] A flight from London

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[4] See Tim Levin, "Virgin Galactic unveiled its newest spacecraft that will take tourists to suborbital space — check out the VSS Imagine" (30 March 2021), online: *Business Insider* <www.businessinsider.com/virgin-galactic-spaceship-vss-imagine-unveiled-2021-3>.
[5] See Virgin Galactic "Learn - Our Vehicles" (last visited 26 January 2021), online: *Virgin Galactic* <www.virgingalactic.com/learn/>; Gabriella Catalano Sgrosso, "Suborbital Flights: Applicable Law" (2014) 57 Proceedings Intl Institute Space L 467 at 480–81. See also Michael Sheetz, "How SpaceX, Virgin Galactic, Blue Origin and others compete in the growing space tourism market" (26 September 2020), online: *CNBC* <www.cnbc.com/2020/09/26/space-tourism-how-spacex-virgin-galactic-blue-origin-axiom-compete.html> ..
[6] See e.g. Francesca Syz, "Why I have paid $250,000 to go to space with Virgin Galactic" (03 April 2021), online: *The Telegraph* <www.telegraph.co.uk/luxury/technology/have-paid-250000-go-space-virgin-galactic/>; Federal Aviation Administration, "The Annual Compendium of Commercial Space Transportation: 2017" (January 2017) at 19, online (pdf): *FAA* <www.faa.gov/about/office_org/headquarters_offices/ast/media/2017_AST_Compendium.pdf> [FAA Compendium 2017].
[7] See Michael Sheetz, "NYC to Shanghai in 40 minutes: SpaceX's goal for point-to-point space travel" (8 June 2019), online: *CNBC* <www.cnbc.com/2019/06/07/nyc-to-shanghai-in-40-minutes-spacexs-goal-for-point-to-point-travel.html>; Virgin Galactic "Mission- Where we are heading" (last visited 26 January 2021), online: *Virgin Galactic* <www.virgingalactic.com/mission/>.
[8] See e.g. Stephen Clark, "Blue Origin test passenger accommodations on suborbital launch" (14 January 2021), online: *Spaceflight Now* <spaceflightnow.com/2021/01/14/blue-origin-new-shepard-ns-14/>; Stephen Clark, "Blue Origin to rehearse for human passengers on suborbital flights" (13 April 2021), online: *Spaceflight Now* <spaceflightnow.com/2021/04/13/blue-origin-to-rehearse-for-human-passengers-on-suborbital-test-flight/>; Eric M. Johnson, "Virgin Galactic completes crewed space test, more flights soon" (13 December 2018), online: *Reuters* <www.reuters.com/article/us-virgingalactic-rockets-idUSKBN1OC1HA>.

to New York will not take 8 hours anymore, or even the 3 hours that Concorde took, but rather 45 minutes. This reduction in travel time and the commercial value that flows from it is significant.[9] This commercial value makes this industry attractive to long-term investment, which drives a rapid development.[10]

However, these suborbital vehicles pose a challenge to lawmakers and scholars as they are potentially subject two different legal systems – air law and space law.[11] To date there has not been a definitive answer as to which legal regime should apply to suborbital vehicles.[12]

Some aspects - liability issues arising from accidents, air traffic control, national control over suborbital flights and environmental impacts - have been discussed in the literature.[13] However, there is a lack of a broader discussion on the application of aviation criminal law to suborbital flights. One author – in an article on criminal and disciplinary issues pertaining to suborbital tourist flights – argues that international aviation criminal law is not yet applicable to suborbital flights as these flights are currently not international in nature and do not serve international transport purposes; he also points out that the sophisticated legal regime of air law (i.e., strict licensing and safety requirements) might not be appropriate for this nascent industry and a new legal regime, consisting of specific norms

[9] It has been estimated that suborbital point-to-point transportation has the potential to grow into a 20 billion Dollar Industry by 2030 competing directly with long-distance airline flights; See Michael Scheetz, "Super fast travel using outer space could be $20 billion market, disrupting airlines, UBS predicts" (18 March 2019), online: *CNBC* <www.cnbc.com/2019/03/18/ubs-space-travel-and-space-tourism-a-23-billion-business-in-a-decade.html>. See also FAA Compendium 2017, *supra* note 7 at 19.
[10] *Cf* A.R. Zahari & F.I. Romli, "Analysis of suborbital flights operation using PESTLE" (2019) 192 J Atmospheric & Solar-Terrestrial Physics 104901 s 2.2.
[11] See Paul Stephen Dempsey & Maria Manoli, "Suborbital Flights and the Delimitation of Air Space Vis-à-vis outer Space: Functionalism, Spatialism and State Sovereignty" (2017) 42 Ann Air & Sp L 209 at 212.
[12] See e.g. Roy Balleste, "Worlds Apart: The Legal Challenges of Suborbital Flights in Outer Space" (2017) 49:4 NYUJ Int L & Pol 1033 at 1041.
[13] See e.g. Melanie Walker, "Suborbital Space Tourism Flights: An Overview of Some Regulatory Issues at the Interface of Air and Space Law" (2007) 33:2 J Space L 375; Seyedeh Mahboubeh Mousavi Sameh, *Suborbital Flights: Selected Legal Issues* (Master of Laws, McGill University, 2013) at 96ff [unpublished]; Fabio Tronchetti, "Regulating Sub-Orbital Flights Traffic: Using Air Traffic Control as a Model" (2011) 54 Proceedings Intl Institute Space L 176 at 180ff; Upasana Dasgupta, "Legal Issues on Sub-Orbital Space Tourism: International and National Law Perspectives" (2013) 38 Ann Air & Sp L 237 at 272ff.

of air and space law, for suborbital flights should be developed with national legislation as a starting point.[14] However, this view does not fully take into account that these flights will be conducted internationally in the future, namely between two points (i.e., two states) on Earth. Further, this article does not consider the advanced technology that is used on suborbital vehicles. The technology and development of these vehicles could easily accommodate the strict licensing and safety regime of air law.

As this thesis will argue, aviation criminal law is applicable to suborbital point-to-point flights. It will address the question of what happens if a crime is committed during a suborbital flight and how these cases should be treated under aviation criminal law.

The need to handle suborbital traffic and ordinary air traffic safely and efficiently has been discussed in the literature with some authors suggesting either an entirely new set of air traffic rules solely for suborbital vehicles, or the creation of a new air traffic management regime for outer space, which could also govern suborbital flights.[15] But it has been correctly pointed out that there is currently a transition from ground-based to satellite-based radar systems in air traffic management.[16] Satellite-based radar systems allow much more precise and accurate real-time tracking of air traffic movements, transmit more flight data and can set off alarms automatically if unusual aircraft behaviour is detected.[17]

Accordingly, this thesis will examine whether this satellite-based air traffic management system could be applied to suborbital flights that are engaged in point-to-point

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[14] See Michael Chatzipanagiotis, "Criminal and Disciplinary Issues Pertaining to Suborbital Space Tourism Flight" (2007) 50 Proceedings on L Outer Space 215 at 220, 224.
[15] See e.g. Benjamyn Ian Scott, "International Suborbital Passenger Transportation: An Analysis of the Current Legal Situation of Transit and Traffic Rights and its Appropriate Regulation" (2015) 14:2 Issues in Aviation L & Policy 277 at 308ff [Scott, "Suborbital Passenger Transportation"]; Tronchetti, *supra* note 13 at 182ff; Bradley Hayward, "Space Flight Rules: Rules of the Air for an Unlimited Sky" in Ram Jakhu & Chen Kuan-Wei, eds, *Regulation of Emerging Modes of Aerospace Transportation*, (Montreal: Centre for Research in Air and Space Law, 2014) 185 at 203ff; Sameh, *supra* note 13 at 105.
[16] See 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 vol 7 (Vienna: Springer-Verlag, 2011) at 122.
[17] See Skytrac, "SKYTRAC Uses Satellite Technology to Track Aircraft Position" (26 March 2020), online: *Skytrack* <www.skytrac.ca/skytrac-uses-satellite-technology-track-aircraft-position/>.

transportation and what role it could play in regulating criminal activities and averting criminal acts.

Most of the literature discusses the law applicable to suborbital vehicles that offer tourist flights to a suborbital height before returning to Earth. Rather than suborbital tourist flights, this thesis will address the regulation of commercial point-to-point transportation via a suborbital vehicle in the areas of air traffic management and aviation criminal law, both of which are elements of Aviation Security. It will be argued that these flights should fall under air law rather than space law. It must be noted at this point when the present thesis mentions suborbital flights or suborbital vehicle, it means suborbital vehicles that are engaged in international point-to-point transportation rather than suborbital tourist flights.

The next sections of this Introduction will address the definition of suborbital vehicle and suborbital flights, examine briefly current legislation pertaining to suborbital flights and provide an overview of the ongoing discussion on whether to take the Functionalist or Spatialist Approach and problems arising from it.

Chapter I and II will be dedicated to two aspects of Aviation Security as it relates to suborbital flights: air traffic management and aviation criminal law.

Chapter I will explore how current air traffic management can be applied to suborbital vehicles engaged in point-to-point transportation and what role it can play in averting criminal acts.

Chapter II will discuss how aviation criminal law can be applied to suborbital point-to-point flights when criminal activities occur during a flight to create a harmonized system that ensures the safety of all participants. A particular focus will be the applicability to suborbital flights of the *Convention for the Suppression of Unlawful Acts against the Safety of*

*Civil Aviation* (Montreal Convention 1971) and the *Convention on the Suppression of Unlawful Acts relating to International Civil Aviation* (Beijing Convention 2010).[18]

## 2. Overview of Suborbital Vehicles and the Current State of Play

This section will introduce the legal issues that will be discussed in the balance of the thesis. It will give an overview of current legislation pertaining to suborbital flights and current legal arguments and positions taken on the law applicable to suborbital flights. It will also explain the current terminology regarding commercial suborbital vehicles engaged in point-to-point transportation.

### a. Definition of "suborbital"

Air and space technologies have evolved and are no longer the exclusive monopoly of states. Rather, commercial interests are the driving force behind development and exploration today.[19] Companies, such as SpaceX, have taken over operations that where once considered to be solely a governmental responsibility such as delivering equipment and provisions to the International Space Station (ISS).[20]

It comes, therefore, as no surprise that the private sector will be the major player in technological development since the suborbital market is projected to grow significantly in the next years.[21] However, to this day there has not been a universally accepted definition of

[18] *Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation*, 23 September 1971, 974 UNTS 177 (entered into force 26 January 1973) [*Montreal Convention 1971*]; *Convention on the Suppression of Unlawful Acts relating to International Civil Aviation*, 10 September 2010, UNTS (entered into force 1 July 2018) [*Beijing Convention 2010*].
[19] As an example may serve the privatisation of Intelsat in the early 2000s. See generally Francis Lyall, "On the Privatisation of Intelsat" (2000) 28:2 J Space L 101.
[20] See Sean Potter, "NASA to Air Departure of SpaceX Cargo Dragon from Space Station" (4 January 2021), online: *NASA* <www.nasa.gov/press-release/nasa-to-air-departure-of-upgraded-spacex-cargo-dragon-from-space-station>.
[21] *Supra* note 9. See also Zahara & Romli, *supra* note 10 ss 2.1 – 2.2.

‘suborbital’ or any of its related activities for the purpose of regulating them in the context of international point-to-point commercial transportation.

ICAO has defined suborbital flight as “a flight up to a very high altitude which does not involve sending the vehicle into orbit.”[22] The International Association for the Advancement of Space Safety defines it as “a flight up to an altitude at which the vehicle does not reach its corresponding orbital velocity.”[23] Members of EASA have expressed the view that ‘suborbital’ means to bring “to high altitudes (…) passengers and/or payload and return them safely back to Earth without reaching orbital speeds and therefore, without being able to stay in space.”[24] In a press release the European Space Agency (ESA) categorises ‘suborbital’ as instances in which “the vehicle reaches space but does not have the much greater speed required to enter orbit.”[25]

The United States of America is among the very few jurisdictions to date that has enacted legislation regarding suborbital activities: It classifies a suborbital rocket, a subcategory of launch vehicle, as “a vehicle, rocket-propelled in whole or in part, intended for flight on a suborbital trajectory, and the thrust of which is greater than its lift for the majority of the rocket-powered portion of its ascent” and defines suborbital trajectory as the “the intentional flight path of a launch vehicle, re-entry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth.”[26] The Federal

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[22] ICAO, "Concept of Sub-Orbital Flights" (2005) Working Paper C-WP/12436 s 1.2 [WP12436].
[23] IASS, “Guidelines for the safe regulation, design and operation of Suborbital Vehicles” (December 2013) at 2, online (pdf): *FAA* <www.faa.gov/about/office_org/headquarters_offices/ast/advisory_committee/meeting_news/media/2014/may/15_IAASSSuborbitalSafetyGuidelinesManual_Dec2013_Master.pdf> [IASS Manual].
[24] Jean-Bruno Marciacq et al, “Establishing a Regulatory Framework for the Development & Operations of Sub-Orbital & Orbital Aircraft (SOA) in the EU” (Paper delivered at the 6th IAASS Conference in Montreal, 21-23 May 2013) at 1.
[25] SpaceRef, “The new – suborbital – frontier” (7 December 2010), online: *SpaceRef* <www.spaceref.com/news/viewpr.html?pid=32209>.
[26] *National and Commercial Space Programs,* 51 USC § 50902 (2010).

Aviation Administration (FAA) stated that a suborbital rocket does not reach the velocity necessary to orbit the Earth but can reach altitudes that could be considered outer space.[27]

Although these definitions differ in its details, they nevertheless create an overlapping and general theme of what should be considered 'suborbital' namely to go up to an orbital height without achieving orbital velocity.[28] Consequently, a suborbital flight should be considered a flight that reaches a very high altitude while staying below orbital velocity. This definition of 'suborbital flight' will serve as a working definition for this thesis.

### b. Air Law or Space Law?

The regulation of suborbital flights does not currently cause problems as all suborbital flights that are presently being conducted and tested, most notably by Virgin Galactic, do not cross any international state borders and therefore fall under national law. Once they start crossing borders, problems will arise as it shifts them from the national to the international legal arena and international treaties could apply.

The double nature of suborbital vehicles, that is their capability of utilizing airspace as well as outer space and their hybrid design, will pose a serious problem from a legal standpoint. Which legal regime – air law or space law – should apply to suborbital vehicles engaged in international point-to-point transportation? This question is of utmost importance as these two legal regimes could not be more different.

As reflected in Article 1 of the *Convention on International Civil Aviation 1944* (Chicago Convention) Air Law is founded upon the principle that "every State has complete

[27] See *Experimental Permits for Reusable Suborbital Rockets*, 72 Fed Reg 17001 (2007).
[28] See especially Scott, "Suborbital Passenger Transportation", *supra* note 15 at 279–281.

and exclusive sovereignty over the airspace above its territory."[29] This principle is well recognised by and between states.[30] Consequently, a state has control over its airspace, can close it and regulate it.[31] In contrast, as reflected in Article 1 of the *Outer Space Treaty 1966*, space law is based on the principle of freedom of exploration and non-appropriation and outer space is thus "province of all mankind."[32] In other words, while airspace above its territory "belongs" to the relevant state, outer space does not belong to anybody and can be referred to as *res communis*.

There are two widely debated approaches to determine whether regulation of suborbital flights is the province of air law or space law: The Functionalist Approach and the Spatialist Approach.

### i. *Functionalist Approach*

The Functionalist Approach, as the name suggests, looks at the function of the vehicle and its operation. It is not concerned with the location of the activity that is carried out by the vehicle.[33] It explores what legal regime applies by examining what kind of object is used – 'aircraft' or 'space object'. [34] There are multiple ways to determine whether the vehicle in

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[29] See *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295 art 8 (entered into force 4 April 1947) [*Chicago Convention*]. See also Dempsey & Manoli, *supra* note 11 at 216; Ram S. Jakhu, "Legal Aspects of Suborbital Personal Flight" in Angie Bukley & Walter Peeters, eds, *Private Human Access to Space*, (Paris: International Academy of Astronautics, 2014) 62 at 63.

[30] See Stefan A. Kaiser, "Sovereignty in the Air: From National Security to the Single European Sky" (2010) 35 Ann Air & Sp L 153 at 154–55; Alexandre Israel, *Reconsidering the Legal and Institutional Challenges*: *A New Approach to Suborbital Flights* (Master of Law, University of Luxembourg, 2019) at 39 [unpublished].

[31] Although Article 1 of the Chicago Convention speaks of "complete and exclusive sovereignty [of a state] over the airspace above its territory" this sovereignty is not limitless. Art 9, for instance, mandates that a state cannot close its airspace to individual countries but must rather do it in a way "that no distinction in this respect is made between the aircraft of the State whose territory is involved, engaged in international scheduled airline services, and the aircraft of the other contracting States likewise engaged."

[32] See *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 art I (entered into force 10 October 1967) [*Outer Space Treaty*]. See also Paul Stephen Dempsey, *Public International Air Law*, 2nd ed (Montreal: Centre for Research in Air and Space Law, 2008) at 749.

[33] See Francis Lyall & Paul B Larsen, *Space law: a treatise*, 2nd ed (New York: Routledge Taylor & Francis Group, 2018) at 149. See also Israel, *supra* note 30 at 35.

[34] Dempsey, *supra* note 32 at 751.

question is ‘aircraft’ or ‘space object’. One way is to examine the specifications and primary purpose of the vehicle.[35] Does the vehicle conduct operations in an Earth-to-Earth context, or does it primarily go into Outer Space? The latter would suggest that it operates as a ‘space object’ while in the former case it arguably does not.[36] Another way is to look at the specifications of the vehicle, that is the technological properties, aerodynamic design and controls.[37] Is the vehicle aerodynamically able to generate lift from the air? If the answer is yes, then it arguably can be classified as ‘aircraft’ and air law would apply.[38]

The Functionalist Approach therefore differentiates between ‘aircraft’ and ‘space object’. If the vehicle in question is considered ‘aircraft’, air law applies. On the other hand, if the vehicle is classified as ‘space object’, it is subject to space law. We must therefore look more closely at these two terms.

