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Where air meets space: legal implications for the provision and use of in-flight internet connectivity by satellite

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WHERE AIR MEETS SPACE: LEGAL IMPLICATIONS FOR THE PROVISION AND USE OF IN-FLIGHT INTERNET CONNECTIVITY BY SATELLITE

Steven Truxal and Dimitra Stefoudi*

Abstract

In view of the increasing scale and broadening scope of the provision and use of in-flight internet connectivity by satellite, this article identifies relevant legal implications for States, satellite operators and airlines. With reference to international air law and international space law, as well as telecommunication law, this article discusses the extent to which existing law can alleviate legal concerns.

The article begins with an introduction that discusses the intersection of air and space, locating the provision and use of in-flight connectivity by satellite. A lack of political and legal consensus on where precisely to delineate outer space is explained next, in the context of the application of and fundamental bases of air law (sovereignty) versus space law (freedom). The relevant legal steps taken to achieve in-flight connectivity are considered separately within the air law and space law regimes. This article attempts to synthesize the two regimes as it explores the possible legal grounds for restricting in-flight connectivity by satellite, also as reflected by the practices on-board internet service providers and airlines. In its conclusion the article advocates for more freedom and less restriction “in the air,” in the spirit of international space law.

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I. Introduction

In-flight internet connectivity by satellite stands at the intersection between air and space. It is a service that is offered to users while they are physically “in the air” on-board an aircraft. At the same time, such connectivity is powered by technology that operates in outer space.

Historically, regulatory barriers in the United States (U.S.) have limited the use of passenger Personal Electronic Devices (PEDs) such as smartphones, tablets, and e-readers at an altitude of below 10,000 feet.¹ This changed in 2013 when the U.S. Department of Transportation’s Federal Aviation Administration (FAA) allowed airline passengers to “use of PEDs during all phases of flight as they did not harmfully interfere with any of an aircraft’s communication systems”.² The next year, the European Aviation Safety Agency (EASA) followed suit in relaxing rules on use of PEDs.³

Simultaneously, the market for in-flight connectivity is becoming increasingly crowded and more competitive. Historically, data transfers were made by way of air-to-ground (ATG) towers through antennas mounted to the belly of aircraft. Later, there was an emergence of geostationary orbit (GEO) players, e.g. Eutelsat (OneWeb, Airbus OneWeb Satellites), Gogo (formerly Aircell), OnAir (Immarsat), GX Aviation, SwiftBroadband, European Aviation Network (Deutsche Telekom), Intelsat, ViaSat, Panasonic; many of these are still active today. Most recently, several “disruptors” have come to the market, offering satellite services in the low Earth orbit (LEO), e.g. Starlink for Aviation, ViaSat, SES, and Inmarsat.

¹ State of Qatar, Communications Regulatory Authority, *Review of Class License for the Provision of Public Telecommunications On-board Aircraft*, ¶ 4 CRARAC/2017/11/09 (Nov. 9, 2017), <https://www.cra.gov.qa/-/media/System/9/B/7/C/9B7C923EFFF456F2B8EE380FDBBA05FC/Consultation--Review-of-Class-License-on-board-Aircraft---9-Nov-17-Final.ashx>, para. 1.2.4.

² *Id.* ¶ 5; see *Advisory Circular: Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags*, FAA (May 9, 2014), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-76C.pdf, 13 and *Portable Electronic Devices (PED) ARC Committee Members*, FAA (Feb. 5, 2013), https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/PED.ARC.Committee.Membership.02.05.2013.pdf.

³ EUROPEAN AVIATION SAFETY AGENCY, ED Decision 2014/029/R (Sept. 24, 2014), <https://www.easa.europa.eu/en/document-library/agency-decisions/ed-decision-2014029r>.

II. In-Flight Internet Connectivity at the Intersection of Air and Space

In-flight internet connectivity can be provided in two ways: either through an air-to-ground network, or through a satellite network.⁴ ATG connectivity relies on both the communication towers on the ground as well as a receiving antenna on-board the aircraft. As the aircraft overflies the coverage area of a tower, an aircraft's antenna can be connected to the tower and the airline can offer internet access to its passengers. As it travels, an aircraft would need to connect to several towers to ensure internet access throughout its route. In the case of international air services, these towers are located in different States. Connectivity via satellite involves a communication satellite in orbit that connects to an antenna on-board an aircraft, either directly or through a ground-based satellite receiving station. This article focuses on in-flight internet connectivity by satellite, as it offers an interesting case study on the intersection of air and space, and consequently, the interplay between international air law and international space law.

In terms of how in-flight connectivity is provided on-board the aircraft, an *external* antenna is first required. This antenna acts as a transceiver attached to an aircraft mainframe, which connects via signals to (ground) cell towers, and to (space) satellites that in turn connect to ground stations. The antenna is also connected to one or more wireless fidelity (WiFi) hotspots *internal* to (on-board) the aircraft.

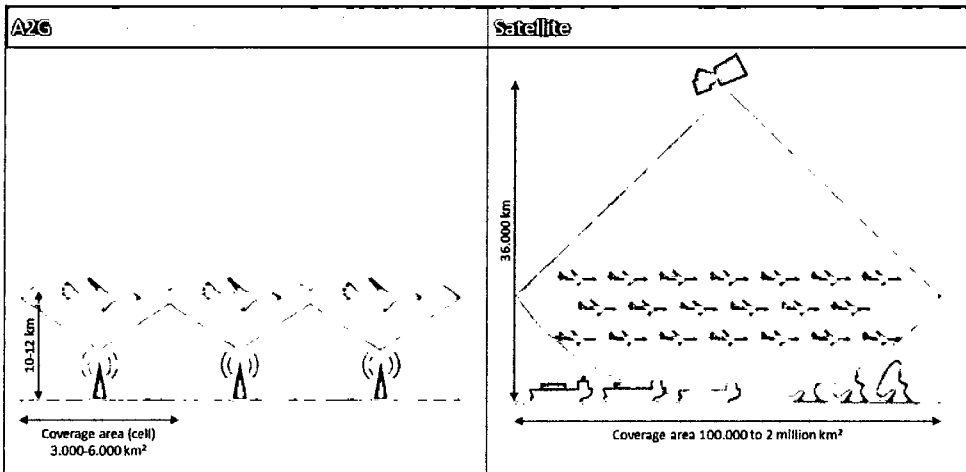


Figure source: A2G Spectrum considerations Ed.2-0, SkyFive AG (2020)

Understanding how connectivity by satellite works can help pinpoint the main legal aspects of in-flight connectivity by satellite and aid in the identification of potential restrictions to its provision. Satellite internet is powered by communication satellites that are launched into GEO or LEO. Communication satellites transmit signals to and from receiving devices, which either diffuse it as internet

⁴ See *Inflight Connectivity: A Guide to Conducting Business at Altitude* 12-13, https://www.aviation-today.com/wp-content/uploads/2018/06/gogo_ifc_101_ebook_small.pdf.

connection to other devices or use it directly to connect the receiving device to the internet.⁵ The receiving devices can be on the ground, e.g. smartphones; at sea, e.g. receivers situated on-board sea-faring vessels; or in the air, e.g. the antennas fixed to aircraft that connect to satellites.

