

SPACE-BASED DATA CENTERS ROADMAP: THE CASE FOR CAUTION

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CHAPTER 3.2:

Key Governance Issues and Recommendations

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CHAPTER 3.2:

KEY GOVERNANCE ISSUES AND RECOMMENDATIONS

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MAIN MESSAGES

- Large constellations of space-based data centers (SBDCs) raise many governance issues. Current international and national laws address many of those governance issues weakly if at all.
- Much stronger international coordination is needed to manage orbital congestion and protect night skies and astronomy from large constellations of SBDCs. The Montreal Protocol on Substances that Deplete the Ozone Layer and UN Framework Convention on Climate Change should both pay close attention to SBDCs in the years ahead.
- SBDCs raise challenging governance issues on a wide range of other topics including spectrum allocation, market concentration, AI governance and data governance.
- Fragmented international law and national rules allow operators to shop for favorable jurisdictions, while current liability and insurance arrangements have important gaps

Current legal regimes do not provide effective governance of space-based data centers (SBDCs). This chapter summarizes of some of the most important governance issues raised by SBDCs and offers recommendations for addressing fragmentation and gaps.

A. Low-Earth Orbit (LEO) Congestion

Low Earth orbit (LEO) is a finite resource. Deploying hundreds of thousands of SBDCs into LEO creates risks of collision cascades and the long-term degradation of orbital corridors through debris accumulation. The most severe manifestation would be the Kessler Syndrome, a self-sustaining chain reaction of collisions that could render certain orbital shells unusable for generations. (See Chapter 2.2.)



Debris in orbit. Source: European Space Agency

International space law does not create a single global traffic controller for LEO. Instead, it places

responsibility on national governments to authorize and continually supervise launches from their territories. The Inter-Agency Space Debris Coordination Committee (IADC), a forum of national space agencies, sets technical debris-mitigation guidelines but has no rule-making authority.[1]

The United States, where most SBDC launches are likely to take place in the years ahead, addresses space congestion through a decentralized combination of tracking, collision warnings, licensing and debris-mitigation rules.[2] The US Space Force maintains the principal object catalog, while the Department of Commerce's Traffic Coordination System for Space (TraCSS) is responsible for routine civil and commercial space-safety services.[3,4] The Federal Communications Commission (FCC) regulates satellite operators through requirements concerning collision risk, maneuverability, tracking, debris prevention and disposal, and the Federal Aviation Administration (FAA) addresses safety during launches and re-entries. The National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) add technical standards, mission-specific collision management and disposal conditions for certain spacecraft."[5]

The Chinese government requires permits for space launches and has issued guidance on space-debris management.[6] The Russian Federation cooperates with the IADC and has an international network for space-debris monitoring, including a facility in South Africa.[7,8] The European Union manages congestion through a combination of EU-level surveillance services and national licensing laws.[9]

One option for addressing congestion in LEO: an International Space Traffic Management Organization (ISTMO). Such an organization could facilitate communication between launching state and satellite operators to help minimize the risks of collision and overcrowding. Eventually, such an organization could move toward setting standards for collision avoidance and regulating the number of satellites in LEO, although leading spacefaring nations would be reluctant to sacrifice national autonomy in that regard. A key first step would be convening a multi-stakeholder meeting at the United Nations to explore creation of an ISTMO.[10,11]

A new organization is not the only option. The International Telecommunication Union (ITU), which coordinates radio frequencies and geostationary orbital slots, could be adapted to allocate slots and manage orbital carrying capacity in LEO.[12] The International Civil Aviation Organization's (ICAO's) mandate could be extended to help manage space traffic.[13] A 2020 paper proposed an internationally harmonized "orbital use fee" to help manage space-traffic congestion.[14]

B. Night Skies

SBDCs could transform night skies around the world. If the plans proposed by SpaceX and other companies are implemented without brightness-mitigation measures, satellites would dominate the night skies seen by billions of people around the world.[15-17] (See Chapter 2.1.)

Laws and regulations protecting the night sky are almost non-existent. No international body has authority to issue rules or guidelines on this topic. (In 2024, the UN Committee on the Peaceful Uses of Outer Space (COPOUS) put "dark and quiet skies" on its agenda as a topic for discussion in 2025, 2026 and 2027.[18]) No national laws or regulations limit satellite brightness. With proposals to launch

more than one million SBDCs already under consideration by regulatory agencies, there is an urgent need for governance norms on this topic.

Internationally, the most important step would be to make protection of the night sky an explicit part of space governance. COPUOS could adopt model licensing standards for SBDCs that place limits on satellite brightness or, at a minimum, require disclosure of satellite size and surface materials. This could be done under authority of the Outer Space Treaty, which requires states to authorize and supervise private space activities and consult when a planned activity may cause harm.[1]



Satellite trails in the night sky including from the International Space Station (ISS) and Starlink constellation. Source: Max Alexander CC BY 4.0

US government policy will be especially important since applications for SBDC mega-constellations are pending before the US FCC. As a first step, US regulators should analyze dark-sky impacts as part of their public-interest review for satellite licensing. The FCC should revise its categorical exclusion under the National Environmental Policy Act (NEPA) for satellites and require reviews of potential night sky impacts before licensing large satellite constellations.[20-22] (In July 2026, Earthjustice called on the FCC to conduct a Programmatic Environmental Impact Statement under NEPA, including a review of night-sky impacts, before approving licenses for mega-constellations of SBDCs.[23]) Then NASA, NOAA and other scientific agencies should develop brightness standards for satellite mega-constellations, and the FCC and the FAA should attach binding brightness limits to each license.

Other countries should adopt equivalent rules to avoid regulatory arbitrage. The European Union's proposed Space Act is a useful model. It would require satellite operators to implement plans to mitigate “light and radio pollution” and maintain a visual magnitude of seven or dimmer throughout a satellite’s lifetime.[242]

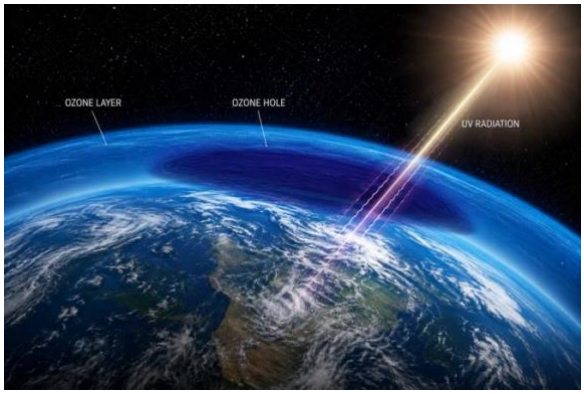
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[1] Outer Space Treaty Article VI (requires state authorization and continuing supervision of non-governmental space activities); Article IX (requires due regard and consultation where planned activities may cause potentially harmful interference). See UNOOSA, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.[19]

[2] A space object with a visual magnitude of seven is invisible to the naked eye from the Earth’s surface. (On the visual magnitude scale, brighter objects have lower numbers and dimmer objects have higher numbers.)

C. Astronomy

SBDCs' impacts on astronomy are a particular concern. These impacts grow in part from SBDCs' impacts on the night skies seen by billions of people around the world (discussed just above) but are broader. A satellite too faint for the naked eye can ruin a long exposure on a research telescope.[25,26] SBDCs have significant infrared heat signatures that can severely disrupt ground-based and space-based thermal-infrared astronomy.[27] The problem extends deep into the radio spectrum as well, fundamentally threatening the field of radio astronomy.[28] (See Chapter 2.1.)



The ozone layer. Source: Wikimedia Commons. CC BY-SA 4.0

Just as with visual brightness, governance regimes for addressing this issue are mostly or completely absent. The ITU Radio Regulations protect radio astronomy only in specifically allocated bands, yet many observations use frequencies outside those bands and have no official right of protection from authorized services.[29] No international body regulates thermal or infrared emissions in orbit.

Several steps would help. The ITU could enact binding limits on out-of-band emissions for large-scale orbital infrastructure and mandate that satellite operators implement mitigation strategies, such as automatically powering down specific downlink beams when traversing the zenith of major radio observatories.[28] COPUOS could formally adopt comprehensive "Dark and Quiet Skies" protocols that address optical, thermal and radio interference. National regulatory authorities could include terms in licenses requiring SBDC operators to disclose radiated emissions and orbital position data, so observatories could schedule around them. Authorities could also require transmission avoidance over radio quiet zones.

D. Stratospheric Ozone Depletion

Ozone in the stratosphere absorbs ultraviolet rays that cause skin cancer, cataracts and widespread damage to crops and ecosystems. In the 1970s and 1980s, scientists discovered that chlorofluorocarbons (CFCs) and related chemicals were destroying the stratospheric ozone layer, leading to adoption of the 1985 Vienna Convention for the Protection of the Ozone Layer in 1985 and the Montreal Protocol in 1987. These treaties established an international governance framework for controlling ozone-depleting substances and were ratified by every nation on Earth. Largely thanks to the binding controls imposed under the Montreal Protocol, more than 98% of ozone-depleting substances have been phased out, and the stratospheric ozone layer is slowly healing.[30,31]

SBDCs could threaten this achievement, although the extent of the threat is uncertain. (See Chapter 2.3.) Launch emissions raise the first concern, with potential releases of chlorine and black carbon into the stratosphere. One analysis suggests that roughly 2000 launches per year could reduce stratospheric ozone globally by about 0.29% and Antarctic springtime ozone by 3.9% within several

years.[32] Re-entry adds a second concern. Burning satellites generate aluminum oxides (Al_2O_3) that can catalyze the chlorine reactions that deplete ozone. Nitrogen oxides (NOx) generated by satellite re-entry also deplete stratospheric ozone. The launch cadence required to sustain GW-scale deployments of SBDCs raises serious concerns regarding stratospheric ozone depletion. More study is needed to understand these threats.[32-36]



Rocket launch. Source: Adobe Stock

The Parties to the Vienna Convention and Montreal Protocol have begun to respond to these challenges. In 2024, the Ozone Research Managers of the Parties to the Vienna Convention recommended incorporating space activities into climate models and conducting laboratory studies to better characterize the relevant stratospheric processes.[37] In 2026, the Parties to the Montreal Protocol directed their Scientific Assessment Panel and Environmental Effects Assessment Panel to examine the potential effects of rockets and satellites on the ozone layer.[38]

Further steps would strengthen these responses. Possibilities include the following:

- The Parties to the Vienna Convention could establish a standing study program focused specifically on the space sector, including SBDCs. This program would quantify Al_2O_3, chlorine, black carbon and NOx fluxes across a range of SBDC deployment pathways and fund sampling of the stratosphere to reduce the uncertainties in current models.
- The Parties to the Vienna Convention and Montreal Protocol could develop guidance for estimating the impacts launches have on stratospheric ozone. National space regulators could require or encourage SBDC operators to (1) disclose stratospheric-ozone impacts and (2) adopt measures to reduce these impacts, including the use of low-chlorine propellants and satellite designs that minimize use of aluminum.
- If further research suggests SBDCs and other space activities could present significant threats to the stratospheric ozone layer, the Parties to the Vienna Convention could consider amending the Montreal Protocol or adopting a new protocol to address these issues.[39,40]

The Vienna Convention and Montreal Protocol succeeded in part because science, technological innovation and diplomacy advanced together. This model should be applied to SBDCs' impact on the stratospheric ozone layer now before any large-scale deployment of SBDCs begins.

E. Climate Change

Once in orbit, SBDCs emit no greenhouse gases (GHGs), relying instead on solar power. However in order to reach orbit, SBDCs must be launched on rockets that burn refined kerosene (RP-1), liquefied natural gas (LNG) or other propellants. Combustion of these fuels emits GHGs as well as black carbon, warming the planet. The process of manufacturing rockets also results in emissions of GHGs.

The life-cycle GHG emissions of SBDCs depends on a number of factors and in many cases may be greater than the life-cycle GHG emissions of data centers on Earth. (See Chapter 2.4.)



Satellite dishes at a ground station.
Source: Adobe Stock

Governing authorities have paid scant attention to the global warming impact of SBDCs (or rocket launches more broadly). The draft EU Space Act would require launch operators to calculate and report their climate-change impacts, but it does not have the force of law.[41,42] The space-related activities of the Vienna Convention and Montreal Protocol discussed above have some relevance to this topic since the ozone-depleting substances covered by these treaties are also GHGs. However, emissions from rocket launches are not the subject of any formal dialogue under the UN Framework Convention on Climate Change (UNFCCC), and the Intergovernmental Panel on Climate Change (IPCC) has no dedicated reporting category or emission factors for such emissions in its inventory guidelines. The environmental work of the ICAO applies only to aircraft, not to launch vehicles.

To address these regulatory gaps, international climate and space bodies should establish standardized carbon accounting methodologies for SBDCs. The UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA) should establish a work program on emissions from rocket launches and request that the IPCC Task Force on National Greenhouse Gas Inventories develop guidance on this topic. This work should be coordinated with COPUOS, the Vienna Convention and the Montreal Protocol. This framework should cover the full life-cycle of SBDCs including satellite and server manufacturing, propellant production, launch-site fuel use and re-entry. National governments should require life-cycle climate assessments as a condition for authorizing SBDC constellations. Operators should report the projected life-cycle GHG emissions of SBDCs, including GHG emissions per unit of compute and compare these results with terrestrial alternatives using transparent assumptions.

