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# BETWEEN AIR AND SPACE: THE ICAO FRAMEWORK AND THE LEGAL CHALLENGES OF COMMERCIAL HYPERSONIC FLIGHT

# *ENTRE O AR E O ESPAÇO: O QUADRO DA OACI E OS DESAFIOS JURÍDICOS DO VOO HIPERSÔNICO COMERCIAL*

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## ABSTRACT

**[Purpose]** Commercial hypersonic travel – including suborbital passenger flights that reach the edge of outer space – presents unprecedented legal and regulatory challenges. The paper's primary aim is to examine these challenges. Hypersonic vehicles blur the line between aviation and spaceflight, raising questions about which legal regime (air law or space law) applies and how to ensure safety, liability coverage, and equitable access to airspace. This study is motivated by the need to address the regulatory gray area created by vehicles that operate in both airspace and outer space.

**[Methodology/approach/design]** The approach of the paper is a doctrinal and comparative legal analysis of existing international frameworks. It examines the current international legal framework under the International Civil Aviation Organization (ICAO) and identifies gaps in coordinating regulations for hypersonic flights. The paper reviews pertinent treaties (such as the Chicago Convention and the Outer Space Treaty), ICAO documents, national laws, and scholarly proposals. It discusses the need for international regulatory coordination, the development of robust safety standards, clear liability regimes, and effective airspace management for vehicles operating beyond traditional altitudes.

**[Findings]** The analysis highlights significant ambiguities in the law. In particular, there is no agreed boundary between national airspace and outer space, resulting in uncertainty over which legal regime governs hypersonic and suborbital flights. The paper finds that current aviation law and space law were not designed for these hybrid operations, leaving gaps in safety oversight, liability coverage, and operational

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regulation. It explores proposals for future legal models – ranging from adapting existing aviation law to developing a sui generis “aerospace” regime under ICAO leadership – to address these gaps.

**[Practical implications]** The paper underscores practical steps needed to ensure safe and orderly integration of hypersonic flight into global transportation. Emphasis is placed on ICAO’s potential role in forging a harmonized global approach that balances innovation with safety and international cooperation. Recommendations include leveraging ICAO’s standard-setting capacity to develop interim guidance for states, promoting mutual recognition of licenses, and encouraging bilateral or multilateral agreements to manage airspace access for hypersonic vehicles. These measures have implications for regulators seeking to maintain safety and legal clarity as commercial spaceflight evolves.

**[Originality/value]** This article provides a timely and original examination of the nascent field of aerospace law as it pertains to commercial hypersonic flight. It bridges the gap between air law and space law, highlighting the novel regulatory challenges at their intersection. The paper’s value lies in its comprehensive analysis of the ICAO framework in the context of hypersonic travel and its proposals for an international legal regime. It offers insights for policymakers, legal scholars, and industry stakeholders on how to proactively craft a legal infrastructure that enables innovation in high-speed travel while safeguarding safety and legal certainty.

**Keywords**: Hypersonic flight; Suborbital travel; ICAO; Aviation law; Space law.

***RESUMO***

***[Objetivo]*** *As viagens hipersônicas comerciais – incluindo voos suborbitais de passageiros que alcançam a fronteira do espaço exterior – apresentam desafios legais e regulatórios sem precedentes. O objetivo principal deste artigo é examinar esses desafios. Os veículos hipersônicos confundem a linha divisória entre aviação e voos espaciais, levantando questões sobre qual regime jurídico (direito aéreo ou direito espacial) se aplica e como garantir a segurança, a cobertura de responsabilidade civil e o acesso equitativo ao espaço aéreo. Este estudo é motivado pela necessidade de abordar a área cinzenta regulatória criada por veículos que operam tanto no espaço aéreo quanto no espaço exterior.*

***[Metodologia/abordagem/design]*** *A abordagem deste artigo consiste em uma análise jurídica doutrinária e comparativa das estruturas internacionais existentes. Examina a atual estrutura jurídica internacional sob a Organização da Aviação Civil Internacional (OACI) e identifica lacunas na coordenação das regulamentações para voos hipersônicos. O artigo revisa tratados pertinentes (como a Convenção de Chicago e o Tratado do Espaço Exterior), documentos da OACI, leis nacionais e propostas acadêmicas. O documento aborda a necessidade de coordenação regulatória internacional, o desenvolvimento de normas de segurança robustas, regimes de responsabilidade claros e gestão eficaz do espaço aéreo para veículos que operam além das altitudes tradicionais.*

***[Resultados]*** *A análise destaca ambiguidades significativas na legislação. Em particular, não há uma fronteira acordada entre o espaço aéreo nacional e o espaço exterior, resultando em incerteza sobre qual regime jurídico rege os voos hipersônicos*

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*e suborbitais. O artigo constata que o direito aeronáutico e o direito espacial atuais não foram concebidos para essas operações híbridas, deixando lacunas na supervisão da segurança, na cobertura de responsabilidade civil e na regulamentação operacional. Explora propostas para futuros modelos jurídicos – desde a adaptação do direito aeronáutico existente até o desenvolvimento de um regime "aeroespacial" sui generis sob a liderança da OACI – para sanar essas lacunas.*

***[Implicações práticas]** O artigo ressalta as medidas práticas necessárias para garantir a integração segura e ordenada do voo hipersônico no transporte global. Enfatiza-se o papel potencial da OACI na criação de uma abordagem global harmonizada que equilibre inovação, segurança e cooperação internacional. As recomendações incluem o aproveitamento da capacidade da OACI de definir normas para desenvolver orientações provisórias para os Estados, a promoção do reconhecimento mútuo de licenças e o incentivo a acordos bilaterais ou multilaterais para gerenciar o acesso ao espaço aéreo para veículos hipersônicos. Essas medidas têm implicações para os órgãos reguladores que buscam manter a segurança e a clareza jurídica à medida que os voos espaciais comerciais evoluem.*

