Saudi Arabia
Centre for
Space Futures

The Future of Space Law

The Evolving Dynamics of Air and Space Regulation

WHITE PAPER
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Foreword

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The rapid expansion of space activity driven by commercialization, technological advancement, and global participation has outpaced the development of coherent and universally adopted governance frameworks. As more nations and private actors engage in space, the need for effective, adaptable, and inclusive legal mechanisms becomes increasingly urgent.

This white paper is the first in a series that aims to explore the evolving landscape of space law by drawing lessons from other domains of global governance. In this initial paper, we examine the development of international civil aviation law as a potential roadmap for shaping space governance, highlighting both the parallels and the limitations in applying aviation's legal architecture to the space domain.

The Centre for Space Futures was established to advance collaborative thinking on the future of the global space economy. Through research and dialogue, we aim to identify practical approaches that support sustainability, equity, and innovation in space. We hope this series will serve as a platform for constructive exchange and policy development as the international community collectively navigates the next chapter of human activity beyond Earth.

We invite your feedback and engagement as we continue this important work.

Executive Summary

The accelerating commercialization of outer space has outpaced the capacity of existing governance frameworks to ensure safety, sustainability, and equitable access. The foundational principles of the 1967 Outer Space Treaty (OST) -though visionary- now face limitations in addressing the realities of a space environment marked by expanding private-sector activity, increasingly complex technologies, and limited coordination across oversight mechanisms.

States may engage with specific tiers or standards based on their strategic interests, without committing to the entire framework.

This white paper introduces a conceptual model for a Multi-Tiered Standards and Recommended Practices (SARPs) Framework for Space, inspired by the successful structure of international aviation governance under the International Civil Aviation Organization (ICAO). Rather than replicating the aviation framework, this model adapts key elements, such as collaborative standard-setting, phased adoption, and compliance auditing, into a modular structure suited to the unique dynamics of the space sector.

The conceptual framework outlines three interoperable tiers:

Tier 1: Legal, Economic and Commercial Foundations

Voluntary norms addressing transparency, pre-launch registration, post-mission reporting, licensing harmonization, and dispute resolution, particularly for cooperative and commercial missions.

Tier 2: Technical Standards

Scientifically grounded guidance developed through expert panels and pilot projects under the United Nations Committee on the Peaceful Use of Outer Space (UNCOPUOS). This includes:

- Standards for orbital debris mitigation and safe satellite deorbiting
- Protocols for space traffic coordination
- Environmental sustainability criteria for launch and satellite operations
- Centralized information-sharing mechanisms, modeled after aviation's Aeronautical Information Management (AIM) system
- Risk and safety benchmarks for emerging propulsion and launch systems

Tier 3: Operational Protocols

Implementation level mechanisms for insurance, licensing, launch safety, and reciprocal recognition among participating states, promoting cross-border interoperability and regulatory clarity.

In addition, a strategic track is proposed to support voluntary alignment through technical working groups and pilot projects under the UNCOPUOS framework. The conceptual model enables gradual convergence around shared standards without requiring new treaties or loss of national autonomy.

By emphasizing **reciprocity, incentive-driven participation, and global capacity-building,** this model offers a practical and scalable pathway toward strengthening cooperation, reducing regulatory fragmentation, and supporting sustainable commercial growth in space.

This paper invites policymakers, commercial actors, and intergovernmental bodies to engage with this conceptual framework as a foundation for future action in building a more cooperative and resilient space governance architecture.

01 Introduction

A growing gap exists between the rapid pace of space commercialization and the capacity of existing governance frameworks to ensure safety, security, and equitable access. The existing space governance framework, largely based on the 1967 Outer Space Treaty (OST), is increasingly limited in its capacity to address the complexities of a rapidly evolving commercial space sector, contributing to “vertical fragmentation” and regulatory uncertainty.

Table 1 displays the main legal framework relevant to this white paper for space and aviation, within the international law domain.

From this, space law is largely governed by United Nations (UN) treaties developed under the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), and is complemented by ITU regulations.

On the other hand, aviation law is governed by the Convention on International Civil Aviation (Chicago Convention) and a comprehensive system of international conventions, supported by ICAO. These instruments are widely ratified and provide detailed frameworks for operational regulation, safety, and enforcement. This reflects a higher level of institutional and regulatory maturity, as aviation law incorporates regularly updated technical standards and procedures through Annexes and SARPs. In comparison, space law remains largely principle-based, with fewer operational mechanisms and limited formal enforcement structures.

Table 1: Comparative Table of Relevant Key International Treaties and Conventions in Space Law and Aviation Law

Domain	Treaty / Convention Name	Treaty / Convention Year	Key Scope / Purpose	Parties / Status As of Sep 2025
Space Law	Outer Space Treaty (OST)[1]	1967	Basic principles governing activities in outer space, Moon & celestial bodies; non-appropriation, peaceful use	116 parties
	(Rescue Agreement) Agreement on the Rescue of Astronauts[2]	1968	Obligation to assist astronauts in distress and return them to the launching state	100 parties
	Liability Convention (Convention on International Liability for Damage Caused by Space Objects)[3]	1972	Establishes liability of launching states for damage caused by their space objects	100 parties
	(Registration Convention) Convention on Registration of Objects Launched into Outer Space[4]	1975	Requires states to register space objects and provide information to the UN	76 parties
	(Moon Agreement) Agreement Governing the Activities of States on the Moon and Other Celestial Bodies[5]	1979	Seeks to govern exploitation of resources on the Moon; less widely adopted	17 parties
	Constitution and Convention of the International Telecommunication Union (Geneva, 1992, as amended)[6]	1992 – latest amendments 2022	Defines the structure, purpose, functions and general principles of the ITU	194 ITU Member States[7]
	Radio Regulations 1906[8]	2020 edition (WRC-19, in force); 2024 edition (WRC-23, enters into force 1 Jan 2025)	Allocation and use of radio frequencies and orbital slots	
Aviation Law	Chicago Convention (Convention on International Civil Aviation)[9]	1944	Establishes ICAO; sets standards for safety, air navigation, sovereignty over airspace	193 parties
	International Air Services Transit Agreement (two freedoms of the air)[10]	1944	Overflight and technical landing rights	135 parties

Continue Table 1

Domain	Treaty / Convention Name	Treaty / Convention Year	Key Scope / Purpose	Parties / Status As of Sep 2025
Aviation Law	Warsaw Convention (Convention for the Unification of Certain Rules Relating to International Carriage by Air)[11]	1929	Governs liability of international air carriers for passengers, baggage, and cargo	152 parties, superseded largely by Montreal Convention 1999
Aviation Law	Montreal Convention (Convention for the Unification of Certain Rules for International Carriage by Air)[12]	1999	Modernized Warsaw regime; liability of air carriers in international carriage	137 parties
	Tokyo Convention (Convention on Offences and Certain Other Acts Committed on Board Aircraft)[13]	1963	Jurisdiction and enforcement of law on board aircraft	188 parties
	Hague Convention (Convention for the Suppression of Unlawful Seizure of Aircraft)[14]	1970	Suppresses unlawful seizure (hijacking) of aircraft	187 parties
	Montreal Convention (Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation)[15]	1971	Suppress sabotage and other unlawful acts against civil aviation	190 parties

1.1

Purpose and Objectives

This white paper examines how foundational features of established international governance regimes may be thoughtfully adapted to inform the evolution of space law and policy. It focuses on selected elements of the civil aviation framework to identify adaptable features such as standardization, multilateral coordination, and institutional arrangements that can support the development of a coherent, scalable, and enabling space governance framework. Particular attention is given to legal foundations, institutional design (both centralized and decentralized), and mechanisms that promote compliance, predictability, and international cooperation.

The ultimate objective is to foster conditions for a safe, inclusive, and economically sustainable space environment while respecting the principles of the Outer Space Treaty.

This is the first in a series of papers that will examine additional governance models, including the United Nations Convention on the Law of the Sea (UNCLOS), the Antarctic Treaty System, and selected multi-stakeholder mechanisms, with the overall aim of informing the development of practical governance approaches suited to the complex and evolving nature of space activities and enabling a sustainable and thriving space economy.

02 The Need for Enhanced Space Governance: Using Aviation as a Model for Space

The current frameworks for space governance are not absent, they're misaligned.