What exactly does ‘aircraft’ mean? Surprisingly, although the Chicago Convention uses the term ‘aircraft’ multiple times, it does not actually define it. ICAO provided a definition in Annex 7 which defines ‘aircraft’ as “any machine that can derive support from the atmosphere from the reactions of the air other than the reactions of the air against the earth’s surface.”[39]

The question whether a vehicle that can reach suborbital height should be considered an aircraft was secondary in the past. Any activity that reached suborbital heights (and above) was usually conducted within the respective space programs of different states. So, these vehicles, even when they derived support from the air, were state property and the Chicago Convention expressly excludes ‘state aircraft’ from ICAOs jurisdiction.[40]

[35] Dempsey & Manoli, *supra* note 11 at 219.
[36] Dempsey, *supra* note 32 at 751–52.
[37] *Ibid* at 752.
[38] *Ibid.*
[39] *Aircraft Nationality and Registration Marks*, ICAO, Annex 7 to the Convention on International Civil Aviation, (2012), s 1 [Annex 7].
[40] *Chicago Convention*, *supra* note 29 art 3 (a).

However, as already noted, more and more private enterprises are engaging in activities that could potentially involve outer space. If the vehicles used are considered 'aircraft', they cannot be classified as 'state aircraft' but must rather be 'civil aircraft' which would make the Chicago Convention applicable.

The term 'space object' is not defined in the five Space Treaties and they were all largely developed without regard to commercial interests.[41] While the *Liability Convention* indicates that a 'space object' includes "component parts of a space object as well as its launch vehicle and part thereof" [42] it does not define the term 'space object' itself.

The next section will explain the Spatialist Approach and discuss why suborbital vehicles should be considered aircraft and why the Functionalist Approach is the most favourable option.

### *ii. Spatialist Approach*

The second approach is referred to as Spatialist Approach. While the Functionalist Approach looks at the function of the vehicle, the Spatialist Approach uses the location of the vehicle to determine which legal regime applies and thus necessitates a definitive boundary between airspace and outer space.[43] In other words: If the vehicle is located in outer space, space law applies, if it is located in airspace, air law applies. For the Functionalist Approach, on the other hand, a demarcation line is irrelevant.[44]

It is generally agreed that the demarcation line should be located somewhere between 80 and 100 km above the Earth's surface, as the air becomes too thin to support any flying

[41] Dempsey, *supra* note 32 at 754–55. The five space treaties are: The Outer Space Treaty 1967, The Rescue and Return Agreement 1968, The Liability Convention 1972, The Registration Convention 1976 and the Moon Agreement 1979 .
[42] *Convention on International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187 art I (entered into force 01 September 1972).
[43] Dasgupta, *supra* note 13 at 245.
[44] *Ibid.*

object unless it travels at orbital velocity.[45] However, the exact location of this boundary line is still very much debated, and states have not reached a consensus.[46] Various opinions for and against a definition and delimitation of outer space have been brought forward by states. In 2020 the Committee on the Peaceful Uses of Outer Space (UNCOPUOS) published a summary of the considerations brought forward by states regarding the definition and delimitation of outer space.[47] It was reported that states in support of an exact delimitation believed that it would, inter alia, reduce the possibility of disputes between states, help to determine the exact application of air and space law, ensure the implementation of the principle of freedom of use of outer space for peaceful purposes, enable a precise definition of whether a vehicle is space object or aircraft and help to demarcate clearly the sphere of influence of states and private actors in the commercial space sector.[48] On the other hand, states that were opposed to delimitation brought forward that the current framework in place has not presented any meaningful difficulties, the absence of a definition has not resulted in any practical problems, air law and space law worked well in their respective spheres and that a definition, given the current level of development of space technologies, is not necessary.[49] This shows that there is still a high degree of varying opinions and states are quite far from reaching consensus.

On a national level, only Australia has enacted actual legislation declaring that all its activities above 100 km shall be considered space activities.[50] Russia proposed an "altitude

[45] Dasgupta, *supra* note 13 at 245; Tronchetti, *supra* note 13 at 178. See also *Historical summary on the consideration of the question on the definition and delimitation of outer space*, UNCOPUOS, UN Doc A/AC.105/769/Add.1 (2020) s 7(a) – (e) [UNCOPUOS Summary].
[46] *Cf* Bin Cheng, *Studies in International Space Law*, (New York: Oxford University Press, 1997) at 35ff. See also Scott, "Suborbital Passenger Transport", *supra* note 15 at 286; Dempsey & Manoli, *supra* note 11 at 233.
[47] UNCOPUOS Summary, *supra* note 45.
[48] *Ibid* s 5(a), (f), (j), (q), (r).
[49] UNCOPUOS Summary, *supra* note 45 s 6(a), (c)–(e).
[50] See *Space Activities Act* (Austl), 1998/123.

not exceeding 110 kilometres above the sea level."[51] The Chinese-Russian Draft Treaty on the Prevention of Placement of Weapons in Outer Space (PPWT) that was proposed at the International Conference of Nuclear Disarmament in 2008 defined outer space as "the space above the Earth in excess of 100 km above sea level."[52] However, this definition was not retained in the second version of the PPWT in 2014.[53] Serbia proposed in 2010 that outer space should begin at a distance of 2 million kilometres from the Earth.[54]

The Chicago Convention (and its predecessor the Paris Convention 1919[55]) recognize the complete and exclusive sovereignty of a state over its airspace but neglect to mention where airspace ends.[56] As mentioned above, suborbital vehicles engaged in point-to-point transportation will operate at suborbital altitude only briefly. If one were to strictly apply the Spatialist Approach, the vehicle would be subject to space law during the period it spends above the demarcation line, while the rest of the flight would be governed by air law. This would subject the vehicle to two separate and different legal regimes during the same flight. Further, as Dempsey and Manoli point out, "if a legal question arose during a flight near the point of demarcation between air space and outer space, it might be difficult to determine on which side of the line the event occurred."[57]

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[51] UNCOPUOS, LSC, *Matters relating to the Definition and, or Delimitation of Outer Space and Outer Space Activities, Bearing in Mind inter alia, Questions Relating to the Geostationary Orbit*, UN Doc A/AC.105/C.2/L.139, 4 April 1983.

[52] UNODA, Conference on Disarmament, *Letter dated 12 February 2008 from the Permanent Representative of the Russian Federation and the Permanent Representative of Chine to the Conference on Disarmament addressed to the Secretary-General of the Conference transmitting the Russian and Chinese Texts of the Draft "Treaty on the Prevention on Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT)" introduced by the Russian Federation and China*, UN Doc CD/1839, 29 February 2008 at 2.

[53] See UNODA, Conference on Disarmament, *Letter dated 10 June 2014 from the Permanent Representative of the Russian Federation and the Permanent Representative of China to the Conference on Disarmament addressed to the Acting Secretary-General of the Conference transmitting the updated Russian and Chinese texts of the draft treaty on prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects (PPWT) introduced by the Russian Federation and China*, UN Doc CD/1985, 12 June 2014.

[54] See UNCOPUOS, LSC, *National legislation and practice relating to the definition and delimitation of outer space*, 49th Sess, UN Doc A/AC.105/865/Add.6, 11 January 2010.

[55] *Convention Relating to the Regulation of Aerial Navigation*, 13 October 1919, 11 LNTS 173 Art I (entered into force 29 March 1922).

[56] Dempsey & Manoli, *supra* note 11 at 234.

[57] *Ibid*.

### c. Suborbital Point-to-Point Transportation

In the light of the above discussion, we must now determine whether a suborbital vehicle should be considered 'aircraft' and thus fall under the legal regime of air law. As already mentioned, these vehicles will be used to transport cargo or passengers, or both, from one point on Earth to another - the same undertaking that is currently being conducted by modern aircraft (aeroplanes).[58] During their journey they will utilize high suborbital altitudes only for a relatively short period; the majority of the flight will be conducted at a height where the vehicle can sustain flight.[59] A journey from Washington DC to Tokyo, normally 14 hours, would only take 2 hours.[60]

Considering the point-to-point nature of these flights, the Functionalist Approach seems most appropriate to determine the applicable legal regime. This raises the question whether suborbital vehicles should be considered 'aircraft' or 'space object'. After all, many of the proposed prototypes include variants that are typical of both, ordinary airplanes and rockets. This has prompted the suggestion that both regimes – air and space law – should apply to these flights.[61] Some authors even go so far as to suggest a completely new legal regime to govern this emerging industry.[62]

However, the first view would be contrary to the foundations of international aviation law, namely standardisation and harmonisation, and would create a confusing and at times

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[58] See Israel, *supra* note 30 at 82. *Contra* Balleste, *supra* note 12 at 1035.
[59] This will be below 100km. The Physiscist von Kármán calculated that 100km is the height at which a vehicle would have to start travelling at orbital velocity to have sufficient lift to derive suppport from the atmosphere. It is the highest alititude at which ordinary aerodynamical controls lose their ability to control the aircraft and alternative means are needed. See Dempsey & Manoli, *supra* note 11 at 230.
[60] See The Tauri Group, "Suborbital Reusable Vehicles: A 10-Year Forecast of Market Demand" (2012) at 82, online (pdf): *FAA* <www.faa.gov/about/office_org/headquarters_offices/ast/media/suborbital_reusable_vehicles_report_full.pdf>.
[61] See Yu Takeuchi, "Regulatory Regime for Tomorrow's Suborbital Space Flights: Point-to- Point International Flights" (2014) 57 Proceedings Intl Institute Space L 487 at 491.
[62] See e.g. Catalano Sgrosso, *supra* note 5 at 478; Balleste, *supra* note 12 at 1057ff; Scott, "Suborbital Passenger Transportation", *supra* note 15 at 311.

conflicting legal system. Further, as explained below, the second view fails to recognise the difficulty of creating a completely new international legal regime for suborbital flights and the reluctance of states to do so.[63]

It is the view of the author that suborbital vehicles engaged in point-to-point transportation should be considered 'aircraft' and fall solely under the regime of air law. This would not only ensure the safety of all participants but also create a clear legal environment for the operation of suborbital flights. ICAO seems to prefer this point of view and has stated that current air law could, in theory, accommodate suborbital vehicles that are engaged in point-to-point transportation and that an amendment of the existing Annexes or the creation of a new Annex to the Chicago Convention is possible.[64] The European Space Agency similarly considers that civil aviation authorities should play a leading role in the regulation of suborbital flights as these flights will substantially be carried out in civil airspace.[65]

The European Aviation Safety Agency (EASA) is the competent authority in Europe and regulates aviation safety, including airworthiness and licensing.[66] Members of EASA therefore favour a Functionalist Approach and expressed the view that suborbital vehicles should be considered 'aircraft' and thus fall under the authority of the agency.[67]

The Chicago Convention was created as an international instrument to ensure safe and orderly growth of international civil aviation.[68] It should be seen as a 'living constitution' that

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[63] This matter will be discussed more in detail below.
[64] WP12436, *supra* note 22.
[65] See ESA, "ESA's position on privately-funded suborbital spaceflight" (10 April 2008), online (pdf): *ESA* <esamultimedia.esa.int/docs/gsp/Suborbital_Spaceflight_ESA_Position_Paper_14April08.pdf>.
[66] See e.g. Jean-Bruno Marciacq et al, "Accommodating sub-orbital flights into the EASA regulatory system" in Joseph N. Pelton & Ram S. Jakhu, eds, *Space Safety Regulations and Standards*, (Oxford: Elsevier, 2010) 187 at 191–92; EU Regulation 2018/1139 establishes EASA and lays down common rules in the field of aviation in the EU. EASA itself has the ability to issue directives regulating competences that were conferred onto the agency by virtue of EU Regulation 2018/1139 (e.g. Airworthiness).
[67] See Jean-Bruno Marciacq et al, "Towards regulating sub-orbital flights an updated EASA approach" (Paper delivered at the Fourth IAASS Conference 'Making Safety Matter' in Huntsville, Alabama, USA 19-21 May 2010) s 2.2.2.
[68] *Chicago Convention*, *supra* note 29 Preamble.

embraces technological advancements and adapts to changing times rather than a rigid document frozen in the aviation context when it was signed in 1944.[69]

Further, the system that was subsequently developed by ICAO through Annexes to the Chicago Convention established a sophisticated 'net' of safety and security standards.[70] As Havel and Sanchez put it "the [Chicago] Convention has been ratified by more than 190 States and contains universal rules covering airspace sovereignty, aircraft registration and airworthiness, navigation, and global Standards and Recommended Practices (SARPs) for technical and safety harmonization."[71]

It would be remiss, even contradictory to the Chicago Convention, if we were to shift suborbital vehicles into the legal regime of outer space and classify them as space objects, thereby displacing the civil aviation system that has been carefully crafted over the past 70 years. It would undermine the goal of the orderly and safe development of international civil aviation as envisioned by the Chicago Convention in its Preamble.[72]

However, does the very definition of 'aircraft' found in Annex 7 – "any machine that can derive support from the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface"[73] – exclude suborbital vehicles engaged in international point-to-point transportation? The author submits that it does not. If the vehicle operates close to orbital velocity (28,400 km/h), it should generate enough lift from the reactions of the air to sustain flight while remaining still a suborbital vehicle.[74] Once the vehicle reaches the

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[69] See generally Brian F. Havel & John Q. Mulligan, "International Aviation's Living Constitution: A Commentary on the Chicago Convention's Past, Present, and Future" (2015) 15:1 Issues Aviation L & Pol'y 7.
[70] Only three Annexes (9,16 and 17) do not primarily deal with safety realted issues.
[71] Brian F. Havel & Gabriel S. Sanchez, *The Principles and Practice of International Aviation Law,* (New York: Cambridge University Press, 2013) at 20.
[72] The Preamble states, inter alia, that governments have "agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically." In this regard the Chicago Convention must be seen as proactive document. It was created to enable future development of air transport and civil aviation. See generally Havel & Mulligan, *supra* note 69.
[73] Annex 7, *supra* note 39.
[74] *Cf* Dempsey & Manoli, *supra* note 11 at 234.

100km altitude (the so-called van Kármán Line), it would need to achieve orbital velocity to sustain flight. However, even the suborbital vehicles that are currently being tested for tourists are not meant to sustain flight above 100km. As long as the vehicle travels slower than orbital velocity it remains a suborbital vehicle regardless of altitude.[75] The vehicle will reach this height only for a couple of minutes before gliding down to lower altitudes. In effect, it operates as a glider. Ordinary gliders do fall under the definition of aircraft.[76] Consequently, it would be appropriate to also consider suborbital vehicles as aircraft, even when they are operating briefly above the van Kármán Line.

Once suborbital vehicles start offering international point-to-point flights on a regular basis, their rising economic value will result in states having greater interest in regulating them. However, achieving international consensus on a new regulatory regime his highly unlikely and, in the view of the author, almost impossible. States will most likely prefer the system they already know, and which has worked well to date, i.e., the regulatory regime of air law. This will be especially true for states that have neither a presence in outer space apart from satellites nor any particular interest in suborbital passenger service and therefore no interest in advocating for a different legal regime. More generally, in the 21st Century states have shown increasing unwillingness to subject themselves to binding international legal instruments such as conventions and achieving consensus is becoming increasingly difficult.[77] Global governance architectures, be legal or institutional, are becoming more

[75] *Ibid*.
[76] See e.g. Benjamyn I Scott & Andrea Trimarchi, *Fundamentals of International Aviation Law and Policy*, 1st ed (New York: Routledge Taylor & Francis Group, 2020) at 37; Annex 7, *supra* note 39 at 1. See also Israel, *supra* note 30 at 47; .
[77] See Ram S. Jakhu & Joseph N. Pelton, eds, *Global Space Governance: An International Study*, (Cham: Springer International Publishing, 2017) at 37, 51; Israel, *supra* note 30 at 84 .

fragmented and "[a]lready weak international laws are becoming even more so"[78], partly as a result of the rising number of global players, including NGOs.[79]

In sum, the current environment makes it increasingly difficult to create a new global regime to specifically addresses suborbital fights and states will need to fall back on the well-established civil aviation system that has been accepted by more than 190 states. Considering that suborbital flights will offer the exact same service as modern aircraft, the only difference being the altitude used to conduct the service and considering that suborbital vehicles will share the same space with ordinary aeroplanes, states will likely prefer to use the same system to control and regulate them.

Furthermore, in today's increasingly interconnected global economy, restrictions on the international transportation of goods and people must be minimised. States should therefore accept the aviation system that is already in place, especially since, as argued above, it can be applied to suborbital vehicles.

For all of the above reasons, it is submitted that suborbital vehicles engaged in point-to-point transportation should be considered aircraft. This means that air law would apply to suborbital flights.