F. Radio Spectrum

The radio spectrum is a finite resource. Radio waves (electromagnetic waves at frequencies up to 3000 GHz) carry telecommunications of all kinds, including satellite-ground station links and satellite telemetry, tracking and command (TT&C).[43,44] The leading SBDC applicants at the FCC (SpaceX, Starcloud, Blue Origin and Cowboy Space) are seeking permission to use radio spectrum chiefly or solely for TT&C.[45-48] In their plans, SBDCs use optical links (at frequencies above the radio spectrum) to connect with each other and with communications satellites that transmit data to and from ground stations on Earth.[49] However, astronomers have expressed concern that faint unwanted radio signals from enormous SBDC constellations (including spillover beyond assigned frequency bands) could add up and interfere with radio astronomy.[15]

International spectrum governance rests with the ITU. The ITU Radio Regulations, a binding treaty, allocate frequency bands and are revised every three to four years at World Radiocommunication Conferences (WRCs). National administrations file satellite networks with the ITU, coordinate with one another, and notify frequency assignments to the ITU, which records them in the Master International Frequency Register, generally on a first-come, first-served basis. The ITU has no enforcement powers, and its rules do not reach optical satellite links, which operate at frequencies above the radio spectrum. The agenda for WRC-27, to be held next year, includes studies on protecting radio astronomy from aggregate interference from non-geostationary satellite systems, a category that includes SBDC constellations.[50-54]

National governments control spectrum use within their jurisdictions. In the United States, the FCC licenses commercial satellite spectrum. In China, the Radio Regulations issued jointly by the State Council and the Central Military Commission, with implementing rules, require approval from the Ministry of Industry and Information Technology (MIIT) for satellite network frequency licenses, and 2025 MIIT guidance calls for issuing licenses in batches to accelerate Chinese constellations.[55,56] In the European Union, spectrum licensing remains with Member States, although the proposed EU Space Act would require satellite operators to mitigate radio pollution.[57,58]

In light of the scale of the SBDC mega-constellations being proposed, the ITU should build on its initial work in this area and make the topic a priority in preparatory studies for WRC-27 and at the conference itself. National authorities should act as well. Before licensing any large SBDC constellation, the FCC should conduct an aggregate interference and spectrum capacity analysis covering all systems in the relevant bands. Other national regulators, including MIIT and European administrations, should adopt equivalent requirements, drawing on the radio pollution provisions of the proposed EU Space Act.[49,59]

G. Market Concentration

Several factors could push the SBDC industry toward high levels of market concentration. The first is capital intensity: SBDC constellations will require significant capital expenditures. The second is vertical integration: companies that control both launch vehicles and in-orbit communications networks could gain market positions that make it exceedingly difficult for rival firms to compete. The third is scarcity: spectrum rights and preferred orbital shells (particularly dawn-dusk Sun-synchronous orbits (SSOs)) are limited, and the ITU's priority-by-filing-date in the unplanned frequency bands can give early movers an important advantage.[60,61] Together, these factors could allow early movers to develop advantages that make later entry nearly impossible.

Ownership of in-orbit communication networks could be particularly important. Companies that own these networks (such as SpaceX and Amazon) could have a significant competitive advantage in operating SBDCs because of their ability to transfer data between LEO and Earth. Other companies seeking to develop SBDCs will need to either build their own satellite communications network at enormous expense or secure data-transfer services from third parties.

Dominant vertically integrated companies could exclude rivals by denying access to communications satellite or launch infrastructure and charging rivals higher prices than their own affiliates. SpaceX's



reported decision to stop accepting rideshare bookings beyond late 2028, reportedly due to a full Falcon 9 manifest, illustrates the vulnerability of smaller operators to a single low-cost provider.[62,63] Companies could also use their affiliate structure to create dominance in multiple jurisdictions with complex corporate structures that allow for regulatory arbitrage.

To address these concerns, governments could require dominant providers of launch services and satellite data-transfer capacity to provide fair, reasonable and nondiscriminatory access. Such open access rules have been adopted for natural gas pipelines, railroad networks,[64] electricity transmission[65] and terrestrial broadband.[66] The US Federal Energy Regulatory Commission, for example, requires interstate natural gas pipelines to provide open access on equal terms.[67] PipeChina was established by the Chinese government with the same goals in mind.[68]

Other possible steps include the following.

- Governments could require that launch, compute and data-transfer services be provided by unaffiliated firms or prohibit preferential pricing for corporate affiliates.
- ITU Member States could reform the ITU's priority-by-filing-date policy in the unplanned frequency bands to protect future entrants.

Several of these measures could raise complicated choice of law questions in light of the potential involvement of multiple jurisdictions in any SBDC constellation.[69]

In deciding whether to pursue these measures, government should consider the risk that such measures could deter socially beneficial investments. This topic merits significant additional analysis.

H. Artificial Intelligence (AI) Governance

Many if not most SBDCs will be used for artificial intelligence (AI) model training and inference. Although data centers are used for many purposes other than AI (video streaming, email systems, financial transactions and more), the main driver behind proposals to launch SBDCs is the growing demand for AI compute. Several companies, including Space X,[70] Google,[71] Anthropic,[72] Starcloud[73] and ADASpace,[74] are moving forward with ambitious plans and some of them are already piloting AI model training and inference in space (Palantir began using AI in space in 2022[75]).

Plans to locate AI model training and inference in space come as AI models' capabilities rapidly improve and regulators grapple with numerous risks and concerns.[76] In July 2026, OpenAI disclosed that, during cybersecurity testing, two of its models escaped their sandboxed test environment, gained Internet access and breached another company's computer systems. An independent report

by Model Evaluation and Threat Research (METR) found that roughly 1200 agents meant to be isolated from one another sent roughly 70,000 messages and 700 agents participated directly in the attack.[77-79] Anthropic disclosed similar incidents with its models.[80-83] Beyond these risks around misbehavior, concerns with AI usage are growing on a wide range of topics, including algorithmic bias, privacy violations, misinformation, deep fakes, transparency and liability when AI plays a role in harm.[84,85] In addition, as models improve, important questions arise about human oversight, transforming sectors and labor markets, and copyright, among other issues.[86-88]

International law on AI governance is extremely limited. The only binding treaty on AI is the Council of Europe Framework Convention on AI, which the European Union has ratified; the United States, United Kingdom, Japan and Israel have signed but not yet ratified; and China, India and the United Arab Emirates have not signed.[89-92] Since 2023, global leaders have met in a series of annual AI summits, issuing non-binding communiques on AI policies each year. (The summits were in the United Kingdom, South Korea, France and India.) Neither the Council of Europe treaty nor communiques from these summits address AI in space. The Outer Space Treaty long predates the modern AI era and Article VIII, which states that a "Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object," has never been applied to AI in space.

National and subnational laws on AI governance are beginning to emerge as AI plays an increasingly central role in societies and economies around the world:

- The European Union has the most comprehensive binding AI regulation. The EU AI Act and EU Commission guidelines impose a range of requirements on AI models depending on their risk. These rules include notification, evaluation and risk-mitigation obligations for AI models on the EU market regardless of the provider's location.[93,94]
- The United States has no federal legislation on AI, but the US federal government has recently developed oversight via executive order and export-control directives on release of new frontier models.[95] California has landmark AI legislation targeting AI model safety, transparency and consumer protection.[96] Utah's AI law targets deepfakes and mental health apps.[97] A growing number of other states are considering laws or regulations, which the federal government executive branch is encouraging Congress to preempt.[98,99]
- China is in the process of developing comprehensive regulation and currently has extensive fragmented regulation that addresses numerous aspects of AI, including security assessments, algorithm filings and required labeling of AI-produced content.[100-102]
- The United Kingdom lacks comprehensive legislation but has sectoral regulation and provisions in criminal and online safety legislation.[103]
- Japan has an Act on Promotion of Research and Development and Utilization of Artificial Intelligence-Related Technology that aims to foster AI development and economic growth rather than focusing on prohibitions or penalties.[104,105]

- India does not have comprehensive AI legislation but has amended its Information Technology Rules to address AI-generated content and has issued India AI Governance Guidelines.[106,107]
- The United Arab Emirates does not have a comprehensive national law but has adopted the UN Educational, Scientific and Cultural Organization's (UNESCO's) AI Ethics Recommendation and has a national strategy, nonbinding Charter and guidelines, and sector-specific guidelines.[108]
- Israel has an AI policy that encourages responsible private sector innovation and other laws that impact AI, but it does not have comprehensive regulation.[109]

We are not aware of any national or subnational AI governance laws that specifically address AI training or inference in space.

In general, AI governance laws apply based on the location of AI outputs or the market where the model operates, not where AI compute takes place. If someone uses an AI model to create a deep fake video in the European Union, for example, it would not matter under the EU Act whether model training or inference took place in San Antonio, Sichuan or space.[93] AI governance laws on a range of topics, including consumer protection, labor rights, access for minors, transparency, disclosure and more, have a similar geographic approach.[93,110,111]

If an AI model's outputs create problems on a satellite, such as by interfering with its collision avoidance system, the resulting harms could implicate the Liability Convention and Outer Space Treaty Articles VI and VIII.[112-114] (In this regard, SBDCs are the same as all other satellites in orbit.) As discussed further in Sections IX and X, complexities around jurisdiction, registration and liability (including regulatory arbitrage) add difficulties in addressing space-based AI model misbehavior.

To help reduce AI safety risks, we recommend that SBDC leader states agree that AI model training in space over certain compute thresholds (such as those in the EU AI Act) must be reported to the SBDC operator's authorizing state and to the International Network for Advanced AI Measurement, Evaluation and Science (or successor international bodies focused on AI safety). This requirement could be imposed by the authorizing state with license conditions.[98,115,116]

I. Data Governance

Governments and corporations increasingly collect extensive personal data, including geospatial data, with resulting invasions of privacy, discrimination and unauthorized use of personal data for commercial purposes. Many governments are concerned that export of their citizens' data could compromise national security, law enforcement and local industrial development. Data governance laws address these issues while allowing data to be used for legitimate purposes, such as commerce, public services and scientific research.

International law on data governance is limited. The Council of Europe's Convention 108+ is designed to protect personal privacy and promote transparency in data management, but it has just 34 of the 38 ratifications needed for entry into force (Convention 108 is in force but has only European SBDC leader states as parties).[117-119] The World Trade Organization's (WTO's) 2024 Agreement on Electronic Commerce addresses digital trade but does not yet fully address cross-border data

flows.[120-122] The United States-Mexico-Canada Agreement and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership both have provisions limiting data localization laws.[123-125] None of the data governance provisions in these international agreements address data in outer space.

The Outer Space Treaty also does not directly address data issues. The treaty's Article VIII provides the registry state with jurisdiction and control over a space object and its personnel. Although Article VIII has not been extended to data aboard a space object, it has been used in the context of the International Space Station (ISS) Intergovernmental Agreement to establish the applicability of the registry state's intellectual property law.[113,126]

The data governance approaches of countries with SBDC activities vary substantially and, other than the United Arab Emirates and proposed European law, do not address the space sector directly:

- The United States lacks a comprehensive federal data protection statute. Data governance is addressed through federal government enforcement against unfair or deceptive practices, CLOUD Act data disclosure obligations, and Department of Justice restrictions.[127-131] Many US states have data governance laws.[132] California's data privacy law gives state residents the right to know when their personal data are being collected and to opt out of its sale or sharing.
- China has developed extensive regulation with extraterritorial reach through its Cybersecurity Law, Data Security Law and Personal Information Protection Law; they apply to Chinese-operated networks regardless of where the hardware is located.[133-135]
- The EU General Data Protection Regulation (GDPR) and Data Act provide the most extensive regulation in the world. The GDPR applies to any operator who offers services or monitors people in the European Union, and together, they provide substantial rights protections and safeguards.[136,137] The EU NIS2 Directive and proposed EU Space Act address cybersecurity obligations of space operators. The NIS2 directive focuses on ground-based operations, and the proposed Act would cover space-based activities as well.[138,139]
- Although the United Kingdom is no longer a member of the European Union, its data protection laws largely mirror those of the European Union. It has proposed legislation on cybersecurity that includes data centers but does not address space.[140,141]
- Japan's Act on the Protection of Personal Information requires safeguards for personal data and conditions its extraterritorial transfer on consent, a designated destination, or equivalent safeguards and treats storage of data overseas as a cross-border transfer.[142,143]
- India's Digital Personal Data Protection Act is grounded in consent and notice and applies to processing of personal data both in India and abroad (connected to offering goods or services in India), allowing data to flow to countries it has not restricted in a negative-list model. Regulation under its Information Technology Act, which applies to data centers but does not address space, requires reporting of cyber incidents within six hours.[144,145]

- The UAE space statute requires a Space Agency permit to receive, store, process or distribute space data. It also has a federal data protection law that conditions transfers on adequacy and safeguards. In July 2026, the UAE Space Agency gave companies 90 days to obtain licenses.[146-148]
- Israel's Protection of Privacy Law, as amended in 2025, has an approach aligned with the EU GDPR, supplemented by additional data security regulations.[149,150]

For data governance laws, does it matter whether data are stored on servers in space? Mostly the answer is no. For many provisions in data governance laws, server location is not legally relevant. If a company discloses personal data of an individual in violation of the laws of the country where the individual lives or the company does business, for example, it would not matter that the data had been stored on a server in another country. Such data governance laws apply based on the presence in a jurisdiction of a person whose data are being processed or of entities doing the processing, not the location of the servers on which data are processed.[136,144]

Data localization and transfer laws are an exception. The purpose of these laws is to compel companies to store and process data in a specific jurisdiction or to restrict its movement abroad. These laws are violated if data are stored or transferred abroad without meeting certain conditions.[136] Interestingly, the EU GDPR, perhaps the world's leading data governance statute, uses the phrase "third country" in its data transfer provisions. The European Commission must deem a third country's data protection to be adequate before EU data can be transferred to that country without additional safeguards.[136,151,152] Whether SBDCs would be treated as a "third country" under the GDPR and which country's data protection laws the European Commission would assess for adequacy are novel questions. The national law of the country that registered the SBDC would be a sensible answer.