While the foundational principles of space governance, anchored in the Outer Space Treaty's focus on peaceful uses and international cooperation, remain essential, they have not kept pace with the rapidly evolving realities of today's space economy. The current landscape is increasingly driven by geopolitical competition,[16] national efforts to assert technological leadership, and a fast-growing commercial sector where innovation and risk-taking often outstrip the capacity of existing regulatory frameworks. In this environment, governance gaps are not simply the result of an absence of frameworks, but of frameworks that are misaligned with today's drivers and dynamics. Without more adaptive, pragmatic, and inclusive mechanisms, the risk of fragmented standards, unmanaged competition, and inequitable outcomes will only grow, undermining the very sustainability and cooperative potential of space activities. **Now is the time to modernize space governance to ensure it supports innovation while safeguarding shared interests.**

2.1 Historical Policy Drivers

A useful historical analogue can be found in the aviation sector. Following World War II (WWII) the international community faced a need to manage the growing cross-border activity in a high risk, technology-driven domain. The post-war creation of ICAO was driven by the need to ensure the safety, interoperability, and economic viability of international civil aviation.[17] Diverse national systems and overlapping airspace claims posed significant challenges to international aviation, prompting governments to pursue a centralized, treaty-based model under ICAO. The SARPs developed under ICAO helped prevent duplication, reduced accident rates, and ensured that smaller states could integrate into global air networks.[18] These historical drivers offer valuable insights for addressing similar risks now emerging in orbital space. Table 2 further illustrates these parallels by mapping key policy drivers from aviation to their counterparts in the space domain. It outlines the original aviation driver and its rationale, then proposes a

corresponding driver adapted to space governance challenges, followed by a description of the governance implications. The table is intended to show how lessons from aviation can inform a coherent, inclusive, and future-facing approach to managing the growing complexity of space activities including Space Traffic Management (STM)* matters.

Table 2: Historical Policy Drivers: Aviation and Implications for Space

Policy Driver in Aviation	Rationale	Policy driver for space	Implication for Space Governance
Post-WWII Multilateralism	Promote global stability through rules-based cooperation and reduce nationalist fragmentation.[19]	Promote cooperative governance to avoid unilateral actions and geopolitical fragmentation in orbit and beyond.[20]	A multilateral treaty or United Nations General Assembly (UNGA) resolution addressing the economic & commercial gaps in the OST could enhance long-term diplomatic cohesion and regulatory alignment.
Safety and Interoperability	Minimize collision risk and ensure the safe, coordinated flow of international air traffic through interoperable systems.[21]	Promote harmonized technical standards and real-time data-sharing protocols for STM,[22] collision avoidance, and mission design.[23]	Advance interoperable standards for debris mitigation, collision avoidance, STM, and mission operations, leveraging IADC† guidelines to foster safe, predictable, and sustainable space activities.
Economic Integration & Open Skies	Enable cross-border air commerce and private investment.[24]	Foster non-discriminatory global market access for satellite and space services while promoting equitable spectrum and orbit allocation.[25]	Encourage harmonized licensing and regulatory frameworks to enable global commercial access.
Institutionalized Audit and Compliance (USOAP, USAP)	Ensure state accountability and consistent standards.[26]	This is a proposed concept to develop an international space oversight mechanism (e.g. audit or peer-review system) aligned with global benchmarks.[27]	Supports the development of a global oversight mechanism (audits) to assess and certify space licensing systems.
Equitable Access and Capacity Building	Support participation by developing countries.[28]	Advance inclusive development through shared infrastructure, regional hubs, and regulatory toolkits for emerging space actors.[29]	Informs inclusive development strategies, such as shared infrastructure models and capacity-building initiatives for emerging space nations.

*Space Traffic Management (STM) refers to the planning, coordination, and on-orbit synchronization of activities to enhance the safety, stability, and sustainability of operations in the space environment.

† Inter-Agency Space Debris Coordination Committee (IADC) Space Debris Mitigation Guideline. IADC coordinate international efforts to mitigate space debris and promote safe and sustainable use of outer space.

Notably, ICAO and the UNCOPUOS with the technical and secretarial support of the United Nations Office for Outer Space Affairs (UNOOSA) have engaged in formal cooperation since 2015, including a series of joint symposia and expert dialogues on air and space traffic management.[30] These initiatives demonstrate a shared institutional recognition of the evolving intersection between aviation and space operations. However, the broader governance of outer space remains decentralized. Section 2.2 hereunder provides a comparative overview of ICAO, UNCOPUOS, and UNOOSA highlighting differences in formal institutional authority, operational roles, and mechanisms influencing compliance, recognizing that UNOOSA, while serving as the Secretariat to UNCOPUOS, plays a significant functional role in capacity building, norm diffusion, and treaty administration within the global space governance ecosystem.

2.2

International Institutional Governance

UNCOPUOS has served as a vital forum for fostering international cooperation in space, successfully establishing foundational principles such as the Outer Space Treaty.[31] However, as space activities increase in complexity and commercialization, there is a rising need for more detailed standards and implementation mechanisms. A key element of UNCOPUOS is its consensus-based approach, which ensures broad international buy-in, legitimacy, and flexibility. Yet this very structure also limits its ability to adopt binding technical standards or enforce compliance.[32] Drawing from the aviation sector, one potential model is a tiered SARPs framework that combines high-level legal principles with enforceable technical standards developed through collaborative, multi-stakeholder processes. In the proposed conceptual model in Section 3, UNCOPUOS's Legal and, Scientific and Technical Subcommittees (LSC and STSC, respectively) could serve as foundational venues for legal and technical standard development. However, the experience of the Long-Term Sustainability (LTS) Guidelines process -where a subset of guidelines was initially adopted- highlights both the potential and the political challenges of pursuing consensus-based governance within the existing UN framework. The aviation sector also underscores the importance of assigning clear responsibilities with accountability and implementing effective compliance mechanisms, features that remain largely absent from today's space governance structures. Future space governance models must therefore address both technical harmonization and political feasibility to ensure meaningful progress.

These contrasting institutional roles and mandates are summarized in Table 3, which highlights the key differences in their approaches to international governance.

Table 3: Comparative Overview of UNCOPUOS, UNOOSA, and ICAO

Aspect	UNCOPUOS	UNOOSA	ICAO
Role	Primary UN body for coordinating international space policy, fostering cooperation in the peaceful use and exploration of outer space, and promoting space law.	Secretariat of UNCOPUOS; supports and implements its decisions, promotes international cooperation, and assists in space capability development.	Specialized UN agency regulating international civil aviation standards for safety, security, and environmental protection.
Institutional Evolution	Established first as an ad hoc committee in 1958 and made permanent in 1959. Evolved into a key space policy forum, which also developed both hard and soft law instruments.	Initially established in 1958 as a small expert group, became a full office in 1992, and relocated to Vienna in 1993.	Established in 1947 as a UN specialized agency, evolved from PICAO[33] (set up in 1945) under the Chicago Convention.
Authority Distribution	Advisory and coordination-based, with no regulatory or enforcement power.	Implementing body for UNCOPUOS, with no enforcement power.	Centralized authority with "quasi-legislative" power over international aviation standards.
Governance Structure	Multilateral forum under the UN, with non-binding recommendations.	Administrative body under the UN that supports space-related policy implementation.	Centralized governance with an Assembly, Council, and Secretariat to set global aviation standards and practices.
Key Functions	Develops international space law, facilitates cooperation, and promotes dialogue among member states, between member states and other bodies, and between observer organizations and member states.	Acts as the secretariat for UNCOPUOS, implements its decisions, promotes space cooperation, and builds space capacity in developing countries.	Develops and adopts international Standards and Recommended Practices (SARPs) for civil aviation, coordinates air transport planning, and monitors implementation by member states.
Establishing Instrument	UN General Assembly Resolution 1348 (XIII) (1958).	Established as a dedicated UN unit following General Assembly Resolution 1721 (XVI) in 1961. Formally elevated to the status of United Nations Office for Outer Space Affairs in 1992 as part of Secretariat restructuring.[34]	Convention on International Civil Aviation (Chicago Convention, 1944).
Membership Requirements	Open to all UN member states, no requirement to be a party to the Outer Space Treaty.	No state membership requirements, serves as the secretariat to UNCOPUOS.	Must be a Contracting State to the Chicago Convention (1944).