***[Originalidade/valor]** Este artigo oferece uma análise oportuna e original do campo emergente do direito aeroespacial no que se refere ao voo hipersônico comercial. Ele preenche a lacuna entre o direito aéreo e o direito espacial, destacando os novos desafios regulatórios em sua interseção. O valor do artigo reside em sua análise abrangente da estrutura da OACI no contexto das viagens hipersônicas e suas propostas para um regime jurídico internacional. Oferece insights para formuladores de políticas, juristas e partes interessadas do setor sobre como criar proativamente uma infraestrutura jurídica que permita a inovação em viagens de alta velocidade, ao mesmo tempo em que salvaguarda a segurança e a certeza jurídica.*

***Palavras-chave:** Voo hipersônico; Viagem suborbital; OACI; Direito aeronáutico; Direito espacial.*

## 1 INTRODUCTION

Hypersonic travel technology is advancing rapidly, promising to transport passengers at speeds above Mach 5 and even via suborbital trajectories that touch the edge of outer space. In recent years, private companies have begun launching commercial suborbital flights carrying civilian passengers, marking the emergence of a nascent hypersonic tourism and point-to-point transport industry. For example, between 2004 and 2021 only a handful of private human spaceflights occurred, but since 2021 the frequency has increased significantly, with dozens of FAA-licensed commercial suborbital missions flown by companies such as Blue Origin and Virgin Galactic (Congressional Research Service, 2024, p. 1). As hypersonic and suborbital

vehicles move from experimental projects to commercial operations, regulators face the challenge of determining which legal frameworks apply to these flights and how to update existing laws to accommodate this new mode of transportation.

International aviation law and space law developed separately and were never designed with hypersonic passenger travel in mind. The Convention on International Civil Aviation of 1944 (Chicago Convention) and the body of ICAO standards govern aircraft in flight through sovereign airspace, while the 1967 Outer Space Treaty and related UN space treaties govern activities in outer space. Commercial hypersonic flights, however, straddle the boundary of airspace and outer space, operating in a legal gray area. Currently there is no clear consensus on how such flights should be regulated, and no dedicated international treaty or ICAO Standard specifically addresses suborbital or hypersonic vehicles (Cheney & Napier, 2015, p. 1). This regulatory ambiguity stems in part from the lack of an agreed legal demarcation between airspace (which is subject to national sovereignty) and outer space (which is free from national appropriation). The result is that hypersonic vehicles today exist in a patchwork of national regulatory regimes and broad principles, without a unified global framework (Savić & Petić, 2020, p. 235).

ICAO, as the United Nations specialized agency for international aviation, has recognized the coming “era of commercial space transportation” and begun to examine how its mandate might extend to hypersonic and suborbital flights. As early as 2005, the ICAO Council considered the “Concept of Sub-Orbital Flights” in relation to the Chicago Convention (ICAO, 2010, p. 1). In that study, ICAO noted the development of vehicles like SpaceShipOne – the first private manned spacecraft to reach suborbital space – and asked whether such vehicles engaged in “international air navigation” and thus fell under air law (ICAO, 2010, p. 2). SpaceShipOne’s profile illustrated the definitional dilemma: it was carried aloft by a conventional aircraft and then released to rocket into space, coasting above the atmosphere before gliding back down to land. During the rocket-powered vacuum phase of flight, it did not derive support from the air and thus was not an “aircraft” as defined under Annex 7 of the Chicago Convention (which defines an aircraft as any machine deriving support in the atmosphere from air reactions) (ICAO, 2010, p. 3). Yet in other phases of flight, it behaved like an aircraft (gliding through the atmosphere to land). This hybrid character blurs the line between airplane and spacecraft, making it challenging to determine which laws and regulations apply at each stage (ICAO, 2010, p. 3).

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This paper explores the legal challenges posed by commercial hypersonic and suborbital travel, with a focus on the ICAO framework and the need for international solutions. It first examines the problem of regulatory coordination among States and regimes, given that no single legal system yet claims clear authority over hypersonic flights. It then analyzes specific issue areas – safety standards, liability and insurance, and airspace access/management – where gaps or conflicts exist between air law and space law. Finally, the paper discusses potential future legal models for governing hypersonic travel, evaluating options ranging from adapting existing international aviation law to creating a new sui generis regime. Throughout, the analysis maintains a scholarly perspective suitable for an academic journal in aviation or space law, drawing on the ICAO's work and international legal principles. The goal is to highlight both the novelty and urgency of regulating hypersonic commercial flights, and to propose how the international legal community might move toward a coherent framework under the auspices of ICAO and allied institutions.

## 2 METHODS

This study employs doctrinal legal research methods grounded in analysis of primary international instruments and policy documents, combined with a comparative law approach. It examines key treaties and conventions (such as the Chicago Convention of 1944 and the 1967 Outer Space Treaty) alongside ICAO resolutions and working papers to assess their applicability to commercial hypersonic flight. The research also reviews ICAO's internal deliberations – including a 2005 ICAO Council study on suborbital flights and the ICAO Assembly's 2019 Resolution A40-7 on "New Entrants" – as well as relevant discussions in United Nations forums (e.g., the UN Committee on Peaceful Uses of Outer Space), in order to capture the evolving international policy perspective. In addition, a comparative analysis of national regulatory responses is undertaken for example, the United States' Commercial Space Launch Amendments Act of 2004 and the United Kingdom's Space Industry Act 2018 are considered to illustrate how pioneering states have begun to govern suborbital and high-altitude flight activities. The study also surveys academic commentary and proposals from legal scholars concerning the classification and regulation of hypersonic vehicles. By synthesizing these sources, the analysis identifies gaps in the current legal framework and informs the evaluation of potential models for a future

regulatory regime. This multifaceted methodological approach ensures that the findings are rooted in existing law and state practice, while also engaging with innovative ideas from both the aviation and space law domains.