For decades, internet has been provided by GEO satellites that orbit the Earth at a speed that is almost synchronous to the Earth's rotation. Therefore, they can be relied on to maintain constant connection with their receiving devices.⁶ GEO satellites are owned by large telecommunication companies and have long been part of the market for telecommunication services, dating back to the 1960's.⁷ LEO satellites, however, do not have a fixed position as compared to their receiving devices. To increase their coverage, they must operate in constellations.⁸ The existence of LEO constellations is a relatively recent development, with the initial launches taking place in the 2010's.⁹ Satellite-based internet is usually the only service they offer. Even though fewer GEO satellites are required to provide global coverage, these satellites tend to be much larger and more expensive in comparison to LEO constellations, which require many more, but significantly smaller and less expensive satellites. Another difference between the two types is that GEO satellites take more time to receive and transmit signal due to their higher latency, as compared to LEO satellites that can be used for real-time applications.¹⁰ The growing need and desire for constant, fast, and reliable internet connectivity have increased corporate and consumer demand for internet by satellite. Satellites can cover the rising demand for connectivity, thus the legal issues associated with their operation as part of connectivity networks are worth addressing.

In-flight internet connectivity is positioned between air law, governing activities that take place in the domain of national airspace, and space law, governing activities carried out in outer space. Therefore, in-flight connectivity is affected

⁵ Yurong Hu & Victor O. O. Li, *Satellite-based Internet: A Tutorial*, IEEE COMMUNICATIONS MAGAZINE, Mar. 2001, at 155-156, <https://hub.hku.hk/bitstream/10722/44853/1/59969.pdf>; see also *How Do Satellites Provide Internet Access?*, <https://www.inmarsat.com/en/insights/corporate/2023/satellite-internet-connected-from-space.html>.

⁶ See International Telecommunication Union & The World Bank, *Digital Regulation Platform: Spectrum Management* (Mar. 28, 2024), <https://digitalregulation.org/regulation-of-ngso-satellite-constellations/>

⁷ *The History of Satellite Internet: A Brief Overview*, VIASAT, <https://www.rsinc.com/history-of-satellite-internet-a-brief-overview.php>; *The Past, Present, and Future of High-Speed Satellite Internet*, HUGHESNET, <https://www.hughesnet.com/blog/past-present-and-future-high-speed-satellite-internet>.

⁸ See Inigo del Portillo, Bruce G. Cameron, & Edward F. Crawley, *A Technical Comparison of Three Low Earth Orbit Satellite Constellations Systems to Provide Global Broadband*, 159 ACTA ASTRONAUTICA 123, 124-126 (June 2019) (for a comparison on how various internet-providing satellite constellations work to provide global coverage).

⁹ Peter B. de Selding, *Signs of a Satellite Internet Gold Rush in Burst of ITU Filings*, SPACENEWS (Jan. 23, 2015), <https://spacenews.com/signs-of-satellite-internet-gold-rush/>.

¹⁰ For a comprehensive explanation and comparison among satellites in different orbits, including LEO and GEO, see *GEO, MEO, and LEO - How orbital altitude impacts network performance in satellite dataservices*, VIASATELLITE, <https://www.satellitetoday.com/content-collection/ses-hub-geo-meo-and-leo/>. See also Ali Laibakhsh et al., *Darkening Low-Earth Orbit Satellite Constellations: A Review*, 10(4) IEEE Access 24383 (2022), 24383-24384 and RocketMe Up Networking, *Low Earth Orbit (LEO) Satellites vs. Geostationary Satellites — A Technical Comparison*, MEDIUM (Oct. 24, 2024), <https://medium.com/@RocketMeUpNetworking/low-earth-orbit-leo-satellites-vs-geostationary-satellites-a-technical-comparison-2a4f15aeadc9>.

by the stark differences in the exercise of State sovereignty in national airspace and the freedom of all States to explore and use outer space. As will be discussed in section III, a State has complete and exclusive sovereignty over the airspace above its territory, which includes land and territorial waters.¹¹ The permission of a State is required for a foreign aircraft to enter and overfly airspace under its sovereignty. By contrast, outer space is an area outside national sovereignty,¹² which States are free to access, use, and explore,¹³ including for operating satellites that enable in-flight connectivity. The lack of national sovereignty permits satellites in space to transmit signal anywhere in the world.

In light of the different treatment of national sovereignty under air law *versus* space law, it is useful to examine whether the exercise of sovereignty in national airspace affects in-flight connectivity by satellite when an aircraft enters a State's airspace and overflies its territory, and whether the freedom to transmit signal from outer space is influenced by the presence of devices that receive satellite signal in the national airspace of States. This article approaches the two questions through a high-level analysis of the regulation of in-flight connectivity by satellite in section IV, and the example of restrictions to in-flight connectivity, discussed in section V. It aims to investigate which legal frameworks may justify limitations to in-flight connectivity, in an attempt to better understand the broader legal implications of the intersection between technology that functions in an area outside national sovereignty and technology that is used in areas under national sovereignty.

III. The Concepts of Sovereignty: Air Law *versus* Space Law

For air and space lawyers, the phrase “where air meets space” is provocative. This is not because air lawyers and space lawyers cannot agree, or are at odds with one another; instead, it is that our political masters have so far chosen not to come to a consensus on legal definitions of the respective scopes of “airspace” and “outer space.”

A lack of delineation between where “airspace” ends and “outer space” begins, and by extension, which legal regime is applicable at a precise moment, is problematic for lawyers. In terms of governance, there are also two different regimes and different bodies responsible for the safe, sustainable, and peaceful development of air and space operations.

As will be seen in the following sections, the fundamental bases of international air law and international space law are distinctive. On the one hand, air law centers on national sovereignty and functions on the principle of equal opportunity to compete. National airspace is *de jure* closed for scheduled international air services, which at the sole discretion of sovereign States may be opened by

¹¹ Convention on International Civil Aviation art. 1-2, Dec. 7, 1944, 15 U.N.T.S. 295 [hereinafter *Chicago Convention*].

¹² Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including The Moon and Other Celestial Bodies art. II, Jan. 27, 1967, 610 U.N.T.S. 205 [hereinafter *The Outer Space Treaty*].

¹³ *Id.* at art. 1.

an air services agreement to exchange traffic rights.¹⁴ States have enumerated rights and duties within their sovereign air space. On the other hand, national sovereignty claims are banned in space;¹⁵ rather, the principles on freedom of use, access and non-appropriation prevail in space law, noting that the concept of “freedom of space” was first advocated in the 1950s, at the dawn of the space age, by U.S. President Dwight D. Eisenhower.¹⁶

A. Air Law

The French Government invited State delegates to Paris in 1910 for the *Conférence internationale de navigation aérienne* (“International Air Navigation Conference”),¹⁷ tasked with how, in law, to treat “airspace.” There were four options: (1) free airspace; (2) territorial airspace; (3) sovereign airspace; or (4) modified sovereign airspace.¹⁸

“Free airspace” would have denoted the complete freedom of aerial navigation that would have been equivalent to that of maritime law based on *Mare Liberum*, a *jus gentium* doctrine and treatise by Hugo Grotius.¹⁹ “Territorial airspace” would have the airspace above the territorial sea treated in the same as it was in customary international maritime law, limiting the right of innocent passage by foreign vessels. “Sovereign airspace” would have treated airspace as fully within national sovereignty of a State, leading to the concept of “sovereignty in the air.” Finally, a “modified sovereign airspace” would have recognized State sovereignty over airspace while also allowing for innocent passage by foreign aircraft.

The 1910 Conference ended in a stalemate: the French advocated for freedom of the air, whereas the British argued for State sovereignty in the air.²⁰ While Conference was a political failure, it was a legal success as it paved the way for the first international air law treaty, the Paris Convention 1919,²¹ negotiated during the Paris Peace Conference following the end of the First World War.