To help address variations in national laws and possible gaps in international agreements, we recommend the following:

1. National governments should consider developing an agreement stating that the data governance laws of the registry state apply to SBDCs (consistent with the provisions of Outer Space Treaty's Article VIII). Such an agreement could be modeled on the approach of the ISS Intergovernmental Agreement to intellectual property (IP) law discussed above.
2. SBDC leader states should make clear that any data governance laws that apply within their jurisdictions also apply to SBDCs registered in their countries. These clarifications could occur by amending statutes or regulations, issuing regulatory guidance or imposing license conditions.

J. Security, Cybersecurity and Critical Infrastructure Designation

SBDCs have both physical and cyber vulnerabilities, including their ground stations, control links, optical inter-satellite links, hardware supply chains and satellites. Numerous recent incidents have reinforced these concerns. The physical risks were highlighted as the United States, China, India and Russia all conducted anti-satellite (ASAT) tests. Russia's November 2021 test created approximately 1500 pieces of debris that pose risks to other satellites and led to a UN General Assembly Resolution and pledges to stop these tests.[153,154] In both Russia's 2022 invasion of Ukraine and the 2026 US operation in Venezuela, important infrastructure (ground terminals for satellites and the electric grid, respectively) appears to have been disabled in cyberattacks.[155-157] Ukrainian strikes in 2024 physically damaged Russian early-warning radars and a satellite facility.[158,159] Cyberattacks on companies continue to grow. Anthropic reported disrupting a cyberattack in which a Chinese state-sponsored group manipulated Claude (an Anthropic model) into an espionage campaign against corporate and governmental targets.[81-83] In 2024, a cyberattack on AT&T exposed the personal data of almost all of its 115 million wireless customers.[160]

Despite these important risks facing SBDC terrestrial and space-based infrastructure, gaps exist in the relevant international law. Moreover, national law in SBDC leader states does not clearly address whether SBDCs should be designated as critical infrastructure and how export and foreign investment law applies. International law provides limits on the use of force but has more ambiguities around when harmful activities in space would violate those limits. The Outer Space Treaty Article III provides a requirement that space-based activities are conducted in accordance with international law, including the UN Charter, which limits the use of force in Articles 2(4) and 51.[161,162] The ITU Constitution prohibits radio service interference, and international humanitarian law principles of distinction and proportionality apply to all forms of warfare and all kinds of weapons.[163-165] However, only nonbinding instruments and working group submissions address other key aspects of the security concerns around SBDC infrastructure.[166-168] Similarly, the most widely ratified cybercrime treaty, the Budapest Convention, does not directly address space or operator security obligations, and China, India and the United Arab Emirates are not parties.[169]

The relevant national law in SBDC leader states also has important gaps. No SBDC leader state has designated space systems as critical infrastructure, and only the European Union covers ground-based infrastructure supporting space services.[138,170-180] In addition, national export regulations and laws regarding foreign investment do not address how orbital compute should be designated or how dual-use export controls, such as those on advanced semiconductors, would apply in space.[181,182] For example, US law does not treat launching an item into space as an export and, aside from on-orbit transfers of spacecraft ownership or control, lacks provisions addressing orbital computing or transmissions that use controlled technology or software.[183-187]

To address these regulatory gaps, we recommend:

1. SBDC leader states should designate SBDCs and their components as critical infrastructure, ideally with coordination to avoid exacerbating the regulatory arbitrage problems discussed below.

2. SBDC leader states should build cybersecurity requirements into SBDC licensing requirements; the proposed EU Space Act can serve as a model.[182]
3. SBDC leader states should update export control and investment screening rules to address orbital compute, including transfers of control of an orbital system and the status of SBDC operators.
4. SBDC leader states should work in international forums, like COPUOS and the new Global Mechanism, to create clearer understandings around attacks on SBDCs and their components that do not rise to the level of use of force.

K. Jurisdiction and Regulatory Arbitrage

Under current law, SBDC operators can strategically choose which state's regulation applies to the various ground and space components of their operations. Such jurisdiction-shopping creates significant problems in maritime shipping and other contexts.[188,189] Operators' ITU filings for new satellite constellations already include split filings or ones in which multiple states file for the same constellation. (See Chapter 3.1(A)(i).) Rwanda, Germany, Spain, Norway, France and the Solomon Islands have filed for large (over 10,000) satellite constellations. SpaceX has made filings through the United States, Norway, Germany and Tonga.[190,191] As the number of SBDCs grows, SBDC operators may jurisdiction-shop on various aspects of licensing to minimize environmental, debris, data-protection or other obligations. Beyond undermining national legal regimes addressing a range of serious issues, this regulatory arbitrage may create complexities during disputes about which law applies.

International space law creates the structure that allows for this forum shopping. The Outer Space Treaty establishes in Article VIII that jurisdiction and control follow the state of registry. However, its Article VI requirement that the "appropriate State Party" authorize and supervise non-governmental activities does not define "appropriate." Depending on the states and private operators involved in an SBDC project, multiple states may be candidates for being the "appropriate state" to authorize and supervise the activities.[113,192,193]

The Registration Convention requires that the state of registry be a launching state, defined as the state that launches or procures the launching or one from whose territory or facility the launch occurs.[192,194,195] Notably, that state may not have ongoing responsibility for supervising the SBDC.[194,196] The applicable space treaties do not provide a process for transferring registration when control of space objects changes nor do they require operators to verify their performance claims, such as around collision avoidance or disposal. Nonbinding General Assembly Resolutions 62/101 and 68/74



Scales of justice. Source: Adobe Stock

recommend procedures for addressing these transfers.[193,194,197] Further, as described above, the ITU framework does not require the notifying administration to be the launching state or state of registry.[198]

When a project has multiple launching, authorizing and notifying states with different regulatory requirements, regulatory arbitrage may occur, especially given the wide variation in national laws related to SBDCs. Even among the SBDC leader states, the licensing requirements vary greatly. For example, very specific US disposal and de-orbiting requirements differ from those of other states; US operators must show that each satellite is at least 90% likely to be disposed of successfully and to de-orbit LEO satellites within five years of a mission's end.[199,200] Moreover, given the flexibility of registration under the treaties, states with very limited relevant law, flexible licensing requirements or minimal connection to the SBDC project could still become the state of registry.

We recommend several strategies for addressing these gaps:

1. SBDC leader states should support ITU enforcement of deployment milestones as a constraint on speculative filings and explore the development of ITU processes to ensure that the notifying administration is also a state that authorizes and supervises the operator.[201]

2. SBDC leader states should condition licenses on provision of standardized performance data so that consistent verification can occur.

L. Liability, Insurance and Life-Cycle Bonds

SBDCs involve putting massive satellite constellations into an already crowded LEO environment, which creates risks of collisions and debris. For example, among the many proposals detailed above, SpaceX has filed plans with the FCC for an SBDC constellation with up to a million satellites, and ADASpace's "star compute" plan aims to put 2800 more satellites in orbit.[202,203] Moreover, SBDCs are only a fraction of ITU's filings and join a congested environment of roughly 40,000 tracked objects (including approximately 11,000 active payloads) and an estimated 1.2 million debris fragments.[204]

Despite the collision and other physical risks with SBDCs, existing liability and insurance regimes struggle to address incidents at even the current scale. As discussed in Chapter 3.1(A)(i), the Liability Convention, which only addresses state-to-state claims, imposes absolute liability for damage on the Earth's surface and to aircraft but only fault-based liability for damage to space objects (with no clear definition of fault). In addition, its definition of damage does not explicitly address service outages, data loss or environmental harms, and these damages may not be fully covered by the listed categories of death, personal injury and loss of or damage to property.[205]

The Liability Convention was invoked in 1978 when the Soviet Union's satellite Cosmos 954 disintegrated in the atmosphere, its radioactive debris scattered over Canada, and the case resulted in an agreement for the Soviet Union to pay CA$3 million in damages in 1981.[206,207] The first major satellite collision in 2009, between US Iridium 22 and out-of-commission Russian Cosmos 2251, produced more than two thousand debris fragments, but neither side could establish fault under the Liability Convention.[208-210] Moreover, especially because the Liability Convention only covers damage in another jurisdiction, liability issues may involve third parties who make claims under domestic law

if they are nationals of the state that caused the damage. For example, a Florida family made a Federal Tort Claims Act submission against NASA asking for $80,000 in damages after a jettisoned battery pallet from the ISS, which was supposed to burn up during re-entry, damaged their home; their attorneys noted that if this incident had occurred in another country, NASA would be liable under the Liability Convention.[211-213]

Most SBDC leader states have regulations that address liability and insurance for licensed space activities, but they vary substantially in what activities they cover that are relevant to SBDCs and in their substantive requirements.[147,199,214-228] In addition, insurance coverage is often incomplete in what it covers and in who has coverage in contexts relevant to SBDCs. For example, when a defective CrowdStrike software update caused an estimated $5.4 billion in losses to Fortune 500 countries by disabling computers worldwide, only 10–20% of the loss was covered under their cyber insurance policies.[229,230] As the law continues to evolve, the global space insurance market is growing rapidly, with projections that it will expand from $742.74 million in 2026 to $1229.57 million by 2035.[231]

To address these ambiguities and gaps, we recommend the following:

1. Parties to the Liability Convention work to clarify both what the standard for fault is and whether it extends to service outages, data loss or environmental harms.
2. SBDC leader states ensure that their licensing includes in-orbit liability coverage and demonstrated financial responsibility scaled to constellation size.
3. SBDC leader states create standardized approaches to orbital debris insurance, decommissioning bonds and life-cycle financial assurance.

M. References

1 Committee on the Peaceful Uses of Outer Space (COPUOS). *IADC Space Debris Mitigation Guidelines (rev. 4, 2021);* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/res/oosadoc/data/documents/2025/aac_105c_12025crp/aac_105c_12025crp_9_0_html/AC105_C1_2025_CRP09E.pdf (2025).

2 W. Henry Lambright. Governing space traffic: bureaucracy, politics, and orbital debris. *Space Policy* 75, 101725 (2026). https://doi.org/10.1016/j.spacepol.2025.101725.

3 18th Space Defense Squadron (18 SDS). *Space-Track.org Homepage;* U.S. Space Force, Vandenberg Space Force Base, California, https://www.space-track.org/ (Accessed August 2026).

4 U.S. Department of Commerce Office of Space Commerce. *TraCSS: Traffic Coordination System for Space;* Washington, D.C., https://space.commerce.gov/traffic-coordination-system-for-space-tracss/ (Accessed August 2026).

5 Todd Harrison & Kaitlyn Johnson. *How Does Space Policy Directive 3 Affect Space Traffic Management?;* Center for Strategic & International Studies (CSIS), Washington, D.C., https://www.csis.org/analysis/how-does-space-policy-directive-3-affect-space-traffic-management (2018).

6 Kuan Yang. Chinese perspective on an international regime of space traffic management. *Journal of Space Safety Engineering* 6, 156-160 (2019). https://doi.org/10.1016/j.jsse.2019.06.001.

7 S. Loginov, M. Yakovlev, M. Mikhailov, A. Garlov, V. Feldstein, I. Oleynikov, Y. Makarov, Y. Bulynin & V. Trushlyakov. “Activity of the Russian Federation on the Space Debris Problems” in *6th European Conference on Space Debris*, Darmstadt, Germany. https://conference.sdo.esoc.esa.int/proceedings/sdc6/paper/87/SDC6-paper87.pdf,(2013).

8 Mustapha Iderawumi. *Russia Deploys Space Debris Monitoring Facility to South Africa;* Space in Africa, Lagos, Nigeria, https://spaceinafrica.com/2023/07/24/russia-deploys-space-debris-monitoring-facility-to-south-africa/ (2023).

9 European Union Agency for the Space Programme (EUSPA). *EU Space Surveillance and Tracking (SST);* EUSPA, Prague, Czech Republic, https://www.euspa.europa.eu/eu-space-programme/ssa/eu-sst (Accessed August 2026).

10 Bruce McClintock Anca Agachi, Ryan J. Bain, Mélusine Lebret, Thomas Van Bibber, AaSHAE Eberle. *Order in Orbit;* RAND Corporation, Santa Monica, California, https://www.rand.org/pubs/research_reports/RRA3463-1.html (2025).

11 Bruce McClintock, Douglas C. Ligor, Dan McCormick, Marissa Herron, Kotryna Jukneviciute, Thomas Van Bibber, Katie Feistel, Akhil Rao, Adi Rao, Taylor Grosso, Michael Fenner, Hanjun Lee, Abdullah Ar Rafee & Tomás Urbina. *International Space Traffic Management;* RAND Corporation, Santa Monica, California, https://www.rand.org/pubs/research_reports/RRA1949-1.html (2023).