## 3 RESULTS

At present, the ICAO framework is only beginning to grapple with the challenge of commercial hypersonic flight, and significant work lies ahead to achieve a coordinated international approach. The ambiguity over applicable law (air vs. space) and the divergence of national regulatory efforts pose a risk of legal conflicts and safety loopholes. Through this analysis, several specific areas emerged where regulatory gaps are most pressing – namely, safety standards, liability rules, and airspace management – each of which is discussed in turn below.

### *International Regulatory Coordination and the ICAO Framework*

One of the foremost challenges is achieving coordination between national and international regulatory regimes for hypersonic travel. Traditional air transport is governed by a comprehensive international regime: ICAO sets global Standards and Recommended Practices (SARPs) for aviation safety, operations, and navigation, and bilateral agreements (air service agreements) manage market access. By contrast, space activities have been regulated primarily through broad multilateral treaties and national licensing, without an operational regulatory agency equivalent to ICAO for civil spaceflight. Suborbital and hypersonic flights fall in between – they have characteristics of both aircraft and spacecraft – and thus risk “falling through the cracks of the existing regulatory regime” (Cheney & Napier, 2015, p. 9). If treated as spacecraft, these vehicles would be subject to space law, but existing space treaties were designed for government-led missions and contain significant gaps when applied to private commercial transport (Balleste, 2017, p. 1055). If treated as aircraft, the well-established air law regime could apply, but only if those vehicles are accepted as “aircraft” by all States and by ICAO, which is not yet the case (ICAO, 2010, p. 3).

At present, no specific international rules conclusively cover commercial suborbital flights (Savić & Petić, 2020, p. 235). In the absence of an agreed global framework, individual States have started developing their own laws for commercial space and high-altitude flights. The United States has been a pioneer in this area: the

U.S. Commercial Space Launch Amendments Act of 2004 (CSLAA) established a regulatory regime for commercial human spaceflight, introducing key definitions (such as “suborbital trajectory,” “launch vehicle,” and “space flight participant”) and requiring licensing for launch and reentry of reusable suborbital rockets (Savić & Petić, 2020, p. 236). Under this regime, vehicles like SpaceShipOne and Virgin Galactic’s SpaceShipTwo are licensed by the FAA’s Office of Commercial Space Transportation (AST) as reusable launch vehicles rather than certified as aircraft. Other countries have followed suit to varying degrees: for instance, the United Kingdom’s Space Industry Act 2018 created a framework for licensing spaceports and suborbital vehicles in the UK, and Italy has been developing regulations to enable suborbital flights from a future spaceport at Taranto-Grottaglie (Italy Working Paper, 2022, p. 1). While these national efforts demonstrate recognition of the industry’s growth, they also raise concerns about regulatory fragmentation. Divergent national rules could lead to inconsistent safety standards and competitive imbalances, as well as complications for vehicles that fly internationally (Cheney & Napier, 2015, p. 9).

ICAO’s involvement is crucial for preventing a patchwork of conflicting regulations. As a global standard-setting body for civil aviation, ICAO offers a mechanism for harmonizing rules across borders. However, ICAO can only act within the scope of its mandate, which traditionally covers “aircraft engaged in international air navigation” (Chicago Convention, art. 1 and 37). Whether suborbital vehicles fall under this description remains debated. The Chicago Convention affirms that States have complete and exclusive sovereignty over the airspace above their territory (Chicago Convention, art. 1), whereas outer space, by contrast, is not subject to national sovereignty under the Outer Space Treaty (Outer Space Treaty, 1967, art. II). Notably, there is no agreed altitude or boundary in international law that separates airspace from outer space (ICAO, 2010, p. 4). This ambiguity complicates the jurisdictional question: if a hypersonic vehicle’s trajectory carries it above the commonly cited “Kármán line” (around 100 km altitude) even briefly, one could argue it enters outer space and thus falls under space law for that segment. Alternatively, using a functional approach, one could argue that because the primary purpose of these flights is transportation from one point on Earth to another, they should be governed by air law regardless of altitude (ICAO, 2010, p. 5). The ICAO 2005 working paper highlighted this functionalist view, suggesting that a suborbital point-to-point flight might be considered an international air service even if it dips into space, because

"any crossing of outer space [would be] brief and only incidental to the flight" (ICAO, 2010, p. 5). To date, ICAO has not officially decided this question, and UNCOPUOS (the UN Committee on Peaceful Uses of Outer Space) has similarly debated the definition of outer space for decades without resolution (ICAO, 2010, p. 5).

In practice, effective regulatory coordination likely requires treating commercial hypersonic vehicles in a holistic manner rather than splitting their legal personality into "aircraft for one part of flight and spacecraft for another." The need for a harmonized approach is evident in matters like vehicle registration and operator licensing. Under air law, every aircraft must be registered to a national registry and carry a nationality (Chicago Convention, arts. 17–20), and personnel such as pilots must be licensed according to international standards (Chicago Convention, art. 32; Annex 1). Under space law, any object launched into outer space should be registered by its launching State (Registration Convention, 1975, art. II), and states bear "continuing supervision" responsibility for nongovernmental space activities (Outer Space Treaty, 1967, art. VI). These regimes are not directly aligned: space law does not impose detailed airworthiness or pilot qualification requirements, for example, and only calls for registering objects launched into Earth orbit or beyond – a criterion that suborbital flights arguably do not meet (ICAO, 2010, p. 3). Indeed, SpaceShipOne was not entered into the UN Register of Space Objects, reportedly because it did not reach orbit (ICAO, 2010, p. 3). If nations were to simply apply space law to hypersonic tourist flights, there would be no global standards for certification of the vehicles or training of crew and passengers, beyond whatever each launching nation mandates. This is a clear gap that international coordination needs to fill.