According to Article 1 of the Paris Convention 1919: “The High Contracting Parties recognize that every Power has complete and exclusive sovereignty over the airspace above its territory.” This position on airspace sovereignty was retained by the drafters of the Convention on International Civil Aviation

¹⁴ *Chicago Convention*, *supra* note 10, at art. 6.

¹⁵ *The Outer Space Treaty*, *supra* note 11.

¹⁶ R. Cargill Hall, *The Origins of U.S. Space Policy: Eisenhower, Open Skies, and Freedom of Space*, Rand Corp. for the Defense Technical Information Center, U.S. Department of Defense (Jan. 1, 1992), <https://apps.dtic.mil/sti/pdfs/ADA344697.pdf>.

¹⁷ *The Postal History of ICAO: The Paris Convention of 1910: The Path to Internationalism*, ICAO, www.icao.int/secretariat/PostalHistory/1910_the_paris_convention.htm (last visited Nov. 15, 2024).

¹⁸ See Steven Truxal, *Economic and Environmental Regulation of Air Transport: From International to Global Governance* (Routledge 2017), for a fuller discussion of these concepts.

¹⁹ Hugo Grotius, *Mare Liberum, 1609 – 2009: Original Latin Text and English Translation* (Robert Feenstra ed., Brill 2009).

²⁰ See John Cobb Cooper, *The International Air Navigation Conference Paris 1910*, 19(2) J. Air L. & Com. 127 (1952).

²¹ Convention Relating to the Regulation of Aerial Navigation, Oct. 13, 1919, 11 L.N.T.S. 173 [hereinafter *The Paris Convention*].

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(“the Chicago Convention”) 1944²²: “The High Contracting Parties recognize that every State has complete and exclusive sovereignty over the airspace above its territory.” The Chicago Convention established the International Civil Aviation Organization, a United Nations (UN) specialized agency for international civil aviation.

What is sovereign, territorial “airspace”? The Chicago Convention provides no definition of “airspace.” Nonetheless, it is commonly understood that airspace “where aerodynamic *lift* provides the upward movement of aircraft, as opposed to the centrifugal force needed to escape the earth’s gravity.”²³ Where is that? At the Von Kármán line, “at 52 to 56 nautical miles [roughly 62 miles] above the earth, is where centrifugal force must be substituted for aerodynamic lift”.²⁴ Thus, this appears to be the height of national airspace.

As for the breadth of this sovereign air space, Article 2 of the Chicago Convention 1944 provides: “For the purposes of this Convention the territory of a State shall be deemed to be the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such State.”

Another example is shown in the Chicago Convention 1944 with the Tokyo Convention on Offences and Certain Other Acts Committed on Board Aircraft 1963²⁵ making it clear that cabin space of any commercial aircraft is the territory of the State in which the aircraft is registered.

B. Space Law

As we turn our attention to space, our first step is to look over our shoulder at the upper limit of airspace. The limit of airspace was already a topic of discussion by 1903. Paul Fauchille, a French air lawyer, advocated that the limit of airspace was 1500 meters, which he later reduced to 500 meters.²⁶ In 1952, an American, John Cobb Cooper argued the limit to be 300 miles.²⁷

The World Air Sports Federation accepts that “space flight” is achieved at the Von Kármán Line.²⁸ With reference to airspace, this line is above the altitude where an aircraft can no longer derive lift from its wing. Some countries recognize a boundary of 100 kilometers, but this is a unilateral arrangement that is not part of treaty law or customary international law, hence not binding on other States.

²² Convention on International Civil Aviation, Apr. 19, 1948, 15 U.N.T.S. 295 (noting that the spelling of “recognised” (British standard) has been changed to “recognized” (American standard)).

²³ Paul B. Larsen, Joseph Sweeney & John Gillick, *Aviation Law: Cases, Laws, and Related Sources* 40 (2d ed. 2012).

²⁴ *Id.*

²⁵ Convention on Offences and Certain Other Acts Committed on Board Aircraft (Tokyo Convention) art. 16, Sept. 14, 1963, 15 U.N.T.S. 295.

²⁶ Joseph F. English, *Air Freedom: The Second Battle of the Books*, 2 J. AIR L. & COM. 356, 364 (1931).

²⁷ John Cobb Cooper, *Legal Problems of Upper Space*, 23 J. AIR L. & COM. 308, 313-4 (1956); see also John Cobb Cooper, *Aerospace Law – Subject Matter and Terminology*, 29 J. AIR. L. & COM. 89, 91 (1963).

²⁸ Fédération Aéronautique Internationale, *Statement about the Karman Line*, <https://www.fai.org/news/statement-about-karman-line> (last visited Nov. 30, 2018).

For instance, according to the Danish Outer Space Act, outer space means the “space above the altitude of 100 kilometers above sea level.”²⁹ The Australian Space Act defines the terms “launch,” “return,” and “space object” by reference to “an area beyond the distance of 100 kilometers above mean sea level.”³⁰ The Kazakh Law on Space Activities describes outer space as “a space extending beyond the airspace at an altitude of more than one hundred kilometers above the sea level.”³¹ These definitions are only valid for States that have accepted them and use them as a means to delineate outer space, as far as their domestic legislation is concerned.

Using the end of the Earth’s atmosphere as a boundary is difficult to assess, as it ranges from between 80 km to 120 km according to proposals, or up to 600 miles to the outermost layer of the atmosphere. For reference, the International Space Station orbits at an average of 400 kilometers³² and the space shuttle was designed to orbit between 185 kilometers and 643 kilometers.³³

The “boundary question” has been on the international agenda since 1967, when it was introduced in the relevant body, the UN Committee on the Peaceful Uses of Outer Space (COPUOS). However, there has been no international agreement by States so far. The Working Group on the Definition and Delimitation of Outer Space of the COPUOS Legal Subcommittee has been addressing the issue but has not produced a definitive outcome.³⁴ Thus, the boundary question remains unanswered. Nevertheless, even though it was not the case when the first artificial object was launched into outer space, permission to enter or overfly a State’s territory on the way after launching a space object into orbit is required.³⁵

Some States propose a functional approach to the matter, whereas others promote a spatial approach.³⁶ According to the former, a clear delineation is required to determine the confines of outer space, while the latter suggests that the nature of an activity as a space activity is decided based on the purpose for which it was designed.³⁷ The definition and delimitation of outer space is essential for activities like suborbital flights, i.e. flights that reach outer space

²⁹ The Outer Space Act 2016, art.2.4.4 (Act No. 409) (Den.).

³⁰ *Space (Launches & Returns) Act 2018* (Cth) pt 1, div 2, ss 8,9 (Austl.).

³¹ Law of Republic of Kazakhstan on Space Activities 2012, art. 1.6 (No. 528.IV) (Kaz.).

³² The European Space Agency, *Science & Exploration: ISS: International Space Station*, https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station/ISS_International_Space_Station (last visited Oct. 30, 2024).

³³ NASA, *The Space Shuttle*, <https://www.nasa.gov/reference/the-space-shuttle/#hds-sidebar-nav-2> (last updated June 2, 2023).

³⁴ See UN Office for Outer Space Affairs, *Working Group on the Definition and Delimitation of Outer Space of the Legal Subcommittee of the UN COPUOS*, <https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/ddos/index.html>.

³⁵ BIN CHENG, *STUDIES IN INTERNATIONAL SPACE LAW* 38 (Clarendon 1997).

³⁶ Olavo Bittencourt, *Revisiting the Delimitation of Outer Space in Light of the Long-Term Sustainability of Space Activities* (2023) 48(SI) AIR & SPACE L.101-102; See generally, FRANCIS LYALL, PAUL B. LARSEN, *SPACE LAW - A TREATISE* 145-150 (2d ed., 2018).