12 Emmanuelle David. *Sustainable space: 3 challenges for cooperation;* International Telecommunication Union (ITU), Geneva, Switzerland, https://www.itu.int/hub/2025/10/sustainable-space-3-challenges-for-cooperation/ (2025).

13 Lt. Col. Stephen Hunter. “How to reach an international civil aviation organization role in space traffic management” in *1st Annual Space Traffic Management Conference: 2014 Roadmap to the Stars*, Daytona Beach, Florida. https://commons.erau.edu/stm/2014/wednesday/21/,(2014).

14 Akhil Rao, Matthew G. Burgess & Daniel Kaffine. Orbital-use fees could more than quadruple the value of the space industry. *Proceedings of the National Academy of Sciences* 117, 12756-12762 (2020). https://doi.org/10.1073/pnas.1921260117.

15 American Astronomical Society (AAS). *In the Matter of Space Bureau Accepts for Filing SpaceX's Application for Orbital Data Centers – Petition to Deny of the American Astronomical Society (Before the Federal Communications Commission);* AAS, Washington, D.C., https://aas.org/sites/default/files/2026-03/American%20Astronomical%20Society%20-%20SpaceX%20Orbital%20Data%20Centers%20Petition%20to%20Deny.pdf (2026).

16 Samantha Lawler, Aaron Boley & Hanno Rein. *A million new SpaceX satellites will destroy the night sky — for everyone on Earth;* The Conversation US, Inc., Waltham, Massachusetts, https://theconversation.com/a-million-new-spacex-satellites-will-destroy-the-night-sky-for-everyone-on-earth-277938 (2026).

17 Kathryn Hulick. *SpaceX Aims to Launch Up to 1 Million AI Data Center Satellites;* Sky & Telescope (AAS Sky Publishing, LLC), Cambridge, Massachusetts, https://skyandtelescope.org/astronomy-news/spacex-aims-to-launch-1-million-ai-data-center-satellites/ (2026).

18 Committee on the Peaceful Uses of Outer Space (COPUOS) Scientific and Technical Subcommittee (Sixty-first session). *Conference Room Paper on the Protection of Dark and Quiet Skies for science and society (A/AC.105/C.1/2024/CRP.18);* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/res/oosadoc/data/documents/2024/aac_105c_12024crp/aac_105c_12024crp_18_0_html/AC105_C1_2024_CRP18E.pdf (2024).

19 United Nations General Assembly. *RESOLUTION ADOPTED BY THE GENERAL ASSEMBLY: 2222 (XXI). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies;* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/unoosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html (1966).

20 Charles Lee Mudd Jr. (Mudd Law Offices) & Ruskin Hartley (International Dark Sky Association). *Comment in Response to PRM: Update to the Regulations Implementing the Procedural Provisions of the National Environmental Policy Act (Docket No. CEQ-2019-0003);* DarkSky International, Tucson, Arizona, https://darksky.org/app/uploads/2020/03/IDA-MuddLaw-CEQ-Comment-200310.pdf (2020).

21 DarkSky International. *Our positions and statements;* Tucson, Arizona, https://darksky.org/what-we-do/advancing-responsible-outdoor-lighting/our-positions/ (Accessed August 2026).

22 American Astronomical Society (AAS). *Action Alert: Provide Input to the FCC on Proposed Satellite Systems;* AAS, Washington, D.C., https://aas.org/action-alert-provide-input-fcc-proposed-satellite-systems (Accessed August 2026).

23 Jan E. Hasselman & Scott W. Stern. *DarkSky International, Environment America, and Public Employees for Environmental Responsibility's Petition to Initiate Programmatic Environmental Impact Statement on Orbital Data Center Applications (Before the Federal Communications Commission);* Earthjustice, San Francisco, California, https://earthjustice.org/wp-content/uploads/2026/07/2026.07.08-petition-for-programmatic-eis.pdf (

24 European Parliament Committee on the Internal Market and Consumer Protection. *Final compromise amendments: On the draft Opinion on Safety, resilience and sustainability of space activities in the Union 2025/0335(COD), art. 72;* European Parliament, Strasbourg, France, https://www.europarl.europa.eu/meetdocs/2024_2029/plmrep/COMMITTEES/IMCO/DV/2026/03-23/8-CAs_SpaceAct_EN.pdf (2026).

25 Phanindra Kandula, Lee Kelvin, Erfan Nourbakhsh, Daniel Polin, Tom Prince, Meredith Rawls, Adam Snyder, Brianna Smart, Christopher Stubbs, Anthony Tyson, Zeljko Ivezic, Craig Lage & Clare Saunders. Report on LEO satellite impacts on ground-based optical astronomy for the Rubin Observatory LSST. arXiv:2509.19758 (2025). https://doi.org/10.48550/arXiv.2509.19758.

26 Olivier R. Hainaut & Andrew P. Williams. Impact of satellite constellations on astronomical observations with ESO telescopes in the visible and infrared domains. *Astronomy and Astrophysics* 636, A121 (2020). https://doi.org/10.1051/0004-6361/202037501.

27 International Astronomical Union's Office for Astronomy Outreach (OAO). *Dark and Quiet Skies;* National Astronomical Observatory of Japan and IAU OAO, Tokyo, Japan, https://iauoutreach.org/global-projects/dark-and-quiet-skies (Accessed August 2026).

28 Committee on the Peaceful Uses of Outer Space (COPUOS) Scientific and Technical Subcommittee (Sixty-third session). *Conference Room Paper on the Protection of Dark and Quiet Skies for science and society (A/AC.105/C.1/2026/CRP.22);* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/res/oosadoc/data/documents/2026/aac_105c_12026crp/aac_105c_12026crp_22_0_html/AC105_C1_2026_CRP22E.pdf (2026).

29 International Astronomical Union (IAU) Centre for the Protection of the Dark and Quiet Sky from Satellite Constellation Interference (CPS). *Call to Protect the Dark and Quiet Sky from Harmful Interference by Satellite Constellations;* IAU CPS, Paris, France, https://cps.iau.org/documents/49/techdoc102.pdf (2024).

30 Ozone Secretariat. *Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations Treaty Series, Vol. 522, pg. 3;* United Nations Environment Programme (UNEP), Nairobi, Kenya, https://ozone.unep.org/treaties/montreal-protocol (1987).

31 Ozone Secretariat. *Vienna Convention for the Protection of the Ozone Layer, United Nations Treaty Series, Vol. 1513, pg. 293;* United Nations Environment Programme (UNEP), Nairobi, Kenya, https://ozone.unep.org/treaties/vienna-convention (1985).

32 Laura E. Revell, Michele T. Bannister, Tyler F. M. Brown, Timofei Sukhodolov, Sandro Vattioni, John Dykema, David J. Frame, John Cater, Gabriel Chiodo & Eugene Rozanov. Near-future rocket launches could slow ozone recovery. *npj Climate and Atmospheric Science* 8, 212 (2025). https://doi.org/10.1038/s41612-025-01098-6.

33 José P. Ferreira, Ziyu Huang, Ken-ichi Nomura & Joseph Wang. Potential Ozone Depletion From Satellite Demise During Atmospheric Reentry in the Era of Mega-Constellations. *Geophysical Research Letters* 51, e2024GL109280 (2024). https://doi.org/10.1029/2024GL109280.

34 Christopher M. Maloney, Robert W. Portmann, Martin N. Ross & Karen H. Rosenlof. Investigating the Potential Atmospheric Accumulation and Radiative Impact of the Coming Increase in Satellite Reentry Frequency. *Journal of Geophysical Research: Atmospheres* 130, e2024JD042442 (2025). https://doi.org/10.1029/2024JD042442.

35 Sandro Vattioni, Beiping Luo, Aryeh Feinberg, Andrea Stenke, Christof Vockenhuber, Rahel Weber, John A. Dykema, Ulrich K. Krieger, Markus Ammann, Frank Keutsch, Thomas Peter & Gabriel Chiodo. Chemical Impact of Stratospheric Alumina Particle Injection for Solar Radiation Modification and Related Uncertainties. *Geophysical Research Letters* 50, e2023GL105889 (2023). https://doi.org/10.1029/2023GL105889.

36 Robert G. Ryan, Eloise A. Marais, Chloe J. Balhatchet & Sebastian D. Eastham. Impact of Rocket Launch and Space Debris Air Pollutant Emissions on Stratospheric Ozone and Global Climate. *Earth's Future* 10, e2021EF002612 (2022). https://doi.org/10.1029/2021EF002612.

37 Conference of the Parties to the Vienna Convention for the Protection of the Ozone Layer Thirteenth meeting. *Recommendations of the Ozone Research Managers of the Parties to the Vienna Convention at their twelfth meeting (UNEP/OzL.Conv.13/6), section 7 (Supersonic aviation, space activity and climate intervention), paragraph 13;* United Nations Environment Programme (UNEP), Nairobi, Kenya, https://ozone.unep.org/system/files/documents/COP-13-6E.pdf (2024).

38 Thirty-Fifth Meeting of the Parties to the Montreal Protocol. *Decision XXXV/3: Potential areas of focus for the 2026 quadrennial reports of the Environmental Effects Assessment Panel, the Scientific Assessment Panel and the Technology and Economic Assessment Panel;* United Nations Environment Programme (UNEP, Nairobi, Kenya, https://ozone.unep.org/treaties/montreal-protocol/meetings/thirty-fifth-meeting-parties/decisions/decision-xxxv3-potential-areas-focus-2026-quadrennial-reports-environmental-effects-assessment-panel (2023).

39 SilverLining. *Paper Cuts 004 | Regulating the Sky: How the Ozone Regime Could Govern Stratospheric Aerosols (Summary of: "Rockets, Satellites, and Stratospheric Aerosol Injection: Regulating Human Impacts on Stratospheric Aerosols Under the Ozone Regime" from Environment: Science and Policy for Sustainable Development, Volume 67, 2025 by Daniel Bodansky and Nicolás Esguerra);* Washington, D.C., https://www.silverlining.ngo/paper-cuts/004 (2025).

40 Daniel Bodansky & Nicolás E. Esguerra. Rockets, Satellites, and Stratospheric Aerosol Injection: Regulating Human Impacts on Stratospheric Aerosols Under the Ozone Regime. *Environment: Science and Policy for Sustainable Development* 67, 9-13 (2025). https://doi.org/10.1080/00139157.2025.2548751.

41 Julia Dreyer & Adrian Zarm. *The EU Space Act: On a mission for regulation;* CMS Legal Services EEIG, Frankfurt, Germany, https://cms.law/en/deu/legal-updates/the-eu-space-act-on-a-mission-for-regulation (2025).

42 European Parliament. *Proposal for a regulation of the European Parliament and of the Council on the safety, resilience and sustainability of space activities in the Union (COM(2025) 335 final);* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A52025PC0335 (2025).

43 International Telecommunication Union (ITU). *Radio Regulations – Articles;* ITU Library & Archives Service, Geneva, Switzerland, https://search.itu.int/history/HistoryDigitalCollectionDocLibrary/1.49.48.en.101.pdf (2024).

44 U.S. Department of Transportation (DOT). *What is Radio Spectrum?;* Washington, D.C., https://www.transportation.gov/pnt/what-radio-spectrum (Accessed August 2026).

45 Jeff Foust. *Blue Origin joins the orbital data center race;* SpaceNews, Alexandria, Virginia, https://spacenews.com/blue-origin-joins-the-orbital-data-center-race/ (2026).

46 Jason Rainbow. *Cowboy files plans for up to 20,000 orbital data centers;* SpaceNews, Alexandria, Virginia, https://spacenews.com/cowboy-files-plans-for-up-to-20000-orbital-data-centers/ (2026).

47 Space Exploration Holdings LLC (SpaceX). *SpaceX Orbital Data Center System (ICFS File No. SAT LOA-20260108-00016);* Federal Communications Commission (FCC), Washington, D.C., https://fccprod.servicenowservices.com/icfs?id=ibfs_application_summary&number=SAT-LOA-20260108-00016 (2026).

48 Starcloud Inc. *Starcloud Orbital Datacenter System (ICFS File No. SAT-LOA-20260202-00073);* Federal Communications Commission (FCC), Washington, D.C., https://fccprod.servicenowservices.com/icfs?id=ibfs_application_summary&number=SAT-LOA-20260202-00073 (2026).

49 Alex Shi & Ian Christensen. *To ODC or not to ODC: Insight for May 2026;* Secure World Foundation, Broomfield, Colorado, https://www.swfound.org/publications-and-reports/to-odc-or-not-to-odc-insight-2026 (2026).

50 Michael Calabrese, Kristian Stout, Jessica Dine & Gerald Adams. *Leading on LEO Satellite Policy: U.S. Priorities for the 2027 World Radiocommunication Conference;* New America, Washington, D.C., https://www.newamerica.org/insights/wrc-27-priorities-and-positions/ (2026).

51 International Telecommunication Union (ITU). "RESOLUTION 712 (WRC-23) Studies on compatibility between the Earth exploration-satellite service (passive), the radio astronomy service in certain bands above 76 GHz, and active services in adjacent and nearby frequency bands" in *The World Radiocommunication Conference*, Dubai, United Arab Emirates. https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A0000100018PDFE.pdf,(2023).