ICAO has begun preliminary steps towards such coordination. After the 2005 "Sub-Orbital Flights" study, ICAO's Secretariat continued monitoring developments and presented information to UN bodies (ICAO, 2010, p. 1). In 2019, the ICAO Assembly adopted Resolution A40-7 on "New Entrants," which acknowledges emerging aerospace activities (like unmanned aircraft, high-altitude platforms, and commercial space operations) and urges States and ICAO to work together to accommodate these new entrants into the global aviation system (Italy Working Paper, 2022, p. 1). ICAO and the UN Office for Outer Space Affairs (UNOOSA) also held a series of Aerospace Symposia between 2015 and 2017, bringing together aviation and space communities to discuss regulatory and technical issues for suborbital flights and other space activities (UNOOSA, 2017). These efforts signal a recognition that

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international regulatory coordination will be essential. However, no binding ICAO Standards have yet been issued specifically for hypersonic or suborbital vehicles. In the interim, coordination may rely on informal cooperation and bilateral agreements. For example, a suborbital flight that travels from one country to another (or overflies another country) would likely require bilateral arrangements or diplomatic clearances, much like traditional overflight rights in aviation, since the question of whether it has a "right of innocent passage" through another State's airspace remains unresolved (ICAO, 2010, p. 5).

***Safety Regulation Challenges***

Ensuring the safety of passengers and third parties is a paramount concern in commercial hypersonic travel, yet the applicable safety regulations are in flux. In conventional aviation, safety is heavily regulated by both international standards (through ICAO) and national authorities: aircraft designs must be certified airworthy, airlines must maintain rigorous maintenance and training programs, and flight crews are licensed and medically certified. For emerging suborbital flights, no comparable international safety regime exists. Instead, safety oversight has so far been left to national authorities, and in some cases, regulators have intentionally taken a hands-off approach to avoid stifling innovation. The United States again provides a prime example: since 2004, U.S. law has imposed a moratorium (the so-called "learning period") restricting the FAA from issuing detailed safety regulations for the protection of passengers on commercial spaceflights, apart from minimal requirements for informed consent (Congressional Research Service, 2024, p. 5). During this learning period – which has been extended repeatedly and is currently set to expire in 2024 – commercial spaceflight companies must simply inform space flight participants of the inherent risks and hazards of the launch and reentry, and obtain written informed consent, but the FAA cannot require vehicle certification or impose airline-level safety standards on crewed space vehicles (Congressional Research Service, 2024, p. 5). The rationale is to allow the industry to mature and gather data before heavy regulation; however, this approach tolerates a higher level of risk than is acceptable in civil aviation. Indeed, by one analysis, the historical failure rate of commercial suborbital

launches is on the order of a few percent – orders of magnitude higher than the safety level demanded in air travel (Congressional Research Service, 2024, p. 2).

From an international perspective, such disparities in safety regime are problematic. If hypersonic transports are to carry passengers between countries, those passengers (and the governments that oversee their travel) will expect a certain baseline of safety. Applying drastically different safety standards – for example, one country allowing essentially experimental vehicles with no certified safety rating to fly, while another country requires full compliance with airliner safety norms – could lead to conflicts and erode public confidence. ICAO's leadership in safety could be crucial here: ICAO could help define what an acceptable safety level is for hypersonic flights and possibly develop recommended practices for vehicle certification, crew training, and operational risk management. However, at present ICAO's Annexes do not contain criteria tailored to vehicles that operate partially outside the atmosphere or that combine aircraft and rocket propulsion. One approach could be to adapt existing Airworthiness (Annex 8) and Operations (Annex 6) standards with additional provisions for high-altitude, high-speed vehicles. Another approach is the use of performance-based regulations – setting safety goals (such as probabilities of failure) rather than prescriptive design rules, which might suit the innovative and varied designs of hypersonic vehicles. Italy's recent regulatory framework for suborbital operations, for example, emphasizes a "performance-based, operation-centric, and adaptive approach" to safety regulation, including the use of experimental test programs and sandboxing to validate new technologies (Italy Working Paper, 2022, p. 1). This approach could inform ICAO if it develops global guidelines.

Human factors also present unique safety challenges. Hypersonic and suborbital flights will expose occupants to extreme conditions: high acceleration (G-forces), microgravity, vacuum, and rapid re-entry deceleration. Training requirements for crew – and even passengers – may be necessary to ensure safety. In aviation, commercial air carriers must brief passengers on safety and have crew trained for emergencies; in space tourism, the U.S. requires that participants undergo training for emergency scenarios like capsule egress. Standards for medical fitness might also need to be internationally agreed, given the physical stress of suborbital flight (Balleste, 2017, p. 1049). There is also the matter of integration with existing safety systems: for instance, search-and-rescue operations if a vehicle makes an unplanned landing, or coordination with air traffic control to prevent mid-air collisions during ascent or

descent. These safety considerations extend beyond one country's borders and again point to ICAO as a forum for collaboration. ICAO already coordinates aviation search and rescue (Annex 12) and accident investigation standards (Annex 13); analogous provisions might be envisioned for commercial spaceflight incidents, perhaps in partnership with space agencies.

The challenge is balancing innovation with safety. The early stage of hypersonic travel might tempt a looser regulatory touch (to "learn by doing"), but history has shown that high safety standards are eventually non-negotiable for public transportation. One way forward is through gradualism: initially relying on national licensing and experimental permits, but incrementally building international consensus on minimum safety requirements. The ICAO Assembly's resolution on New Entrants and its associated working groups indicate that States are aware of the need for global safety benchmarks. Over time, we may see the development of ICAO circulars or guidance material for commercial space operations safety. Additionally, industry standards bodies (like ISO or aerospace industry associations) could develop best practices that ICAO could endorse. In summary, ensuring safety for hypersonic travel will require bridging the gap between the current laissez-faire experimental approach and the rigorous safety culture of aviation – a process that demands international coordination, data sharing, and likely the extension of ICAO's standard-setting role into this domain.