2.3

Challenges of Fragmented Oversight

As in aviation, where private sector actors dominate operations but remain governed through state-based obligations under the Chicago Convention, space governance frameworks similarly rely on states to authorize and supervise private activities under the Outer Space Treaty. However, space activities are overseen by a complex landscape of national authorities applying diverse laws, regulations and policies to national space activities. This results from varying interpretations of international obligations and differences in national priorities, leading to vertical fragmentation in global space regulation, especially as commercial space activities continue to grow.[35] This challenge has been noted in the European space sector, where regulatory variation has at times affected coherence across national boundaries.[36] Yet the EU Space Act initiative aims to address such fragmentation by harmonizing the space regulatory framework.[37]

At the global level, the longstanding model of governance, in which private space activities are supervised through national mechanisms under international law, is increasingly shaped by the growing scale and transnational nature of commercial space activities. Private companies are now not only launching and operating satellites but also influencing standards, technologies, and service models that extend across jurisdictions.[38]

Despite this trend, UNCOPUOS remains primarily a state-driven forum, with participation structured around Member States and observer organizations. While a number of non-governmental and international entities, including those with technical and commercial expertise, contribute as observers,[39] the mechanisms for private sector engagement are not yet institutionalized in a way that enables sustained and structured input into agenda-setting or norm development. At the same time, UNOOSA has taken important steps to enhance its outreach to industry through partnerships, capacity-building initiatives, and thematic dialogues. These efforts reflect growing recognition of the private sector's role in shaping the future of space activities.[40] In contrast, ICAO benefits from long-standing formalized engagement with civil aviation stakeholders such as the International Air Transport Association (IATA) and the International Federation of Air Line Pilots' Associations (IFALPA), offering one model of structured coordination that may provide useful lessons for the evolving space governance landscape.[41]

The limited inclusion of commercial actors reflects broader challenges in aligning regulatory efforts and may add to global regulatory fragmentation. As activities expand across jurisdictions, fragmented approaches may affect coherence and mutual accountability.[42]

Oversight remains primarily state-based, with varying capacities and priorities. A Multi-Tiered SARPs framework could offer a constructive path forward. Tier 1, developed through UNCOPUOS, would focus on shared legal, economic, and commercial principles. It could also open space for more structured dialogue with industry to inform future technical and operational guidance.

2.4

Implementation and International Compliance

Previous research highlights efforts to create a comprehensive space governance framework using treaties, principles, and guidelines. However, consistent compliance remains a challenge, particularly regarding Space Situational Awareness (SSA), data pooling and sharing, and space debris mitigation. For example, despite existing guidelines, consistent and effective implementation of debris mitigation measures remain elusive. A more unified approach, combining binding and non-binding instruments, is needed to close this gap.

ICAO's evolution in aviation safety offers a valuable model. Initially reliant on national oversight systems, ICAO adopted Assembly Resolution A32-11 in 1998, which established the Universal Safety Oversight Audit Programme (USOAP) in 1999,[43] enhancing global transparency and accountability in aviation safety.[44] In response to heightened security concerns, ICAO established the Universal Security Audit Programme (USAP) in 2002, which now operates under a Continuous Monitoring Approach (USAP-CMA) to assess States' aviation security oversight capabilities.[45] To support implementation, especially in developing countries, ICAO introduced the International Financial Facility for Aviation Safety (IFFAS) in 2003, later succeeded by the Safety Fund (SAFE) in 2010, to help nations meet safety obligations identified in ICAO's USOAP audits.[46]

Despite some funding constraints, ICAO's experience demonstrates the value of well-resourced audit programs, technical assistance, and international cooperation in strengthening compliance and driving regulatory convergence. Crucially, ICAO's ability to perform these functions rests on a stable funding model supported by sustained Member State commitment, an area where space governance continues to evolve. As recent efforts by UNOOSA to secure staffing resources illustrate, Member States have not yet provided the level of political and financial support needed to translate cooperative dialogue into effective governance.[47] These structural insights remain highly relevant to space governance, where diverse oversight approaches, varying institutional capacities, and limited mechanisms for implementing shared standards continue to present coordination challenges.

Building on this model, a Multi-Tiered SARPs framework for space could improve implementation and ensure international compliance. Specifically, Tier 3, which focuses on implementation-level protocols, could incorporate SARPs-based national licensing and reciprocal audits. This would promote transparency, strengthen accountability, and improve compliance in critical areas like SSA and debris mitigation just as ICAO has achieved in civil aviation with USOAP.

2.5

Non-Appropriation as an Enabler of Commercial Space Activity

The Chicago Convention and the OST share similarities in their regulatory approaches to jurisdiction and international cooperation. Both assign jurisdiction to states over their registered vehicles -aircraft and spacecraft- through a formal process of national registration. This process creates a legal link between the vehicle and the state, ensuring responsibility, oversight, and liability.[48] That link is also essential for enabling international cooperation and supporting the obligation to ensure safety for peaceful purposes in their respective domains. However, despite this common jurisdictional approach, the two treaties differ in their approach and treatment of territoriality and sovereignty. The Chicago Convention establishes the complete and exclusive sovereignty of states over their national airspace,[49] resulting in clear, enforceable rules for civil aviation. In contrast, the OST explicitly prohibits the national appropriation of outer space or celestial bodies,[50] asserting that no country

may claim sovereignty over any part of space. This non-appropriation principle was designed to ensure that outer space remains free from national appropriation and governed as a shared domain under international law. These distinctions between jurisdiction over vehicles and control over territory are summarised in Table 4.

These fundamental differences in territorial jurisdiction introduce distinct considerations for the development of governance frameworks. Whereas aviation operates within a well-defined territorial framework supported by international oversight, space activities are implemented under national supervision in accordance with international obligations. This is often justified on the basis that space launches typically originate from national territory, implying a natural role for national control. While this may be sufficient for traditional, state-led launches from national territory, it calls for enhanced coordination for modern space operations. For instance, companies engaged in on-orbit servicing and other emerging activities often face overlapping national frameworks and legal uncertainty, requiring engagement with multiple national authorities to secure mission approval.[51] This proliferation of national laws reflects the broader limitations of a governance model that relies solely on national oversight for increasingly transnational operations. While this rationale remains particularly strong for national space missions, it is increasingly challenged in the context of commercial and cooperative missions that involve cross-border partnerships, shared assets, and operations beyond traditional territorial boundaries.

To address these gaps, a Multi-Tiered SARPs framework offers a more flexible and scalable approach. Tier 3 could establish pre-clearance procedures, harmonised licensing practices, and operational clarity around the non-appropriation principle, steps that would support a safer and more cooperative international space environment.

Table 4: Sovereignty and Jurisdictional Principles - Aviation vs. Space

Feature	Aviation (Chicago Convention)	Space (Outer Space Treaty)
Registration	Mandatory for international flights	Required, but no international pre-clearance standards
Jurisdiction/Control	State of registry	State of registry
Territorial Sovereignty	Complete and exclusive sovereignty over national airspace (Article 1)	Non-appropriation: No national claim of sovereignty over outer space or celestial bodies (Article II)
Focus	Safety, order in airspace	Peaceful exploration and use

2.6

Enabling Compliance and Fostering Equity

The UN's 'Benefits Declaration' (UNGA resolution 51/122) prioritizes space exploration for all countries -especially developing nations- by promoting international cooperation. It envisions broad access to technological advancements and scientific discoveries, driving global development and helping to close the gap between spacefaring and non-spacefaring nations. However, the Declaration lacks binding mechanisms to ensure equitable participation or compliance- and many barriers go beyond access alone. National policy choices, political will, institutional capacity, financial, and competing development priorities all shape the extent to which countries can engage meaningfully in space activities. To achieve the Declaration's vision, future frameworks must incorporate practical, inclusive approaches that address both structural barriers and the need for sustained national commitment and capacity-building.

A noteworthy parallel is ICAO's "No Country Left Behind" (NCLB) initiative, which assists ICAO member states, particularly those with safety or oversight challenges, in implementing SARPs.[52] NCLB recognizes that disparities in technical and legal capabilities can undermine the safety and efficiency of the global air transport system.[53] To address this, it promotes more equitable outcomes through knowledge transfer and technical assistance, enabling these states to meet essential SARPs.[54] Both the Benefits Declaration and ICAO's NCLB initiatives reflect a common goal: ensuring nations benefit from global governance systems. However, while aviation has made measurable progress through initiatives like the NCLB, the Benefits Declaration remains largely aspirational and lacks effective implementation mechanisms. This contrast is further illustrated in Table 5.