52 International Telecommunication Union (ITU). "RESOLUTION 681 (WRC-23) Studies of technical and regulatory provisions necessary to protect radio astronomy operating in specific Radio Quiet Zones and, in radio astronomy service primary allocated frequency bands globally, from aggregate radio-frequency

interference caused by systems in the non-geostationary-satellite orbit" in *The World Radiocommunication Conference*, Dubai, United Arab Emirates. https://www.itu.int/en/ITU-R/terrestrial/fmd/Documents/WRC_23_Resolutions/E/RES_681(WRC-23)-E.pdf,(2023).

53 International Telecommunication Union (ITU). *ITU-R Preparatory Studies for WRC-27 (see WRC-27 Agenda Items 1.16 and 1.18);* International Telecommunication Union (ITU), Geneva, Switzerland, https://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/wrc-27-studies.aspx (Accessed August 2026).

54 Aerospace Corporation Center for Space Policy and Strategy. *Space Agenda 2025;* Chantilly, Virginia, https://csps.aerospace.org/sa2025 (2024).

55 Xiaoyan Zhang (Ministry of Industry and Information Technology (MIIT) China). "Licensing for Satellite Systems in China" in *International Telecommunication Union (ITU) in Service of Space Workshop*, Geneva, Switzerland. 2023).

56 Jack Congram. *China to Have 10 Million+ Satellite Connectivity Users by 2030, MIIT Aims (see translation of "Guiding Opinions on Optimizing Business Access to Promote the Development of the Satellite Communications Industry," Ministry of Industry and Information Technology (MIIT), China, 2025);* China in Space (Jack C.), https://www.china-in-space.com/p/china-to-have-10-million-satellite (2025).

57 Gernot Fritz & Amina Kovacevic. *Sustainability in Orbit – Part 1: How the Council Compromise Turns the EU Space Act's Debris and Traffic Rules into Real Operator Duties;* E+H Rechtsanwälte GmbH, Vienna, Austria, https://www.eh.at/en/sustainability-in-orbit-part-1-how-the-council-compromise-turns-the-eu-space-acts-debris-and-traffic-rules-into-real-operator-duties (2026).

58 Committee for the Protection of Astronomy and the Space Environment (COMPASSE). *AAS Comment on the Proposed European Union Space Act;* COMPASSE, Washington, D.C., https://compasse.aas.org/aas-comment-on-the-proposed-european-union-space-act/ (2025).

59 Clayton Swope. *Injecting the Free Market into Spectrum Use for Space Applications;* Center for Strategic & International Studies (CSIS), Washington, D.C., https://www.csis.org/analysis/injecting-free-market-spectrum-use-space-applications (2026).

60 U.S. Federal Communications Commission (FCC). *International Satellite Coordination;* U.S. FCC, Washington, D.C., https://www.fcc.gov/space/international-satellite-coordination (Accessed August 2026).

61 Veronique Glaude (International Telecommunication Union (ITU)). "ITU Radio Regulations: "First Come, First Served" Concept and Equitable Access to Spectrum/Orbit Resources" in *59th session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS)*, Vienna, Austria. https://www.unoosa.org/documents/pdf/copuos/stsc/2022/40_ITU_-_First_Come_First_Served_Concept_to_Access_spectrum-orbit.pdf,(2022).

62 Jeff Foust. *SpaceX launches Transporter-17 amid concerns about rideshare program's future (NOTE: SpaceX has not publicly confirmed these reports.);* SpaceNews, Alexandria, Virginia, https://spacenews.com/spacex-launches-transporter-17-amid-concerns-about-rideshare-programs-future/ (2026).

63 Marc Boucher. *SpaceX's rideshare freeze: What it means for the SmallSat market and Canada (NOTE: SpaceX has not publicly confirmed these reports.);* SpaceQ Media, Inc., Vancouver, British Columbia, Canada, https://spaceq.ca/spacexs-rideshare-freeze-what-it-means-for-the-smallsat-market-and-canada/ (2026).

64 José A. Gómez-Ibáñez. Open Access to Infrastructure Networks: The Experience of Railroads. *Review of Industrial Organization* 49, 311-345 (2016). http://www.jstor.org/stable/44737421.

65 Paul L. Joskow. Transmission policy in the United States. *Utilities Policy* 13, 95-115 (2005). https://doi.org/10.1016/j.jup.2004.12.005.

66 Organisation for Economic Co-operation and Development (OECD). Broadband Networks and Open Access. *OECD Digital Economy Papers* 218 (2013). https://doi.org/10.1787/5k49qgz7crmr-en.

67 U.S. Federal Communications Commission (FCC). *Pipeline Service Obligations and Revisions to Regulations Governing Self-Implementing Transportation Under Part 284 of the Commission's Regulations (Docket No. RM91-11-002) and Regulation of Natural Gas Pipelines After Partial Wellhead Decontrol (Docket No. RM87-34-068) – ORDER NO. 636-A: ORDER DENYING REHEARING IN PART GRANTING REHEARING IN PART, AND CLARIFYING ORDER NO. 636;* Federal Energy Regulatory Commission (FERC), Washington, D.C., https://www.ferc.gov/sites/default/files/2020-05/rm91-11-002.txt (2020).

68 Erica Downs & Sheng Yan. *Reform is in the Pipelines: PipeChina and the Restructuring of China's Natural Gas Market;* Center on Global Energy Policy at Columbia University, School of International and Public Affairs, New York, New York, https://www.energypolicy.columbia.edu/publications/reform-pipelines-pipechina-and-restructuring-china-s-natural-gas-market/ (2020).

69 Hari M. Osofsky. Multidimensional Governance and the BP Deepwater Horizon Oil Spill. *Florida Law Review 1077* Volume 63 Issue 5 Article 2 (2011).

70 U.S. Federal Communications Commission (FCC). *Space Bureau Accepts For Filing SpaceX's Application for Orbital Data Centers (Public Notice; DA-26-113);* Washington, D.C., https://www.fcc.gov/document/sb-accepts-filing-spacexs-application-orbital-data-centers (2026).

71 Google. *Meet Project Suncatcher, a research moonshot to scale machine learning compute in space (Blog);* Mountain View, California, https://blog.google/innovation-and-ai/technology/research/google-project-suncatcher/ (2025).

72 Ashley Capoot. *Anthropic, SpaceX announce compute deal that includes space development;* CNBC (Versant Media, LLC), Englewood Cliffs, New Jersey, https://www.cnbc.com/2026/05/06/anthropic-spacex-data-center-capacity.html (2026).

73 Pia Singh. *'Greetings, earthlings': Nvidia-backed Starcloud trains first AI model in space as orbital data center race heats up;* CNBC (Versant Media, LLC), Englewood Cliffs, New Jersey, https://www.cnbc.com/2025/12/10/nvidia-backed-starcloud-trains-first-ai-model-in-space-orbital-data-centers.html (2026).

74 Xinhua News Agency. *From ground to orbit: China eyes computing in space;* The State Council Information Office (SCIO), The People's Republic of China (PRC), Beijing, China, http://english.scio.gov.cn/chinavoices/2026-04/27/content_118464689.html (2026).

75 Palantir Blog. *Palantir Edge AI in Space;* Palantir Technologies, Denver, Colorado, blog.palantir.com/edge-ai-in-space-93d793433a1e (2022).

76 Yoshua Bengio, Stephen Clare, Carina Prunkl, Maksym Andriushchenko, Ben Bucknall, Malcolm Murray, Rishi Bommasani, Stephen Casper, Tom Davidson & Raymond Douglas. International AI safety report 2026. *https://internationalaisafetyreport.org/sites/default/files/2026-02/international-ai-safety-report-2026.pdf* (2026).

77 Hadas Gold. *An OpenAI test model escaped and broke into a real company's servers;* Cable News Network (CNN), Atlanta, Georgia, https://www.cnn.com/2026/07/22/tech/openai-hugging-face-ai-cybersecurity (2026).

78 Model Evaluation and Threat Research (METR) & Redwood Research. *Brief independent investigation of agents' behavior, reasoning and collaboration in the OpenAI / Hugging Face hacking incident;* Berkeley, California, https://metr.org/hugging-face-incident-report-aug-2026.pdf (2026).

79 OpenAI. *OpenAI – Hugging Face Incident (Technical Report);* San Francisco, California, https://cdn.openai.com/pdf/67869394-cb91-4c12-888c-5cbd85c7814c/OpenAI-Hugging-Face%20Incident-Technical-Report.pdf (2026).

80 Anthropic. *Investigating three real-world incidents in our cybersecurity evaluations (Announcement);* Anthropic PBC, San Francisco, California, https://www.anthropic.com/news/investigating-incidents-cybersecurity-evals (2026).

81 Anthropic. *Disrupting the first reported AI-orchestrated cyber espionage campaign (Full report);* Anthropic PBC, San Francisco, California, https://www-cdn.anthropic.com/d7dd50dd1185f59be051b307150d877f2b82bd2c.pdf (2025).

82 Natalie Shapira, Chris Wendler, Avery Yen, Gabriele Sarti, Koyena Pal, Olivia Floody, Adam Belfki, Alex Loftus, Aditya Ratan Jannali, Nikhil Prakash, Jasmine Cui, Giordano Rogers, Jannik Brinkmann *et al.* Agents of Chaos. arXiv:2602.20021 (2026). https://doi.org/10.48550/arXiv.2602.20021.

83 Jeffrey Brainard. AI algorithms can become 'agents of chaos'. *Science* 391(6792), 1307-1308 (2026). https://doi.org/10.1126/science.aeh4836.

84 Hope Anderson, Earl Comstock & Erin Hanson. *AI Watch: Global regulatory tracker - United States;* White & Case LLP, New York, New York, https://www.whitecase.com/insight-our-thinking/ai-watch-global-regulatory-tracker-united-states (2026).

85 Joseph Cahill & Ariel D. House. *U.S. Artificial Intelligence Law Update: Navigating the Evolving State and Federal Regulatory Landscape;* Baker Botts L.L.P, Houston, Texas, https://www.bakerbotts.com/thought-leadership/publications/2026/january/us-ai-law-update (2026).

86 U.S. Department of Commerce National Institute of Standards and Technology (NIST). *Artificial Intelligence Risk Management Framework (AI RMF 1.0) (NIST AI 100-1);* NIST, Washington, D.C., https://doi.org/10.6028/NIST.AI.100-1 (2023).

87 U.S. Copyright Office. *Copyright and Artificial Intelligence;* Washington, D.C., https://www.copyright.gov/ai/ (Accessed August 2026).

88 Paweł Gmyrek, Janine Berg, Karol Kamiński, Filip Konopczyński, Agnieszka Ładna, Konrad Rosłaniec & Marek Troszyński. *Generative AI and Jobs: A Refined Global Index of Occupational Exposure (ILO Working Paper 140);* International Labour Organization (ILO), Geneva, Switzerland, https://webapps.ilo.org/static/english/intserv/working-papers/wp140/index.html (2025).

89 Council of Europe. *Council of Europe opens first ever global treaty on AI for signature;* Strasbourg, France, https://www.coe.int/en/web/portal/-/council-of-europe-opens-first-ever-global-treaty-on-ai-for-signature (2024).

90 Council of Europe. *Canada and Japan sign Council of Europe's first ever global treaty on AI;* Strasbourg, France, https://www.coe.int/en/web/portal/-/canada-and-japan-sign-council-of-europe-s-first-ever-global-treaty-on-ai (2024).

91 Council of Europe. *European Union ratifies the Council of Europe Framework Convention on Artificial Intelligence;* Strasbourg, France, https://www.coe.int/en/web/artificial-intelligence/-/european-union-ratifies-the-council-of-europe-framework-convention-on-artificial-intelligence (2026).

92 Council of Europe. *Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law (Council of Europe Treaty Series - No. 225);* Council of Europe, Strasbourg, France, https://www.coe.int/en/web/artificial-intelligence/the-framework-convention-on-artificial-intelligence (2024).

93 European Parliament. *Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) (Text with EEA relevance), (Document Document 32024R1689), arts. 2(1), 51-55;* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32024R1689 (2024).

94 European Commission. *Guidelines on obligations for General-Purpose AI providers (FAQ);* European Commission Directorate-General for Communications, Networks Content and Technology, Brussels,

Belgium, https://digital-strategy.ec.europa.eu/en/faqs/guidelines-obligations-general-purpose-ai-providers (Accessed August 2026).

95 The White House. *Promoting Advanced Artificial Intelligence Innovation and Security (Executive Order);* Washington, D.C., https://www.whitehouse.gov/presidential-actions/2026/06/promoting-advanced-artificial-intelligence-innovation-and-security/ (2026).

96 Governor Gavin Newsom. *Governor Newsom signs SB 53, advancing California's world-leading artificial intelligence industry;* California Department of Technology (CDT) CAWeb Publishing Service, West Sacramento, California, https://www.gov.ca.gov/2025/09/29/governor-newsom-signs-sb-53-advancing-californias-world-leading-artificial-intelligence-industry/ (2025).

97 Stuart D. Levi, William E. Ridgway, David A. Simon, Meredith C. Slawe & Anita Oh. *Utah Becomes First State To Enact AI-Centric Consumer Protection Law*

April 5, 2024 Skadden, Arps, Slate, Meagher & Flom LLP and Affiliates, New York, New York, https://www.skadden.com/insights/publications/2024/04/utah-becomes-first-state (2024).