***Liability and Legal Responsibility***

Another critical area of legal uncertainty is liability for injury or damage caused by hypersonic commercial flights. In the context of international air transport, liability is well-established by treaties like the Montreal Convention of 1999, which makes airlines strictly liable (up to certain limits) for passenger death or injury and for damage to baggage or cargo during international flights. Additionally, ICAO contracting States often require aircraft operators to carry insurance for damage to third parties on the ground. By contrast, in the context of space activities, the primary instrument is the 1972 Convention on International Liability for Damage Caused by Space Objects (Liability Convention). This treaty establishes that a "launching State" is absolutely liable for any damage a space object causes on the surface of the Earth or to aircraft

in flight, and liable for fault-based damage in space (Liability Convention, 1972, art. II & III). The Liability Convention, however, is state-to-state: claims must be espoused by States (injured parties have no direct cause of action under the treaty), and it was intended mainly for large-scale incidents (e.g., a satellite falling on another country). It was not designed for routine commercial passenger operations.

If a hypersonic passenger craft were considered a “space object,” an odd mismatch arises: any damage it causes to people or property on the ground in a foreign country could trigger absolute liability of the launching State, even if the operator is a private company. Meanwhile, passengers on board that vehicle would not have the benefit of the Montreal Convention regime and might only have recourse to whatever contractual or tort remedies are available under national law. In the United States, spaceflight participants are currently required to sign liability waivers acknowledging the risks, and federal law provides that they have no legal recourse against the operator for ordinary negligence – essentially assuming the risk of spaceflight (51 U.S.C. § 50914). Such waivers might not be enforceable or even permissible in other jurisdictions that have stronger consumer protection or common carrier liability rules. This disparity creates uncertainty: a paying customer on a hypersonic flight that takes off in one country and lands in another might have very different legal rights depending on which law is found to apply – air law or space law, or the contract they signed.

Clarity on the legal classification of the vehicle is thus important for liability. If considered an aircraft engaged in international carriage, then presumably the Montreal Convention or a similar air law liability regime should apply, giving passengers a clear path to compensation for accidents (subject to limits and defenses, and usually requiring insurance by the carrier). If considered a space object, the Liability Convention might make the launching State liable to other States but does nothing for the passengers’ own injury claims. Additionally, third-party liability could fall into a gap. For example, imagine a scenario where a suborbital spacecraft passing over a foreign territory breaks apart and debris causes damage on the ground. If it is deemed a “space object,” the launching State would be absolutely liable under space law. If it were deemed an “aircraft,” the operator might be liable under air law principles or possibly under the 1952 Rome Convention on damage caused by foreign aircraft (though that treaty is not widely adopted). Because suborbital vehicles do not neatly fit categories, it is conceivable that disputes could arise over which liability regime

governs a particular incident. One scholar noted the risk of "vehicles that are not 'launched' (in orbit) being classified as space objects and thus not subject to aviation registration or liability rules either" (Cheney & Napier, 2015, p. 9), highlighting the potential for a liability vacuum if definitions are not clarified.

To address these concerns, some legal experts have proposed creating special liability rules for space tourism and suborbital flights. This might take the form of a new international agreement or an update to existing ones. For instance, a protocol to the Montreal Convention could be imagined, extending its application to "aerospace transportation" with appropriate modifications (e.g., possibly higher liability limits given the inherently riskier nature of spaceflight). Alternatively, an entirely new convention could be drafted to govern the liability of commercial human spaceflight operators, borrowing elements from both air and space law. At the national level, countries like the US require launch companies to carry third-party liability insurance up to a certain tier (based on risk calculations) and the government provides indemnification above that (51 U.S.C. § 50915). Other countries with space launch legislation have similar schemes. An international approach could consider a mandatory insurance regime for commercial space operators, ensuring that regardless of how a vehicle is classified, victims would have access to compensation. ICAO could potentially coordinate such policies; indeed, ICAO has experience administering international funds and insurance requirements for aviation (for example, proposals were discussed in ICAO for an international third-party liability regime for aircraft, though not fully realized). Given ICAO's technical expertise and convening power, it might serve as a forum to negotiate liability and insurance minimums for hypersonic flights.

The question of criminal liability and jurisdiction is also noteworthy. In air law, the Tokyo Convention 1963 provides rules for crimes on aircraft (jurisdiction is primarily with the State of registration of the aircraft). In space, if a vehicle is deemed a "space object" registered by a State, that State retains jurisdiction and control over the object and personnel while in outer space (Outer Space Treaty, 1967, art. VIII). Suborbital flights could complicate this, especially if the vehicle is considered an aircraft for part of the journey and a space object for another. It underscores again the importance of a consistent classification. Ultimately, to avoid confusion, there is a strong argument that the same set of legal expectations should follow the vehicle and its occupants throughout the journey. If a passenger boards a hypersonic transport in State A and lands in State B, both the passenger and the operator should ideally know in advance

which liability rules apply for the entire route. Achieving this certainty likely requires either declaring that such flights are a form of international air carriage (hence under Montreal Convention, etc.) or crafting a new liability framework specific to them.

Therefore, the current legal landscape for liability in hypersonic travel is fragmented and inadequate. The ICAO Legal Committee, in coordination with UNCOPUOS, could take the lead in developing solutions – perhaps by interpreting existing conventions in a complementary way or spearheading new legal instruments. As commercial hypersonic operations ramp up, resolving liability issues will be key to protecting the public and providing the legal certainty that insurers and investors in this industry will demand.