Table 5: Capacity Building and Compliance Together with Enabling License and Insurance

Feature	Aviation (ICAO)	Space (Current Framework)	Proposed Solution (Multi-Tiered SARPs)
Equity/ Capacity Building	"No Country Left Behind" initiative	Benefits Declaration (limited implementation)	Tier 1: Capacity-building initiatives and knowledge-sharing
Compliance Mechanisms	USOAP (mandatory audits), economic repercussions for non-compliance, frameworks in place to ensure implementation by member states.	Primarily voluntary compliance, limited enforcement mechanisms, varied and unharmonized national licensing practices.	Tier 3: SARPs-based national licensing, reciprocal audits among participating states, and incentives for compliance to support enforcement of robust licensing regimes. However, these measures must be voluntarily adopted into national law.
Nature of Standards	Non-binding until adopted nationally, but widely implemented due to strong institutional framework and potential economic implications.	Primarily non-binding guidelines with limited global uptake and soft regulatory influence.	Multi-tiered structure enabling voluntary alignment (Tier 1), with pathways to structured, enforceable standards in Tiers 2 and 3 through national adoption.

Continue Table 5

Feature	Aviation (ICAO)	Space (Current Framework)	Proposed Solution (Multi-Tiered SARPs)
Enforcement Capacity	Strong institutional framework with centralized oversight, auditing authority, and implementation support.	Fragmented authority with no centralized enforcement; relies on voluntary compliance.	Proposed SARPS framework envisions a modular structure with tiered authority, allowing for coordination, support, and eventual enforcement via national systems.
Licensing Scope	International Agreement	Varied: Regulate launch only; others include operations.	Harmonizes licensing standards to create a level-playing field for commercial operators.
Insurance Requirements	Clear Requirements	Varies: Ranges from comprehensive to optional or capped.	Establishes consistent insurance requirements across jurisdictions, aligned with international norms to enhance legal clarity for operators.

While the Chicago Convention establishes well-defined procedures to ensure compliance, such as the formal adoption of SARPs and Annexes and their integration into national laws, non-compliance can result in significant economic repercussions, including denial of airspace access.[55] In contrast, space governance remains largely dependent on voluntary compliance, supported by non-binding guidelines even when developed through consensus within UNCOPUOS. These guidelines encourage states to adopt best practices, without a binding force as a "soft enforcement" tool.

Although many states have incorporated the OST into their national legal systems, they do so through diverse mechanisms and with varying interpretations. Only recently have some spacefaring nations begun to apply monitoring and enforcement measures, along with mechanisms to address deficiencies in implementation.

This underscores the urgency of establishing SARPs-based national licensing systems to promote consistency and accountability in space activities. A Multi-Tiered SARPs framework could provide this foundation, with Tier 1 focused on capacity building, and Tiers 2 and 3 addressing implementation, reciprocal audits and compliance. For example, states could agree to recognize each other's licenses for commercial spaceport licenses, provided that those spaceports meet jointly developed SARPs for safety and environmental protection. This approach is further detailed in Figure 1.

2.7

Commercial and Dual-Use Technologies

With respect to civil and dual-use activities, the treaties reflect distinct approaches. The Chicago Convention establishes a comprehensive regulatory framework for the technical dimensions of international air transport and sets out the legal foundations that enable states to structure its economic organization through bilateral and multilateral agreements.[56] It also draws a clear distinction between civil and state operations, enabling standardized rules for civil operations that facilitate coordination and growth in the aviation sector.[57]

On the other hand, the OST promotes the peaceful exploration and use of outer space. While it encourages scientific investigation and explicitly prohibits the placement of weapons of mass destruction in orbit or on celestial bodies, it does not set out detailed provisions specific to economic development and related space activities. As commercial space activities continue to expand in scope and complexity, the legal and regulatory frameworks that support such developments

remain general in nature, without specialized provisions to address commercial realities.[58] In space, the rise of dual use technologies, such as, satellites and launch vehicles, serving both civil and defense purposes, has blurred these lines, creating challenges that are less pronounced in aviation.[59] These overlapping functions highlight the importance of consistent classification practices and regulatory clarity to support operational predictability for commercial actors.

Understanding how legal frameworks organize and classify civil and commercial activities is essential for evaluating governance approaches across domains. Continued dialogue is needed on how foundational principles, such as those established under the OST, can be complemented by practical mechanisms through the Multi-Tiered SARPs. Together, these elements can support the development of a responsive governance framework for long-term commercial participation in space.

2.8

The Need for a New Approach

The existing space governance framework, primarily developed in the 1960s-1980s, is becoming less well-aligned with the current landscape of modern space activities and technologies.[60] Despite numerous calls for comprehensive space SARPs, current governance remains fragmented and inadequate.[61] Challenges include the proliferation of actors, emerging technologies, and competing geopolitical interests.[62] Scholars propose various solutions, including adaptive governance frameworks,[63] polycentric governance systems,[64] and issue-specific forums led by stakeholders and experts.[65] The need for new "rules of the road" such as norms of responsible behavior and transparency measures, is emphasized. However, fostering consensus among major spacefaring actors remains an important part of the ongoing effort to advance effective and inclusive space governance.

Private actors are shaping space faster than international governance can respond.

This white paper addresses these shortcomings by proposing a Multi-Tiered, phased implementation model for space SARPs, drawing from ICAO's success in civil aviation. Unlike previous proposals, this approach:

- Emphasizes voluntary adoption, reinforced by reciprocal incentives among participating states.
- Prioritizes consensus-building through technical working groups and pilot projects.
- Integrates existing regional and national policies, which can be submitted for review by the UNCOPUOS LSC and STSC.
- Proposes incentive structures to adequately address the incentives for states to adopt and comply with standardized practices.

This tiered structure enables flexible, step-by-step implementation that reflects the complexity and political sensitivity of the space sector. It complements the OST's foundational principles with specific, actionable standards better suited to today's commercial space environment.

03 Designing a Multi-Tiered SARPs Framework for Space

This tiered structure enables flexible, step-by-step implementation that reflects the complexity and political sensitivity of the space sector.

3.1 Understanding the Tiered SARPs Framework

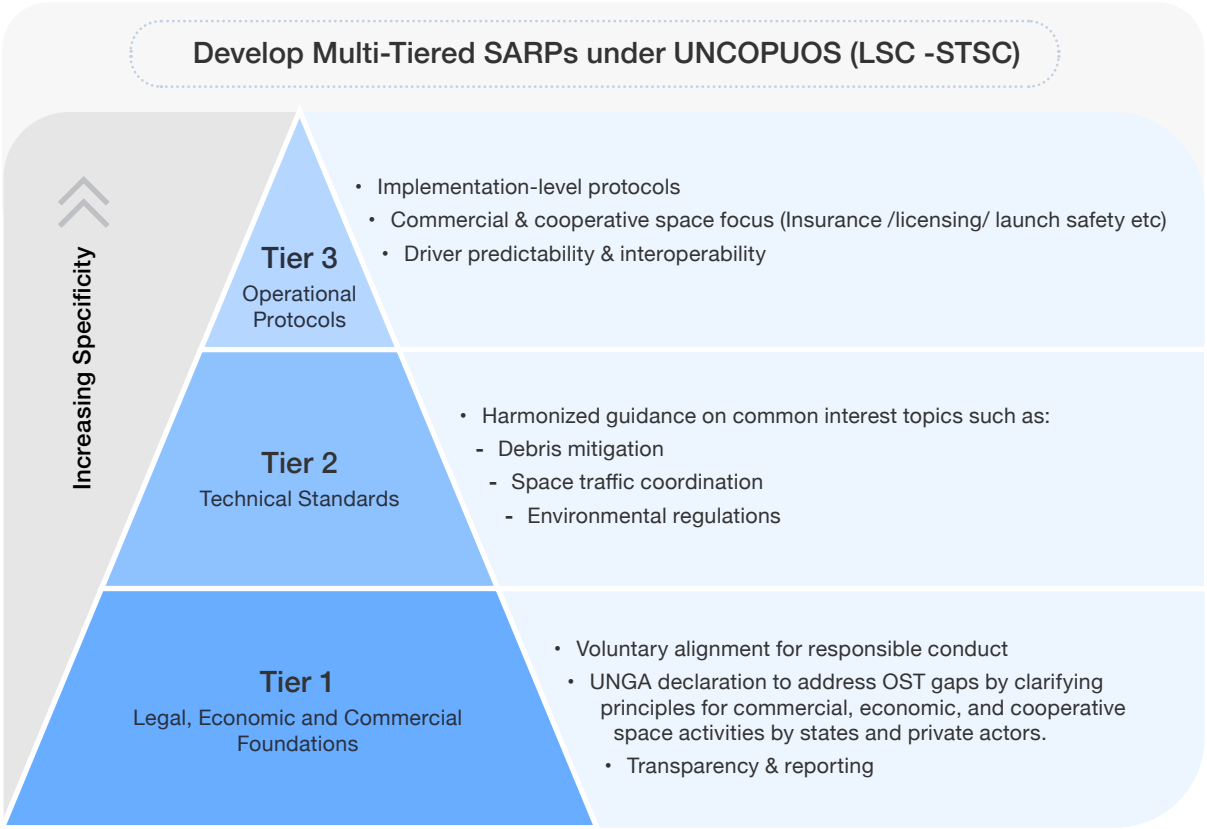
ICAO's SARPs model offers a proven process: SARPs are developed collaboratively, voluntarily adopted into national law, and assessed through coordinated audit mechanisms. This process has steadily raised global aviation standards without compromising national sovereignty.