³⁷ See generally, OLAVO BITTENCOURT, *DEFINING THE LIMITS OF OUTER SPACE FOR REGULATORY PURPOSES* (Springer Verlag 2015) (providing a comprehensive overview of the issue, delimitation of outer space and recommending a compromise on international and national space law); See also THOMAS GANGALE, *HOW HIGH THE SKY? - THE DEFINITION AND DELIMITATION OF OUTER SPACE AND TERRITORIAL*

at an altitude that is still affected by the Earth's gravitational pull. The characterization of such activities as aviation activities or space activities consequently establishes whether air law or space law will be applied.³⁸ Satellites that enable in-flight connectivity, even those in LEO, are undoubtedly situated in outer space. The delimitation between airspace and outer space is relevant to in-flight connectivity because it showcases the different treatment of national sovereignty between the two regimes.

Unlike airspace, outer space is an area outside national sovereignty. That is established in Article II of the Outer Space Treaty 1967, which is the cardinal document of international space law. International space law comprises five treaties that were negotiated and adopted by UN COPUOS in the 1960's and the 1970's. The Outer Space Treaty 1967 includes general principles, such as the freedoms of outer space, the prohibition of appropriation of outer space, the peaceful use of outer space, cooperation among States, and the conduct of space activities according to international law. It also includes more specific principles concerning the responsibility and liability of States, the registration of space objects, the protection of astronauts, harmful interference, and the effect of space activities on the environment of the Earth and of outer space.³⁹

Several provisions of the Outer Space Treaty 1967 were elaborated in separate, dedicated space treaties. The Registration Convention 1975 pertains to the registration and sharing of information about space objects.⁴⁰ The Liability Convention 1972 sets out the conditions for the liability of the launching State for damages caused on the Earth and in outer space.⁴¹ The Rescue and Return Agreement 1967 calls for the provision of assistance to astronauts in case of emergency or distress, as well as for the return of astronauts and space objects to their appropriate State.⁴² Lastly, the Moon Agreement 1979 includes provisions for the activities of States on the Moon and other celestial bodies.⁴³

Article II of the Outer Space Treaty 1967 stipulates that: "Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

Article 11.2 of the Moon Agreement 1979 also proclaims outer space as an area outside national sovereignty. It reads: "The Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means."

AIRSPACE IN INTERNATIONAL LAW, (Brill Nijhoff 2018) (giving an analysis of the functional and spatial approach).

³⁸ Tanja Masson-Zwaan, *Private Law Aspects of Suborbital Flights: Second- and Third-Party Liability and Insurance* 87 J. AIR L. & COM. 413, 431 (2022).

³⁹ *The Outer Space Treaty*, *supra* note 11, at art. 3.

⁴⁰ Convention on Registration of Objects Launched into Outer Space, Jan. 27, 1967, 1023 U.N.T.S. 15 [hereinafter *Registration Convention*].

⁴¹ Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 961 U.N.T.S. 187 [hereinafter *Liability Convention*].

⁴² See Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 672 U.N.T.S. 199 [hereinafter *Rescue and Return Agreement*].

⁴³ See Agreement Governing the Activities of States on the Moon and Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter *Moon Agreement*].

The lack of State sovereignty in outer space means that, unlike airspace, no permission is required for the launch and operation of a satellite in orbit. Bar any requirements in place to ensure the unobstructed presence of an object in orbit and adherence to other applicable laws, States are free to use, explore, access, and scientifically investigate outer space, as enshrined in Article I of the Outer Space Treaty 1967. Despite being an area outside national sovereignty, there are links between States and their objects and activities in outer space. According to Article VI of the Outer Space Treaty 1967, States are responsible for their national space activities, which they should authorize and supervise, whether they are conducted by governmental or non-governmental entities. In addition, according to Article VIII of the Outer Space Treaty 1967, States should register their space objects to retain jurisdiction and control over them.

IV. The Regulation of In-Flight Connectivity in General

This section examines the approaches to regulate in-flight connectivity by satellite, firstly with reference to the international air law regime and secondly under international space law.

A. In-Flight Connectivity (Air Law)

To achieve in-flight connectivity, an antenna attached externally to the aircraft communicates with (ground) cell towers and (space) satellites. This antenna is a receiving station that is directly used to provide internet access or can be used as a modem to provide wireless access to nearby devices (WiFi, in-flight internet connectivity).

In air law, State sovereignty prevails; accordingly, in terms of the use of aircraft radio equipment, one must first revisit the applicable international air law regime in the form of the Chicago Convention 1944, specifically to Article 30 that provides rules on aircraft radio equipment:

“(a) Aircraft of each contracting State may, in or over the territory of other contracting States, carry radio transmitting apparatus only if a license to install and operate such apparatus has been issued by the appropriate authorities of the State in which the aircraft is registered. The use of radio transmitting apparatus in the territory of the contracting State whose territory is flown over shall be in accordance with the regulations prescribed by that State.

(b) Radio transmitting apparatus may be used only by members of the flight crew who are provided with a special license for the purpose, issued by the appropriate authorities of the State in which the aircraft is registered.”⁴⁴

Article 30 should be read in connection with Article 33 of the Chicago Convention 1944, which provides that a State shall recognize licenses issued by Contracting States as equivalent to their own. According to Article 30(b) of the

⁴⁴ *Chicago Convention*, *supra* note 10, at art. 30.

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Chicago Convention 1944, in-flight connectivity for passengers is not allowed. However, as technology has advanced, the international aviation community of States adopted ICAO Assembly Resolution A29-19 in 1992. It provides:

“...Whereas the Legal Committee interpreted Article 30(a) of the Chicago Convention as recognizing the sovereignty of States in the airspace over their territory *and subjecting public correspondence* to the regulations of the State *overflown*;

The Assembly Resolves:

1. that *nothing in Article 30(b) of the Chicago Convention* shall be taken to preclude the use by *unlicensed persons* of the radio transmitting apparatus installed upon an aircraft where that use is for non-safety related air-ground radio transmissions;⁴⁵
2. that all Member States should ensure that such *use of such apparatus shall not be prohibited* in their air space; and
3. that such use of such apparatus shall be subject to the conditions set out in the Annex hereto.”⁴⁶

The Annex provides several conditions on the use of the radio transmitting apparatus on-board an aircraft for non-safety air-to-ground radio transmissions; these conditions are applicable to a Member State when it is the State of registry or the State of the operator under Article 83 *bis* of the Chicago Convention:

- (i) *compliance* with the conditions of the license for the installation and operation of that apparatus issued by the State of Registry (or State of the operator) of the aircraft;
- (ii) *any person may use* that apparatus for non-safety air-ground radio transmissions provided always that control of that apparatus shall be by an operator duly licensed by the State of Registry (or State of the operator) of the aircraft;
- (iii) *compliance* with the requirements of the International Telecommunication Convention and the Radio Regulations⁴⁷ adopted thereunder as amended from time to time, including the applicable radio frequencies, the avoidance of harmful interference with other services and priority for aeronautical communications relating to distress, safety and regularity of flight; and
- (iv) compliance with any technical and *operating conditions set forth in the applicable regulations of the Member State in or over whose territory the aircraft is operating*”⁴⁸ (emphasis added).

⁴⁵ Int’l Civil Aviation Org. [ICAO], Assembly Res. A29-19, Doc 10022, at Annex (Oct. 4, 2023) (satellites enable air-ground communication).

⁴⁶ *Id.*

⁴⁷ See generally, Int’l Telecomm. Union [ITU], *Radio Regulations* (2020), <https://www.itu.int/pub/R-REG-RR-2020>.