The entire system of aviation is only possible through an efficient system of air navigation, which influences all aspects of aviation, including the criminal side. Consequently, Chapter I will examine air traffic management in detail. The transition from ground to satellite-based radar systems will enable real time and precise tracking of air traffic movements and eliminate any 'black spots' without radar coverage. Air service providers will

[78] Jakhu & Pelton, *supra* note 77 at 18. The International Law Commission (ILC) highlighted and examined the phenomenon of fragmentation of international law and noted that the emergence of specialized rules and rules-system that share no relationship with one another is one of the root causes of the fragmentation of international law and that the expansion of international law has taken place in an uncoordinated fashion. See *Report of the International Law Commission*, UNGA, 61st Sess, Supp No 10, UN Doc A/61/10 (2006) at 242.
[79] *Cf* Raymond Saner & Lichia Yiu " Business-Government-NGO Relations: Their Impact on Global Economic Governance" in Andrew F Cooper, Brian Hocking & William Maley, eds, *Global Governance and Diplomacy: Worlds Apart?*, (London: Palgrave Macmillan UK, 2008) 86 at 101–02.

be in a better position to help avoid criminal acts, attempted or in progress, and through precise tracking keep other flights safe. Satellite navigation systems can transmit crucial data such as engine data, fuel data, and flight system data.[80] Additionally, satellite systems can be programmed to automatically raise an alert if unexpected events take place such as flying off the flight path, missing a waypoint or other unusual aircraft behaviour.[81] This could significantly increase safety and decrease the "reaction-time" to potential criminal threats. If an aircraft is lost (for example due to criminal acts), the precise tracking capabilities of satellite-based radar systems will enable authorities to locate the fuselage quickly and efficiently. As Chapter I of the thesis will demonstrate in detail, all these aspects can be utilised to counteract criminal activities in aviation including in the context of suborbital flights.

Chapter II of this thesis will examine the criminal side of air law in more detail and how it should apply to suborbital flights in case criminal acts are committed against suborbital vehicles while in flight. In particular, the emerging threat of cyberterrorism will be explored by discussing the *Montreal Convention 1971* and the *Beijing Convention 2010*. It will be argued that aviation criminal law can be applied to suborbital flights, thereby exemplifying why air law is best suited to govern suborbital flights.

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[80] See Skytrac, "SKYTRAC Uses Satellite Technology to Track Aircraft Position" (26 March 2020), online: *Skytrack* <www.skytrac.ca/skytrac-uses-satellite-technology-track-aircraft-position/>.
[81] *Ibid.*

## Chapter I – Aviation Security and Suborbital Flights: Air Traffic Management

Although the term 'aviation security' is not expressly mentioned in the Chicago Convention, Article 4 provides that contracting states agree not to use "civil aviation for any purpose inconsistent with the aims of [the] Convention."[82] To this end the Convention Preamble states that the principles and arrangements agreed to in the Convention are aimed at the development of international civil aviation in a "safe and orderly manner"[83] to ensure that it does not " become a threat to the general security."[84] Therefore, the core principle of the Chicago Convention is to develop civil aviation in a way that ensures the safety and security of all participants. This core value guides the work of ICAO and the overwhelming majority of Annexes deal with safety and security.[85]

Although the terms 'safety and security' are frequently used in the same sentence and share the same goal, namely to protect aircraft, crew, passengers and cargo from harm, there is a subtle but important difference between them: as Dempsey observes "safety focuses on prevention from unintentional harm, while security focuses on intentional harm."[86]

That said, aviation safety and security issues cannot always be strictly separated. Many areas, such as air navigation services, address both safety and security. On the one hand air navigation services keep the skies safe by providing air traffic information and guiding airplanes to avoid accidents (unintentional harm). On the other hand, they deal with potential security issues such as hijacked aircraft (intentional harm).

ICAO has expressly recognised the important role air traffic management plays in aviation security, observing that air navigation service providers "have also been more

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[82] *Chicago Convention*, *supra* note 29 art 4.
[83] *Ibid* Preamble.
[84] *Ibid*.
[85] *Supra* note 70.
[86] Dempsey, *supra* note 32 at 237.

frequently involved in supporting roles in national security and law enforcement situations, including disaster prevention."[87] These criminal incidents "[can] have profound negative impacts on the aviation system."[88]

Therefore, this chapter will look at the applicability of the current air traffic management (ATM) system to suborbital flights and how it can be effectively utilised to help manage criminal acts. Chapter II will then examine aviation criminal law and how criminal acts onboard a suborbital vehicle, or directed at a suborbital flight, should be addressed.

## Air Traffic Management

### 1. Introduction to the Chapter

ATM plays a pivotal role in the orderly and safe development of modern civil aviation. It ensures that all participants, from the smallest Cessna to the largest jet liner, can safely share, operate and use the airspace for their operations. Although ATM plays an important role in international aviation, it is handled nationally. This is the direct result of the sovereignty of each state over the airspace above its territory as enshrined in Article 1 of the Chicago Convention.[89] ATM is the most obvious and effective way for a state to assert sovereignty over its airspace and control all participants. It also helps to preserve a state's security and national defence interests.[90] In sum, "States' sovereignty over the airspace above their territories goes hand in hand with the States' responsibility for Air Traffic Management in that airspace."[91]

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[87] *Air Traffic Management Security Manual*, ICAO, Doc 9985 AN/492 (2013) at vii.
[88] *Ibid.*
[89] Chicago Convention, *supra* note 29 art 1.
[90] As an example may serve the closure of US Airspace after the 9/11 attacks on the World Trade Center. The United States feared further attacks and closed its airspace to all flights.
[91] Catherine Erkelens, "Sovereignty in Relation to Air Traffic Management" in Pablo Mendes de Leon & Niall Buissing, eds, *Behind and Beyond the Chicago Convention*, (Alphen aan den Rijn: Kluwer Law International, 2019) 187 at 187.

On the other hand, the ATM system is also needed for international civil and commercial aviation. It determines what route a plane can take, at what altitude it needs to fly and how it can safely navigate the skies. What used to be a rudimentary system has developed into a sophisticated international cooperative framework enabling millions of flight movements each day.

As mentioned earlier, suborbital vehicles engaged in point-to-point transportation will traverse altitudes that are used by ordinary aeroplanes while also reaching heights over 100km for a brief period of time. Considering that there is currently a transition from ground-based to satellite-based radar systems, suborbital vehicles could be regulated via the same ATM system that is currently in place. This chapter will discuss how these flights can be included in and handled by a satellite-based ATM system to ensure the safety of all participants. More specifically, it will look at how this system can be used to prevent criminal acts and regulate criminal activities during a suborbital flight to make the skies safer.

## 2. Current Air Traffic Management System

### a.) Chicago Convention

We first need to examine the regulatory regime that is currently in place to provide efficient air navigation and air traffic services and how it addresses today's aviation market.

ATM forms part of the necessary infrastructure that enables the transport of people and cargo by air on a global scale.[92] ATM is an air navigation service that handles air traffic primarily through air traffic control (ATC), air traffic flow management (ATFM) and airspace management (ASM).[93] It makes it possible for an aircraft to fly safely from one point

[92] See Margaret Arblaster, *Air Traffic Management: Economics, Regulation and Governance*, (Amsterdam: Elsevier, 2018) 1 at 1.
[93] *Ibid* at 11.

to the next using a sophisticated system to ensure separation between aircraft and smooth air traffic flow.[94]

The term ATM must not be confused with the term air navigation services (ANS). ANS refers to a range of services such as search and rescue, meteorological services, aeronautical information services in addition to ATM.[95] In other words, as the following chart illustrates, ATM is a subcategory of ANS.

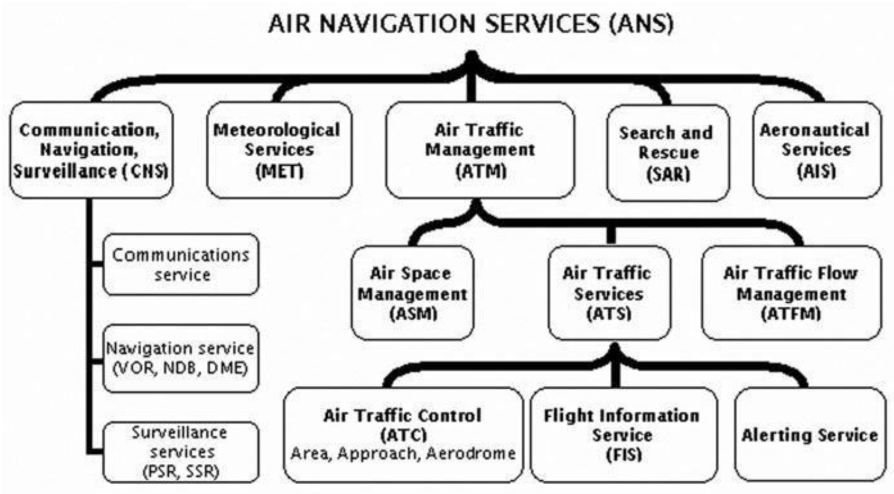


Figure 1.1 from Andrew Cook, ed, *European Air Traffic Management*, (New York: Routledge Taylor & Francis Group, 2007)

The foundation of this system can be found in the Chicago Convention. The Convention requires that all laws and regulations pertaining to the admission or departure of an aircraft from the territory of a state party to the Convention must be applied to the aircraft of all contracting states without any distinction as to nationality and likewise all aircraft entering the territory of a party must comply with these rules and regulations.[96]

The Convention further requires that each contracting state undertake to adopt measures to ensure that every aircraft flying through its airspace complies with "the rules and regulations relating to the flight and manoeuvre of aircraft."[97]

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[94] Arblaster, *supra* note 92 at 2.
[95] *Ibid*.
[96] *Chicago Convention*, *supra* note 29 art 11.
[97] *Ibid* art 12.

Each state must make sure “to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under [the Chicago] Convention.”[98] Further, contracting states must adopt all practicable measures that facilitate air navigation between their territories and provide international air navigation services.[99]

To this end ICAO, as the body entrusted with the safe and orderly growth of civil aviation, has created appropriate Annexes that establish Standards and Recommended Practices (SARPs) that states need to follow when providing air navigation and ATM services. Annex 2 “Rules of the Air” and Annex 11 “Air Traffic Services” are two Annexes that ICAO has created to establish appropriate SARPs in this regard.[100]

Although ATM is critical to the operation of the international aviation network and keeps the whole machinery running, ANS are, as already mentioned, the responsibility of individual states.[101] This stems from the wording of the Chicago Convention that delegates this power to the contracting states as a direct result of the sovereignty principle[102]: that is, the principle that a state asserts and exercises its sovereignty over its airspace via ANS, in particular via ATM.[103]

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[98] *Ibid.*
[99] *Ibid* arts 22, 28.
[100] See *Rules of the Air*, ICAO, Annex 2 to the Convention on International Civil Aviation, (2005); *Air Traffic Services*, ICAO, Annex 11 to the Convention on International Civil Aviation, (2018).
Annex 3 “Meteorological Service for International Air Navigation” is another Annex that deals in part with air traffic management.
[101] This is made clear by Article 28 of the Chicago Convention:
“Each contracting State undertakes, so far as it may find practicable, to:
(a) Provide, in its territory, airports, radio services, meteorological services and other air navigation facilities to facilitate international air navigation, in accordance with the standards and practices recommended or established from time to time, pursuant to this Convention;
(b) Adopt and put into operation the appropriate standard systems of communications procedure, codes, markings, signals, lighting and other operational practices and rules which may be recommended or established from time to time, pursuant to this Convention;
(c) Collaborate in international measures to secure the publication of aeronautical maps and charts in accordance with standards which may be recommended or established from time to time, pursuant to this Convention.”
[102] *Chicago Convention*, *supra* note 29 arts 12, 22, 28; The ATM Policy Institute, “The case for liberalising air traffic control” (January 2016) at 1/14, online (pdf): *The ATM Policy Institute* <www.atmpolicy.aero/wp-content/uploads/2016/12/The_ATM_Policy_Institute_Report.pdf> [ATM Report]. See also Francis Schubert, “Sovereignty and Air Navigation Services” in Pablo Mendes de Leon & Niall Buissing, eds, *Behind and Beyond the Chicago Convention*, (Alphen aan den Rijn: Kluwer Law International, 2019) 147 at 152–56.
[103] *Cf* Schubert, *supra* note 102 at 148.

No fly zones, air space closures and flight diversions can only be efficiently accomplished, and its compliance monitored, via ATM. For instance, after 09/11 the US closed its airspace to all aircraft and this closure was executed via ATM. ATM is comprised of and serves three main functions: airspace management, air traffic flow management and air traffic services.[104] ATM is provided by national air navigation service providers (ANSP).

Consistently with the sovereignty principle, ANSP are generally nationally controlled or under strict national supervision.[105] The applicable national regime is consequently influenced by cultural and regional diversity, including differences in traffic density, technological standards and security and defence concerns.[106] The discussion that follows compares the approaches taken in Canada, the US and the European Union. As will be seen, the problem of disharmony in national approaches is especially visible in the EU which is still in the process of unifying the airspace of individual member states into a community airspace.

### b.) Canada

NAV CANDA (NAV-C) is a private capital cooperation that owns, operates and handles air navigation services in Canada.[107] Created in 1996, it is considered to be the first fully privatised ANSP.[108] It coordinates over 3.3 million flights a year via a sophisticated network of more than 100 airport control towers and seven area control centres, which makes it one of the largest in the world.[109]

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[104] Arblaster, *supra* note 92 at 2

[105] *Ibid*; ATM Report, *supra* note 102 at 3/14.

[106] *Cf* Marc Bourgois, “Introduction” in Andrew Cook & Damián Rivas, eds, *Complexity science in air traffic management*, (New York: Routledge Taylor & Francis Group, 2016) 1 s 1.1. See also Arblaster, *supra* note 85 at 2, 5.

[107] See Clinton V. Oster & John S. Strong, *Managing the Skies*, (New York: Routledge Taylor & Francis Group, 2007) at 41.

[108] See NAV CANADA,"About Us - Who We Are” (last visited 11 February 2021), online: *NAV CANADA* <www.navcanada.ca/en/about-us/pages/who-we-are.aspx>.

[109] *Ibid*; Oster & Strong, *supra* note 107 at 41.

NAV-C's main revenue is generated by its customers rather than government subsidies, contrary to the approach in the US, where ANS are handled by the FAA.[110]

Although NAV-C's non-share private capital structure could generate enough incentive to modernize and update the ANS system in Canada, it makes NAV-C more dependent on the industry – NAV-C's financial stability is closely linked to the well-being of aviation sector.[111]

At the time of writing the full economic impact of COVID-19 is not yet known. Global border closures and the corresponding decline in air traffic have greatly reduced aircraft movements in Canada. NAV-C reported a decline by 58% in air traffic levels and a decrease of CAD 162 million in revenue.[112] It has already begun the financial restructuring process and laid off approximately 900 employees.[113]

### c.) United States of America

Contrary to Canada, ATM in the US is under strict government control. ATM is handled by the Air Traffic Organization, which is part of the Federal Aviation Administration (FAA).[114] The FAA is unique insofar as it is tasked with developing ATC rules and procedures while at the same time enforcing them through operational oversight.[115] It is both operator and regulator. It both develops the rules to which it is subject and enforces those rules. Simply put, the FAA is self-regulating in ATC matters.[116] This makes the US the only major country

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[110] *Supra* note 108.
[111] Oster & Strong, *supra* note 107 at 44–45,50.
[112] See NAV CANADA," NAV CANADA announces first quarter financial results" (13 January 2021), online: *NAV CANADA* <www.navcanada.ca/EN/Pages/NR-02-2021.aspx>.
[113] See NAV CANADA," NAV CANADA announces additional workforce change" (09 December 2020), online: *NAV CANADA* <www.navcanada.ca/EN/media/Pages/NR-49-2020.aspx>.
[114] See Federal Aviation Administration, "Air Traffic Organization" (last modified 05 December 2017), online: *FAA* <www.faa.gov/about/office_org/headquarters_offices/ato/>.
[115] Oster & Strong, *supra* note 107 at 152.
[116] *Ibid*.

to use a self-regulatory system – most other states have opted to separate the legislative procedures from operational oversight.[117]

The funding and budget of the ATM in the US largely depend on the annual appropriations passed by Congress rather than the operational fees that are charged to the air transport operators such as airlines.[118] This means that the FAA is under extensive and strict government oversight and subject to politically motivated decisions.[119]

Nevertheless, the FAA provides one of the biggest and most complex air navigation system in the industry.[120] The unified airspace of the US is frequently used as a benchmark when comparing the fragmentation of other markets, particularly in the European Union.[121]

### d.) European Union

The European Union is a unique "creature" in international aviation law. The Union is not party to the Chicago Convention and the provisions of the Convention do not directly apply to it.[122] However, all the Member States of the EU are party to the Chicago Convention and thus subject to its provisions.

117 *Ibid* at 156.
118 Arblaster, *supra* note 92 at 70.
119 *Ibid*; Oster & Strong, *supra* note 107 at 151.
120 *Cf* Oster & Strong, *supra* note 107 at 201.
121 Arblaster, *supra* note 92 at 46. See generally Ben Van Houtte, "The Single European Sky – EU Reform of ATM" in Andrew Cook, ed, *European Air Traffic Management*, (New York: Routledge Taylor & Francis Group, 2007) 181 at 181ff.
122 See Laura Pierallini, "Sovereignty: The Implications of the EU Internal Air Transport Market for Air Services Agreements with Third Countries" in Pablo Mendes de Leon & Niall Buissing, eds, *Behind and Beyond the Chicago Convention*, (Alphen aan den Rijn: Kluwer Law International, 2019) 233 at 237.