While UNCOPUOS, IADC, and various regional initiatives have already developed key elements of soft law and best practices, they lack the coordinated, tiered structure and audit mechanisms that ICAO provides. This framework builds on those efforts rather than replacing them.

This section proposes a Multi-Tiered framework of SARPs embedded within the existing UNCOPUOS structure. While inspired by ICAO, the framework is tailored to the unique challenges and political sensitivities of the space sector. It emphasizes reciprocity, incentivized compliance through licensing, and alignment with existing regional and national policies. The UNCOPUOS LSC and STSC would play a central role in reviewing, refining and endorsing proposed SARPs at each tier. Figure 1 provides a conceptual model of the proposed Multi-Tiered SARPs Model.

In detail, Tier 1 builds on OST, LTS Guidelines, and transparency mechanisms; Tier 2 complements IADC Guidelines, Committee on Earth Observation Satellites (CEOS) principles, existing SSA efforts, and similar efforts; and Tier 3 addresses gaps in national licensing and insurance interoperability.

Figure 1: Proposed Multi-Tiered SARPs Framework (Conceptual Model)



The Multi-Tiered SARPs framework is guided by the following key principles:

- **Tiered Approach:** Instead of a "one-size-fits-all" approach, the framework consists of multiple tiers, each addressing different aspects of space governance with varying levels of specificity and obligation.
- **Voluntary Adoption with Reciprocity:** The initial tiers are based on voluntary adoption, incentivized by reciprocal benefits among participating states. This means that countries that adopt and implement the SARPs would receive preferential treatment or benefits from other participating states, creating a "race to the top."
- **Building Consensus:** The framework is designed to foster consensus-building through technical working groups, pilot projects, and the sharing of best practices, with the LSC and STSC playing a central role in facilitating this process.
- **Hybrid Approach:** The framework aims to integrate the strengths of both the UNCOPUOS (consensus-based) and ICAO (standardized) models, creating a hybrid system that is both effective and politically feasible.
- **Phased Implementation:** The framework is intended to be implemented in a phased manner, starting with voluntary measures and gradually progressing towards more structured national incorporation or even multilateral agreements.
- **SARPs-Based Licensing & Auditing:** National licensing by states, adhering to the SARPs, ensures compliance. Auditing will be conducted reciprocally among participating states, fostering transparency and accountability.
- **Mission/Project-Based Adoption:** Countries can adopt the SARPs based on their specific interests, missions, or projects. This allows for a flexible and targeted approach to implementation, focusing on areas where the benefits are most apparent.

- **Building on Existing Policies:** The framework aims to build upon existing policies and initiatives, such as IADC Space Debris Mitigation Guidelines, CEOS Principles for Data Sharing and Interoperability, Charter on Cooperation to Achieve the Coordinated Use of Space Data in Disaster Management, particularly those being developed at the regional or bloc level. These existing policies can be submitted for review and potential admission by the STSC and LSC of UNCOPUOS, ensuring that the framework is aligned with existing efforts and leverages existing expertise.

The following subsections will provide a more detailed explanation of each tier and how the LSC and STSC contribute to the overall framework.

The Multi-Tiered SARPs framework value lies in enabling practical coordination without centralized control and incentivized participation through reciprocity, not pressure.

Tier 1: Legal, Economic and Commercial Foundations

Tier 1 draws upon the foundations laid by the LTS Guidelines and Legal Subcommittee discussions on transparency and responsible behavior, providing an updated, modular framework for evolving commercial practices.

This tier establishes a shared baseline for responsible space conduct by addressing the OST's limited application to modern commercial and cooperative space missions. Rather than redrafting OST principles, Tier 1 fills key governance gaps by proposing voluntary alignment with updated norms tailored to contemporary realities-such as joint operations, cross-border service models, and international ground satellite infrastructures such as shared control stations, data relay networks, and cross-border telemetry systems. The LSC would play a key role in ensuring that the legal foundations of this tier are consistent with the OST and other relevant international legal instruments.

Key Elements:

- Voluntary alignment with updated norms for responsible behavior.
- Best practices in transparency (e.g. pre-launch registration and notification).
- Post-mission reporting.
- Dispute resolution mechanism for technical/operational activities.

Nature:

- Primarily voluntary, focused on promoting ethical conduct and building trust.

To incentivize adoption, Tier 1 offers several benefits, including: enhanced reputation and public trust, access to information and best practices, participation in pilot projects and working groups, and reciprocal benefits (preferential treatment or benefits from other participating states). Table 6 below outlines these problems and how Tier 1, inspired by the aviation sector, addresses them.

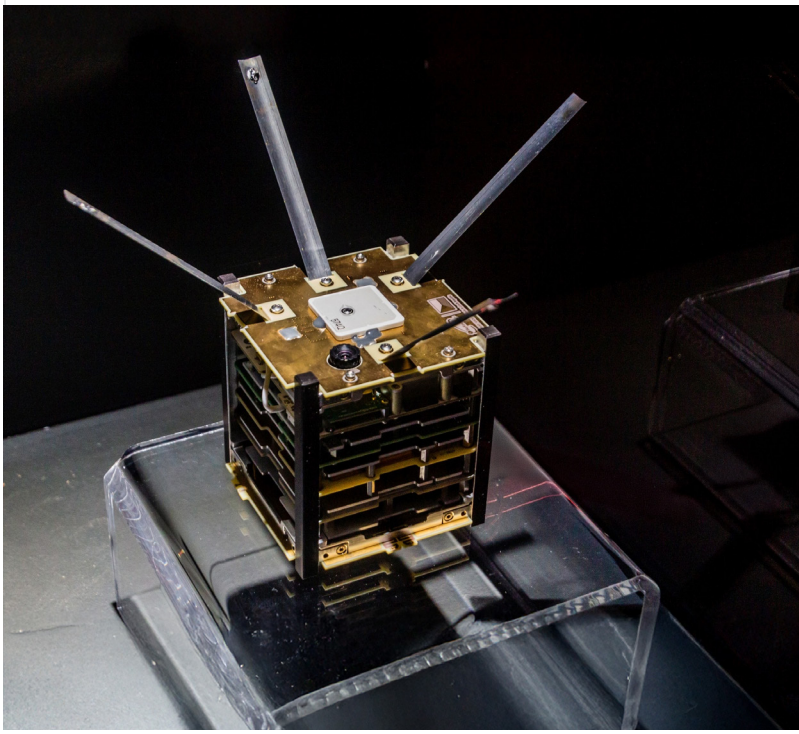


Table 6: Problems Addressed by Tier 1: Legal, Economic and Commercial Foundations

Problem in Space Governance	Aviation-Inspired Solution	Incentives
Limited Enforcement Mechanisms & Compliance: The OST lacks robust enforcement mechanisms, leading to inconsistent implementation.	ICAO's Universal Safety Oversight Audit Programme (USOAP): ICAO conducts regular audits of its member states' aviation safety oversight systems, promoting transparency and identifying areas for improvement. A similar framework is incentivized through public confidence.	- Improved insurance ratings and lower premiums for compliant operators - Public trust and reputation benefits for states with strong oversight - Preferential eligibility for participation in international STM platforms and data-sharing networks - Access to audit tools and expert teams for capacity support
Inequitable Access to Space & Capacity Building: Many developing nations lack expertise, regulatory frameworks, and infrastructure.	ICAO's "No Country Left Behind" Initiative: ICAO's NCLB provides targeted assistance and capacity-building programs to help developing states meet international aviation standards.	- Access to shared ground stations or satellite data services - Free or subsidized training, toolkits, and legal advisory support - Inclusion in multilateral partnerships and technology transfer programs - Visibility in international forums as an “emerging space partner” (reputation/ influence incentive)
Challenges of Dual-Use Technologies & State vs. Commercial Activities: Creates challenges for regulation and oversight.	ICAO's distinction between civil and state aircraft: The Chicago Convention distinguishes between civil and state aircraft, allowing nations to maintain sovereignty over state aviation while establishing regulations for civil aviation.	- Regulatory clarity improves investor confidence and reduces licensing uncertainty - Legal carve-outs protect sensitive operations - Enables commercial licensing without jeopardizing national security - Avoids geopolitical friction by explicitly preserving sovereign discretion

Tier 2: Technical Standards

Tier 2 builds upon existing efforts like the IADC Space Debris Mitigation Guidelines and similar initiatives which aim to integrate technical best-practices already adopted at the national and regional levels into a more coherent, harmonized global framework.