⁴⁸ *Supra* note 44.

At first glance, ICAO Member States must permit the use of in-flight connectivity subject only to operating conditions that may vary from State to State. The question, however, as a matter of air law, is whether an ICAO Assembly Resolution is binding on contracting States to the Chicago Convention 1944.

What is the legal status of an ICAO Assembly Resolution? There is no mention of the word “resolution” in the Chicago Convention 1944. Article 48(c) of the Chicago Convention 1944 discusses *decisions of the Assembly*.⁴⁹ While a resolution may be more formal than a decision, as both constitute decisions under Article 48(c), no distinction to be made from a legal standpoint. The legal *effect* may vary, however, from being a general agreement that would be binding when addressed to ICAO bodies or to the Secretariat. A working paper presented in 2017 to the ICAO Council puts forward that, although resolutions and decisions of the Assembly are not legally binding on States, States “must consider their application in good faith.”⁵⁰

It can be concluded that every ICAO Member State should in good faith permit airlines to offer in-flight connectivity to passengers, subject to the operating conditions that each State, as an exercise of its sovereignty, prescribes. These operating conditions may therefore vary from State to State, which translates to a series of potentially different conditions imposed on commercial airlines operating on a route through the national airspaces of a line of different States.

B. In-Flight Connectivity (Space Law)

The satellites that provide in-flight internet connectivity are primarily regulated by international space law, which governs the activities of States, and by association their private actors, in outer space.

According to Article VI of the Outer Space Treaty 1967⁵¹:

“States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.”

Since their international responsibility and their obligation to authorize and supervise their national space activities, States issue licenses for the launch and

⁴⁹ See Chicago Convention, *supra* note 10, at art. 48 (establishing quorum and voting procedures).

⁵⁰ ICAO, *Draft Assembly Working Paper – The Role and Effect of Assembly Decisions and Resolutions* (May 25, 2007), A36-WP/xxxx P/xx (explaining that, while not legally binding, Assembly Resolutions and Decisions have legal effects and may contribute to the formation of customary international law).

⁵¹ See generally, U.N. Office for Outer Space Affairs, *National Space Law*, <https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/index.html>, (maintaining an online database of national space laws); See also, Annette Froehlich & Vincent Seffinga, *The European Space Policy Institute, National Space Legislation – A Comparative and Evaluative Analysis* 146-195 (Springer 2018) (comparing national space legislation).

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operation of satellites by public and private entities. The rules that these entities should follow to be granted and maintain a license vary per jurisdiction, but they commonly pertain to liability for damage, insurance of the space object, and technical and financial characteristics of the space mission.⁵²

States that launched or procured the launching of a space object or States from whose territory or facility an object is launched may also be held internationally liable when their object causes damage on the Earth or in outer space. Under Article VII of the Outer Space Treaty 1967:

“Each State Party to the Treaty . . . is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.”

The Liability Convention further specifies the international liability of States. Article II of the Liability Convention 1972 stipulates that States are *absolutely* liable for any damage their space objects cause on the surface of the Earth or to an aircraft in flight. When it comes to damage in outer space though, Article III of the Liability Convention 1972 provides for *fault* liability when damage is caused in outer space. Damage under the space treaties is understood as direct damage⁵³, such as physical collision between two space objects or strike of an aircraft by a piece of a space object that reenters the atmosphere. Therefore, damage caused by satellite signal used to provide in-flight connectivity may not fall under space law liability. Other liability avenues may be sought through product liability or the service’s terms and conditions.

In addition, launching States that register their space objects retain jurisdiction and control over them, according to Article VIII of the Outer Space Treaty 1967. The Registration Convention 1975 elaborates on the duty to register and the information about space objects that should be included in the national registry of States and in the UN register.

Except for the formality aspects of authorizing, supervising, registering and being liable for their space ventures, States should also conduct their activities in space in a manner that complies with the provisions of Article IX of the Outer Space Treaty 1967, according to which⁵⁴:

“. . . If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall

⁵² Carl Q. Christol, *International Liability for Damage Caused by Space Objects*, 74 AM. J. INT’L L. 346, 361 (Apr. 1980).

⁵³ Mitsuhiro Sakamoto, *ITU and Harmful Interference Prevention*, in *Harmful Interference in Regulatory Perspective – Legal Rules for Interference-Free Radio Communication* 31-32. (Mahulena Hoffman ed., 2016).

⁵⁴ Global Future Council on Space Technologies, *Six Ways Space Technologies Benefit Life on Earth, Briefing Papers*, World Economic Forum, Sept., 2020, at 7.

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undertake appropriate international consultations before proceeding with any such activity or experiment.”

The International Telecommunication Union (ITU) framework coordinates frequencies and orbital slots, to create an interference-free environment, regarding space activities and their applications on the Earth.⁵⁵ As stated in Article 45 of the ITU Constitution:

“All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States or of recognized operating agencies, or of other duly authorized operating agencies which carry on a radio service, and which operate in accordance with the provisions of the Radio Regulations.

Each Member State undertakes to require the operating agencies which it recognizes and the other operating agencies duly authorized for this purpose to observe the provisions (. . .) above.”

Harmful interference is defined as the “interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service.” To comply with the ITU instruments, States coordinate the orbital slots and frequencies that their space objects use and establish domestic frameworks to outline the process through the ITU. In most cases, next to the license or other permission to launch or operate a satellite, national laws also require a satellite to obtain permission for frequencies.

In sum, the satellites that enable the provision of in-flight connectivity should be authorized, supervised, and registered. They should also operate in a way that does not cause harmful interference with the activities of other States in outer space and with radiocommunication services, such as the ones supporting in-flight connectivity by satellite.

V. Legal Grounds for Restricting In-Flight Internet Connectivity by Satellite

In-flight internet connectivity by satellite is a multifaceted topic; it touches upon several areas, including space technology, telecommunications, aviation, and internet data traffic, each of which raises equivalent legal implications. Looking into the legal grounds that can justify potential restrictions on connectivity may shed some light on some of these.

This section examines various restrictions that can be attached to in-flight connectivity by satellite. Some limitations may stem from the involvement of

⁵⁵ See G.A. Res. 37/92, U.N. Doc. A/RES/37/92 at Annex (Dec. 10, 1982), https://www.unoosa.org/oosa/oosadoc/data/resolutions/1982/general_assembly_37th_session/res_3792.html (regarding principles for managing content sharing via satellite); see Abram Chayes & Leonard Chazen, *Policy Problems in Direct Broadcasting from Satellites*, 5 *stan. j. int'l stud.* 4, 6 (1970); David Webster, *Direct Broadcast Satellites: Proximity, Sovereignty and National Identity*, 62 *foreign aff.* 1161, 1161 (1984).

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satellites launched into space, an area that States are free to use and explore and where activities should not cause harmful interference. Other constraints are related to the equipment on-board aircraft that enables the connection of passengers to an internet network. There are also limitations relating to the transmission and collection of data, as well as to the provision of in-flight connectivity as a service. With a view to clarifying which legal fields affect in-flight connectivity by satellite, each of these grounds will be examined in relation to applicable laws.

A. Limiting the Freedom to Use and Explore Outer Space

Outer space is an area outside of national sovereignty and that States are thus free to use, explore, scientifically investigate, and have access to in all areas. In their exploration and use of outer space, States are free to launch and operate satellites so long as the launch and operation take place in accordance with applicable law. The freedoms of outer space are fundamental principles of international space law, and their scope cannot be limited without significantly sufficient legal justification.⁵⁶ If their activities are carried out lawfully, there are no legitimate reasons to limit the freedom of States to use and explore outer space. To ensure the lawfulness of their conduct, as previously explained, States grant licenses to their national activities, for which they are responsible, as a means to authorize and supervise them. This ensures conformity with the applicable legal framework and eliminates possible reasons to limit the freedom to exploration and use.