This requires a balancing act between the obligations states must fulfil under European Law and those under the Chicago Convention, particularly because the European Union has competence in major aspects of the aviation sector.[123]

The fragmentation of airspace and inefficient ATM in Europe posed a serious challenge to adequately "facilitate international air navigation" as envisioned by Article 28 of the Chicago Convention. Member states were unwilling to improve and innovate their ATM services.[124] Accidents quickly revealed the failure of a system that was the direct result of weak cooperation and the interaction of multiple factors, particularly the absence of shared ATM rules.[125]

This led the European Union to intensify the work on a single European air transport market. In 1999 the European Commission launched the Single European Sky (SES) initiative which was eventually adopted in 2004.[126] By adopting the SES Regulations the European Union decided to transcend national ANS in order to create a truly uniform regulatory framework capable of creating a harmonised set of ANS rules and address the

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[123] Article 100/2 of The Treaty on the Functioning of the European Union states that "the European Parliament and the Council, acting in accordance with the ordinary legislative procedure, may lay down appropriate provisions for sea and air transport. They shall act after consulting the Economic and Social Committee and the Committee of the Regions." This provision confers authority in air transport and aviation matters to the Union. Based on this competency the European Union has legislated many aspects of aviation such as flight crew licensing and airworthiness of aircraft and established appropriate authorities to oversee and steer the process such as the EASA. Further, the aviation market in Europe is integrated into one single European Common Aviation Area (ECAA). The ECAA Agreement was signed in 2006 between the European Union (including Norway and Iceland) and Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Kosovo. It came into force in 2017. For more details see European Commission, "International Aviation: ECAA" (last updated 14 May 2021), online: *European Commission* <ec.europa.eu/transport/modes/air/international_aviation/country_index/ecaa_en>.

[124] See Anna Masutti, "Sovereignty Pertaining to Air Traffic Management" in Pablo Mendes de Leon & Niall Buissing, eds, *Behind and Beyond the Chicago Convention*, (Alphen aan den Rijn: Kluwer Law International, 2019) 111 at 112.

[125] In 2002 a mid-air collision between Bashkirian Airlines Flight 2937 and DHL Flight 611 occurred in Überlingen near the Swiss-German border. One of the main reasons for the crash was the actions of the Swiss Air Traffic Controller and non-uniform rules regarding the Air Traffic Collision Avoidance System. For detailed information see German Federal Bureau of Aircraft Accidents Investigation, "Investigation Report AX001-1-2/02" (May 2004), online (pdf): *Bundesstelle für Flugunfalluntersuchung* <www.bfu-web.de/EN/Publications/Investigation%20Report/2002/Report_02_AX001-1-2_Ueberlingen_Report.pdf?__blob=publicationFile>.

[126] Van Houtte, *supra* note 121 at 181.

fragmentation of the system while still ensuring that all states fulfil their obligations under the Chicago Convention.[127]

The first SES legalisation (SES-I), based on Article 100/2 of the Treaty on the Functioning of the European Union (TFEU), was conceived as a pan-European project that is also open to neighbouring countries. This initiative was subsequently adopted and formalised through Regulation (EC) 549/2004, Regulation (EC) 550/2004, Regulation (EC) 551/2004 and Regulation (EC) 552/2004.[128] In 2009 the system was amended by Regulation (EC) 1070/2009 (SES-II). SAS-II aimed, among other goals, to merge the national European airspaces into 9 Functional Airspace Blocks (FABs).[129] The process was eventually completed in 2012 and the 9 FABs were established.[130] Despite this progress, ATM in the European Union is still very fragmented which impacts safety, adds costs and reduces overall capacity.[131] Regulation 1070/2009 also extended the competence of the European Union Aviation Safety Agency (EASA) to include ATM and "shifted rule-making support for technical implementing rules, together with the oversight of Member States, from [the European Organisation of the Safety of Air Navigation (EUROCONTROL)] to EASA."[132]

EUROCONTROL is an international organisation founded in the 1960s and headquartered in Brussels. Although its name might indicate that it is part of the system of

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[127] Masutti, *supra* note 124 at 113

[128] EC, *REGULATION (EC) No 549/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 March 2004 laying down the framework for the creation of the single European sky*, [2004] OJ, L 96/1 [*Regulation 549/2004*]; EC, *REGULATION (EC) No 550/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 March 2004 on the provision of air navigation services in the single European sky*, [2004] OJ, L 96/10; EC, *REGULATION (EC) No 551/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 March 2004*, [2004] OJ, L 96/20; EC, *REGULATION (EC) NO 552/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 March 2004 on the interoperability of the European Air Traffic Management network*, [2004], OJ, L 96/26.

[129] EC, *REGULATION (EC) No 1070/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 amending Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 in order to improve the performance and sustainability of the European aviation system*, [2004] OJ, L 300/34 Preamble (18) [*Regulation 1070/2009*].

[130] European Commission, "Functional airspace blocks (FABs)" (22 September 2016), online: *Mobility and Transport - European Commission* <ec.europa.eu/transport/modes/air/single-european-sky/functional-airspace-blocks-fabs_en>.

[131] *Ibid*.

[132] Masutti, *supra* note 124 at 117.

the European Union, it is in fact not a European Union agency but rather an international organisation of which the European Union is a member.[133] Nevertheless, the European Union has delegated part of its SES regulatory competence to EUROCONTROL making it, together with the EASA, the central organisation for coordinating the SES initiative.[134]

However, the SES initiative is still very much a "work in progress" and its full potential – to create a truly uniform SES with centralised air traffic management – has not been realised yet. The reasons for this include the absence of any penalties for not implementing the system on time, the lack of incentives for doing so as well as the lack of integration of ATC centres.[135] Furthermore, many states remain unwilling to relinquish even part of their airspace sovereignty.[136]

Nevertheless, the SES initiative is a step in the right direction. In time it will eventually eradicate the hurdles that still exist in the European aviation sector provided that Member States are willing to share part of their airspace sovereignty.

## 3. Suborbital Flights and Air Traffic Management

Having compared how ATM and ANS are currently structured and provided in several major national and regional markets, let us examine whether the current system could be applied to suborbital flights.

Before doing so we must briefly discuss proposals in the literature for a Space Traffic Management (STM) system as a way to regulate traffic involving outer space or part thereof.[137] STM has been defined as "set of technical and regulatory provisions for promoting

[133] Van Houtte, *supra* note 121 at 189.
[134] *Regulation 549/2004*, *supra* note 128 Preamble (15), art 8.
[135] Masutti, *supra* note 124 at 120–21.
[136] *Ibid.*
[137] See e.g. Jakhu, Sgobba & Dempsey, *supra* note 16 at 63–64. See generally Kenneth Wong, "Developing commercial human space-flight regulations" in Joseph N. Pelton & Ram S. Jakhu, eds, *Space Safety Regulations and Standards*, (Oxford: Elsevier, 2010) 149 at 149ff.

safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference."[138]

On a purely textual interpretation, this non-authoritative definition could be read as including suborbital flights.[139] However, this is problematic in multiple ways:

First, a STM systems would fall under space law.[140] But space law lacks the provisions necessary to enable efficient traffic control and regulate flight movements[141] and there is currently "no comprehensive and unified set of regulations for Space Traffic Management."[142]

Second, existing space law is intended only to enable safe access and safe operations in outer space pursuant to the *Outer Space Treaty*: it was never intended to cover ATM issues.[143]

Third, the STM system is geared towards regulating in-orbit traffic and flight movements into outer space.[144]

Finally, if we were to create a STM system for suborbital flights, there would have to be a close coordination with the ATM system. This would be necessary because suborbital vehicles, due to their high speeds, particularly in their ascending and descending phases, could pose a threat to other civil aircraft.[145] This coordination would add another unnecessary layer of complexity to the whole system and thus would not be an appropriate solution.[146]

These considerations make the application of a STM system unsuitable for suborbital flights.

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138 Corinne Contant-Jorgenson, Petr Lála & Kai-Uwe Schrogl, "The IAA Cosmic Study on space traffic management" (2006) 22:4 Space Pol'y 283 at 284.
139 See also Israel, *supra* note 30 at 62.
140 Contant-Jorgenson, Lála & Schrogl, *supra* note 138 at 284.
141 *Ibid* at 285.
142 Sameh, *supra* note 13 at 104.
143 Israel, *supra* note 30 at 63.
144 Contant-Jorgenson, Lála & Schrogl, *supra* note 138 s 6. See also Israel, *supra* note 30 at 63.
145 Israel, *supra* note 30 at 65.
146 *Ibid* at 64.

Nevertheless, there is a need for a harmonised traffic management system that can be applied to suborbital flights.[147] Can this goal be achieved through the ATM system currently used for international civil aviation? We must therefore discuss the suitability and applicability of the current ATM system to suborbital flights.

As two authors have observed, the main function of ATM is "to keep aircraft separated, that is prevent airplanes from colliding with one another either in the air or on the ground and move aircraft along efficient flight paths from their origin airport to their destination airport."[148] This suggests that the current ATM systems only apply to vehicles that can be classified as 'aircraft'. It must therefore be examined whether the classification as an 'aircraft' is in fact a prerequisite for the applicability of the ATM system to suborbital flights. If that were the case, someone who strictly classifies suborbital vehicles as 'space object' would undoubtedly conclude that the current ATM system cannot, even theoretically, apply to these flights even when they use the same airspace as aircraft. Let us therefore examine whether it can apply to vehicles that are not considered 'aircraft' when they are traversing the airspace of different countries.

To date, the ATM system has played only a minor role in the launch of space objects – the main duty of the ANS provider was to keep the skies in and around the launch path of a rocket clear of any air traffic movement.[149] They are not actively involved in the launch – they do not control the flight path of the rocket or engage with the crew onboard via radio. As mentioned earlier, the Chicago Convention in Article 28 allocates responsibility to contracting states to provide ANS. The Chicago Convention itself only applies to 'civil

[147] See e.g. Jakhu, Sgobba & Dempsey, *supra* note 16 s 2.3.4.
[148] Oster & Strong, *supra* note 107 at 7.
[149] This usually means that a no-fly zone is introduced and the ANS provider re-routes airplanes to keep the zone clear of any traffic. This routinely causes commercially expensive delays for airlines. See e.g. Christian Davenport, John Muyskens & Shin "Wonder why your flight is delayed? It could be due to a SpaceX launch" (13 December 2018), online: *The Washington Post* <www.washingtonpost.com/graphics/2018/business/spacex-falcon-heavy-launch-faa-air-traffic/>. See also Tronchetti, *supra* note 13 at 183.

aircraft'[150] and many states expressly use the term 'aircraft' in their respective national aviation regulations and provisions dealing with ANS.[151]

State practice in the interpretation of the Chicago Convention as well as the clear wording of the Convention itself suggests that ANS are presently only open to vehicles that are indeed classified as 'civil aircraft'.[152] Consequently, most of the rules and regulations pertaining to ANS can only apply to suborbital vehicles if they fall under the definition of 'aircraft'. As discussed in detail in the Introduction of this thesis, suborbital vehicles can be considered aircraft and subsequently can be legally integrated into the existing ANS system.

Nevertheless, in an ideal scenario, states would make their laws applicable to any vehicle, apart from military machines, that utilises airspace for its operation, even if it does not fall under the definition of 'aircraft' as long as it uses the airspace of a country, similar to what Germany did in its *Luftfahrtgesetz* (*Air Traffic Act*) or expressly include 'rockets' in the definition of aircraft like Canada in its *Aeronautics Act*.[153] This would not only ensure the safety of all participants but would also allow the states' ANS to assert the necessary control over them.

However, absent this desired legislation, the regulations pertaining to the ATM system that is currently in place has to be used. For the purpose of this research, the ATM system can be legally applied to suborbital vehicles since these vehicles fall under the definition of 'aircraft' and therefore under the current ATM regime (as discussed above).

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[150] *Chicago Convention*, *supra* note 29 art 3

[151] Canada uses the term 'aircraft' for vehicles that are subject to Air Traffic Services; see *Canadian Aviation Regulations* SOR/96-433, s 801.02. The United States does the same; see *Aeronautics and Space*, CFR §71.31 (2020). So does Austria; see arts 3,124ff Luftfahrtgesetz (Austria). Germany in a similar fashion reserves air traffic management for aircraft. Germany classifies space objects as aircraft as long as they are physically present in airspace; see art 1 Luftverkehrsgesetz (Germany).

[152] *Cf* Frans von der Dunk "Passing the Buck to Rogers: International Liability Issues in Private Spaceflight" (2007) 86:2 Neb L Rev 401 at 427–29; Sameh, *supra* note 7 at 108; Jakhu, Sgobba, & Dempsey, *supra* note 16 at 62–63.

[153] See art 1 Luftverkehrsgesetz (Germany); *Aeronautics Act*, RSC 1985, c A-2, s 3(1).

We must now examine a different problem, namely the heavy dependence of ANS providers on ground-based radar systems.

International air traffic is still mainly controlled using ground-based radar systems and the technology is not significantly different from the systems used in the second half of the 20th Century.[154] Ground-based radar systems use antennas that rotate and work together with ground-based navigational aids to determine the location of an aircraft inflight.[155] Aircraft navigation is accomplished through a network of rigid waypoints and airways that guide pilots via ground-based beacons along a pre-defined route.[156]

There are some obvious major drawbacks to these radar systems, however. First, there is a transmission delay: they are slow to report the accurate actual position of an aircraft relative to its speed. This inaccuracy increases, the greater the distance to the ground-based navigation aid (i.e., the rotating antenna).[157] Second, there are still “black spots” with no radar coverage, particularly over the oceans.[158] In these areas pilots largely depend on communication with each other in order to navigate safely and report their position manually to ATC.[159] As a result, planes have to be placed further apart than they would need to be if they were flying over land. The geographical limitations of these radar systems make them inadequate for significant portions of suborbital flights. Controlled airspace extends until 60.000ft (18 kilometres) and most radar systems currently used for tracking air traffic and

[154] Oster & Strong, *supra* note 107 at 13. See also Jakhu, Sgobba & Dempsey, *supra* note 7 at 122.
[155] *Ibid.*
[156] Arblaster, *supra* note 92 at 22. See also Marc Baumgartner, "The Organisation and Operation of European Airspace" in Andrew Cook, ed, *European Air Traffic Management*, (New York: Routledge Taylor & Francis Group, 2007) 1 at 19–21.
[157] In order to get an accurate reading of an aircraft’s heading, the controller needs three radar readings which take approximately 14 seconds. If the aircraft is further away from the navigation aid, this period could stretch to over 35 seconds. See Oster & Strong, *supra* note 107 at 13.
[158] Oster & Strong, *supra* note 107 at 13.
[159] *Ibid*. See also Jakhu, Sgobba, & Dempsey, *supra* note 16 at 121.
This was one of the reasons why authorities had problems locating Air France 447 after it had crashed into the Atlantic Ocean while en-route from Rio de Janeiro to Paris. When it failed to report to Senegalese Air Traffic Control, the alarm was raised. For the detailed accident report see Bureau d’Enquêtes et d’Analyses pour la sécurité de l’aviation civile "Final Report on the accident on 1st June 2009 to the Airbus A330-203 registered F-GZCP operated by Air France flight AF 447 Rio de Janeiro - Paris" (last visited 14 May 2021), online (pdf): *BEA* <www.bea.aero/fileadmin/documents/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf>.

transit are designed for a height of 40.000ft (13 kilometres) or less.[160] As already mentioned, suborbital vehicles engaged in point-to-point transportation will ascend to a far higher altitude.

Further, as just noted, these systems already face the problem of tracking planes at cruising speed accurately and suborbital vehicles will travel much faster than aeroplanes. In other words, a new mode of tracking air traffic is needed. This new mode could be Global Navigation Satellite Systems (GNSS).[161]

ICAO officially supported the transition from ground-based radar systems to GNSS as the primary source of navigation for future air traffic movements during the Worldwide CNS/ATM Systems Implementation Conference in Rio de Janeiro in 1998, and in 2005 published the first Global Satellite System Manual.[162]

These GNSS can provide a much more precise air traffic location information and are not subject to the same limitations of ground-based radar systems; in particular they do not suffer from any coverage gaps.[163] However, core-constellation systems, such as GPS, GALILEO, GLONASS and BDS, by themselves do not meet the requirements for high performance manoeuvres and applications such as automated precision approach for aircraft, which would undoubtably be needed for suborbital flights. Therefore, augmentation systems, which complement the GNSS and enable high precision performance applications, have been implemented. The US has developed the Wide Augmentation System (WAAS) for the GPS

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[160] See Joseph N. Pelton, "Regulatory Issues for New Global Aerospace Systems" in Ram S Jakhu & Kuan-Wei Chen, eds, *Regulation of Emerging Modes of Aerospace Transportation*, (Montreal: Centre for Research in Air and Space Law, 2014) 77 at 90; U.S. Department of Transportation, "Point-to-Point Commercial Space Transportation in National Aviation System" (10 March 2010), online (pdf): *FAA* <www.faa.gov/about/office_org/headquarters_offices/ast/media/point_to_point.pdf> at 2 [FAA Report].
[161] GNSS is a broad term which includes various satellite systems with global coverage that have already launched or are in the process of being developed, such as GALILEO (European Union), GPS (United States) and GLONASS (Russia).
[162] See *Global Navigation Satellite System (GNSS) Manual*, ICAO, Doc 9849 AN/457 (2005) [GNSS Manual]; ICAO, "Declaration on Global Air Navigation Systems for the Twenty-First Century" (15 May 1998), online (pdf): *ICAO* <www.icao.int/Meetings/AMC/MA/1998/rio/DECLARATION.PDF>
[163] Baumgartner, *supra* note 156 at 21.

constellation, Russia the System for Differential Corrections and Monitoring (SDCM) for GLONASS and the EU the European Geostationary Navigation Overlay Service (EGNOS) for their GALILEO constellation.[164] In the US, the FAA is currently undertaking a comprehensive upgrade of its National Airspace System.[165] The implementation of 'NextGen' is expected to be completed in 2025.[166]

A satellite navigation system consists of a space segment (i.e., the satellites in orbit), a ground-based segment (necessary to monitor the status of the satellites and to relay the signal as well as incorporate the measurements from each satellite into the overall navigational signal) and a user system (the terminal a user can use to access the information).[167] Unlike ANSP, many airlines are already using satellite-based navigation to routinely check on their aircraft in flight and have equipped their fleets with user terminals that can receive the respective navigational signals on board.[168]