This tier defines harmonized technical guidance on debris mitigation, space traffic coordination, and environmental sustainability. STSC would take the lead in developing these technical standards, drawing upon the expertise of scientists, engineers, and other technical experts from around the world. SARPs in this tier would be developed by expert panels and pilot groups, building on the best national and regional practices.

Key Elements:

- Technically specific standards developed by expert panels and pilot groups, under the guidance of the STSC
- Building on existing national and regional best practices

- Focus on promoting safety and sustainability

Nature:

Primarily technical, relying on scientific consensus and best practices, and offer expert-driven, harmonized guidance on topics of interest such as, orbital debris mitigation, space traffic coordination, environmental sustainability for launch systems, Space Information Management (SIM) system modeled on aviation's AIM, and safety benchmarks for new propulsion and deployment technologies.

To incentivize adoption, Tier 2 offers several benefits, including: access to technical expertise and resources, recognition as a leader in space safety and sustainability, influence over the development of international standards, and reciprocal benefits (preferential treatment or benefits from other participating states). The absence of harmonized technical standards for space activities poses significant risks to the long-term sustainability and safety of the space environment. Table 7 below outlines these problems and how Tier 2, inspired by the aviation sector, addresses them.

Table 7: Problems Addressed by Tier 2: Technical Standards

Problem in Space Governance	Aviation-Inspired Solution	Incentives
Increasing Space Debris & Risk of Collisions: The growing amount of space debris increases the risk of collisions.	ICAO's Air Traffic Management (ATM) Standards: ICAO establishes global standards for air traffic management, ensuring the safe and efficient flow of air traffic.	- Reduced liability exposure under international and commercial law - Lower insurance premiums for missions following recognized debris mitigation standards - Access to STM tools and technical data developed under Tier 2 protocols - Eligibility for participation in coordinated orbital slots and launch corridors
Lack of a Centralized Information Sharing Platform: The absence of a platform hinders coordination and increases risk.	ICAO's Aeronautical Information Management (AIM): ICAO's AIM system provides a centralized platform for sharing critical information related to air navigation, including airspace restrictions.	- Access to shared SSA data, alerts, and best practices - Priority orbital coordination for actors complying with Tier 2 sharing protocols - Reciprocal data access agreements between compliant states - Technical support to establish national data interfaces and reporting tools

Useful metrics can be adopted in Tier 2 SARPs for specific quantitative thresholds that enable transparent auditing and public reporting. Many of these metrics already exist within widely recognized guidelines such as the IADC Space Debris Mitigation Guidelines, ISO 24113, China's GB/T 31501-2015 standard, and national rules set by agencies like the US Federal Communication Commission (FCC), France's Centre National d'Études Spatiales (CNES), the UK Space Agency, and the European Space Agency (ESA). These standards offer credible foundations from which more harmonized international metrics could be developed and aligned.

For Example:

- FCC: 5-year post-mission deorbit requirement – five times stricter than the IADC's 25-year recommendations.
- ISO 24113: Collision probability$\leq 10^{-4}$; post-mission disposal success rate >90%
- ESA "Zero Debris" Charter: no permanent debris in protected regions by 2030
- China's GB/T 31501-2015: 25-year deorbit, passivation of stages, and <1 in 10,000 casualty risk for re-entry risk

Building on these precedents, illustrative Tier 2 metrics may include:

- ≤ 5 collision alerts per 1,000 satellite-days
- ≥ 95% of satellites deorbited within 25 years of launch
- ≥ 90% of missions publishing orbital parameters to shared SSA database
- ≤ 2% untracked objects generated per mission

By embedding such measurable thresholds into Tier 2 SARPs, tailored to the specific standards they address, and linking compliance with these thresholds to national incentive structures, participating states can promote adherence through mechanisms such as licensing advantages, audit exemptions, or public recognition. Reaching the targets set out in Tier 2 SARPs would not only strengthen global alignment but also enable states applying the SARPs to reward responsible behavior and reinforce sustainable practices in space operations.

Tier 3: Operational Protocols

Tier 3 addresses inconsistencies in national licensing and insurance frameworks by drawing from successful examples such as the U.S. Commercial Space Launch Act, French Space Operations Act, and emerging EU and Asian licensing models, while proposing pathways toward mutual recognition and interoperability.

This tier provides implementation-level protocols for insurance, licensing, launch safety, and risk-sharing tailored to commercial space operations. The LSC and STSC would work together to ensure that these protocols are both legally sound and technically feasible. These protocols encourage predictability and cross-border interoperability.

Key Elements:

- Detailed protocols tailored to commercial activities
- Addressing issues like insurance requirements, licensing procedures, and launch safety standards
- Promoting predictability and cross-border interoperability

Nature:

- More prescriptive, focused on facilitating commercial activities and reducing uncertainty.

Tier 3 will be implemented using streamlined regulatory processes and will promote innovation and economic growth.

To incentivize adoption, Tier 3 offers several benefits, including: streamlined licensing processes, reciprocal licensing recognition, favorable insurance rates, increased access to global space markets, reduced liability risks, preferential treatment in international collaborations, and reciprocal benefits (preferential treatment or benefits from other participating states). Currently, fragmented operational protocols create uncertainty and hinder the growth of the commercial space sector. Table 8 below outlines this problem and how Tier 3, inspired by the aviation sector, addresses them.

Table 8: Problems Addressed by Tier 3: Operational Protocols

Problem in Space Governance	Aviation-Inspired Solution	Incentives for states when applying Tier 3
Fragmented National Licensing Practices & Insurance: Creates uncertainty for commercial space actors and hinders collaboration.	ICAO's Standardized Licensing & Air Carrier Liability: ICAO establishes standardized licensing procedures and the Montreal Convention creates a liability framework.	- Mutual recognition of licenses with other Tier 3-compliant states (reduces bilateral negotiation burden) - Faster access to international launch and reentry markets - Preferential treatment in global insurance and liability pooling mechanisms - Access to shared legal templates, audit mechanisms, and arbitration frameworks - Eligibility for capacity-building grants to modernize national licensing frameworks

3.2

Strategic Track: A Scalable Pathway to Deeper Coordination

The Multi-Tiered SARPs Framework is not intended to create legal convergence overnight, nor to impose centralized rules. Rather, it offers a scalable, modular pathway through which civil and commercial space activities can gradually align around shared norms without undermining national sovereignty or regional autonomy.

Rather than competing with bilateral or regional arrangements such as the Artemis Accords, BRICS partnerships, or the proposed EU Space Act, the SARPs framework provides an interoperable reference point to bridge across these initiatives and foster greater global coherence.

This approach begins with voluntary technical working groups, ideally hosted under the STSC of UNCOPUOS. These groups can pilot SARPs on issues such as debris mitigation, launch coordination, or licensing standards, building from national and regional best practices.

Over time, these efforts may evolve into more structured arrangements. While formal treaty development is not the immediate goal,

The Multi-Tiered SARPs Framework offers a scalable, modular pathway for gradual alignment around shared norms- without undermining national sovereignty.

the Multi-Tired SARPs framework could provide the foundation for future international instruments tailored to the realities of a diverse and multipolar space sector. These instruments may take many forms, including regional compacts, UN-led protocols, or soft law mechanisms built around coordinated audit, transparency, and technical exchange.

Takeaways

1.