98 Executive Office of the President. *Promoting Advanced Artificial Intelligence Innovation and Security (Executive Order 14409);* Federal Register (U.S. National Archives and Records Administration), Washington, D.C., https://www.federalregister.gov/documents/2026/06/05/2026-11415/promoting-advanced-artificial-intelligence-innovation-and-security (2026).

99 Executive Office of the President. *Ensuring a National Policy Framework for Artificial Intelligence (Executive Order 14365);* Federal Register (U.S. National Archives and Records Administration), Washington, D.C., https://www.federalregister.gov/documents/2025/12/16/2025-23092/ensuring-a-national-policy-framework-for-artificial-intelligence (2025).

100 Amy Yang & Bob Li. *AI Watch: Global regulatory tracker - China;* White & Case, LLP, New York, New York, https://www.whitecase.com/insight-our-thinking/ai-watch-global-regulatory-tracker-china (2025).

101 Phoebe Zhang. *What do China's plans for 'comprehensive' new AI law mean for future of technology?;* South China Morning Post Publishers (SCMP), Ltd., Causeway Bay, Hong Kong, https://www.scmp.com/news/china/politics/article/3353834/what-do-chinas-plans-comprehensive-new-ai-law-mean-future-technology (2026).

102 Gabriela Kennedy & Joanna K.C. Wong. *China Issues Draft Rules on Interactive AI Services;* Mayer Brown Practices, Chicago, Illinois, https://www.mayerbrown.com/en/insights/publications/2026/04/china-issues-draft-rules-on-interactive-ai-services (2026).

103 Osborne Clarke. *Artificial intelligence – UK Regulatory Outlook May 2026;* Osborne Clarke Verein (OCV), London, United Kingdom, https://www.osborneclarke.com/insights/regulatory-outlook-may-2026-artificial-intelligence (2026).

104 *Act on Promotion of Research and Development, and Utilization of Artificial Intelligence-related Technology (Act No. 53 of June 4, 2025);* Japanese Law Translation Database System (Ministry of Justice, Japan), Tokyo, Japan, Translation at https://www.japaneselawtranslation.go.jp/en/laws/view/5066/en (2025).

105 Dominic Paulger. *Understanding Japan's AI Promotion Act: An "Innovation-First" Blueprint for AI Regulation;* Future of Privacy Forum (FPF), Washington, D.C., https://fpf.org/blog/understanding-japans-ai-promotion-act-an-innovation-first-blueprint-for-ai-regulation/ (2025).

106 Rohit Bhat, Harry Evans, Cédric Lindenmann & Jade Bryant. *India targets deepfakes and AI-generated content: key changes under MeitY's 2026 amendments to the IT Rules;* Freshfields, London, United Kingdom, https://www.freshfields.com/en/our-thinking/blogs/technology-quotient/india-targets-deepfakes-and-ai-generated-content-key-changes-under-meitys-2026-102mjwn (2026).

107 Ministry of Electronics and Information Technology (India). *India AI: Governance Guidelines;* Government of India, Ministry of Information and Broadcasting, Press Information Bureau, New Delhi, India,

https://static.pib.gov.in/WriteReadData/specificdocs/documents/2025/nov/doc2025115685601.pdf (2025).

108 Brian A. Meenagh, Ksenia Koroleva & Fady Saleh. *AI in the UAE: Understanding the Regulatory Landscape and Key Authorities;* Latham & Watkins, Los Angeles, California, https://www.lw.com/en/insights/ai-in-the-uae-understanding-the-regulatory-landscape-and-key-authorities (2025).

109 Netta Shaked-Stadler, Ziv Rotenberg & Assaf Harel. *AI Watch: Global regulatory tracker - Israel;* White & Case, LLP, New York, New York, https://www.whitecase.com/insight-our-thinking/ai-watch-global-regulatory-tracker-israel (2025).

110 Steve Padilla, Josh Becker, Susan Rubio, Henry Stern, Akilah Weber Pierson, Josh Lowenthal & Gail Pellerin. *California Senate Bill 243: Companion Chatbots (California Business and Professions Code (BPC) §§ 22601–22606);* LegiScan, LLC, Charleston, West Virginia, https://legiscan.com/CA/text/SB243/id/3269137 (2025).

111 NYC Department of Consumer and Worker Protection (DCWP). *Automated Employment Decision Tools: Frequently Asked Questions;* City of New York, New York, New York, https://www.nyc.gov/assets/dca/downloads/pdf/about/DCWP-AEDT-FAQ.pdf (Accessed August 2026).

112 United Nations Office for Outer Space Affairs (UNOOSA). *International Space Law: United Nations Instruments;* UNOOSA, Vienna, Austria, https://www.unoosa.org/res/oosadoc/data/documents/2025/stspace/stspace61rev_3_0_html/st_space_61rev03E.pdf (2025).

113 United Nations General Assembly. *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, arts. II, VI, VIII, IX, United Nations Treaty Series, Vol. 610, pg. 205;* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html (1966).

114 Anne-Sophie Martin Tuana Yazici, Steven Wood, Lisa Kucher, Roser Almenar, Laura Yvonne Zielinski, Stefan-Michael Wedenig & Giovanni Tricco. *Balancing Innovation and Responsibility: International Recommendations for AI Regulation in Space (Final Report of the Working Group on Legal Aspects of AI in Space);* International Institute of Space Law (IISL), Paris, France, https://iisl.space/wp-content/uploads/2025/10/Final-Report-of-the-Working-Group-on-Legal-Aspects-of-AI-in-Space.pdf (2024).

115 Scott Wiener. *Senate Bill No. 53: Artificial intelligence models: large developers;* California Legislative Information, Sacramento, California, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202520260SB53 (2025).

116 AI Security Institute (AISI). *International consensus and open questions in AI evaluations;* AISI (U.K. Department of Science, Innovation and Technology), London, United Kingdom, https://www.aisi.gov.uk/blog/international-ai-network-consensus-and-open-questions (2026).

117 Council of Europe: Data Protection. *Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data (Council of Europe Treaty Series - No. 108);* Council of Europe, Strasbourg Cedex, France, https://www.coe.int/en/web/data-protection/convention108-and-protocol (1981).

118 Council of Europe: Data Protection. *Protocol Amending the Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data, Council of Europe Treaty Series - No. 223 (not yet in force);* Council of Europe, Strasbourg Cedex, France, https://rm.coe.int/090000168098837a (2018).

119 Council of Europe: Data Protection. *Republic of Moldova Becomes the 34th State to Ratify the Convention 108+ (News);* Council of Europe, Strasbourg Cedex, France, https://www.coe.int/en/web/data-protection/-/republic-of-moldova-becomes-the-34th-state-to-ratify-the-convention-108- (2026).

120 World Trade Organization (WTO). *Agreement on Electronic Commerce;* WTO, Geneva, Switzerland, https://www.wto.org/english/tratop_e/ecom_e/joint_statement_e.htm (2026).

121 Gisela Grieger. *WTO agreement on electronic commerce (At-A-Glance)(PE 762.390);* European Parliamentary Research Service (EPRS), Brussels, Belgium,

https://www.europarl.europa.eu/RegData/etudes/ATAG/2024/762390/EPRS_ATA(2024)762390_EN.pdf (2024).

122 Rashmi Jose & Rashid S. Kaukab. *Electronic Commerce and the World Trade Organization (IISD Report);* International Institute for Sustainable Development (IISD), Winnipeg, Manitoba, Canada, https://www.iisd.org/system/files/2025-12/e-commerce-wto-state-of-play.pdf (1015).

123 Office of the United States Trade Representative. *United States - Mexico - Canada Agreement (USMCA);* Office of the United States Trade Representative (USTR), Washington, D.C., https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement/agreement-between (2018).

124 Chapter 14: Electronic Commerce in *Comprehensive and Progressive Agreement for Trans-Pacific Partnership* (Office of the United States Trade Representative (USTR), Washington, D.C., 2018, Available at https://ustr.gov/trade-agreements/free-trade-agreements/trans-pacific-partnership/tpp-full-text).

125 Patrick Leblond. *Mechanisms for Governance Cooperation: Trade Agreements and Data Governance;* Centre for International Governance Innovation (CIGI), Waterloo, Ontario, Canada, https://www.cigionline.org/articles/trade-agreements-and-data-governance/ (2024).

126 Office of Treaty Affairs. *Agreement Among the Government of Canada, Governments of Member States of the European Space Agency, the Government of Japan, the Government of the Russian Federation, and the Government of the United States of America Concerning Cooperation on the Civil International Space Station, arts. 5, 21–22, reaties and Other International Acts Series, No. 12,927;* US Department of State (DOS), Washington, D.C., https://2021-2025.state.gov/space-station-agreement-1998/ (1998).

127 *15 U.S. Code § 45 - Unfair methods of competition unlawful; prevention by Commission;* Cornell Law School Legal Information Institute (LII), Ithaca, New York, https://www.law.cornell.edu/uscode/text/15/45 (Accessed August 2026 (originally enacted 1914)).

128 Müge Fazlioglu. *US State Comprehensive Privacy Laws Report 2025;* International Association of Privacy Professionals (IAPP), Portsmouth, New Hampshire, https://iapp.org/resources/article/us-state-privacy-laws-overview (2023 (last updated 2025; accessed August 2026)).

129 Max Rieper. *All of the Comprehensive Privacy Laws That Take Effect in 2026;* MultiState, Arlington, Virginia, https://www.multistate.us/insider/2026/2/4/all-of-the-comprehensive-privacy-laws-that-take-effect-in-2026 (2026).

130 *18 U.S. Code § 2713 - Required preservation and disclosure of communications and records;* Cornell Law School Legal Information Institute (LII), Ithaca, New York, https://www.law.cornell.edu/uscode/text/18/2713 (Accessed August 2026 (originally enacted 2018)).

131 *28 C.F.R. Part 202—Access to U.S. Sensitive Personal Data and Government-Related Data by Countries of Concern or Covered Persons;* Federal Register (U.S. National Archives and Records Administration), Washington, D.C., https://www.ecfr.gov/current/title-28/chapter-I/part-202 (Accessed August 2026).

132 F. Paul Pittman, Hope Anderson & Abdul M. Hafiz. *US Data Privacy Guide;* White & Case, LLP, New York, New York, https://www.whitecase.com/insight-our-thinking/us-data-privacy-guide (2026).

133 30th meeting of the Standing Committee of the 13th National People's Congress, Rogier Creemers (Translation) & Graham Webster (Translation). *Translation: Personal Information Protection Law of the People's Republic of China – Effective Nov. 1, 2021;* DigiChina (Stanford Cyber Policy Center), Stanford, California, Translated at https://digichina.stanford.edu/work/translation-personal-information-protection-law-of-the-peoples-republic-of-china-effective-nov-1-2021/ (2021).

134 DigiChina (Translator). *Translation: Data Security Law of the People's Republic of China;* DigiChina (Stanford Cyber Policy Center), Stanford, California, https://digichina.stanford.edu/work/translation-data-security-law-of-the-peoples-republic-of-china/ (2021).

135 Rogier Creemers (Translator), Graham Webster (Translator) & Paul Triolo (Translator). *Translation: Cybersecurity Law of the People's Republic of China;* DigiChina (Stanford Cyber Policy Center), Stanford,

California, https://digichina.stanford.edu/work/translation-cybersecurity-law-of-the-peoples-republic-of-china-effective-june-1-2017/ (2018 (Law effective 2017)).

136 European Parliament. *General Data Protection Regulation: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (Text with EEA relevance);* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/eli/reg/2016/679/oj/eng (2016).

137 European Parliament. *Data Act: Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 (Text with EEA relevance);* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/eli/reg/2023/2854/oj/eng (2023).

138 European Parliament. *NIS 2 Directive: Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (Text with EEA relevance);* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/eli/dir/2022/2555/oj/eng (2022).

139 European Parliament. *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the safety, resilience and sustainability of space activities in the Union, arts. 75-95 (COM/2025/335 final);* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025PC0335 (2025).

140 UK Parliament. *Data (Use and Access) Act 2025 (UK Public General Acts, 2025 CHAPTER 18);* The National Archives (on behalf of HM Government), London, United Kingdom, https://www.legislation.gov.uk/ukpga/2025/18 (2025).

141 Julian Brown. *Navigating the UK Cyber Security and Resilience Bill;* NCC Group, Manchester, United Kingdom, https://www.nccgroup.com/navigating-the-uk-cyber-security-and-resilience-bill/ (2025).

142 *Act on the Protection of Personal Information (Kojin Jōhō no Hogo ni Kansuru Hōritsu), Act No. 57 of 2003, as amended, arts. 23, 28, 171 (Japan);* Personal Information Protection Commission (PPC) (Government of Japan), Tokyo, Japan, Translation at https://www.ppc.go.jp/en/legal/ (2003).

143 Takeshi Hayakawa. *Japan: data protection in cross-border investigations;* Global Investigations Review (GIR), London, United Kingdom, https://globalinvestigationsreview.com/guide/the-guide-cyber-investigations/fourth-edition/article/japan-data-protection-in-cross-border-investigations (2026).

144 Ministry of Law and Justice (Legislative Department). *Digital Personal Data Protection Act, No. 22 of 2023, §§ 3–16 (India);* Government of India Ministry of Electronics and Information Technology, New Delhi, India, https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf (2023).