The freedom to use and explore outer space also enables satellites to transmit signal anywhere to in the world, elevating them to an accessible technology that extends the reach of connectivity and permits global coverage and distribution of information.⁵⁷ In the past, these capabilities of satellites were seen as concerning given that the availability and dissemination of information does not take place in the same way in every country. Worries over the potential of satellites to share content without any barriers were voiced when satellite broadcasting was an emerging field of space activities, as reflected in the text of the Direct Broadcasting Satellites Guidelines (“DBS Guidelines”).⁵⁸

The DBS Guidelines were adopted by the UN General Assembly in 1982, with the purpose of providing recommendations for the operation of satellites used for the VI broadcasting of television. They declare that television broadcasting should be carried out in a manner compatible with a State’s sovereign rights, including non-intervention, and with the right to seek, receive, and distribute information and ideas.⁵⁹ Among others, the broadcasting should also

⁵⁶ On the freedoms of outer space, see generally Stephen Gorove, *Freedom of Exploration and Use in the Outer Space Treaty: A Textual Analysis and Interpretation*, 1 DENV. J. INT’L L. & POL’Y 93 (1971).

⁵⁷ G.A. Res. 37/92, U.N. Doc. A/RES/37/92 at Annex (Dec. 10, 1982).

⁵⁸ See G.A. Res. 37/92, U.N. Doc. A/RES/37/92 at Annex (Dec. 10, 1982), https://www.unoosa.org/oosa/oosadoc/data/resolutions/1982/general_assembly_37th_session/res_3792.html (regarding principles for managing content sharing via satellite); see also Abram Chayes & Leonard Chazen, *Policy Problems in Direct Broadcasting from Satellites*, 5 STAN. J. INT’L STUD. 4, 6 (1970); David Webster, *Direct Broadcast Satellites: Proximity, Sovereignty and National Identity*, 62 FOREIGN AFF. 1161, 1161 (1984).

⁵⁹ G.A. Res. 37/92, U.N. Doc. A/RES/37/92 at Annex (Dec. 10, 1982).

provide entertainment with respect to a State's 'political and cultural integrity'.⁶⁰ The language used in the DBS Guidelines does not imply any prohibition of broadcasting certain content nor does it aim to function as grounds for censoring or otherwise limiting the broadcasted material. Besides, the DBS Guidelines are non-binding; they merely recognize that direct broadcasting by satellite may conflict with some interests of States related to the flow of information in their territory.

Restrictions to broadcasted content are mostly related to the protection of intellectual property rights attached to the broadcasted content. In the EU, Directive 2019/789 sets out rules concerning the exercise of copyrights and related rights for the transmission of radio and television.⁶¹ Although broadcasting differs from in-flight connectivity by satellites, insofar as the former transmits specific content while the latter provides access to any content available online, this is a useful analogy to draw observations regarding the ability of satellites to enable unobstructed access to information.

Given the above, constructing a case that justifies limitations to the freedom to use and explore outer space and consequently to the freedom to launch and operate satellites that enable in-flight connectivity remains cumbersome. So long as satellites are licensed,⁶² do not cause interference,⁶³ and do not create other risks,⁶⁴ they cannot and should not be limited. Grounds for restrictions should instead be sought around the use of the devices that receive satellite signal on the ground, in the air, and at sea. First, it is signal receivers that allow connection to a satellite, without which the transmission of satellite signal does not produce any effect. Second, receivers are situated in areas that fall under the jurisdiction of States, where national laws, including those related to content dissemination, are applicable.

The following sections examine restrictions connected to the function of receiving devices on the basis of potential interference with other transmissions and on the basis of the registration of the equipment on-board aircraft that powers in-flight internet connectivity.

B. Limiting Potential Interference Caused by In-Flight Internet Connectivity

According to Article 46 of the ITU Constitution, Member States should enforce the ITU instruments to avoid systems in their territory causing harmful

⁶⁰ *Id.* Annex A.2.

⁶¹ Directive 2019/789 of the European Parliament and of the Council of 17 April 2019, *laying down rules on the exercise of copyright and related rights applicable to certain online transmissions of broadcasting organisations and retransmissions of television and radio programmes, and amending Council Directive 93/83/EEC*, 2019 O.J. (L 130) 82 (EU).

⁶² *Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (Outer Space Treaty), art. VI, Jan. 27, 1967, 610 U.N.T.S. 205.

⁶³ *Id.* art. IX.

⁶⁴ *Id.* art. III.

interference.⁶⁵ Therefore, besides authorizing and supervising their national space activities and managing the allocation of frequencies for their satellites, States may take additional measures to ensure an interference-free environment in areas under their sovereignty, such as their territory and the airspace above it. For that, they may require a license or similar arrangement for ground-based infrastructure, such as Earth stations used in ATG or satellite network.

Examples of licensing requirements for Earth stations are introduced by the U.S. Federal Communications Commission (FCC),⁶⁶ the UK Ofcom,⁶⁷ the Dutch Authority for Digital Infrastructure,⁶⁸ as well as national authorities in several other countries. Whereas these requirements are in place primarily for the purpose of eliminating interference, they may inadvertently limit the operation of or access to infrastructure that enables satellite connectivity, both in the territory of a State and when an aircraft flies over its airspace.

A practical example can be seen in the Indian Flight and Maritime Connectivity Rules of 2018,⁶⁹ which require any Indian or foreign company that is permitted to enter Indian airspace and intends to provide in-flight connectivity by satellite to have a license or cooperate with a licensed entity.⁷⁰ The license holder or the entity with which it cooperates should also have ground-based satellite infrastructure in India and use satellite capacity that is authorized in India. Furthermore, Indian authorities may intercept messages that pass through the connectivity network.

Another example, in terms of the operation of service providers, is the product that Starlink recently brought to market: 'Starlink for Aviation'.⁷¹ The terms and conditions of use vary by jurisdiction,⁷² but as most airlines operate internationally it is unclear how the provider or user of Starlink services will reconcile divergences in State approach. Examples of differing State practice include India where only Inmarsat is permitted,⁷³ and Starlink is prohibited in

⁶⁵ Int'l Telecomm. Union [ITU], *supra* note 46; see also ITU, Radio Regulations art. 4 (2020), <https://www.itu.int/pub/R-REG-RR-2020>.

⁶⁶ Fed. Comm'n's Comm'n, *Overview of Earth Station Licensing and License Contents* (Dec. 7, 2023), <https://www.fcc.gov/space/overview-earth-station-licensing-and-license-contents>.

⁶⁷ Ofcom, *Apply for a satellite earth station licence* (Oct. 30, 2023), <https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/satellite-earth/earth-stations>.

⁶⁸ Rijksinspectie Digitale Infrastructuur, *Application form satellite-earth-station Radiocommunication Agency Netherlands* (Jan. 12, 2018), <https://www.rdi.nl/onderwerpen/satellietgrondstation/documenten/formulieren/2018/januari/12/application-form-satellite-earth-station-radiocommunication-agency-netherlands>.

⁶⁹ The Flight and Maritime Connectivity Rules, 2018 (English version), <https://thc.nic.in/Central%20Governmental%20Rules/Flight%20and%20Maritime%20Connectivity%20Rules,%202018.pdf>; Amendment of 2022 to the Flight and Maritime Connectivity Rules (English version), <https://dot.gov.in/sites/default/files/2022%2002%2025%20IFMS%20AS-I.pdf>.