***Airspace Access and Traffic Management***

Commercial hypersonic vehicles will operate in altitudes and flight regimes that push the limits of today's air traffic management systems. A rocket launching a suborbital craft must traverse through controlled airspace on its way up and come back down through those layers to land. This raises both practical and legal issues regarding airspace use. Legally, as noted, States have sovereignty over the airspace above their territory up to an undefined limit. Thus, any vehicle passing through a country's airspace – even for a brief suborbital transit – would normally require that State's permission (unless one argues it is above sovereign airspace). In contrast to satellites in orbit (which overfly countries routinely without consent under the freedom of outer space), suborbital trajectories may not reach sustained orbital altitude and will spend significant time in or near national airspace. The longstanding uncertainty about the upper boundary of airspace means there is no clear rule on whether a suborbital vehicle at, say, 80 km altitude over Country X is within X's territorial airspace or in free outer space. In practice, prudent operators will treat it as if they need clearance, to avoid diplomatic conflict. Thus, one can envision airspace access agreements being needed for international hypersonic routes, analogous to overflight rights for airlines. Bilateral or multilateral agreements could specify permissible corridors and altitudes for hypersonic transit. Indeed, the ICAO suborbital study alluded that space objects might claim a sort of "innocent passage" for launch/reentry, but acknowledged the

matter is not settled and that bilateral agreements may be the pragmatic solution (ICAO, 2010, p. 5).

From a safety and operational standpoint, integrating hypersonic flights into airspace will require coordination with Air Traffic Management (ATM) to prevent conflicts with conventional aircraft. An ascending rocket can create hazardous airspace below its path (due to potential debris in case of failure), and similarly a descending vehicle may need a cleared corridor. Currently, launches are handled by issuing Notices to Airmen (NOTAMs) that block off airspace during launch windows, sometimes disrupting civil air traffic. If hypersonic point-to-point travel becomes frequent, such ad hoc blocking of airspace may not be sustainable on busy air routes. This has led to discussions about developing a more dynamic air traffic management for space or Space Traffic Management (STM) system that can coexist with traditional ATM (UNOOSA, 2017, Theme 4). The ICAO/UNOOSA Aerospace Symposia specifically identified the need to study how suborbital operations will affect airspace and to compare approaches of ATM and potential STM (UNOOSA, 2017). It is likely that new procedures and perhaps new technological solutions (such as real-time tracking of space vehicles by air traffic control, automated separation tools, etc.) will be needed. There may also be altitude stratification – for instance, reserving a band of very high altitude (say 60,000 ft to 100 km) for “transit” of aerospace vehicles, separate from commercial airliner altitudes. Some have started referring to this realm as “higher airspace” and considering special regulatory treatment for it (Italy Working Paper, 2022, p. 1). Eurocontrol and EASA in Europe have engaged in research about “higher airspace operations” to ensure that high-altitude supersonic or hypersonic flights can be accommodated without disrupting lower airspace traffic.

Additionally, there is the question of radio communication and navigation. Aircraft are required to have certain communications equipment and to follow air traffic control instructions in controlled airspace. Space launch vehicles typically do not communicate with ATC in the same way; they might be handled by a separate range control. With commercial passenger vehicles, especially if they carry people from one airport to another spaceport, it may be necessary for them to interface with civil ATC for portions of flight. This will require protocols to be established – for example, what call sign or identification a spaceplane uses, how it is displayed on radar/tracking systems, and how handovers are managed between air traffic controllers and any space-specific controllers. In the long run, one could imagine ICAO expanding its CNS

(Communication, Navigation, Surveillance) standards to include provisions for spacecraft communication and tracking when operating in airspace (indeed, ICAO has already begun examining spectrum and frequency issues, as evidenced by working papers on data links with aerospace vehicles (ICAO, 2018)).

Airspace access also relates to equitable use and avoiding congestion. While it may seem fanciful now, if hypersonic transport became common on certain routes (say dozens of launches daily between major cities), the upper atmosphere could see much more traffic. Avoiding collisions between spacecraft and aircraft (or between spacecraft themselves) would then become a serious issue requiring international rules—essentially extending the concept of "rules of the air" (ICAO Annex 2) into near-space. Concepts like designated ascent/descent corridors, separation standards, and perhaps speed limits or maneuver restrictions could be considered. For now, these scenarios are hypothetical, but proactive legal modeling can ensure we are prepared. An example can be drawn from how international air law handles supersonic flight: ICAO environmental standards currently prohibit civilian supersonic transport from creating sonic booms over land in most cases (an issue of noise pollution). Hypersonic vehicles will likewise produce sonic booms during reentry or descent; regulations may be needed to address these environmental and noise concerns on an international scale so that one nation's hypersonic flights do not unduly impact another's population or environment.

Hence, airspace access and management for hypersonic flights present a dual challenge: legally securing permission to transit through national airspaces, and practically integrating into the traffic management system. Both aspects will require new norms and likely the leadership of ICAO in collaboration with space agencies. It may be necessary to establish a hybrid oversight mechanism—perhaps a joint civil/military and aviation/space coordination center—to manage these flights. The complexity of this task underscores why treating hypersonic travel solely as an extension of either aviation or space operations is insufficient; a blended approach is needed to ensure safe and efficient use of the upper atmosphere by all parties.