For a long time, the US GPS System was the only fully operational GNSS and a combination of ground-based radar systems and GNSS was used in other states.[169] However, the GNSS of the European Union (GALILEO), Russia (GLONASS) and China (BDS) are fully functional now.[170] This enables true global coverage and eases dependence on the GPS system of the US. Once all the standard navigation procedures that are based on a fully operational GNSS network are advanced further, ground-based navigational aids can be

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[164] See Michael Chatzipanagiotis & Konstantina Liperi, "Regulation of global navigation satellite systems" in Ram S. Jakhu & Stephen Dempsey, eds, *Routledge Handbook of Space Law,* (New York: Routledge Taylor & Francis Group, 2017) 160 at 162.
[165] FAA Report, *supra* note 160 at 2.
[166] *Ibid.*
[167] See e.g. Delphine Jaugey, *The use of Global Navigation Satellite Systems (GNSS) for air navigation purposes: benefits, vulnerabilities of the systems and legal issues,* (Master of Laws, McGill University, 2006) at 9 [unpublished].
[168] See Len Jacobson, "GNSS Markets and Applications" in Elliot D. Kaplan & Christopher J. Hegarty, eds, *Understanding GPS/GNSS Principles and Applications*, (Boston: Artech House, 2017) 915 at 931.
[169] Ibid; Baumgartner, *supra* note 156 at 23.
[170] See Ben Westcott, "China's GPS rival Beidou is now fully operational after final satellite launched" (24 June 2020), online: *CNN Business* <www.cnn.com/2020/06/24/tech/china-beidou-satellite-gps-intl-hnk/index.html>.

slowly phased out.[171] In Europe, for example, most aircraft already have GNSS receivers on board and a major transition from ground-based radar systems to a satellite-based one is ongoing.[172] The FAA has undertaken in its NextGen system upgrade to completely move away from ground-based systems and transition to a dynamic GPS based navigation and surveillance system.[173]

These GNSS are most efficient when used in combination with one another and thus international cooperation is necessary to facilitate efficient coverage.[174] To that end many states have concluded "bilateral agreements on interoperability and compatibility."[175] The US has concluded bilateral agreements, Joint Statements, with Australia, China, Europe, India, Japan and Russia.[176] The European Union signed agreements with China, Israel, India, Ukraine, Morocco, Korea, Norway and Switzerland.[177] In 2004 both the European Union and the United States concluded a historic agreement which established cooperation between the GALILEO and GPS.[178] ICAO similarly exchanged letters with the US and Russia regarding the usage of the GPS and GLONASS System.[179] These agreements enable true global coverage along with precise tracking capabilities.

Suborbital international point-to-point flights could therefore be handled efficiently via this new satellite-based radar system. These flights can be tracked in real-time without any height restrictions.[180]

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[171] Baumgartner, *supra* note 156 at 23.
[172] Jakhu, Sgobba, & Dempsey, *supra* note 16 at 122; Baumgartner, *supra* note 156 at 23; Jacobson, *supra* note 168 at 931.
[173] FAA Report, *supra* note 160 at 2.
[174] Chatzipanagiotis & Liperi, *supra* note 164 at 163.
[175] *Ibid.*
[176] *Ibid* at 164.
[177] *Ibid.*
[178] *Ibid*. The full text of the agreement can be found online <www.gps.gov/policy/cooperation/europe/2004/gps-galileo-agreement.pdf>.
[179] GNSS Manual, *supra* note 162 ss 3.2.1, 3.2.2.
[180] See generally FAA Report, *supra* note 160.

Considering the navigational precision of these systems, and that the transition from ground to satellite-based navigation is already well under way, the best solution going forward is to integrate suborbital flights into the existing regulatory ATM framework.[181] This would also ensure the safety of other aviation participants since suborbital vehicles will use the same altitudes as normal aeroplanes for parts of their flight, particularly during the ascending and descending phases.[182] A new ATM system solely for suborbital flights is therefore not needed.

The next part will discuss how a satellite-based radar system improves safety and how it can help to mitigate the risks resulting from criminal activities using the example of aircraft hijacking.

### a.) Suborbital Flights, Air Traffic Management and Criminal Activities

Criminal activities on board an aircraft are still a major concern despite the rigorous safety and security system currently in place.[183] The unlawful seizure of an aircraft (hijacking) can have fatal consequences, not only for the people onboard but also for potential targets on the ground. It has been recognised as a considerable threat to civil aviation.[184] As the coordinated attacks of 9/11 showed, even civil aircraft can easily be transformed into a weapon and cause immense suffering.[185] Consequently, appropriate measures are needed to minimize casualties as well as protect targets on the ground.[186]

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[181] See also Israel, *supra* note 30 at 64, Sameh, *supra* note 13 at 110.
[182] *Cf* Tronchetti, *supra* note 13 at 183.
[183] See IATA, "Closer Collaboration Key to Enhancing Aviation Security" (5 June 2017), online: *IATA* <www.iata.org/en/pressroom/pr/2017-06-05-05/>.
[184] See *Convention for the Suppression of unlawful seizure of Aircraft*, 16 December 1970, 860 UNTS 105 Preamble (entered into force 14 October 1971) [*Hague Convention 1970*].
[185] See John C. Cooper, "Air Power and the Coming Peace Treaties" (1946) 24:3 Foreign Affairs 441 at 441ff; Michael Steven Dodge, *Global Navigation Satellite Systems (GNSS) and the GPS-Galileo Agreement* (Masters of Laws, McGill University, 2011) at 8 [unpublished].
[186] The coordinated attacks of 09/11 showed how an aircraft can be used as a weapon and cause unmeasurable suffering.

A hijacking situation requires the coordination of pilots, ground services, authorities and air traffic control.[187] Once the cockpit door is breached, air traffic control becomes the last line of defence and needs to ensure the safety of other aircraft and provide as much support as possible.[188] Hijacking scenarios do not follow a specific template and multiple outcomes are possible including but not limited to complete or partial loss of communication with the aircraft, unannounced flight path deviations, diversion to airports not on the flight plan or non-compliance with ATC instructions.[189]

This danger is greater in areas with limited radar coverage such as over oceans or developing countries where pilots must manually report their position to air traffic control.[190] The unlawful seizure of an aircraft in these areas can remain hidden for quite some time as flight path deviations are not immediately detected by air traffic control and pilots under duress could submit wrong information to air traffic control.[191]

GNSS "allows users to determine their location in either two or three dimensions"[192] and thus can provide very accurate position, velocity and time information.[193] Further, satellite systems are capable of transmitting engine, fuel and other critical flight data and can automatically raise the alarm if unforeseen events occur or unusual flight behaviour is detected.[194] This allows the responsible air traffic controller to recognise a possible hostile threat much more quickly and take the appropriate steps to keep other aircraft secure as well

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[187] See Les Abend, "Pilot: What keeps you safe on a plane" (26 February 2015), online: *CNN* <www.cnn.com/2015/02/26/opinion/abend-terror-hijack-threat/index.html>.
[188] See SKYbrary, "Unlawful Interference: Guidance for Controllers - SKYbrary Aviation Safety" (last visited 14 May 2021), online: *SKYbarary* <www.skybrary.aero/index.php/Unlawful_Interference:_Guidance_for_Controllers>.
[189] *Ibid.*
[190] Oster & Strong, *supra* note 107 at 13. See also Jakhu, Sgobba, & Dempsey, *supra* note 16 at 121.
[191] As an example may serve Malaysia Air MH370 which disappeared over the Indian ocean. The ground-based radar systems of Malaysia did not report the position and Malaysia Air did not equip their aircraft with GNSS. See Jacobson, *supra* note 168 at 931.
[192] Dodge, *supra* note 185 at 6.
[193] See Amit Kumar et al, "Introduction to GPS/GNSS technology" in *GPS and GNSS Technology in Geosciences*, (Oxford: Elsevier, 2021) 3 at 3–4; Jaugey, *supra* note 167 at 9.
[194] See e.g. SkyTrac,"SKYTRAC Uses Satellite Technology to Track Aircraft Position" (26 March 2014), online: *Skytrac* <www.skytrac.ca/skytrac-uses-satellite-technology-track-aircraft-position/>.

as inform the appropriate authorities in case they have not already received an alarm automatically.[195] The precise tracking capabilities of a satellite based radar system allow air traffic controllers to know the actual live position of an aircraft.[196] The controller is then able to immediately separate other aircraft from the flight path and vicinity of the rogue airplane. GNSS further enable controllers to track aircraft close to state borders without any "grey areas" between the jurisdictions of different ANSP. Usually each ANSP (i.e., each country) uses its own ground based-radar system which makes it necessary to handoff a flight once it leaves the coverage area.[197] If multiple countries are using the same satellite systems (e.g., the member states of the European Union using GALILEO), a handoff does not have to be executed solely because of the limited range of ground-based radar systems since all the ANSPs are using the same source of information, the GNSS. This means that the same ANSP could continue to monitor the situation and inform the authorities of the other state if necessary and the other state in turn could monitor the position of the aircraft concurrently. Further, GNSS can receive distress beacons as soon as they are activated and automatically raise the alarm.[198] In case unlawful interference results in the loss of an aircraft, the appropriate authorities could locate the fuselage quickly and efficiently as they are provided with accurate position data.[199]

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[195] Military interception is not uncommon and can include measures such as gathering information, accompanying an aircraft, or forcing it to land and, as a last resort, the use of weapons to minimise casualties. See SKYbrary "Unlawful Interference - SKYbrary Aviation Safety" (last visited 14 May 2021), online: *SKYbrary* <www.skybrary.aero/index.php/Unlawful_Interference>.
[196] Kumar et al, *supra* note 193 at 3, 6–7; Dodge, *supra* note 185 at 6.
[197] The FAA defines handoff as "[a]n action taken to transfer the radar identification of an aircraft from one controller to another controller if the aircraft will enter the receiving controller's airspace and radio communications with the aircraft will be transferred." See US, Department of Transportation, *Air Traffic Organization Policy,* ORDER JO 7110.65Y (15 August 2019) s 5-4-2. See also Jaugey, *supra* note 167 at 4.
[198] The European Union's GALILEO Constellation provides a dedicated Search and Rescue Service. The signals of the distress beacons are automatically relayed to the Search and Rescue Services. See GSA, "Search and Rescue (SAR)/Galileo Service" (last visited 23 March 2021), online: *European Global Navigation Satellite Systems Agency* <www.gsa.europa.eu/european-gnss/galileo/services/search-and-rescue-sar-galileo-service>. See also FAA Report, *supra* note 160 at 17.
[199] *Cf* Jacobson, *supra* note 168 at 931.

For the above reasons, modern GNSS system will improve the safety, security and efficiency of the aviation industry. They can be utilised to react to criminal threats more quickly and efficiently and can help mitigate the outcome. Since suborbital flights will largely face the same security and safety issues as ordinary aircraft do today, full transition to a satellite-based ATM system is possible and desirable.

However, as already mentioned, ATM is the responsibility of individual states as the direct result of the sovereignty of each state over the airspace above its territory. It follows that even if satellite-based GNSS can handle suborbital traffic, a state could not assert ATM authority if the suborbital vehicle operates outside the boundaries of its jurisdiction. We must therefore now look for an approach that would allow a state to assert its ATM sovereignty over suborbital flights.

### b.) Sovereignty Over Airspace

The Introduction to this thesis discussed Functionalism versus Spatialism and concluded that the Functionalist Approach was best suited to determine whether air law or space law should apply to suborbital flights. We concluded that air law should apply to suborbital flights as they can be considered 'aircraft'. However, the Functionalist Approach is only appropriate to determine what legal regime should govern the flight (i.e., the vehicle). The right of a state to exercise ATM authority over suborbital flights is a separate issue.

ATM goes with the sovereignty of a state over its airspace and its airspace is linked to its territory.[200] It is therefore inherently a location-based approach. If an aircraft crosses a state border, the air traffic management authority also changes.[201] As long as the vehicle is in

[200] 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." The Convention therefore directly links the airspace to the territory of the state. See also Erkelens, *supra* note 91 at 187.
[201] *Cf* Erkelens, *supra* note 91 at 187.

an airspace that is controlled by a state, ATM authority can and will be exercised.[202] In outer space on the other hand, there is no sovereignty and consequently no ATM authority.[203] This poses a problem from a legal point of view. As discussed in the Introduction, the exact demarcation line between airspace and outer space is debated internationally and no consensus has thus far been reached. The Introduction determined that air law should apply to suborbital flights. However, considering that air traffic management is inherently location-based, the ATM authority of a state while the suborbital vehicle is flying well above the highest flight level utilised by ordinary aeroplanes, could be contested on the grounds that the state has no sovereignty and thus no jurisdiction. We must therefore look at a way that could address this problem.

The foremost consideration and concern states have is national security.[204] The lack of international consensus seems to be caused by the fear of states that suborbital flight activity could pose a threat to national sovereignty and security.[205] It has been correctly pointed out that "[w]ithout [some] kind of right or guarantee, at least up to the maximum altitude of the suborbital flight, the activity will be deemed as a threat over national sovereignty and security."[206] A state therefore must be able to assert its sovereignty over suborbital flights even when they are utilising higher altitudes.

It would therefore be desirable that the airspace, and thus the sovereignty of a state, is recognised to the highest altitude a suborbital vehicle can fly. This would ensure that ATM authority of a state can be exercised during all phases of an international point-to-point suborbital flight. Consequently, threats to the national security of a state would be minimised.

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[202] *Cf* Schubert, *supra* note 102 at 148.
[203] Article I of the Outer Space treaty states that Outer Space "shall be the province of all mankind." It therefore expressly rejects the sovereignty principle recognised in Air Law.
[204] Cheng, *supra* note 46 at 30.
[205] Zahari & Romli, *supra* note 10 s 2.1.
[206] *Ibid.*

Looking at the history of aviation and the corresponding technological advancement of aircraft, this has been accepted in the past. The first aeroplanes used far lower altitudes than modern day aircraft do. The more aircraft advanced, the higher they were able to fly.[207] The sovereignty of a state over "usable" airspace was recognised and not disputed.[208]

The same logic could be applied to suborbital flights, especially considering the capabilities of satellite-based radar systems that are not subject to the height restrictions of ground-based radar systems.

This could also help to minimise the perceived threat to the national security of states and a consensus of a definitive demarcation line might be easier to achieve. Further, once suborbital vehicles become fully operational, higher altitudes are utilised and thus more airspace becomes "useable".

## 4. Conclusion

This chapter reviewed the ATM navigational systems currently in place to track flight movements. The latency and the delay in transmitting signals from ground-based radar systems make them inadequate for the 21st century. Further, their lack of coverage of 'black-spots' over oceans and developing countries can pose a safety hazard and flights must be placed further apart. ICAO embraced the transition from ground-based to satellite-based radar system early on and with the development of sophisticated GNSS, accurate tracking of all flight movements is possible. This improves safety and can help authorities react to criminal acts more efficiently and quickly. Satellite based radar systems are not subject to the same height restrictions and thus suborbital flights can be tracked. Once the transition from ground

[207] The Boeing Model 314 "Clipper" had a cruising altitude of approx. 13.500 ft. A Boeing 747-8 can fly at 40.00 ft.
[208] *Cf* Peter Haanappel, "Aerial Sovereignty: From Paris 1919, Through Chicago 1944, to Today" in Pablo Mendes de Leon & Niall Buissing, eds, *Behind and Beyond the Chicago Convention*, (Alphen aan den Rijn: Kluwer Law International, 2019) 25 at 30.

to satellite-based radar systems is complete, these flights can be fully integrated into the ATM system. However, as in the past, states will need to agree on extending the airspace to the height of suborbital flights so that ATM authority may be exercised. This in turn could help states to minimise national security threats and thus could facilitate agreement on a definitive boundary between airspace and outer space.

Suborbital flights will be subject to multitude of criminal threats, in the same way as ordinary aeroplanes are today. Chapter II of this thesis will therefore address aviation criminal law in more detail, including how it can be applied to suborbital flights and to what extent new emerging threats, such as cyberattacks, are covered.

## Chapter II – Aviation Security and Suborbital Flights: Aviation Criminal Law

Aviation criminal law is an umbrella term referring to the rules applicable to criminal offences committed in relation to aviation, such as terrorism, aircraft hijackings and attacks against airports. It consists of national legislation, i.e., the penal law of the state in which the incident occurred, and codified international law in the form of treaties.[209]

Aviation criminal law forms an important aspect of aviation security. Terrorism has, and always will be, a major threat to the aviation industry. How terrorists conduct their attacks is imaginative and ever evolving and aviation security, especially aviation criminal law, has always been more reactive rather than proactive.[210]

Suborbital flights will not be exempt from the atrocities of terrorist networks but rather subject to the same threats as modern aeroplanes are. Indeed, suborbital vehicles could be an attractive target for terrorists due to the publicity attacks would generate. At the same time new threats, such as cyberattacks, are becoming a serious security threat in civil aviation.[211]

Although cyberterrorism has been recognised as a major threat to civil aviation, there are currently no dedicated agreed international rules specifically dealing with cyberattacks and most initiatives that have been taken are more "an intention rather than a decisive measure."[212] We are therefore left with the international legal instruments that are currently in place. This chapter will discuss the applicability of aviation criminal law to suborbital flights with a focus on the new emerging threat of cyberterrorism. It will explore aviation security

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[209] *Cf* Chatzipanagiotis, *supra* note 14 at 217.
[210] Dempsey, *supra* note 32 at 232–33.
[211] See ICAO, "Aviation Cybersecurity Strategy" (October 2019), online (pdf): *ICAO* <www.icao.int/cybersecurity/Documents/AVIATION%20CYBERSECURITY%20STRATEGY.EN.pdf>; Laura K. Ashdown, "Preventing a Cyber-9/1: How Universal Jurisdiction Could Protect International Aviation in the Digital Age" (2019) 84:1 J Air L & Com 3 at 9.
[212] Sarah Jane Fox, "Flying challenges for the future: Aviation preparedness – in the face of cyber-terrorism" (2016) 9:3–4 J Transp Secur 191 at 208.

from the perspective of aviation criminal law building on the theory that suborbital vehicles should be considered aircraft and thus subject to aviation criminal law. This chapter will focus on international instruments rather than national criminal legislation.