⁷⁰ Access Partnership, *India's In-Flight Connectivity Rules: Eligibility, Restrictions, Fees, and Obligations for IFMC Service Providers* (Jan. 9, 2019), <https://accesspartnership.com/indias-in-flight-connectivity-rules-eligibility-restrictions-fees-and-obligations-for-ifmc-service-providers/>.

⁷¹ Starlink, *Starlink for Aviation*, <https://www.starlink.com/business/aviation> (last visited Oct. 15, 2024).

⁷² Starlink, *Starlink Legal*, <https://www.starlink.com/legal> (last visited Oct. 15, 2024).

⁷³ Inmarsat, *BSNL Granted Authorisation to Provide Inmarsat's In-Flight and Maritime GX Services in India* (Apr. 3, 2019), <https://www.inmarsat.com/en/news/latest-news/corporate/2019/bsnl-granted-authorisation-to-provide-inmarsats-in-flight-and-maritime-gx-services-in-india.html>.

South Africa⁷⁴ and Zimbabwe,⁷⁵ and is unavailable or prohibited in Cuba, the Russian Federation, Iran, and China.⁷⁶

Other than for minimizing interference, ground-based infrastructure that enables satellite connectivity may be restricted for trade reasons. That is the case in countries that do not permit the import of satellite user terminals, although the rationale behind such restrictions is not disclosed.⁷⁷ Whereas there are ways to circumvent such obstacles to connectivity, it is worth reflecting whether they may pose challenges for in-flight internet connectivity by satellite.

C. Aircraft Radio Equipment

As discussed above, aircraft radio equipment may be used by airlines subject to compliance with technical and operating conditions determined by ICAO Member States. While the extent to which each State has established regulations on the conditions for use of in-flight connectivity by satellite is unclear, observation of the growingly common practice of airlines around the world reveals the trend of airlines seeking to offer in-flight connectivity to their passengers. It follows that such practice provides some insight on how the legal situation is at least *perceived* by the airline industry.

Southwest Airlines was the first commercial airline in the world to offer “gate-to-gate connectivity” in 2013,⁷⁸ following which other airlines around the world followed suit. For example, in 2017, Qatar Airways and Inmarsat Global Limited announced a project to install Inmarsat’s Global Xpress (GX) system on their aircraft to allow high-speed Wi-Fi internet access for passengers at all altitudes.⁷⁹

Airlines that offer in-flight connectivity tend to include, in the terms and conditions of use, provisions relating to potential restrictions. With a view to providing a global view, the terms of three airlines are examined. First, the provision on restrictions of KLM Royal Dutch Airlines states: “It is possible that the internet connection is temporarily unavailable or not available at all due to the status of the satellite connection or *over certain regions or countries where restrictions apply*.”⁸⁰ Qatar Airways warns: “Service interruptions may

⁷⁴ Matshepo Sehloho, *Starlink cuts off users in South Africa, Connecting Africa* (Feb. 12, 2024), https://www.connectingafrica.com/author.asp?section_id=816&doc_id=786754.

⁷⁵ Godfrey Marawanyika & Ray Ndlovu, *Zimbabwe Asks StarLink to Cut Off Services Pending Licensing Approval*, BLOOMBERG (Apr. 12, 2024), <https://www.bloomberg.com/news/articles/2024-04-12/zimbabwe-asks-starlink-to-cut-off-services-pending-licensing-approval?embedded-checkout=true>.

⁷⁶ Starlink, *Availability*, <https://www.starlink.com/map> (last visited May 8, 2024).

⁷⁷ Berna Akcali Gur & Joanna Kulesza, *Equitable Access to Satellite Broadband Services: Challenges and Opportunities for Developing Countries*, 48(5) TELECOMMUNICATIONS POL’Y 102731, 4 (2024).

⁷⁸ Kristin Majcher, *Southwest First U.S. Airline to Offer Gate-to-Gate Wi-Fi*, FLIGHTGLOBAL (Nov. 20, 2013), <https://www.flightglobal.com/southwest-first-us-airline-to-offer-gate-to-gate-wi-fi/111781.article>.

⁷⁹ Inmarsat, *Inmarsat Certified for GX Aviation Installations on Qatar Airways’ Boeing Aircraft Fleet* (Aug. 29, 2017), <https://www.inmarsat.com/en/news/latest-news/aviation/2017/inmarsat-certified-gx-aviation-installations-qatar-airways-boeing-aircraft-fleet.html>.

⁸⁰ KLM Royal Dutch Airlines, *Inflight Wi-Fi Conditions* (emphasis added) <https://www.klm.nl/en/information/legal/extra-options/inflight-wifi> (last visited Oct. 15, 2024).

occur while flying due to *regulatory restrictions over some countries*.”⁸¹ And China Southern Airlines makes clear that: “Restrictions for the product: software downloads and updates, online games, cloud storage, iOS and Android updates, as well as websites and applications *unallowable under the law* are not available when using the In-flight WiFi service.”⁸² Whereas KLM and Qatar indicate that some States or groups of States may prohibit the use of in-flight connectivity, China Southern does not mention countries or regions, rather “unallowable under the law” appears to refer to the law of China. This position is confirmed by air law; the prevailing law on-board an aircraft in flight is the law of the State of registry. China’s well-known “Golden Shield” project, also called the National Public Safety Work Informational Project, is a legal tool for censorship and surveillance that restricts content, among other things.⁸³

For an airline, it is possible to limit the operation of the receiving device, the antenna on the aircraft. Article 30 of the Chicago Convention 1944, like the entirety of the air law regime, is focused on safety. Airlines will require permission to use a receiving device in States over which they fly as, regardless of the satellite communication aspect, the antenna will communicate via the satellite and eventually to a ground station on the territory of a State.

It is unclear whether airlines are following States’ operational conditions, or they are being cautious in their practices and mitigating the risk of violating national regulations or ambiguous State positions for fear of implicating their operating (traffic) rights in the sovereign airspace of such States, or both.

D. Other Grounds for Limitations to In-Flight Connectivity by Satellite

Additional restrictions could be imposed on in-flight internet connectivity by satellite for reasons related to the privacy and data security of users. Such restrictions may be present in other information technology applications as well, but they are particularly pertinent to in-flight connectivity as it is an emerging field as its legal implications are currently being explored.

The definition of privacy is derived from various frameworks and is described, among others, as the “assurance that the confidentiality of, and access to, certain information about an entity is protected,”⁸⁴ and the “freedom from intrusion into the private life or affairs of an individual when that intrusion results from undue or illegal gathering and use of data about that individual.”⁸⁵

⁸¹ Qatar Airways, *On-board Wi-Fi and Connectivity* (emphasis added) <https://www.qatarairways.com/en/onboard/connectivity.html> (last visited Oct. 15, 2024).

⁸² China Southern Airlines, *In-flight Internet Services* (emphasis added) https://www.csair.com/newh5/en/tourguide/flight_service/wifi/ (last visited Oct. 15, 2024).

⁸³ Yaqiu Wang, *In China, the ‘Great Firewall’ Is Changing a Generation*, POLITICO (Sept. 1, 2020), <https://www.politico.com/news/magazine/2020/09/01/china-great-firewall-generation-405385>.

⁸⁴ ELAINE BARKER ET AL., A FRAMEWORK FOR DESIGNING CRYPTOGRAPHIC KEY MANAGEMENT SYSTEMS 108 (Nat’l Inst. of Standards and Tech., 2013).

⁸⁵ ISO/IEC 2382:2015(en) *Information Technology – Vocabularly*, INT’L ORG FOR STANDARDIZATION, <https://www.iso.org/standard/63598.html> (last visited Oct. 2, 2024).