## DISCUSSION

Given the unique challenges outlined above, scholars and policymakers have been actively debating what form a future legal and regulatory regime for commercial

hypersonic flight should take. A range of models have been proposed, each with its own advantages and drawbacks:

1. **Treat Hypersonic Vehicles as Aircraft (Aviation-Centric Approach):** One option is to largely subsume suborbital and hypersonic flights under existing air law by classifying the vehicles as a type of aircraft. Under this approach, ICAO would take the lead in developing any needed new standards, and suborbital transports would be required to meet adapted versions of aircraft regulations (Cheney & Napier, 2015, p. 9). The attraction of this model lies in the mature infrastructure of aviation law: we already have robust mechanisms for certifying aircraft and licensing crews, and a century's worth of experience in safety management. By treating hypersonic vehicles as "just another kind of airplane" (even if technically they are not supported by air throughout), regulators could extend familiar frameworks to cover them. This approach would also preserve state sovereignty up to the point of agreed delimitation – meaning states control launches and reentries in their airspace similar to how they control flights. The ICAO study in 2005 noted that if such vehicles are considered aircraft and engage in international navigation, they would trigger obligations under the Chicago Convention like registration and airworthiness certification (ICAO, 2010, p. 3). Some ICAO Assembly resolutions already anticipate that certain new categories might operate under national regulations until international Standards catch up, with mutual recognition of licenses in the interim (ICAO, 2010, p. 5). The downside of the aviation-centric approach is that it may be perceived as too restrictive or inappropriate for what are partly spacecraft. Some in the space industry worry that imposing traditional aviation rules could stifle innovation or negate the "space" aspect of the experience (Cheney & Napier, 2015, p. 9). Additionally, not all states are parties to the key air law treaties (e.g., not every country has ratified Montreal 1999), though virtually all are in ICAO.

2. **Treat Hypersonic Vehicles as Spacecraft (Space-Centric Approach):** The converse model is to treat these operations primarily under space law. This could involve empowering the UN Committee on Peaceful Uses of Outer Space (COPUOS) or UNOOSA to develop guidelines or even a new multilateral agreement specifically for commercial suborbital flights (Cheney & Napier, 2015, p. 9). Proponents argue that because these vehicles reach outer space (even briefly) and are launched by rockets, they should be considered "space objects." A space-centric regime might better accommodate the novelty of these craft, crafting rules from scratch tailored to their needs. It would also satisfy those who philosophically see these ventures as part of humanity's spacefaring activities rather than aviation. However, a major drawback is that the existing space law machinery is not designed for fast regulatory responses or detailed operational standards. COPUOS works by consensus and historically has been slow – for example, it has been unable for decades to agree on a definition of outer space. Developing a new treaty could take many years, and in the meantime varying national practices would proliferate. Furthermore, a purely space-based approach might clash with the fact that launches and reentries inherently affect national airspace and territory – states will not want to cede

control over who can launch or fly above their territory. Indeed, as noted, states would object if their sovereign airspace could be penetrated without permission under a broad "freedom of space." Thus, a space-centric regime might face political resistance from aviation-focused states and could also result in lower safety expectations (since space law's bar for safety oversight is lower and less specific than ICAO's).

3. **Dual-Regime or Hybrid Approach:** Recognizing the limitations of pure approaches, some have suggested a hybrid model whereby elements of both air law and space law are combined. This could mean applying air law up to a certain altitude and space law above it (the "spatial" hybrid) or applying air law to certain aspects (like safety and operation) and space law to others (like liability and registration) – a "functional" hybrid. One idea is to define an altitude boundary (perhaps at 100 km or another agreed line) and stipulate that everything below is under ICAO's aviation framework, everything above is under space law. However, because suborbital flights cross that boundary, one would need provisions for how a flight transitions from one regime to the other and back. Another variant is the concept of "aerospace zones" or "higher airspace" as an intermediate jurisdiction. For example, some have floated the idea of an internationally agreed altitude (say 60 km) below which full sovereignty applies and above which some freedoms akin to outer space apply, effectively creating a new legal zone (Hobe, 2018, p. 250). Within that zone, special rules could govern transit rights and vehicle requirements. While elegant in theory, negotiating such a boundary has proved elusive historically, and some major powers oppose setting any boundary at all (fearing it could later constrain military or surveillance activities).

4. **New Sui Generis "Aerospace" Regime Under ICAO:** A promising path, advocated by various legal experts, is to establish a completely new set of international rules specifically for commercial suborbital/hypersonic flights – essentially a sui generis regime – but to place it under the umbrella of ICAO for administration. Savić and Petić (2020) conclude that the best solution would be to create a dedicated regulatory regime for suborbital flights governed by ICAO, precisely because ICAO brings institutional experience in managing international operations and balancing state interests (Savić & Petić, 2020, p. 249). Such a regime could be implemented via a new ICAO Annex, or a standalone multilateral agreement negotiated under ICAO's auspices. It would not simply treat these vehicles as aircraft; it would craft rules that borrow from both air and space law to suit the unique characteristics of hypersonic travel. ICAO's involvement would ensure that key areas like safety, navigation, licensing, and liability are addressed in a comprehensive manner, while also giving commercial space actors a voice through ICAO's consultative processes. A sui generis aerospace framework could set requirements for vehicle certification that consider both aerodynamic and ballistic flight phases, mandate insurance and passenger protections tailored to spaceflight, and establish coordination procedures for airspace integration. Because it's under ICAO, it would benefit from ICAO's enforcement mechanisms (States would incorporate the standards into their national regulations, and operators would need to

comply to operate internationally). One challenge here is political: convincing ICAO's 193 Member States to extend its mandate in this way. Some states might worry about blurring the line between air and space sovereignty, or about giving a civilian agency say over what has often been dual-use technology (rockets have military implications too). But ICAO has shown adaptability in the past to new technologies (for instance, ICAO now deals with drones/UAS and cybersecurity, which were not traditional aviation subjects).