## 1. Criminal Issues and Suborbital Flights

Suborbital flights will be subject to the same security concerns as modern day aircraft and similar security considerations will have to be made when operating a suborbital flight. As already mentioned, suborbital flights are still under development and the only suborbital vehicles that are presently being tested are meant for tourist flights. These tourist flights depart from and return to the same point on Earth and thus do not cross any international state borders. For that reason, international aviation criminal law cannot apply and these flights are subject to national criminal law. However, as discussed in the Introduction to this thesis, suborbital point-to-point transportation has the potential to become a reality in the not-too-distant future. These suborbital flights will enable intercontinental travel at fast speeds and cross multiple state borders. It is therefore necessary to discuss the potential applicability of international aviation criminal law.

One author suggests developing a uniform legal framework for criminal activities on board suborbital vehicles by applying specific norms of air and space law through national legislation.[213] While this view certainly reflects one possible outcome for the lex ferenda, state consensus on a new regime would be hard to achieve. We are therefore left with the lex lata and suborbital flights, once they become a regular occurrence, will have to be integrated into the existing international aviation criminal law regime. It is therefore necessary to

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[213] Chatzipanagiotis, *supra* note 14 at 224; The author proposes to create national legislation establishing criminal jurisdiction of the state of registry and adopt specific norms of air and space law to govern criminal activities.

discuss the relevant international instruments in more detail while also taking into consideration that criminal threats against civil aviation have changed over the decades and terrorists may take advantage of the anonymity of the cyberspace environment to launch attacks against aircraft that increasingly rely on modern technology and GNSS navigation.

Cyberattacks have become a threat of global importance and pose one of the most serious risks to civil aviation today.[214] This threat "is rapidly and continuously evolving"[215] and thus endangers the safety of all participants. The aviation system in the 21st Century has become increasingly dependent on information and technology systems.[216] This dependence will increase even more once the transition from ground to satellite-based radar systems is completed. Suborbital vehicles will be integrated into this system and could be vulnerable to cyberterrorism.[217] Suborbital vehicles will therefore not only face old threats but also new ones. Consequently, a discussion of aviation criminal law pertaining to suborbital flights is necessary.

### a. The Tokyo Convention of 1963

#### *Object and Scope*

*The Convention on Offences and Certain Other Acts Committed on Board Aircraft* (Tokyo Convention) was the first international instrument to address unlawful interference with civil aviation.[218]

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[214] See UN SC, 71st year, 7775th Mtg, UN Doc S/RES/2039 (2016) [Res 2309]; *Addressing Cybersecurity in Civil* Aviation, ICAO Res A40-10, 40th Sess (2019) [Res A40-10].
[215] Res A40-10, *supra* note 214 at 1.
[216] *Ibid.*
[217] In 2015 a US government official was able to hack into the computer systems of a Boeing 757 and took over flight controls remotely while the aircraft was sitting on the tarmac. See Margi Murphy, "US government hackers were able to remotely take control of a plane" (14 November 2017), online: NewsComAu <www.news.com.au/technology/online/hacking/boeing-757-controls-hacked-remotely-while-on-the-runway-officials-reveal/news-story/48f41ed3fd10011e223faf59e2998e54#.128pg>.
[218] Dempsey, *supra* note 32 at 237; Ashdown, *supra* note 212 at 22.

The Tokyo Convention applies to two types of acts committed onboard an aircraft: (a) "penal offences"; and (b) acts that jeopardize, or may jeopardize, the "safety of the aircraft or of persons or property therein or acts which jeopardize "good order and discipline on board" (herein referred to as "jeopardizing acts").[219]

The Tokyo Convention only applies when the aircraft is "in flight or on the surface of the high seas or of any other area outside the territory of any State."[220] An aircraft is considered "to be in flight" from the moment when power is applied for the purpose of take-off until the landing run ends.[221] This means that penal offences or jeopardizing acts carried out while the aircraft is taxiing or still parked are not within the scope of the Convention.[222] In line with the Chicago Convention, the Tokyo Convention excludes aircraft used in military, customs or police services.[223] It follows that even if an aircraft is registered in a contracting state, the Tokyo Convention does not apply if the aircraft is being used to perform military, customs or police services.

### *Penal Jurisdiction*

While the Tokyo Convention does not itself establish "penal offences" it confirms that the state of registration of an aircraft may exercise penal jurisdiction over offences committed on board that aircraft anywhere in the world and requires contracting states to take necessary measures to establish jurisdiction on this basis.[224] Contracting states are not prevented from establishing additional bases for jurisdiction.[225] However, the Tokyo Convention prohibits a state that is not the state of registration from interfering with an aircraft in flight "in order to

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[219] See *Convention on Offences and Certain other Acts Committed on board Aircraft*, 14 September 1963, 704 UNTS 219 art 1 (entered into force 04 December 1969) [*Tokyo Convention 1963*].
[220] *Ibid* art 1 para 2.
[221] *Ibid* art 1 para 3.
[222] Subject to important qualification noted later with respect to the powers accorded to the aircraft commander.
[223] *Tokyo Convention 1963*, *supra* note 219 art 1 para 4.
[224] *Ibid* art 3 paras 1–2.
[225] *Ibid* art 3 para 3.

exercise its criminal jurisdiction over an offence committed on board" except in specified circumstances.[226]

### *Powers of the Aircraft Commander*

The Tokyo Convention gives the aircraft commander power to impose "reasonable measures including restraint" on any person who the commander has "reasonable grounds" to believe has committed or is about to commit a jeopardizing act "onboard the aircraft."[227] The commander may also "require or authorise" the assistance of other crew members in the exercise of this power and may "request or authorize, but not require" the assistance of passengers.[228] Crew members and passengers may also take "reasonable preventive measures" without the authorisation of the commander if they have "reasonable grounds to believe" that this is "immediately necessary to protect the safety of the aircraft or of persons or property on board."[229]

Unlike the provisions delineating the application of the Tokyo Convention for jurisdictional purposes, this power is conferred on the commander only in the case of an international flight and not in the case of a flight between two points within the territory of the state of registration.[230] For the purpose of the exercise of this power, the Tokyo Convention sets out a broader definition of "in flight": the Tokyo Convention considers an aircraft to be "in flight" for this purpose "any time from the moment when all its external

[226] Pursuant to art 4 of the Tokyo Convention, these specified circumstances are as follows:
"(a) the offence has effect on the territory of such State;
(b) the offence has been committed by or against a national or permanent resident of such State;
(c) the offence is against the security of such State;
(d) the offence consists of a breach of any rules or regulations relating to the flight or manoeuvre of aircraft in force in such State;
(e) the exercise of jurisdiction is necessary to ensure the observance of any obligation of such State under a multilateral international agreement."
[227] *Tokyo Convention 1963*, *supra* note 219 art 6 para 1.
[228] *Ibid* art 6 para 2.
[229] *Ibid.*
[230] *Ibid* art 5 para 1.

doors are closed following embarkation until the moment when any such door is opened for disembarkation."[231]

The measures of restraint imposed by the commander may not be continued after the first point of landing except in specified circumstances.[232] The commander must notify the authorities of the state of landing that a person on board is under restraint and why as soon as practicable and if possible before landing.[233]

The Tokyo Convention empowers the commander to disembark any person who the commander has reasonable grounds to believe has committed or is about to commit a jeopardizing act in any state in which the aircraft lands.[234] The commander must report the disembarkation and the reasons for it to the authorities of the state in which the person disembarks.[235] Contracting states have a corresponding duty to allow the commander of an aircraft registered with another contracting state to disembark the person.[236]

The Tokyo Convention also gives the commander power to deliver to the competent authorities of any contracting state where the aircraft lands a person who the commander has reasonable grounds to believe has committed an act which is a serious offence under the penal law of the state of registration.[237] The commander must notify the authorities that a person on board is to be delivered and why as soon as practicable and if possible before landing and must also furnish relevant evidence and information.[238] Contracting states have a corresponding duty to take delivery of the person.[239]

Finally, the Tokyo Convention protects the commander, crew members, passengers, as well as the owner or operator of the aircraft and the person on whose behalf the flight was

[231] *Ibid* art 5 para 2.
[232] *Ibid* art 7 para 1.
[233] *Ibid* art 7 para 2.
[234] *Ibid* art 8 para 1.
[235] *Ibid* art 8 para 2.
[236] *Ibid* art 12.
[237] *Ibid* art 9 para 1.
[238] *Ibid* art 9 paras 2–3.
[239] *Ibid* art 13 para 1.

performed, from legal responsibility for actions taken in accordance with the Convention.[240] This is of great practical value because it ensures that the commander and others enjoy immunity from legal prosecution brought against them because of the ‘use of force’ provided they had reasonable grounds for believing it was necessary.

### *Unlawful seizure of aircraft (hijacking)*

The Convention addresses, albeit only in a rudimentary way, the offence of unlawful seizure of an aircraft (hijacking). It requires contracting states to take “all appropriate measures” to restore or preserve control of an aircraft to its lawful commander when a person on board has “unlawfully committed” or is about to commit “by force, or threat thereof an act of interference, seizure or other wrongful exercise of control of an aircraft in flight.”[241] The contracting state in which the aircraft lands must “permit its passengers and crew to continue their journey as soon as practicable” and “return the aircraft and its cargo to the persons lawfully entitled to possession.”[242] However, the Tokyo Convention failed to declare hijacking an international crime.[243]

### *Other Duties and Powers of Contracting States*

If satisfied that the circumstances warrant, a contracting state must take “custody or other measures to ensure the presence” of a person who has been “delivered” to the authorities in that state or in whose territory an aircraft lands following a hijacking or attempted hijacking.[244] The nature of these measures is determined by national law, but custody may be continued only for as long “as is reasonably necessary to enable any criminal

[240] *Ibid* art 10.
[241] *Ibid* art 11 para 1.
[242] *Ibid* art 11 para 2.
[243] Ashdown, *supra* note 212 at 23.
[244] *Tokyo Convention 1963*, *supra* note 219 art 13 para 2.

or extradition proceedings to be instituted" and the state must assist a person in custody to communicate immediately with the nearest appropriate representative of the State of which the person is a national.[245] The state of landing is required to immediately make a preliminary inquiry into the facts.[246] If the person has been taken into custody, the findings must be reported promptly to the state of registration of the aircraft and the state of nationality of the person in custody and the state must indicate whether it intends to exercise jurisdiction.[247]

The Tokyo Convention further confirms that neither disembarkation nor delivery nor taking into custody is to be considered "admission to the territory" of the state of landing.[248] If the person is not a national of that state and cannot or does not wish to continue the journey, the state may return the person to another state.[249] Persons who want to continue the journey must be allowed to proceed to their destination of choice as soon as practicable unless their presence is required by the law of the state of landing for the purpose of extradition or criminal proceedings.[250] In the latter case, the state of landing must accord treatment which is no less favourable than that accorded to nationals of that state in like circumstances.[251]

### *Application of the Convention to Suborbital Flights*

Considering that suborbital vehicles fall under the definition of aircraft, the Tokyo Convention would apply to suborbital flights. The pilot of a suborbital flight will therefore be equipped with the power and authority set out in the Tokyo Convention should any person on board carry out or attempt to carry out a jeopardizing act. Contracting states likewise would

245 *Tokyo Convention 1963*, *supra* note 219 art 13 paras 2–3.
246 *Ibid* art 13 para 4.
247 *Ibid* art 13 para 5.
248 *Ibid* art 14 para 2.
249 *Ibid* art 14 para 1.
250 *Ibid* art 15 para 1.
251 *Ibid* art 15 para 2.

have the penal jurisdiction and the powers and duties specified in the Tokyo Convention. Further, if any person on board a suborbital flight hijacked or attempted to hijack the suborbital vehicle, the unlawful seizure provisions of the Tokyo Convention would become applicable.

However, the Tokyo Convention only applies to acts that are committed by a person on board the aircraft.[252] Any act initiated from the ground, would therefore not fall within the scope of the Tokyo Convention. Should a perpetrator shoot down a suborbital vehicle from the ground, the Tokyo Convention would not apply.

### *Application of the Convention to Cyberattacks*

In 2015 the EASA warned of the risks of cyberattacks and revealed that it had hired a former pilot to purposefully exploit the vulnerabilities of the Aircraft Communications Addressing and Reporting System (ACARS) used to transmit messages between aircraft and ground systems.[253] It took the pilot only a few minutes to hack the messaging system and another couple of days to gain access to the aircraft's control systems.[254] Consequently, an aircraft could be unlawfully seized by taking over the electronic systems onboard and locking the flight crew out.

Could cyberattacks fall under the scope of the Tokyo Convention? The Convention was drafted in the 1960s, when cyberattacks were non-existent. Attacks or attempted attacks from the ground are excluded from the scope of the Convention, which arguably rules out any remote cyberattack. However, what if a person onboard would use a mobile phone or computer to interfere with the electronic systems on an aircraft?

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[252] *Ibid* arts 1,11.
[253] See Rene Millman, "European aviation body warns of cyber-attack risk against aircraft" (13 October 2015), online: *SCMagazine*: <www.scmagazine.com/home/security-news/european-aviation-body-warns-of-cyber-attack-risk-against-aircraft/>. See also Fox, *supra* note 213 at 198.
[254] Fox, *supra* note 213 at 198.

As previously explained the Tokyo Convention applies all acts that *may or do* jeopardise the safety of the aircraft, or of persons or property onboard or good order and discipline on board.[255] Therefore, cyberattacks, initiated by a person on board are within the scope of the Tokyo Convention if they jeopardize safety or good order and discipline, even though such attacks were not envisaged at the time of drafting.

As noted above, the unlawful seizure (i.e., hijacking), interference or wrongful exercise of control of an aircraft is covered by Article 11 of the Tokyo Convention so long as the act is committed "by force or threat thereof."[256] A cyberattack that takes over control of an aircraft would therefore only fall within the scope of Article 11 if it was accomplished 'by force' or 'threat of force'. Can a cyberattack, which is inherently non-physical, constitute a take-over 'by force'? The 'by force' element usually includes a physical component (i.e., using violence to coerce someone into something).[257] This normative definition of the term 'by force' suggests that only an act that has a physical element is covered by Article 11. However, the US took the clear position that cyber activities could constitute a use of force under Article 2(4) of the UN Charter[258] and permit the right to self-defense.[259] If one adapts the American view, cyberattacks that hijack an aircraft can be classified as an act committed by force and therefore fall within Article 11 and the scope of the Tokyo Convention. On this approach a saboteur who unlawfully hacks the control systems of an aircraft and gains access to them would be considered to have seized control of the aircraft 'by force'.

The Tokyo Convention was the first international instrument to deal with hijackings and other acts of unlawful interference in international civil aviation and applies to all acts

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[255] *Tokyo Convention 1963, supra* note 219 art 1.
[256] *Ibid* art 11 para 1.
[257] According to the Oxford Dictionary 'by force' means "violent physical action used to obtain or achieve something". See Oxford Learners Dictionary, "Force" (last visited 05 May 2021), online: *Oxford Learners Dictionary* <www.oxfordlearnersdictionaries.com/us/definition/english/force_1?q=force>.
[258] *Charter of the United Nations*, 26 June 1945, Can TS 1945 No 7.
[259] See Koh Harold Hongju, "International Law in Cyberspace" (18 September 2012), online: *US Department of State* <//2009-2017.state.gov/s/l/releases/remarks/197924.htm>.

that *may* jeopardize the safety of an aircraft.[260] In interpreting the provisions of international treaties one must consider “the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose.”[261] Since the Convention applies to all acts that jeopardise or may jeopardize the safety of an aircraft or of persons or property on board or good order and discipline on board, cyber interference with control systems would likely satisfy minimum threshold of ‘may’ and thus be subject to the Tokyo Convention, even if one were to exclude it from Article 11.

Further, the application of the Tokyo Convention is not limited to the jeopardizing acts mentioned in the Convention itself. Article 1 stipulates that the Tokyo Convention also applies to acts that are penal offences under the national law of states having penal jurisdiction over the offender.[262] Consequently, if a contracting state makes cyberattacks on civil aviation a criminal offence in its national law, they would be covered by the Tokyo Convention.

That said, the Tokyo Convention faces the major drawback already emphasized above, namely that it only applies to offences committed by a person onboard.[263] This means that the cyberattack must originate on the aircraft and be executed by a person who is onboard. Considering the nature of cyberattacks and the anonymity they permit, they are usually executed from afar. This is precisely where the power of such an attack lies. The physical element that requires the perpetrator to be onboard, makes the Tokyo Convention largely inadequate to deal with modern cyberattacks. This does not change the fact, however,

[260] See also Dempsey, *supra* note 32 at 237.
[261] *Vienna Convention on the Law of Treaties*, 23 May 1969, 1155 UNTS 331 art 31 (entered into force 27 January 1980) [*VCLT*]; Although the VCLT itself is only applicable to treaties that were concluded after the VCLT entered into force (Art 4), the VCLT is nevertheless an important source for the interpretation of international treaties and can be seen to a certain degree as a codification of international customary law. Especially the rules of interpretation contained in Article 31 to 33 have been seen as rules of customary international law. See e.g. *Golder v United Kingdom*, (1975) 18 ECHR (Ser A), 16 YB Eur Conv HR 482. See also Ian Sinclair, *The Vienna Convention on the Law of the Treaties,* 2nd ed (Manchester: Manchester University Press, 1984) at 20.
[262] *Tokyo Convention 1963*, *supra* note 219 art 1 para 1.
[263] *Tokyo Convention 1963*, *supra* note 21 art 1 para 2.

that the Convention would apply to suborbital flights for jeopardizing acts, such as placing an explosive onboard or hijacking a suborbital vehicle by entering the flight deck and seizing control.