A Multi-Tiered System for Modern Space Governance

The increasing complexity of space activities -driven by commercialization, dual-use technologies, and national competition- demands a governance approach that is adaptable, cooperative, and implementation-focused. Drawing from the aviation sector, this white paper proposes a conceptual, Multi-Tiered SARPs framework for space, designed to complement existing treaties while filling operational and technical gaps.

This proposed structure in Section 3 supports gradual alignment -beginning with voluntary adoption and scaling toward more formalized cooperation- without requiring treaty reform. Countries may choose to adopt from one or more tiers based on their national interests; there is no obligation to adopt the entire framework.

2.

Strategic Enablers

To implement the framework, the following supporting initiatives are proposed:

- Global Safety Audits for Commercial Activities:
  - Modeled on ICAO's USOAP, a UN-facilitated audit mechanism to promote transparency and verify adherence to Tier 3 SARPs (safety, interoperability, sustainability) through state-issued commercial space licenses. This mechanism would complement, not duplicate, existing non-proliferation regimes, which already address export control and defense dual-use concerns.
- Space Information Management (SIM):
  - A standardized, globally accessible system for sharing orbital data, based on the principles of ICAO's AIM. Enables timely coordination between civil aviation and spaceflight operations.
- Joint Training and Certification Programs:
  - Harmonized training standards for commercial space operators and certifying institutions, ensuring a shared safety culture and regulatory readiness.
- Environmental Stewardship Mechanism:
  - A global emissions monitoring and offsetting initiative for space launch activities -similar to ICAO's CORSIA- focused on sustainable propellants and carbon reporting.

3.

A Pragmatic, Cooperative Future

This conceptual SARPs framework is not a treaty, but it can lay the groundwork for one. Its value lies in enabling:

- Practical coordination without centralized control
- Incentivized participation through reciprocity, not pressure
- Modular adoption enabling countries to engage with specific tiers or standards based on their strategic interests, without committing to the entire framework

By leveraging the tested strengths of aviation governance standards, audits and transparency, the space community can take a meaningful step toward a more predictable, inclusive, and sustainable future.

Conclusion

The evolving landscape of space activities underscores the need for a structured, adaptable governance framework that promotes safety, sustainability, and equitable access. Drawing on the proven success of aviation's tiered SARPs, this paper advocates for establishing a similar Multi-Tiered approach within the UN framework, specifically under UNCOPUOS, to bridge existing regulatory gaps.

Implementing this framework through coordinated, phased efforts, starting with voluntary, incentive-driven collaboration can gradually build trust, promote compliance, and foster international cooperation. The developmental process should leverage existing regional initiatives, while establishing mechanisms for safety oversight, data-sharing, and environmental responsibility that incentivize participation and transparency.

By adopting principles such as reciprocity, incremental standard-setting, and robust info-exchange platforms, mirroring ICAO's safety audits and AIM system in civil aviation, the global community can develop a more cohesive, resilient, and responsible governance structure. This approach not only supports the continued growth of the commercial space sector but also ensures that space remains a safe and accessible domain for all nations.

In conclusion, the following Table 9 illustrates examples of mechanisms and practices from the aviation sector that could serve as valuable sources of inspiration to support the evolution of space by field of application.

Table 9: Examples of ICAO Mechanisms that could Inspire Space Governance

ICAO Mechanism / Tool	Potential Space Application / Inspiration
SARPs (Standards and Recommended Practices)	Development of technical and operational standards for space traffic management (STM), debris mitigation, launch and reentry operations
Universal Safety Oversight Audit Program (USOAP)	Possible audit mechanism for national space regulatory authorities to ensure compliance with international norms (e.g., licensing, safety, debris mitigation)
Air Navigation Plans	Equivalent "Space Traffic Navigation Plans" at regional and global levels to coordinate traffic and avoid collisions
Global Aviation Safety Plan (GASP)	Development of a "Global Space Safety Plan" addressing safety risks from space debris and uncontrolled reentries
ICAO Council and Assembly decision-making processes	More agile governance mechanism for updating space norms (compared to treaty renegotiation)

Continue Table 9

ICAO Mechanism / Tool	Potential Space Application / Inspiration
Air Operator Certificates (AOCs)	Could inspire licensing of commercial space operators with specific operational standards attached
Registry of aircraft	Stronger global space object registry (building on but improving the UN Registration Convention)
Security standards under ICAO Annex 17	Could inspire security standards for spaceports and launch/reentry operations
Montreal and Warsaw Convention frameworks for liability	Could inform reform of space liability regime for commercial operations (insurance & compensation mechanisms)

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Endnotes

1. United Nations Office for Outer Space Affairs (UNOOSA). A/AC.105/C.2/2025/CRP.9: Status of International Agreements Relating to Activities in Outer Space as at 1 January 2025. Vienna: United Nations, 5 May 2025. Available at: https://www.unoosa.org/res/oosadoc/data/documents/2025/aac_105c_22025crp/aac_105c_22025crp_9_0_html/AC105_C2_2025_CRP09E.pdf
2. See note 1
3. See note 1
4. See note 1
5. See note 1
6. International Telecommunication Union (ITU). Constitution and Convention of the International Telecommunication Union (Geneva, 1992, as amended by subsequent Plenipotentiary Conferences). Geneva: ITU, latest amendments 2022. Available at: https://www.itu.int/en/history/Pages/ConstitutionAndConvention.aspx
7. International Telecommunication Union (ITU). List of ITU Member States. Geneva: ITU, latest update 2025. Available at: https://www.itu.int/hub/membership/our-members/
8. International Telecommunication Union (ITU). Radio Regulations (Edition of 2020, revised by WRC-19; Edition of 2024 adopted at WRC-23, enters into force 1 January 2025). Geneva: ITU. Available at: https://www.itu.int/pub/R-REG-RR
9. International Civil Aviation Organization (ICAO). List of Parties to the Convention on International Civil Aviation (Chicago Convention), Doc 7300. Montreal: ICAO, latest update 2025. Available at: https://www2023.icao.int/secretariat/legal/List%20of%20Parties/Chicago_EN.pdf
10. International Civil Aviation Organization (ICAO). List of Parties to the International Air Services Transit Agreement. Montreal: ICAO, latest update 2025. Available at: https://www2023.icao.int/secretariat/legal/List%20of%20Parties/Transit_EN.pdf
11. International Civil Aviation Organization (ICAO). List of Parties to the Warsaw Convention and The Hague Protocol. Montreal: ICAO, latest update 2025. Available at: https://www.icao.int/secretariat/legal/List%20of%20Parties/WC-HP_EN.pdf
12. International Civil Aviation Organization (ICAO). List of Parties to the Montreal Convention of 1999. Montreal: ICAO, latest update 2025. Available at: https://www2023.icao.int/secretariat/legal/List%20of%20Parties/Mtl99_EN.pdf
13. International Civil Aviation Organization (ICAO). List of Parties to the Tokyo Convention of 1963. Montreal: ICAO, latest update 2025. Available at: https://www2023.icao.int/secretariat/legal/List%20of%20Parties/Tokyo_EN.pdf
14. International Civil Aviation Organization (ICAO). List of Parties to the Hague Convention of 1970. Montreal: ICAO, latest update 2025. Available at: https://www2023.icao.int/secretariat/legal/List%20of%20Parties/Hague_EN.pdf
15. International Civil Aviation Organization (ICAO). List of Parties to the Montreal Convention of 1971. Montreal: ICAO, latest update 2025. Available at: https://www2023.icao.int/secretariat/legal/List%20of%20Parties/Mtl71_EN.pdf

16. United Nations Office for Outer Space Affairs. (2025). UNOOSA Annual Report 2024: From Strategy to Action. Available at: https://www.unoosa.org/documents/pdf/annualreport/UNOOSA_Annual_Report_2024.pdf

17. Dempsey, P. S. (2008). *Public international air law* (p. 37). McGill University. Available at SSRN: https://ssrn.com/abstract=3295922

18. See note 17 (p. 74–79).

19. Eilstrup-Sangiovanni M. (2022). Ordering global governance complexes: The evolution of the governance complex for international civil aviation. The review of international organizations, 17(2), 293–322. https://doi.org/10.1007/s11558-020-09411-z

20. United Nations Office for Outer *Space Affairs (UNOOSA), Space2030 Agenda: Space as a Driver of Sustainable Development*, UN Doc. A/AC.105/1201 (2021). Available at: https://www.unoosa.org/oosa/oosadoc/data/documents/2024/stspace/stspace88_0.html; Committee on the Peaceful Uses of Outer Space (COPUOS), *Annual Reports and Resolutions*. UNOOSA. Available at: https://www.unoosa.org/oosa/en/ourwork/copuos/report-archive.html