5. **Multi-Stakeholder Governance Model:** A more novel proposition, inspired by how the internet is governed, is to create a multi-stakeholder entity to manage certain aspects of the regime. Balleste (2017) suggests a "cyberspace model" in which a new international corporation or body – analogous to ICANN in internet governance – would be formed to draft and implement rules for suborbital travel (Balleste, 2017, p. 1057). This body would include not just states but also industry representatives, engineers, and other stakeholders, thereby ensuring that the regulatory framework is informed by technical realities and commercial needs. Such a corporation could, for instance, set industry standards, coordinate launch scheduling to avoid conflicts, and evolve rules more flexibly than a traditional treaty process. Governments would retain ultimate authority (perhaps through an oversight board or an agreement that empowers the corporation), but day-to-day governance might be more technocratic and collaborative. The benefit of this approach is agility and inclusiveness; the downside is that it deviates from the classic state-centered international lawmaking, so it may be difficult to reconcile with issues of sovereignty and public accountability. Still, as a component of the overall regime, a multi-stakeholder group could function as an advisory or standards-setting arm within an ICAO-led framework. For example, ICAO might charter a permanent "Aerospace Operations Panel" with broad stakeholder membership to continually update recommended practices for hypersonic flight operations, analogous to how ICANN manages domain name rules with input from many parties (Balleste, 2017, p. 1059).

In weighing these models, many experts converge on the idea that some degree of new regulation is needed, and it should leverage ICAO's capabilities while also involving the space community. The hybrid or sui generis approach under ICAO seems to strike a balance: it doesn't force an arbitrary physical boundary, it acknowledges the competencies of both air and space law, and it uses an existing institution (ICAO) that is well placed to achieve global buy-in. A possible roadmap could be as follows: in the short term, ICAO issues guidance encouraging mutual recognition of national licenses for suborbital vehicles (as a stop-gap measure, per Chicago Convention Article 33 and the ICAO resolution mentioned earlier). In parallel, ICAO's Legal Committee could start drafting principles of a new framework, consulting with COPUOS to ensure compatibility with space treaties. This might eventually crystallize

into an “International Aerospace Transport Agreement” or a new ICAO Annex dedicated to “Aerospace Vehicles and Operations.” Matters of safety, navigation, and liability would be addressed therein, potentially with appendices that adapt Montreal Convention liability to these flights and mandate that passengers be informed of and protected against certain risks. Over time, as technology and traffic volume increase, the framework could be amended, much as ICAO’s SARPs evolve.

Ultimately, the success of any legal model will depend on international consensus. It is encouraging that forums like ICAO and COPUOS have started dialogue on this subject. The coming years, with more commercial players entering the hypersonic arena (including proposals for ultra-fast intercontinental transport using rockets), will add pressure to move from talk to action. The legal vacuum cannot persist indefinitely without either an accident or dispute forcing the issue. Therefore, proactively developing a robust legal regime is not merely an academic exercise but a necessary step to ensure the safe and sustainable growth of hypersonic travel.

## CONCLUSION

The commercialization of hypersonic and suborbital flight stands at the frontier of both technology and law. As vehicles breach the atmosphere to carry civilians at unprecedented speeds, they also breach the neatly separated domains of air law and space law that lawyers have relied on for decades. This paper has highlighted the resulting legal challenges in the context of the ICAO framework and international law: the need for coordinated regulations across nations, the imperative to uphold safety in an inherently risky endeavor, the unresolved questions of liability and jurisdiction, and the complexity of granting airspace access to hybrid vehicles. The analysis shows that the status quo is not an option – relying solely on outdated treaties (Chicago 1944, Outer Space 1967) or unaligned national laws would leave significant gaps and conflicts as hypersonic operations expand.

Fortunately, there is a growing recognition among policymakers and scholars of the need for a forward-looking legal regime. ICAO, with its experience in forging global consensus for aviation, is poised to play a central role. Within its existing mandate, ICAO can begin by issuing practical guidance to help national authorities reconcile disparate rules and by fostering agreements for mutual acceptance of

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licenses and certifications for experimental flights (ICAO, 2010, p. 5). In parallel, ICAO's member States can initiate the development of a new regulatory framework – whether through an ICAO instrument or a separate multilateral treaty – that specifically addresses aerospace vehicles. Such a framework should draw on the strengths of both air and space law. It should define clear lines of responsibility (so that every flight is under a responsible State's jurisdiction throughout), impose baseline safety and training requirements (perhaps escalating over time as the industry matures, akin to how early airmail evolved into strict airline standards), and ensure liability coverage and insurance for passengers and third parties that is no less protective than what exists in aviation. It should also delineate how these vehicles will be integrated into airspace management to prevent harmful interference with traditional air traffic.

The process of crafting this regime will require unprecedented cooperation between bodies like ICAO and COPUOS, between regulators and industry, and between nations with divergent interests (spacefaring nations vs. those more concerned about sovereignty and overflights). Innovative governance structures, like the proposed multi-stakeholder approach, may offer valuable tools to achieve consensus and adapt rules in a fast-changing technological environment (Balleste, 2017, p. 1057). Additionally, interim measures – such as bilateral agreements for specific flights, industry self-regulation through standards, and national "pilot programs" under governmental oversight – will play an important role in bridging the gap until a full international regime is in place.

In conclusion, the legal challenges of commercial hypersonic travel are significant but not insurmountable. History provides a guide: the dawn of aviation in the early 20th century also presented a radical challenge to law, and through forums like ICAO and instruments like the Chicago Convention, the global community established an orderly system that made air travel safe and routine. Now, as we stand at the dawn of the hypersonic age, a similar evolution in law is needed. By proactively developing an ICAO-led international framework that ensures coordination, safety, liability, and equitable access, we can avoid the pitfalls of regulatory fragmentation and realize the benefits of hypersonic travel. The task calls for creativity and collaboration among the aviation and space sectors – truly an "astral partnership." The payoff will be a legal regime that enables humanity's next great leap in transportation to happen with confidence, safety, and respect for the rule of law, thus turning the exciting prospects of hypersonic flight into a sustainable reality.

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