### *Addendum on the Protocol to Amend the Tokyo Convention*

In 2014 during the International Air Law Conference in Montreal a Protocol to amend the Tokyo Convention was adopted (Montreal Protocol 2014). The Protocol entered into force in January 2020 and it has been ratified or acceded to by 31 states to date.[264] The primary objective of the Montreal Protocol 2014 was to deal with increasing incidents of unruly and disruptive behaviour on board aircraft.[265] To that end the Montreal Protocol 2014 expands the jurisdiction of contracting states over penal offences to include the state of landing and the state of location of the operator.[266] It also seeks to enhance global aviation security by extending legal recognition and protections to in-flight security officers.[267]

Most notably the Protocol brought the general definition of 'in flight' under the Tokyo Convention into line with the definition applicable to the powers of the aircraft commander: an aircraft is considered to be 'in flight' for all purposes of the Tokyo Convention from the moment the external doors are closed until they are opened for disembarkation.[268] The different number of state parties to the Tokyo Convention and the Protocol means that original definition still applies in those contracting states that have not yet adopted the protocol.

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[264] The Protocol has currently 36 signatories, 13 ratifications and 16 accessions and 2 acceptances. See ICAO, "Protocol to Amend the Convention on Offences and Certain Other Acts Committed On Board Aircraft" (last visited 04 August 2021), online (pdf): *ICAO* <www.icao.int/secretariat/legal/List%20of%20Parties/Montreal_Prot_2014_EN.pdf>.
[265] See IATA, "Boost for Efforts to Tackle Unruly Passengers as MP14 Set to Come into Force" (28 November 2019), online: *IATA* <www.iata.org/en/pressroom/pr/2019-11-28-01/>.
[266] See *Protocol to Amend the Convention on Offences and Certain other Acts committed on board Aircraft*, 04 April 2014, art IV (entered into force 01 January 2020, DCTC Doc No 34) [*Montreal Protocol 2014*].
[267] *Ibid* art VII para 3.
[268] *Ibid* art II.

As this thesis argued in detail above, suborbital vehicles engaged in point-to-point transportation should be considered 'aircraft' and they will be subject to largely the same threats as modern aeroplanes. The Tokyo Convention (and the amending Protocol) would be applicable to those instances provided that the states involved are party to it.

### b. The Hague Convention of 1970

*The Convention for the Suppression of Unlawful Seizure of Aircraft* (Hague Convention) was developed in response to the increased number of hostile acts against aircraft in the late 1960s and sought to repair some shortcomings of the Tokyo Convention.[269]

Whereas the Tokyo Convention did not itself penalize hijacking, leaving it to national law, the Hague Convention made hijacking an international offence for which severe penalties are required.[270] The Hague Convention outlaws any act, or attempted act, to seize or exercise control over an aircraft while it is in flight.[271] An aircraft is considered to be 'in flight' from the moment the external doors are closed after boarding until they are opened again for disembarkation.[272] This means that the Hague Convention applies, even if the aircraft is still at the parking position or taxiing as long as all external doors are closed. While this is broader than the general 'in-flight' period in the Tokyo Convention, it is consistent with the Tokyo Convention's 'in-flight' definition for the purpose of the commander's exercise of power and authority and with the broader definition in the 2014 Montreal Protocol.[273]

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[269] Dempsey, *supra* note 32 at 241.
[270] *Hague Convention 1970*, *supra* note 184 art 2. See also Dempsey, *supra* note 32 at 241; Ashdown, *supra* note 212 at 23.
[271] *Hague Convention 1970*, *supra* note 184 art 1.
[272] *Ibid* art 3 para 1.
[273] *Montreal Protocol 2014*, *supra* note 266 art II; *Tokyo Convention 1963*, *supra* note 219 art 5 para 2.

The Hague Convention also expanded penal jurisdiction to include not just the state of registration of the aircraft but also the state in which the aircraft landed with the alleged offender still on board, and the state of the principal place of business or permanent residence of the lessee of the aircraft in the case of an aircraft leased without crew.[274]

Unlike the Tokyo Convention, the Hague Convention imposes mandatory extradition requirements on contracting states.[275] If the state that has the alleged hijacker in custody within its territory does not extradite the offender to a state that has jurisdiction, the Hague Convention requires it to prosecute even if that state was not affected by the offense and would not otherwise have jurisdiction.[276] This obligation to extradite or prosecute has been replicated in the subsequent international aviation conventions discussed below.

Unlike the Tokyo Convention, the Hague Convention only deals with jeopardizing acts or attempts that involve the unlawful seizure of aircraft (i.e., hijacking). However, it applies not just to the person who hijacks or attempts to hijack the aircraft but also to any accomplice of that person.[277] The unlawful seizure of a suborbital vehicle will be a threat in the future. Considering that suborbital vehicles will be a novelty drawing widespread media attention, they will provide an attractive stage for potential terrorists to spread their message or achieve their goals.[278] Having established that suborbital vehicles can be classified as aircraft, the Hague Convention will apply to any acts or attempts to seize or take control of the suborbital vehicle unlawfully.

However, like the Tokyo Convention, the Hague Convention requires that the unlawful seizure or attempted seizure be done 'by force' or threat of force.[279] This again raises the question of whether a cyberattack can be considered an attack executed 'by force'.

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[274] *Hague Convention 1970, supra* note 184 art 4 para 1.
[275] *Ibid* arts 6,8.
[276] *Ibid* art 7.
[277] *Ibid* art 1.
[278] See also Chatzipanagiotis, *supra* note 14 at 215.
[279] *Hague Convention 1970*, *supra* note 184 art 1.

Consequently, the same considerations regarding the meaning of the term ‘by force’ apply. If one were to follow the US view, then a cyberattack could be seen as an attack ‘by force’ and therefore constitute an offence under the Hague Convention.

Moreover, like the Tokyo Convention, the Hague Convention only penalises acts or attempts to seize control of the aircraft that are performed by a person onboard.[280] The same applies to an accomplice. This requirement makes it largely inapplicable to cyberattacks as these attacks are generally done from a distance, even if one were to determine that a cyberattack can be treated as accomplished ‘by force’.

However, any ambiguity on the latter point was put to rest when *the Protocol Supplementary to the Convention for the Suppression of Unlawful Seizure of Aircraft* (Beijing Protocol 2010) came into force in 2018. The Protocol states that “[a]ny person commits an offence if that person unlawfully and intentionally seizes or exercises control of an aircraft in service by force or threat thereof, or by coercion or by any other form of intimidation, or *by any technological means* [emphasis added].”[281] This wording expressly includes acts or attempts to unlawfully seize or take control of an aircraft by technological means and separating it from the term ‘by force’. Cyberattacks are therefore recognised as a separate category. The fact that the contracting states to the Hague Convention thought it necessary to include technological threats in the Supplementary Protocol could arguably be seen as indication that they did not consider cyberattacks to be covered by the original Hague Convention of 1970.[282]

In addition, the Protocol eliminates the requirement for the alleged offender to be physically onboard the aircraft.[283]

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[280] *Ibid.*

[281] *Protocol Supplementary to the Convention for the Suppression of Unlawful Seizure of Aircraft*, 10 September 2010, UNTS art II (entered into force 1 January 2018) [*Beijing Protocol 2010*].

[282] Indeed, the same could be said for the Tokyo Convention 1963.

[283] Art II states that “any person commits an offence (…)”. It is therefore not necessary anymore that the person is onboard the aircraft.

Relatedly, the Protocol also inserts a new Article 3 and replaces the term ‘in flight’ by the term ‘in service’: an aircraft is considered to be ‘in service’ from the beginning of the pre-flight preparation of the aircraft until twenty-four hours after any landing.[284] In the case of a forced landing, the flight is “deemed to continue until the competent authorities take over the responsibility for the aircraft and for persons and property on board.”[285] This time period was adopted from the Montreal Convention 1971 and Beijing Convention 2010 which define ‘in service’ the same way. This period is significantly longer than the ‘in flight’ period in the original Hague Convention. At the date of writing, the Protocol is in force in 37, compared to 185 state parties to the Hague Convention.[286] Nevertheless, the Protocol has entered into force and will therefore also apply to suborbital flights depending on whether the states involved have ratified or acceded to it. It would be desirable for state parties to the Hague Convention which have not yet ascended or ratified the Protocol to do so in order to ensure that the Hague Convention definitively applies to cyberattacks that result in the unlawful seizure or hostile take-over of a suborbital vehicle in service.[287]

### c. The Montreal Convention of 1971

One of the shortcomings of the Hague Convention of 1970 was its failure to criminalize acts of aircraft sabotage other than the unlawful seizure of attempted seizure of aircraft.[288] Incidents in which explosives were smuggled onboard an aircraft and subsequently detonated exposed the need for a new international legal instrument.[289] The Montreal

[284] *Beijing Protocol 2010*, *supra* note 280 art V.
[285] *Ibid*.
[286]See ICAO, “Convention for the Suppression of Unlawful Seizure of Aircraft” (last visited 04 August 2021), online (pdf): *ICAO* <www.icao.int/secretariat/legal/list%20of%20parties/hague_en.pdf>; ICAO, “Protocol Supplementary to the Convention for the Suppression of Unlawful Seizure of Aircraft” (last visited 04 August 2021), online (pdf): *ICAO* <www.icao.int/secretariat/legal/List%20of%20Parties/Beijing_Prot_EN.pdf>.
[287] This is also the view of the ICAO Assembly, who urges Member States to adopt the Protocol. See Res A40-10, *supra* note 214.
[288] Ashdown, *supra* note 212 at 24.
[289] See Scott & Trimarchi, *supra* note 76 at 124.

Convention is in many aspects similar to the Hague Convention, including repeating the "extradite or prosecute" requirement.[290] However, it establishes wider range of international offences, five in total.[291] As will be seen, the Montreal Convention, also largely eliminates the location-based ("on board requirement') approach that limited the scope of the Tokyo and Hague Conventions, with only one exception.[292]

The first offence established by the Montreal Convention is any act, or attempted act, of violence committed by a person against another person on board an aircraft in flight if the act is "likely endanger the safety of the aircraft."[293] The Montreal Convention links this offence to the safety of the aircraft in flight. Cases of passenger upon passenger assault are therefore excluded from its scope.[294] The Montreal Convention also seeks to "restrain acts of unlawful interference with civil aviation"[295] and although acts of unlawful seizure or attempted seizure of an aircraft in flight are not expressly mentioned in the Montreal Convention 1971, hijackings are usually accomplished by exerting violence or the threat

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[290] *Montreal Convention 1971, supra* note 18 arts 6–7; Dempsey, *supra* note 32 at 245.

[291] Article 1 of the Montreal Convention 1971 states:
"1. Any person commits an offence if he unlawfully and intentionally:
(a) performs an act of violence against a person on board an aircraft in flight if that act is likely to endanger the safety of that aircraft; or
(b) destroys an aircraft in service or causes damage to such an aircraft which renders it incapable of flight or which is likely to endanger its safety in flight; or
(c) places or causes to be placed on an aircraft in service, by any means whatsoever, a device or substance which is likely to destroy that aircraft, or to cause damage to it which renders it incapable of flight, or to cause damage to it which is likely to endanger its safety in flight; or
(d) destroys or damages air navigation facilities or interferes with their operation, if any such act is likely to endanger the safety of aircraft in flight; or
(e) communicates information which he knows to be false, thereby endangering the safety of an aircraft in flight".

[292] One provision requires the act to be committed 'on board' the aircraft: article 1 para 1 (a) outlaws any act of violence against a person on board.

[293] *Montreal Convention 1971, supra* note 18 art 1 para 1 (a).

[294] Abeyratne makes the same observation in the context of the Beijing Convention 2010, which uses the same wording as the Montreal Convention 1971. See Ruwantissa Abeyratne, "The Beijing Convention of 2010 on the suppression of unlawful acts relating to international civil aviation – an interpretative study" (2011) 4:2 J Transp Sec 131 at 136 [Abeyratne, "An interpretative study"].

[295] See C. S. Thomas & M. J. Kirby, "The Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation" (1973) 22:1 ICLQ 163 at 166.

thereof on people on board an aircraft. Hijackings would therefore come within the scope of this offence.[296]

The second offence is any act that "destroys an aircraft in service" or causes enough damage "to render it incapable of flight or which is likely to endanger the safety in flight."[297]

The terms 'in flight' and 'in service' are defined differently. An aircraft is considered 'in flight' from the moment the doors are closed until they are opened for disembarkation, while the aircraft is considered to be 'in service' from the beginning of the pre-flight preparations until twenty-four hours after landing.[298] This means that this second offence would cover not only ground attacks against a suborbital flight using anti-aircraft weaponry but also acts of sabotage against the suborbital vehicle carried out in the pre-flight preparatory stage.

The third offence is for a person "to place or cause to be placed any device or substance on an aircraft in service which is likely to destroy that aircraft" or to cause damage to it "which renders it incapable of flight or which is likely to endanger its safety in flight."[299] Interestingly, the Montreal Convention does not define the terms 'device' and 'substance' and the drafters did not include 'weapon' in the provision.[300] This offence ordinarily covers instances in which somebody places explosives on board an aircraft.[301] Therefore, should a suborbital vehicle be destroyed by a bomb placed on board by a person before its departure, this act would fall within the scope of the offence.

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[296] Article 1 (a) states "Any person commits an offence if he unlawfully and intentionally performs an act of violence against a person on board an aircraft in flight if that act is likely to endanger the safety of that aircraft." Using violence against the crew or fellow passengers to ultimately gain access to the flight deck would therefore be covered by the Convention.
[297] *Montreal Convention 1971*, *supra* note 18 art 1 para 1 (b).
[298] *Ibid* art 2.
[299] *Ibid* art 1 para 1 (c).
[300] Abeyratne makes a similar observation in the context of the Beijing Convention 2010, which adopts the wording of the Montreal Convention 1971. See Abeyratne, "An interpretative study", *supra* note 294 at 137.
[301] Havel & Sanchez, *supra* note 71 at 206.

The fourth offence reflects the first effort to deal with technological threats in an international treaty. The Montreal Convention make it an offence if a person "destroys or damages air navigation facilities or interferes with their operation if any such act is likely to endanger the safety of aircraft in flight."[302] This would include an attempt by an outsider to unlawfully gain access to navigational facilities. It could be argued that the drafters did not intend to include cyberattacks in this offence as these types of threats were unknown in the 1970s. However, this argument would fail to respect the main purpose of the Montreal Convention, namely protection against unlawful acts that jeopardize the safety of civil aviation.[303] A broad interpretation of this offence is therefore warranted.[304] This means that a cyberattack directed at the flight computer of a suborbital vehicle falls within the scope of the offence as long as the attack is likely to endanger the safety of the vehicle in flight. The Convention does not require the air navigation facility to be on board an aircraft. Consequently, a cyberattack on a navigational facility not located onboard the suborbital vehicle that helps it to navigate (for example, a ground station of a GNSS) would arguably qualify as an offence.

The fifth and final offence established by the Montreal Convention is for a person to communicate information that the person "knows to be false, thereby endangering the safety of an aircraft in flight."[305] This would cover, for example, a false claim that a hijacker or an explosive is on bord. Considering technological advancements since the drafting of the Montreal Convention, this offence should be interpretated to include information that is communicated electronically.[306]

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302 *Montreal Convention 1971*, *supra* note 18 art 1 para 1 (d).
303 *Ibid* Preamble.
304 *VCLT*, *supra* note 261 art 31
305 *Montreal Convention 1971*, *supra* note 18 art 1 para 1 (e).
306 *Cf* Thomas & Kirby, *supra* note 295 at 166. A clear distinction must be made between the types of wrong electronic information that are submitted. If the wrong information transmitted would interfere with the navigation of an aircraft, this would arguably fall under Article 1 para 1 (d) as this would interfere with the normal operation of air navigation facilities. On the other hand, if somebody submits data that does not target the air navigation facilities onboard an aircraft, then this would be covered by Article 1 para 1 (d).

The Montreal Convention currently has 188 state parties which means it will apply to a large number of acts of aircraft sabotage that constitute international offences under the Montreal Convention.[307]

As the first international instrument to deal with technological threats, the Montreal Convention is particularly suitable for suborbital vehicles that will rely heavily on computer technology and GNSS to safely operate and navigate. Criminal acts directed at the electronic systems utilised during a suborbital flight will therefore be covered by the Montreal Convention. This is especially important since there is only one other major international treaty that is suitable for cyberattacks in aviation. The Beijing Convention of 2010 discussed below. The Beijing Convention only recently came into force and therefore has far fewer state parties than the Montreal Convention. Consequently, it will take time achieve global application.[308]

### d. The Beijing Convention of 2010

#### *Introduction*

*The Convention on the Suppression of Unlawful Acts Relating to International Civil Aviation* (Beijing Convention 2010) was adopted at a diplomatic conference held by ICAO in Beijing from 30 August to 10 September 2010. The Beijing Convention 2010 is unique insofar as it aims to respond not just to known threats but also to new and emerging threats. This is made clear in the preamble which states that "new types of threats against civil

[307] See ICAO, "Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation" (last visited 30 April 2021), online (pdf): *ICAO* <www.icao.int/secretariat/legal/List%20of%20Parties/Mtl71_EN.pdf>.