21. See note 19

22. Space Traffic Management

23. UNOOSA, Guidelines for the Long-Term Sustainability of Outer Space Activities, A/AC.105/2018/CRP.20 (2019). Available at: https://www.unoosa.org/documents/pdf/PromotingSpaceSustainability/Publication_Final_English_June2021.pdf; International Organization for Standardization (ISO), ISO 24113:2023 – Space Systems – Space Debris Mitigation Requirements. Available at: https://www.iso.org/standard/83494.html; Consultative Committee for Space Data Systems (CCSDS), Standards for Space Mission Interoperability. Available at: https://public.ccsds.org/

24. See note 19.

25. International Telecommunication Union (ITU), *International Satellite Coordination Resources.* Federal Communications Commission (FCC) summary. Available at: https://www.fcc.gov/space/international-satellite-coordination; Organisation for Economic Co-operation and Development (OECD), *The Space Economy in Figures: How Space Contributes to the Global Economy*, 2022. Available at: https://www.oecd.org/en/publications/the-space-economy-in-figures_fa5494aa-en.html

26. ICAO, *Universal Safety Oversight Audit Programme (USOAP)*. Available at: https://www.icao.int/safety

27. Lindsey, D. (2022). The Architecture of Authority in Global Space Governance: Power, Legitimacy, and Compliance. Utrecht Law Review, 18(1), 35–54. Available at: https://utrechtlawreview.org/articles/10.36633/ulr.974

28. Bliss, T. (2019). *ICAO at 75: Sustaining International Aviation*. Aviation Policy & Research Review. Available at: https://www.americanbar.org/content/dam/aba/publications/air_space_lawyer/Winter2019/as_bliss.pdf

29. Group on Earth Observations (GEO), *About GEO and Global Data Access Initiatives*. Available at: https://www.earthobservations.org/

30. United Nations Office for Outer Space Affairs (UNOOSA). Aviation and space community meet at landmark event. UNIS/OS/447, 18 March 2015. Available at: https://www.unoosa.org/oosa/en/informationfor/media/2015-unis-os-447.html

31. United Nations Office for Outer Space Affairs. (n.d.). *History and Overview of the Committee on the Peaceful Uses of Outer Space*. Available at: https://www.unoosa.org/oosa/en/ourwork/copuos/history.html

32. Rajagopalan, R. (2018, August 28). *Space Governance. Oxford Research Encyclopedia of Planetary Science*. Retrieved 1 June 2025, from https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-107

33. Provisional International Civil Aviation Organization.

34. United Nations Office for Outer Space Affairs. (n.d.). History. Available at: https://www.unoosa.org/oosa/en/aboutus/history/index.html

35. Seffinga, V., & Eldholm, M. (2019). The fragmentation of international space law. International Institute of Air and Space Law (IISL) Journal, 3, 213-225. Available at: https://doi.org/10.5553/IISL/2019062003001

36. Caraveo, P., & Iacomino, C. (2023). On the reasons of European fragmentation. In Europe in the global space economy (pp. 43–69). SpringerBriefs in Space Development. Springer. https://doi.org/10.1007/978-3-031-36619-2_3

37. European Commission. (2025). EU Space Law – Proposal for a Regulation of the European Parliament and of the Council on the EU Space Law. Available at: https://defence-industry-space.ec.europa.eu/eu-space-act_en

38. Oltrogge, D. L., & Christensen, I. A. (2020). Space governance in the new space era. Journal of Space Safety Engineering, 7(3), 432–438. https://www.sciencedirect.com/science/article/pii/S2468896720300550

39. United Nations Office for Outer Space Affairs. (n.d.). Observers to the Committee on the Peaceful Uses of Outer Space (COPUOS). Available at: https://www.unoosa.org/oosa/sk/ourwork/copuos/members/copuos-observers.html

40. United Nations Office for Outer Space Affairs (UNOOSA), The “Space2030” Agenda: Space as a Driver of Sustainable Development, 2024. Available at: https://www.unoosa.org/res/oosadoc/data/documents/2024/stspace/stspace88_0_html/st_space-088E.pdf

41. Goran Petrović, Non-Governmental Organization (NGO) Participation in Civil Aviation Policy and Decision Making, 88 J. Air L. & Com. 465 (2023), https://scholar.smu.edu/cgi/viewcontent.cgi?article=4229&context=jalc

42. Durkee, Melissa (MJ). Space Enterprises as International Lawmakers: Nudges, Pledges, and Other Bottom-Up Modalities. Forthcoming in Private Enterprises in Space (Jędrzej Górski & Yun Zhao, eds.), May 1, 2025. Available at: https://ssrn.com/abstract=5325413 or http://dx.doi.org/10.2139/ssrn.5325413

43. International Civil Aviation Organization (ICAO). The Universal Safety Oversight Audit Programme (USOAP): History and Evolution. Montréal: ICAO. Available at: https://applications.icao.int/postalhistory/the_universal_safety_oversight_audit_programme.htm

44. ICAO, Assembly Resolution A32-11: Establishment of a Universal Safety Oversight Audit Programme. https://www2023.icao.int/Meetings/AMC/MA/Assembly%2032nd%20Session/resolutions.pdf

45. ICAO, Universal Security Audit Programme (USAP-CMA). https://www.icao.int/USAP

46. ICAO, Safety Fund (SAFE). https://www.icao.int/safety/Pages/Safety-Fund-SAFE.aspx

47. United Nations Office for Outer Space Affairs. (2025). Statement by the Director of the United Nations Office for Outer Space Affairs to the Scientific and Technical Subcommittee of COPUOS. Available at: https://www.unoosa.org/documents/pdf/copuos/stsc/2025/Statements/1_UNOOSA_Directors_statement_and_Annex_FINAL_For_webpage_1.pdf

48. Heere, W. P. (2000). Problems of jurisdiction in air and outer space. In Principles and practice of international law. Brill. https://brill.com/downloadpdf/book/edcoll/9789004478596/B9789004478596_s008.pdf

49. Article 1 of the Chicago Convention.

50. Article II of the Outer Space Treaty.

51. Center for Strategic and International Studies (CSIS), The Private Sector's Assessment of U.S. Space Policy and Law. https://aerospace.csis.org/the-private-sectors-assessment-of-u-s-space-policy-and-law

52. ICAO, No Country Left Behind. https://www.icao.int/about-icao/nclb/pages/default.aspx

53. ICAO, Implementation Support – NCLB Initiatives. https://www2023.icao.int/annual-report-2018/Pages/implementation-support-nclb-implementation.aspx

54. ICAO, Technical Assistance Programme. Available at: https://www2023.icao.int/Meetings/a41/Documents/Information_Related_to_the_Report_on_the_ICAO_Technical_Assistance_Programme_and_Implementation_Support_en.pdf

55. See note 17 (p. 76–79).

56. ICAO, Policy and Guidance Material on the Economic Regulation of International Air Transport (Doc 9587). https://www2023.icao.int/Meetings/atconf6/Documents/Doc%209587_en.pdf

57. See note 17 (p. 49).

58. Steele, S. M. (2022). International space law: A hindrance to space activities or a resolute action for change? American Journal of Aerospace Engineering, 9(1), 1–13. https://sciencepublishinggroup.com/article/10.11648/j.ajae.20220901.11

59. Smith, M., & Johnson, L. (2023). Strategic and legal challenges of dual-use technologies in space: Implications for global security. RAND Corporation. Available at: https://www.rand.org/pubs/external_publications/EP68801.html

60. Freeland, S. (2020). The limits of law: challenges to the global governance of space activities. Journal & Proceedings of the Royal Society of New South Wales, 153(1), 70–82. ISSN 0035-9173/20/010070-13. Available at: https://royalsoc.org.au/wp-content/uploads/2020/03/153-1-Freeland.pdf

61. See note 38.

62. Migaud, M. R., Greer, R. A., & Bullock, J. B. (2020). Developing an adaptive space governance framework. Space Policy, 54, 101400. https://doi.org/10.1016/j.spacepol.2020.101400

63. See note 62.

64. Tepper, E. (2022). The Big Bang of Space Governance: Towards Polycentric Governance of Space Activities. New York University Journal of International Law and Politics, 54(2), 485–557. Available at: https://www.nyujilp.org/wp-content/uploads/2022/05/nyi_54-2-181-254_Tepper.pdf

65. See note 32.

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