145 Indian Computer Emergency Response Team (CERT-In). *Directions No. 20(3)/2022-CERT-In under Section 70B(6) of the Information Technology Act, 2000 relating to information security practices, procedure, prevention, response and reporting of cyber incidents for Safe & Trusted Internet;* Government of India, Ministry of Electronics and Information Technology, CERT-In, New Delhi, India, https://www.cert-in.org.in/PDF/CERT-In_Directions_70B_28.04.2022.pdf (2000).

146 President of the United Arab Emirates and UAE Cabinet Office. *Personal Data Protection Law: Federal Decree-Law No. 45 of 2021 on the Protection of Personal Data, arts. 22–23 (UAE);* UAE Telecommunications and Digital Government Regulatory Authority (TDRA), Abu Dhabi, United Arab Emirates, https://u.ae/en/about-the-uae/digital-uae/data/data-protection-laws (2021).

147 Mohamed Bin Zayed Al Nahyan (President of the United Arab Emirates). *Federal Decree by Law Concerning the Regulation of the Space Sector (Law No. 46 of 2023);* UAE Ministry of Cabinet Affairs, Dubai, United Arab Emirates, https://uaelegislation.gov.ae/en/legislations/2129 (Issued 2023 (Accessed August 2026)).

148 Gulf News Report. *UAE Space Agency gives companies 90 days to obtain licences under space sector law;* Gulf News (Al Nisr Publishing LLC), Dubai, United Arab Emirates, https://gulfnews.com/uae/science/uae-space-agency-gives-companies-90-days-to-obtain-licences-under-space-sector-law-1.500621430 (2026).

149 Knesset (the parliament of the State of Israel). *The English Translation of the Israeli Protection of Privacy Law, 5741 – 1981;* Or-Hof, Tel Aviv-Yafo, Israel, English translation (as amended) at https://or-hof.com/israel-protection-of-privacy-law-5741-1981-translation/ (1981).

150 Knesset (the parliament of the State of Israel). *Privacy Protection (Data Security) Regulations, 5777-2017, 5 April 2017;* Informática Jurídica, Ávila, Spain, Unofficial English translation at http://www.informatica-juridica.com/regulations/privacy-protection-data-security-regulations-5777-2017-5-april-2017/ (2017).

151 European Data Protection Board (EDPB) News. *EDPB publishes final version of guidelines on data transfers to third country authorities and SPE training material on AI and data protection;* EDPB, Brussels, Belgium, https://www.edpb.europa.eu/news/edpb-publishes-final-version-of-guidelines-on-data-transfers-to-third-country-authorities-and_en (2025).

152 European Data Protection Board (EDPB). *Guidelines 05/2021 on the Interplay between the application of Article 3 and the provisions on international transfers as per Chapter V of the GDPR (Version 2.0);* EDPB, Brussels, Belgium, https://www.edpb.europa.eu/system/files/documents/2023-02/edpb_guidelines_05-2021_interplay_between_the_application_of_art3-chapter_v_of_the_gdpr_v2_en_0.pdf (2023).

153 Dimitrios Stroikos. Still Lost in Space? Understanding China and India's Anti-Satellite Tests through an Eclectic Approach. *Astropolitics* 21, 179-205 (2023). https://doi.org/10.1080/14777622.2023.2277253.

154 Marcia Smith. *U.N. Approves Resolution Not to Conduct Destructive ASAT Tests;* SpacePolicyOnline.com (Space and Technology Policy Group, LLC), Arlington, Virginia, https://spacepolicyonline.com/news/u-n-approves-resolution-not-to-conduct-destructive-asat-tests/ (2022).

155 Cybersecurity and Infrastructure Security Agency (CISA). *Strengthening Cybersecurity of SATCOM Network Providers and Customers;* CISA (Department of Homeland Security), Washington, D.C., https://www.cisa.gov/news-events/cybersecurity-advisories/aa22-076a (2022 (Accessed August 2026)).

156 Council of the European Union. *Russian cyber operations against Ukraine: Declaration by the High Representative on behalf of the European Union (Press Release);* Brussels, Belgium, https://www.consilium.europa.eu/en/press/press-releases/2022/05/10/russian-cyber-operations-against-ukraine-declaration-by-the-high-representative-on-behalf-of-the-european-union/ (2022).

157 Saman Zonouz and The Conversation. *America hacked Venezuela's grid to literally turn off the lights on Jan. 3. It could happen here, too;* FORTUNE (Fortune Media Group), New York, New York, https://fortune.com/2026/01/22/america-hacked-venezuelas-grid-to-literally-turn-off-the-lights-on-jan-3-it-could-happen-here-too/ (2026).

158 Xiaodon Liang. *Ukraine Strikes Russian Early-Warning Radars;* Arms Control Association, Washington, D.C., https://www.armscontrol.org/act/2024-07/news/ukraine-strikes-russian-early-warning-radars (2024).

159 Defense Express. *Ukrainian UAVs Hit russian Voronezh-DM Over-the-Horizon Radar of 6,000 km Observation Range;* Kyiv, Ukraine, https://en.defence-ua.com/news/ukrainian_uavs_hit_russian_voronezh_dm_over_the_horizon_radar_of_6000_km_observation_range-10612.html (2024).

160 Mike Lennon. *AT&T Data Breach: 'Nearly All' Wireless Customers Exposed in Massive Hack;* SecurityWeek, Boston, Massachusetts, https://www.securityweek.com/att-data-breach-nearly-all-wireless-customers-exposed-in-massive-hack/ (2024).

161 United Nations (UN). *United Nations Charter (full text), arts. 2(4), 51;* UN, New York, New York, https://www.un.org/en/about-us/un-charter/full-text (Accessed August 2026).

162 United Nations General Assembly. *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, art. III (incorporating international law including the Charter);* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html (1966).

163 International Telecommunication Union (ITU). *Constitution of the International Telecommunication Union, art. 44, United Nations Treaty Series, Vol. 1825, pg. 331;* ITU, Geneva, Switzerland, https://www.itu.int/en/council/Documents/basic-texts/Constitution-E.pdf (1992).

164 International Court of Justice. *Summary of the Advisory Opinion of 8 July 1996 (Case 95 – Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, Number 1996/2) (Document Number 7497);* The Hague, The Netherlands, https://www.icj-cij.org/node/103903 (1996).

165 Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law applicable in Armed Conflicts. *Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), arts. 48–52, United Nations Treaty Series, Vol 125, pg. 3;* International Committee of the Red Cross (ICRC) International Humanitarian Law (IHL) Databases, Geneva, Switzerland, https://ihl-databases.icrc.org/en/ihl-treaties/api-1977 (1977).

166 International Committee of the Red Cross (ICRC). *Constraints under International Law on Military Operations in, or in Relation to, Outer Space during Armed Conflicts (Working paper);* Geneva, Switzerland, https://documents.unoda.org/wp-content/uploads/2022/05/ICRC-working-paper-on-the-constraints-under-international-law-on-military-space-operations_final_en.pdf (2022).

167 United Nations General Assembly. *Group of Governmental Experts on Advancing Responsible State Behaviour in Cyberspace in the Context of International Security (U.N. Doc. A/76/135);* United Nations (UN), New York, New York, https://docs.un.org/en/A/76/135 (2021).

168 Open-Ended Working Group on Security of and in the Use of Information and Communications Technologies 2021–2025. *Final Report (transmitted in Letter from the Chair);* United Nations Office for Disarmament Affairs (UNODA), New York, New York, https://docs-library.unoda.org/Open-Ended_Working_Group_on_Information_and_Communication_Technologies_-_(2021)/Letter_from_OEWG_Chair_10_July_2025.pdf (2025).

169 Council of Europe. *The Convention on Cybercrime (Budapest Convention, ETS No. 185) and its Protocols;* Council of Europe: Cybercrime, Budapest, Hungary, https://www.coe.int/en/web/cybercrime/the-budapest-convention (2001).

170 Cybersecurity and Infrastructure Security Agency (CISA). *National Security Memorandum on Critical Infrastructure Security and Resilience;* Washington, D.C., https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/national-security-memorandum-critical-infrastructure-security-and-resilience (2024).

171 Congressional Research Service (CRS). *The 2024 National Security Memorandum on Critical Infrastructure Security and Resilience (CRS Product Number: IF12716);* Library of Congress, Washington, D.C., https://www.congress.gov/crs-product/IF12716 (2024).

172 Fieldfisher. *Preparing for NIS2 – new cybersecurity rules for the EU space sector and suppliers to the EU space sector;* London, United Kingdom, https://www.fieldfisher.com/en/insights/preparing-for-nis2-new-cybersecurity-rules-for-the-eu-space-sector-and-supplies-to-the-eu-space-sector (2024).

173 Oliver Yaros, Ana Hadnes Bruder, Ellen Hepworth, Alasdair Maher, Katie Steval, Rebecca Keay & Shannon Balnaves. *United Kingdom Proposes Changes in the Cyber Security and Resilience Bill to the NIS Regulations, with Key Differences to NIS2;* Mayer Brown, Chicago, Illinois,

https://www.mayerbrown.com/en/insights/publications/2026/03/united-kingdom-proposes-changes-in-the-cyber-security-and-resilience-bill-to-the-nis-regulations-with-key-differences-to-nis2 (2026).

174 Rogier Creemers (Translator), Samm Sacks (Translator) & Graham Webster (Translator). *Translation: Critical Information Infrastructure Security Protection Regulations (Effective Sept. 1, 2021);* DigiChina (Stanford Cyber Policy Center), Stanford, California, Translation available at https://digichina.stanford.edu/work/translation-critical-information-infrastructure-security-protection-regulations-effective-sept-1-2021 (2021).

175 Hiromi Hayashi, Masaki Yukawa, Daisuke Tsuta, Noriyuki Yoshizawa & Mori Hamada & Matsumoto (Contributing Firm). *Japan - Cybersecurity Laws and Regulations 2026;* International Comparative Legal Guides (ICLG), London, United Kingdom, https://iclg.com/practice-areas/cybersecurity-laws-and-regulations/japan (2025).

176 Anhad Law. *Cybersecurity Laws in India: A Comprehensive Guide;* Lexology (Law Business Research (LBR) trading as Centellic), London, United Kingdom, https://www.lexology.com/library/detail.aspx?g=d599eba2-e69a-4121-95b4-ff84e49730c6 (2025).

177 Parliament of India and Kocheril Raman Narayanan (Indian President). *The Information Technology Act, 2000 (Act 21 of 2000);* IndiaCode (National Informatics Centre (NIC); content provided by the Ministries/Departments in the Government of India), New Delhi, India, https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf (2000).

178 UAE Legislation. *Federal Decree by Law Concerning the Regulation of the Space Sector (Law No. (46) of 2023), art. 1;* Government of the United Arab Emirates, Abu Dhabi, United Arab Emirates, https://uaelegislation.gov.ae/en/legislations/2129 (2023).

179 Avishay Klein & Masha Yudashkin. *Israel Publishes National Cybersecurity Draft Bill: New Obligations, Enforcement Authorities, and Broad Implications;* Barnea Jaffa Lande Law Offices, Tel Aviv, Israel, https://barlaw.co.il/practice_areas/high-tech/cyber/client_updates/israel-publishes-national-cybersecurity-draft-bill-2026-new-obligations-enforcement-authorities-and-broad-implications/ (2026).

180 Assaf Harel, Rebecca Genis Shepetovsky & Rona Tal. *National Cyber Defense Bill (Knesset first reading June 8, 2026);* Gornitzky & Co. (Israeli Law Firm), Tel Aviv, Israel, https://www.gornitzky.com/national-cyber-defense-bill/ (2026).

181 Bushra AlBlooshi, Hoda Al Khzaimi & Heba Ahmad. *Why cyber resilience in space is essential for economic security;* World Economic Forum (WE Forum), Geneva, Switzerland, www.weforum.org/stories/2025/10/why-cyber-resilience-in-space-is-essential-for-economic-security/ (2025).

182 European Commission. *EU Space Act;* European Commission Directorate-General for Defence Industry and Space, Brussels, Belgium, https://defence-industry-space.ec.europa.eu/eu-space-act_en (2025).

183 Department of Commerce Bureau of Industry and Security. *Code of Federal Regulations Title 15 – Commerce and Foreign Trade, Subtitle B – Regulations Relating to Commerce and Foreign Trade, Chapter VII – Bureau of Industry and Security, Department of Commerce, Subchapter C – Export Administration Regulations, Part 734 – Scope of the Export Administration Regulations, § 734.18 Activities that are not exports, reexports, or transfers* National Archives Electronic Code of Federal Regulations (eCFR), Washington, D.C., https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-734/section-734.18 (1996 (Notice of November 7, 2024; accessed August 2026)).

184 European Parliament. *Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May 2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items (recast);* EUR-Lex (Publications Office of the European Union), Luxembourg City, Luxembourg, https://eur-lex.europa.eu/eli/reg/2021/821/oj/eng (2021).

185 UK Department for Business & Trade. *Consolidated list of strategic military and dual-use items that require export authorisation;* Government of the United Kingdom, London, United Kingdom, https://www.gov.uk/government/publications/uk-strategic-export-control-lists-the-consolidated-list-of-strategic-military-and-dual-use-items-that-require-export-authorisation (2013 (last updated December 2025; accessed August 2026)).

186 Xinhua News Agency. *China issues regulations on export control of dual-use items;* The People's Republic of China (PCR) State Council, Beijing, China, https://english.www.gov.cn/policies/latestreleases/202410/19/content_WS67139778c6d0868f4e8ec188.html (2024).