Privacy is established as a fundamental human right by the UN's Universal Declaration on Human Rights⁸⁶ and is included in the Fourth Amendment of the U.S. Constitution⁸⁷ and the Treaty on the Functioning of the European Union.⁸⁸ Privacy laws form the legal basis for regional and national regulations on data protection that aim to protect against the unlawful collection and processing of personal data. Personal data or personally identifiable information are described as data that can be used, individually or combined with other data, to identify or can identify a person.⁸⁹

In the case of in-flight connectivity by satellite, personal data such as the users' names and e-mail addresses, may be requested or required to connect to the service and may also be gathered during the use of the service, for instance in the form of traffic data or IP addresses. The legal requirements for the handling of personal data vary by jurisdiction. What is usually essential is the consent of the data subject to the detailed description of the uses of its data. Consent can be requested as a condition to access the service. Moreover, the transfer of personal data and third parties' access should be done under specific terms. That may prove cumbersome, given that, throughout an aircraft's journey, ground stations in several States may be employed to provide in-flight connectivity. The challenge is accentuated by the employment of satellites that operate in an area outside national sovereignty and whose determination about whether it constitutes another State for the purpose of data transfer is unclear.⁹⁰ Therefore, the providers of in-flight connectivity services should have appropriate privacy safeguards in place, even if that poses limitations to the use of their services.⁹¹

⁸⁶ G.A. Res. 217A, Universal Declaration of Human Rights, U.N. Doc. A/RES/217A (III) (Dec. 10, 1948).

⁸⁷ U.S. CONST. amend. IV.

⁸⁸ Consolidated Version of the Treaty on the Functioning of the European Union art. 15, Oct. 26, 2012, O.J. C 326/47.

⁸⁹ See Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of such Data, and Repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA Relevance) 2016 O.J. (L 119) art. 4 (defining personal data); See HILDEGARD FERRAILOLO ET AL., GUIDELINES FOR THE AUTHORIZATION OF PERSONAL IDENTITY VERIFICATION CARD ISSUERS (PCI) AND DERIVED PIV CREDENTIAL ISSUERS (DPCI) 54 (Nat'l Inst. of Standards & Tech., 2015) (defining personally identifiable information); See also Amir Saboorian, *A Brave New World: Using the Outer Space Treaty to Design International Data Protection Standards for Low-Earth Orbit Satellite Operations*, 84 J. AIR L. & COM. 575, 586 (2019).

⁹⁰ *Inflight Connectivity?*, ACCESS P'SHIP (Apr. 24, 2018), <https://accesspartnership.com/how-will-the-gdpr-affect-inflight-connectivity-and-other-service-providers/>.

⁹¹ See *Privacy Notice for In-Flight Connectivity*, INMARSAT (May 11, 2022), <https://www.inmarsat.com/en/site-services/privacy-policy-ifc.html> (demonstrating the clear description of the type of personal data collected through their in-flight connectivity service, how they are used, and who has access to them); See also *Privacy Policy*, INTELSAT (Jan. 1, 2024), <https://www.intelsat.com/privacy-policy/> (demonstrating safeguards within privacy policies); See also *Privacy Policy*, GOGO BUSINESS AVIATION, <https://www.gogoair.com/policies/privacy-policy/> (last visited Oct. 2, 2024) (demonstrating safeguards within privacy policies); See also Khushboo Bhatia, *Starlinked! An Analysis of SpaceX's Small Satellite Mega-Constellation Under the Fourth Amendment*, 32 INFO. & COMM'C'N TECH. L. 1, 16-22 (2023) (comparing the concept of privacy, and specifically the approach of the reasonable expectation of privacy, as shaped by US courts to the privacy policy of Starlink).

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In addition to those regarding privacy, restrictions to in-flight connectivity may be necessary to protect the security of the data circulated through its use. Data security is translated to the measures that are taken to protect information from unauthorized access, use, and manipulation. It is broader than privacy, in that it protects not only personal data, but any digital information.⁹² In the context of in-flight connectivity, data security concerns any information transmitted through the provided network.⁹³ Similar to the challenges associated with privacy, the use of several ground stations and satellites increases the chance of data being compromised.⁹⁴

VI. Final Remarks

This article has considered in-flight internet connectivity by satellite, a concept which sits at the intersection of air and space. In-flight connectivity serves as a useful case study on the exploring, with reference to State sovereignty, the simultaneous application of international air law and international space law regimes. In general, in-flight connectivity is regulated through the separate processes of (1) licensing by ICAO Member States of the aircraft radio equipment in accordance with the Chicago Convention 1944 and national laws, and reciprocal recognition of such licenses; (2) State licensing of the launch and operation of satellites through national law and in connection to the Outer Space Treaty 1967 principles; and (3) orbit and frequency allocation by ITU Member States in accordance with the applicable provisions of the ITU instruments and relevant national laws.

If restrictive in nature, the exercise of sovereignty by States through operational conditions applied to use of aircraft radio equipment within national airspace, on the one hand, and the freedom enjoyed by State and non-State actors to conduct lawful space operations, on the other hand, appear to conflict in the case of in-flight internet connectivity by satellite. With that said, in-flight internet connectivity has been rolled out extensively by airlines around the world and the restrictions appear to be the exception; unfettered access appears to be the norm. What began in the international air law regime as licensing of in-flight connectivity (by radio communication) for the exclusive use of flight crew has evolved in tune with technological developments and commercial demands, all within the four corners of ensuring aviation safety as the top priority.

Despite their differences, the common spirit of air law and space law is safety. If, in the case of in-flight internet connectivity by satellite, the law is unclear, the focus of regulation should be on the ensuring safety of flight operations. This

⁹² *What is Data Security?*, IBM, <https://www.ibm.com/topics/data-security> (last visited Oct. 2, 2024); see also *Data Security*, NAT'L INST. OF STANDARDS AND TECH., <https://www.nccoe.nist.gov/data-security> (last visited Oct. 2, 2024).

⁹³ See generally Huan Cao et al., *Analysis on the Security of Sayellite Internet*, in CYBER SECURITY 193 (2020) (discussing the matter of security concerns surrounding satellite internet); See generally Ayan Roy-Chowdhury et. al., *Security Issues in Hybird Networks with a Satellite Component*, IEEE WIRELESS COMM'C'N MAG., Dec. 2005 at 50 (discussing the matter of security concerns surrounding satellite internet).

⁹⁴ Rosie Frost, *Is Inflight Wi-Fi Safe or Could it be Leaking your Data?*, EURONEWS (July 20, 2021), <https://www.euronews.com/travel/2021/07/20/is-inflight-wi-fi-safe-or-could-it-be-leaking-your-data>.

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includes the fact that the connectivity does not cause harmful interference, rather than for instance the content that users will access. Restrictions on the latter may be reasonably implemented through an agreement on the terms of use. In the future, if State practice becomes too restricted or fragmented, how will the use of personal devices with direct satellite internet connectivity rather than today's common in-flight internet connectivity through a single WiFi portal be handled? Will such devices be banned for use in-flight, owing to safety concerns, just as PEDs were until just over a decade ago? It will be interesting to see if the current international air law and international space law regimes are fit for the purpose of banning or allowing companies to provide and individuals to use direct satellite internet connectivity on-board commercial aircraft.

Independent from the air law and space law implications of in-flight connectivity by satellite, internet access remains an essential component of today's information society, as well as a crucial requirement for bridging the digital divide around the world. These are also factors to consider when reflecting on any future regulations related to connectivity.