[308] The Beijing Convention 2010 is currently in force in 37 states whereas the Montreal Convention 1971 has 188 state parties that adhere to it. See ICAO, "Convention on the Suppression of Unlawful Acts relating to International Civil Aviation" (last visited 14 May 2021), online (pdf): *ICAO* <www.icao.int/secretariat/legal/List%20of%20Parties/Beijing_Conv_EN.pdf>.

aviation require new concerted efforts and policies of cooperation on the part of States."[309] This makes the Beijing Convention 2010 a proactive legal instrument.

At the same conference states also adopted a supplementary protocol to the Hague Convention: *The Protocol Supplementary to the Convention for the Suppression of Unlawful Seizure of Aircraft* (Beijing Protocol 2010). Both, the Beijing Convention 2010 and the Beijing Protocol 2010, are meant to work together and "strengthen the global legal framework for aviation security."[310] While the Beijing Convention 2010 intends to modernize the Montreal Convention 1971 and its 1988 supplementary protocol, the Beijing Protocol 2010 updates the Hague Convention 1970 by extending its coverage against various forms of aircraft hijackings.[311]

Like the 1988 Protocol to the Montreal Convention[312], the Beijing Convention 2010 expands the reach of international aviation criminal law to include both acts of violence and sabotage carried out at airports serving international civil aviation.[313] The discussion that follows will focus on offences against aircraft rather than airports.

Like the older Conventions discussed above, the aircraft related offences set out in the the Beijing Convention 2010 only apply to a vehicle is considered an 'aircraft'. This thesis has already established that suborbital vehicles engaged in point-to-point transportation should be considered 'aircraft'.[314] The author submits that the Beijing Convention 2010 therefore applies to suborbital flights. This is appropriate especially considering the forward thinking and proactive tenor of the Beijing Convention 2010.

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[309] *Beijing Convention 2010*, *supra* note 18 Preamble
[310] ICAO, "Promotion of the Beijing Convention and the Beijing Protocol of 2010" (2012) Working Paper HLCAS-WP/15 [WP15].
[311] *Ibid* ss 1.2–1.3
[312] *Protocol for the Suppression of Unlawful Acts of Violence at Airports serving International Civil Aviation*, 24 February 1988, 1589 UNTS (entered into force 6 August 1989).
[313] *Ibid* art 1 paras 2–4.
[314] See Introduction – Suborbital Point-to-Point Transportation, *above*.

### *Offences*

The Beijing Convention seeks to consolidate and modernize the Montreal Convention 1971 and the 1988 Protocol to the Montreal Convention.[315] To that end, it not only replicates the five offences recognized by the Montreal Convention but extends the list of offence.[316]

In response to the attacks of 9/11[317] the Beijing Convention 2010 makes it an offence for any person to use "an aircraft in service for the purpose of causing death, serious bodily injury or serious damage to property or the environment."[318] In other words, the Beijing Convention 2010 makes it an offence for a person to use an aircraft 'in service' as a weapon. It follows that if a terrorist were to hijack a suborbital vehicle and subsequently use it to attack targets on the ground, this would be within the scope of the Beijing Convention 2010. But because it applies to an aircraft 'in service' the offence would also cover acts carried out in the ground before and after the flight aimed at facilitating the use of the aircraft as a weapon of destruction.[319]

The new offences covered by the Beijing Convention 2010 also include the use of Biological, Chemical, and Nuclear (BCN) weapons or dangerous substances to attack aircraft

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[315] WP15, *supra* note 310 s 1.2.
[316] Art 1 para 1 (a)–(e) of the Beijing Convention 2010 states:
"Any person commits an offence if that person unlawfully and intentionally:
(a) performs an act of violence against a person on board an aircraft in flight if that act is likely to endanger the safety of that aircraft; or
(b) destroys an aircraft in service or causes damage to such an aircraft which renders it incapable of flight or which is likely to endanger its safety in flight; or
(c) places or causes to be placed on an aircraft in service, by any means whatsoever, a device or substance which is likely to destroy that aircraft, or to cause damage to it which renders it incapable of flight, or to cause damage to it which is likely to endanger its safety in flight; or
(d) destroys or damages air navigation facilities or interferes with their operation, if any such act is likely to endanger the safety of aircraft in flight; or
(e) communicates information which that person knows to be false, thereby endangering the safety of an aircraft in flight;". These provisions are verbatim taken from Article 1 para 1 (a)–(e) of the Montreal Convention 1971.
[317] See Ruwantissa Abeyratne, "The Beijing Convention of 2010: An Important Milestone in the Annals of Aviation Security" (2011) 36:3 Air & Space L 243 at 251 [Abeyratne, "The Beijing Convention: An Important Milestone]
[318] *Beijing Convention 2010*, *supra* note 18 art 1 para 1 (f).
[319] *Ibid* art 2 (b).

or targets on the ground as well as the transport of BCN weapons and other dangerous materials, unless their transport is approved and done by a state party.[320]

Like the Montreal Convention, the Beijing Convention 2010 also makes it an offence for a person to attempt to commit any of the criminal offences within its scope or to participate as an accomplice and also extends its application to anyone who organises or directs others to commit one of the offences.[321]

Interestingly, the Beijing Convention 2010 further makes it an offence if a person "unlawfully and intentionally assists another person to evade investigation, prosecution or punishment knowing that the person has committed an act that constitutes and offence" or "has been sentenced" or "is wanted for criminal prosecution by the law enforcement authorities for such an offence."[322] This is the first time a major criminal air law treaty addresses this issue. The older Conventions did not address any issues in which a person assists a perpetrator to avoid criminal prosecution.

The Convention additionally makes it an offence to threaten to commit an offence within its scope or to participate in a group with the aim of committing such an offence.[323] Finally, a corporation or other legal entity may be held criminally liable if the relevant national law so provides.[324]

### *Jurisdiction*

The Beijing Convention 2010 not only carries forward the jurisdictional provisions of the older Convention (as well as the 'extradite or prosecute' formula first introduced by the Hague Convention) but expands them, first, by requiring state parties to establish jurisdiction

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[320] *Ibid* art 1 para 1 (g)–(i).
[321] *Ibid* art 1 para 4 (a)–(c).
[322] *Ibid* art 1 para 4 (d). This would exclude any instances in which the person unknowingly assists the perpetrator.
[323] *Beijing Convention 2010*, *supra* note 18 art 1 paras 3,5.
[324] *Ibid* art 4.

if the alleged offender is a national and second, by setting out other optional grounds for jurisdiction.[325] Additionally, it allows a legal entity, such as a corporation, to be held criminally liable if the applicable national law so allows.[326]

### *Cyber-Terrorism*

The Beijing Convention 2010 makes it an offence for a person to unlawfully and intentionally destroy or damage air navigation facilities or interfere with their operation if their actions are likely to endanger the aircraft 'in flight'.[327] While the Montreal Convention 1971 contained the same provision, the Beijing Convention 2010 goes to define air navigation facility to include "signals, data, information or systems necessary for the navigation."[328] This is confirmation that the offence applies to acts of cyberterrorism aimed at air navigation facilities. Like the Montreal Convention 1971, the Beijing Convention 2010 does not prescribe a specific location to the air navigation facility. Consequently, air navigation facilities on the ground or onboard an aircraft are equally covered by the Beijing Convention 2010.

### *Conclusion*

The Beijing Convention 2010 "is a proactive and timely initiative of both ICAO and the international civil aviation community."[329] It exclusively addresses aviation security related issues and adopts all the criminal offences of the Montreal Convention 1971 but extends it further to include new and emerging threats.[330] The proactive nature of the Beijing Convention makes it particularly suitable for suborbital point-to-point transportation. Once

[325] *Ibid* art 8.
[326] *Ibid* art 4.
[327] *Ibid* art 1 para 1 (d).
[328] *Ibid* art 2 (c).
[329] Abeyratne,"The Beijing Convention: An Important Milestone", *supra* note 317 at 254.
[330] *Ibid* at 254.

this mode of transportation becomes feasible for public use, the Beijing Convention will provide a suitable international legal instrument for criminal acts committed on and against suborbital vehicles as well as airports.

The Beijing Convention came into force only recently, in 2018. Unsurprisingly, the number of states in which it is presently in force is very modest. Only 37 countries currently adhere to the Beijing Convention.[331] It would be desirable for the state parties to the other conventions to ratify or accede to the Beijing Convention and the Beijing Protocol of 2010 as soon as possible to better ensure a globally harmonized international aviation criminal law regime.

### e. Annex 17

Annex 17 – Safeguarding International Civil Aviation Against Acts of Unlawful Interference – was originally issued by ICAO in 1974 and incorporated many elements of the Tokyo, Hague and Montreal Conventions.[332] It is the main Annex to address aviation security and has been updated many times since its inception. It deals with "preventive measures for aircraft, airports, passengers, baggage, cargo, and mail as well as standards and qualifications for security personnel and responsive measures to acts of unlawful interference."[333] Annex 17 stipulates that "[e]ach Contracting State shall have as its primary objective the safety of passengers, crew, ground personnel and the general public in all matters related to safeguarding against acts of unlawful interference with civil aviation."[334]

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[331] See ICAO, "Convention on the Suppression of Unlawful Acts relating to International Civil Aviation" (last visited 30 June 2021), online (pdf): *ICAO* <www.icao.int/secretariat/legal/List%20of%20Parties/Beijing_Conv_EN.pdf>.
[332] Dempsey, *supra* note 32 at 250.
[333] *Ibid.*
[334] *Safeguarding International Civil Aviation Against Acts of Unlawful Interference*, ICAO, Annex 17 to the Convention on International Civil Aviation, (2020), s. 2.1.1 [Annex 17].

To that end, Annex 17 mandates that contracting states, airports and aircraft operators install an aviation security program to safeguard civil aviation from unlawful interference.[335] Additionally, States must create a national civil aviation security programme and designate a dedicated authority to oversee it.[336] Annex 17 further requires the establishment of measures to prevent weapons, explosives and any other dangerous devices, articles or substances that may be used to commit an act of unlawful interference to be introduced onto an aircraft and to ensure access control to airports.[337]

Measures to address security threats against civil aviation are a relatively new addition to Annex 17 and were only added in 2011.[338] Annex 17 now requires contracting states to identify critical information and communications technology systems and develop appropriate measure to protect them from harmful interference.[339] However, it only recommends that states implement appropriate measures, inter alia, to limit remote access capabilities.[340]

Chapter 5 of Annex 17 deals with the management by states of responses to acts of unlawful interference building on the Tokyo, Hague and Montreal Conventions. [341] Their inclusion in an Annex to the Chicago Convention extends their application to contracting states that have never ratified any of the conventions dealing with aviation criminal law.[342] Since suborbital vehicles undertaking point-to-point transportation can be considered aircraft, they will fall within the scope of Annex 17 and states will have to meet the prescribed standards and recommended practices and ensure the security of suborbital flights.

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[335] *Ibid* ss 3.1.1, 3.2.1, 3.3.1.
[336] *Ibid* ss 3.1.2, 3.1.3.
[337] *Ibid* ss 4.1–4.2.
[338] Fox, *supra* note 213 at 208.
[339] Annex 17, *supra* note 334 s 4.9.1.
[340] Annex 17, *supra* note 334 s. 4.9.2.
[341] Dempsey, *supra* note 32 at 251.
[342] Dempsey, *supra* note 32 at 251.

Considering the grave threat cyberterrorism poses to civil aviation, it is remarkable that ICAO has only dedicated two sections in Annex 17 to this threat and largely pushed responsibility to the member states. In the author's opinion, ICAO should develop more stringent measures and guidelines – in the form of standards – regarding cybersecurity, especially considering the still modest participation of states in the Beijing Convention 2010.

## 2. Conclusion

The aviation criminal law conventions examined in this chapter collectively cover a wide range of offences committed against the safety and security of civil aviation. "Interference with civil aviation should be viewed as an act committed against the international order and world peace"[343] and should consequently be treated as a priority by states. This is especially true for emerging threats such as cyberterrorism. As one author aptly observed:

> Cyber-terrorism has the advantage of anonymity, which enables the hacker to obviate checkpoints or any physical evidence being traceable to him or her. It is a low budget form of terrorism where the only costs entailed in interfering with the computer programs of an air transport system would be those pertaining to the right computer equipment.[344]

The Montreal Convention of 1971, although a reactive convention, does allow for a sufficiently broad interpretation to include modern cyberterrorism in its scope. States have shown willingness in the recent past to strengthen the international legal framework

[343] Ruwantissa Abeyratne, *Aviation Security*, (New York: Routledge Taylor & Francis Group, 1998) at 191.
[344] Ruwantissa Abeyratne, *Aviation Security Law*, (Berlin: Springer, 2010) at 24.

pertaining to technological threats against civil aviation. This is evidenced by the adoption of both the Beijing Protocol 2010 and the Beijing Convention of 2010. Unfortunately, ICAO has not yet sufficiently addressed cyberthreats and arguably remains unprepared. In the absence of clear guidelines from ICAO, we are left with the existing legal framework.

Suborbital point-to-point transportation will soon become a reality and once these flights start crossing state borders the international legal regime pertaining to aviation criminal law will become applicable. As this chapter discussed, suborbital vehicles engaged in point-to-point transportation will be subject to old threats as well as emerging threats. The publicity that will accompany these technological achievements will make suborbital vehicles an especially attractive target to terrorists. Bringing suborbital vehicles within the scope of the existing aviation criminal law treaties would ensure a clear legal framework and eliminate gaps. The most desirable outcome would be the swift widespread ratification by states of the Beijing Convention 2010 and the Beijing Protocol 2010. The Beijing Convention provides for a proactive legal framework that not only covers every aspect of the older conventions and protocols but is also sufficiently flexible to address future threats which are not yet known. Until the Beijing Convention has been ratified by a large enough number of states, the Tokyo, Hague and Montreal Conventions will apply to the majority of acts of interference with civil aviation committed on or against a suborbital vehicle or flight. As argued in this chapter, those conventions will apply to suborbital vehicles and flights and states will have the same obligations regarding them as they presently have towards ordinary aeroplanes and ordinary flights.

## Conclusion

As Sputnik I hailed in a new space era, so will suborbital vehicles revolutionise the aviation industry. The technology has already developed to the point that suborbital vehicles for tourist flights are presently being tested by companies such as Virgin Galactic and will soon become a reality. Once these vehicles are fully operational suborbital point-to-point transportation will not be far behind. As soon as suborbital vehicles start crossing international state borders, they will fall outside the exclusive domain of national law and shift into the international legal arena. Consequently, international aviation law will apply.

The most desirable outcome would undoubtedly be a new international treaty or an ICAO Annex (or both) catering specifically to suborbital vehicles and flights. However, international consensus is notoriously hard to achieve and ICAO has not come up with any meaningful standards. Considering the pace of technological development, international suborbital point-to-point transportation will likely outpace any meaningful legislation. An ex post facto approach is not advisable as it could jeopardise the safety and security of suborbital civil aviation.[345] We are therefore left with the existing legal framework.

This thesis discussed the applicability of the existing international aviation law framework in the realm of aviation security with a focus on air traffic management and aviation criminal saw. It concluded that the definition of 'aircraft' as established by ICAO in Annex 7 is sufficiently broad to include suborbital vehicles that are engaged in point-to-point transportation, a view supported by ICAO and EASA. International suborbital flights can and should therefore fall within the scope of the regulatory regime of international aviation law.

The technology surrounding air traffic management is currently undergoing a major transition from old-fashioned ground-based to modern satellite-based radar systems. Global

[345] Sameh, *supra* note 13 at 121.

Navigation Satellite Systems, under construction over the past decade and now fully operational, enable true global coverage with precise tracking capabilities. Suborbital vehicles can be seamlessly integrated into this new system. This integration would ensure the safety of all participants.  The comprehensive automatic data transmitted via GNSS combined with precise-real time tracking capabilities enables ATC controllers to respond far more quickly to criminal activities that might occur on suborbital vehicles. This in turn would allow the ATC controller to separate other aircraft in the vicinity safely and efficiently.

Acts that threaten the safety and security of civil aviation are subject to multiple international conventions and are also addressed extensively by ICAO. Suborbital vehicles will largely be subject to the same threats as ordinary aeroplanes. This thesis has concluded that the Tokyo Convention 1963, the Hague Convention 1970, the Montreal Convention 1971 and the Beijing Convention 2010 can all be applied to acts of unlawful interference with suborbital vehicle and flights.

"There can be no denying that the day has come when one of the biggest threats to aviation safety and security lies in attacks, in, or related to, cyberspace."[346] This is especially true for suborbital vehicles that will likely rely even more on automated technology than aeroplanes. The prestige of suborbital flight will make these vehicles a prime target for terrorists that will utilise the anonymity of the internet to attack the computer systems on board. ICAO has done remarkably little to date to address this threat. An extensive regulatory initiative spearheaded by ICAO is overdue. In the absence of a dedicated international framework pertaining to cyberterrorism against civil aviation, we are left with the 2010 Beijing Protocol to the Hague Convention and the 2010 Beijing Convention, which both penalise attacks conducted by technological means.

[346] Fox, *supra* note 213 at 214.

This thesis concluded that the regimes currently in place in the realms of aviation criminal law and air traffic management can regulate international suborbital point-to-point transportation without any modification. A new international treaty, although certainly desirable, is not strictly necessary as the current framework is sufficient and can be applied to suborbital vehicles that provide international point-to-point transportation. This supports the overall conclusion that air law as opposed to space law is the most suitable legal regime to address suborbital flights. The safety of passengers and civil aviation demands no less.

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