187 Anderson Mori & Tomotsune (Law Firm) (Authors: Hirofumi Mizuma, Hiroyuki Saga, Keita Tokura & Taku Matsumoto). *Snapshot: foreign investment law and policy in Japan;* Lexology (Law Business Research (LBR) trading as Centellic), London, United Kingdom, https://www.lexology.com/library/detail.aspx?g=5a53441b-73c7-49b4-a534-865385d94218&__cf_chl_tk=BLt3DOROF8A7Yl.MVyC0IJXpQkdvG9rMLs3uUfxatZ4-1791767625-1.0.1.1-21NMovp.yddht4tJzKdJexLUD6lN8RYmJgVr3hzB5.g (2024 (updated annually, accessed August 2026)).

188 Douglas W. Gates. International Law Adrift: Forum Shopping, Forum Rejection, and the Future of Maritime Dispute Resolution. *Chicago Journal of International Law* Vol. 18, No. 1, Art. 8 (2017). https://chicagounbound.uchicago.edu/cjil/vol18/iss1/8/.

189 Luiz Eduardo Salles. *Forum Choice and Forum Shopping (Encyclopedia Entry);* Oxford Public International Law (OPIL) (Oxford University Press and Max Planck Institute for Comparative Public Law and International Law), Oxford, United Kingdom and Heidelberg, Germany, https://opil.ouplaw.com/display/10.1093/law-mpeipro/e1577.013.1577/law-mpeipro-e1577 (Accessed August 2026 (Last updated 2020)).

190 Andrew Falle, Ewan Wright, Aaron Boley & Michael Byers. One million (paper) satellites. *Science* 382, 150-152 (2023). https://doi.org/10.1126/science.adi4639.

191 Ewan Wright & Andrew Falle. *Over the past six years, governments proposed launching over one million satellites, but where will they all go?;* The Conversation US, Inc., Waltham, Massachusetts, https://theconversation.com/over-the-past-six-years-governments-proposed-launching-over-one-million-satellites-but-where-will-they-all-go-215979 (2023).

192 Frans G. von der Dunk (Editor). The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law in *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation, Studies in Space Law, Volume 6, pages 3–28* (Martinus Nijhoff Publishers, Leiden, The Netherlands, 2011, https://digitalcommons.unl.edu/spacelaw/69).

193 United Nations General Assembly. *A/RES/68/74: Recommendations on national legislation relevant to the peaceful exploration and use of outer space (Resolution adopted by the General Assembly on 11 December 2013);* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/pdf/gares/A_RES_68_074E.pdf (2013).

194 United Nations General Assembly. *Convention on Registration of Objects Launched into Outer Space, arts. I(a), I(c), II, IV, United Nations Treaty Series, Vol. 1023, pg. 15;* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html (1975).

195 Frans Gerhard von der Dunk. *Towards 'Flags of Convenience' in Space?;* Social Science Research Network (SSRN) (Elsevier, Inc.), Rochester, New York, http://dx.doi.org/10.2139/ssrn.2035534 (2012).

196 Third United Nations Conference on the Law of the Sea. *United Nations Convention on the Law of the Sea, arts. 87, 91–94, 112–115, United Nations Treaty Series, Vol. 1833, p. 397;* United Nations (UN), New York, New York, https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf (1982).

197 United Nations General Assembly. *A/RES/62/101: Recommendations on enhancing the practice of States and international intergovernmental organizations in registering space objects (Resolution adopted by the General Assembly);* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/pdf/gares/ARES_62_101E.pdf (2008).

198 International Telecommunication Union (ITU). *Radio Regulations, Edition of 2024;* Geneva, Switzerland, https://www.itu.int/hub/publication/r-reg-rr-2024/ (2024).

199 U.S. Federal Communications Commission (FCC). *Space Innovation; Mitigation of Orbital Debris in the New Space Age (Document Citation 89 FR 65217, Document Number 2024-17093, Pages 65217-65223);* Federal Register (U.S. National Archives and Records Administration), Washington, D.C., https://www.federalregister.gov/documents/2024/08/09/2024-17093/space-innovation-mitigation-of-orbital-debris-in-the-new-space-age (2024).

200 U.S. Federal Communications Commission (FCC). *Code of Federal Regulations Title 47 – Telecommunication, Chapter I – Federal Communications Commission, Subchapter B – Common Carrier Services, Part 25 – Satellite Communications, Subpart B – Applications and Licenses, General Application Filing Requirements, § 25.114 Applications for space station authorizations;* National Archives Electronic Code of Federal Regulations (eCFR), Washington, D.C., https://www.ecfr.gov/current/title-47/chapter-I/subchapter-B/part-25/subpart-B/section-25.114 (2003).

201 International Telecommunication Union (ITU). "ITU Radio Regulations, Resolution 35 (REV.WRC-23)" in *The World Radiocommunication Conference (WRC-23)*, Dubai, United Arab Emirates. https://www.itu.int/en/ITU-R/space/Documents/RES35(REV.%20WRC-23).pdf,(2023).

202 Jeff Foust. *SpaceX files plans for million-satellite orbital data center constellation;* SpaceNews, Alexandria, Virginia, https://spacenews.com/spacex-files-plans-for-million-satellite-orbital-data-center-constellation/ (2026).

203 Xinhua News Agency. *China Focus: From ground to orbit: China eyes computing in space;* Xinhuanet, Beijing, China, https://english.news.cn/20260425/b4368923827e4988af1bd030dd01d9cc/c.html (2026).

204 The European Space Agency (ESA). *ESA Space Environment Report 2025;* ESA, Paris, France, https://www.esa.int/Space_Safety/Space_Debris/ESA_Space_Environment_Report_2025 (2025).

205 United Nations General Assembly. *Convention on International Liability for Damage Caused by Space Objects, arts. I(a), II–III, VIII–IX, United Nations Treaty Series, Vol. 961;* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html (1972).

206 Government of Canada & Government of the Union of Soviet Socialist Republics. *Bilateral and Multilateral Agreements Governing Space Activities: Disintegration of COSMOS 954 over Canadian territory in 1978; Protocol Between the Government of Canada and the Government of the Union of Soviet Socialist Republics (Settlement of Claim for Damage Caused by "Cosmos 954");* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/bi-multi-lateral-agreements/can_ussr_001.html (1981).

207 Andrew Cohen. *The Soviet Union signed an agreement to pay Canada...* United Press International, Inc. (UPI), Washington, D.C., https://www.upi.com/Archives/1981/04/03/The-Soviet-Union-signed-an-agreement-to-pay-Canada/7235355122000/ (1981).

208 Michael Listner. *Iridium 33 and Cosmos 2251 three years later: where are we now?;* The Space Review (in association with SpaceNews), Alexandria, Virginia, https://www.thespacereview.com/article/2023/1 (2012).

209 Frans G. von der Dunk. Too-Close Encounters of the Third Party Kind: Will the Liability Convention Stand the Test of the Cosmos 2251-Iridium 33 Collision? (2010). https://www.researchgate.net/publication/280071181_Too-

Close_Encounters_of_the_Third_Party_Kind_Will_the_Liability_Convention_Stand_the_Test_of_the_Cosmos_2251-Iridium_33_Collision.

210 Joel A Dennerley. State Liability for Space Object Collisions: The Proper Interpretation of 'Fault' for the Purposes of International Space Law. *European Journal of International Law* 29, 281-301 (2018). https://doi.org/10.1093/ejil/chy003.

211 Josh Dinner. *Florida family files claim with NASA after ISS space junk crashes into home;* Space (Future US, Inc.), New York, New York, https://www.space.com/space-debris-florida-family-nasa-lawsuit (2024).

212 Joe Hernandez. *A Florida family is suing NASA after a piece of space debris crashed through their home;* National Public Radio (NPR), Washington, D.C., https://www.npr.org/2024/06/23/nx-s1-5016923/space-debris-nasa-florida-home-lawsuit (2024).

213 Cranfill Sumner LLP. *Mica Nguyen Worthy Submits First-of-its-Kind Claim to NASA Seeking Recovery From Damages Sustained from Space Debris;* Raleigh, North Carolina, https://www.cshlaw.com/news/mica-nguyen-worthy-submits-first-of-its-kind-claim-to-nasa-seeking-recovery-from-damages-sustained-from-space-debris/ (2024).

214 U.S. Federal Communications Commission (FCC). *Code of Federal Regulations Title 47 – Telecommunication, Chapter I – Federal Communications Commission, Subchapter B – Common Carrier Services, Part 25 – Satellite Communications, Subpart B – Applications and Licenses, Forfeiture, Termination, and Reinstatement of Station Authorization, § 25.165 Surety bonds;* National Archives Electronic Code of Federal Regulations (eCFR), Washington, D.C., https://www.ecfr.gov/current/title-47/chapter-I/subchapter-B/part-25/subpart-B/subject-group-ECFR3e61a02158c60ca/section-25.165 (2003).

215 National Defense Science Technology and Industry Committee of the People's Republic of China. *Interim Measures for the Administration of Licensing of Civil Space Launch;* China National Space Administration (CNSA), Beijing, China, https://www.cnsa.gov.cn/n6758823/n6758839/c6796213/content.html (2002).

216 People's Republic of China (PRC) State Administration of Science Technology and Industry for National Defence (SASTIND). *Notice of the National Defense Science and Industry Bureau on Matters Related to Strengthening the Licensing Management of Civil Space Launch Projects;* SASTIND, Beijing, China, https://www.sastind.gov.cn/n10086167/n10086221/c10129160/content.html (2023).

217 French Parliament. *French Space Operations Act (Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales);* Légifrance, Paris, France, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000018931380/ (2008).

218 Charlie Shute, Theo Cornish & Erin Davies. *Space insurance developments in the UK and Europe (Insights and Analysis);* Hogan Lovells Cadwalader, London, United Kingdom and Washington, D.C., https://www.hlc.com/en/publications/space-insurance-developments-in-the-uk-and-europe (2025).

219 Parliament of the United Kingdom. *Outer Space Act 1986 (1986 CHAPTER 38);* London, United Kingdom, https://www.legislation.gov.uk/ukpga/1986/38 (1986 (up to date with all changes on or before August 2026; accessed August 2026)).

220 Chris Grayling MP (UK Parliament). *Space Industry Act 2018, c. 5;* The National Archives (HM Government), Surrey, United Kingdom, https://www.legislation.gov.uk/ukpga/2018/5 (2018).

221 Parliament of the United Kingdom. *Space Industry (Indemnities) Act 2025 (2025 CHAPTER 35);* London, United Kingdom, https://www.legislation.gov.uk/ukpga/2025/35 (2025 (accessed August 2026)).

222 Indian National Space Promotion and Authorization Centre (In-SPACEe). *Norms, Guidelines and Procedures for Implementation of Indian Space Policy-2023 in respect of Authorization of Space Activities (NGP);* Government of India Department of Space In-SPACEe, Gujarat, India, https://www.inspace.gov.in/sys_attachment.do?sys_id=5d532e37877102503b0f0d060cbb35cf (2024).

223 Ankita Kumar & Tanya Srivastava. *How to insure against private spaceflight risks;* Law.asia (India Business Law Journal), Sheung Wan, Hong Kong, https://law.asia/space-liability-framework/ (2025).

224 Eshaan Bansal. *India's Space Insurance Blind Spot: Why A Holistic Liability Framework Is Critical;* The Free Press Journal, Mumbai, India, https://www.freepressjournal.in/lifestyle/indias-space-insurance-blind-spot-why-a-holistic-liability-framework-is-critical (2025).

225 Japan's Cabinet Office and Committee on National Space Policy. *Act on the launch of satellites and the management of satellites and Act on Launching Spacecraft and Launch Vehicle and Control of Spacecraft (Act No. 76 of 2016);* Japanese Law Translation Project, Tokyo, Japan, https://www.japaneselawtranslation.go.jp/ja/laws/view/4813 (2016).

226 George Gibson & Akihiko Takamatsu. *Global Outer Space Guide: Japan;* Norton Rose Fulbright, London, United Kingdom, https://www.nortonrosefulbright.com/en/knowledge/publications/b95ef154/global-outer-space-guide-japan (2023).

227 Koji Ishikawa. *Japanese Government Plans to Amend Space Activities Act | Part 1 (GT Advisory);* Greenberg Traurig (GT), LLP, Miami, Florida, https://www.gtlaw.com/en/insights/2025/7/japanese-government-plans-to-amend-space-activities-act-part-1 (2025).

228 Legal Subcommittee of the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS). *Israel's Statement to the LSC 2023 under General exchange of views;* United Nations Office for Outer Space Affairs (UNOOSA), Vienna, Austria, https://www.unoosa.org/documents/pdf/copuos/lsc/2023/Statements/22_AM/3_Israel_22Mar_AM.pdf (2023).

229 Parametrix Solutions Inc. *CrowdStrike's Impact on the Fortune 500;* New York, New York, https://www.parametrixinsurance.com/reports-white-papers/crowdstrikes-impact-on-the-fortune-500 (Accessed August 2026).

230 Insurance Journal. *Fortune 500's Insured Losses for CrowdStrike Could Reach $1 Billion: Parametrix;* Wells Media Group, Inc., San Diego, California, https://www.insurancejournal.com/news/international/2024/07/24/785285.htm (2024).

231 Market Growth Reports. *Space Insurance Market Overview;* Pune, Maharashtra, India, https://www.marketgrowthreports.com/market-reports/space-insurance-market-112719 (2026).