

A Legal Mirage: State Responsibility for Non-State Actor Interference with Space Systems

Un mirage juridique: la responsabilité étatique pour les ingérences non-étatiques dans le fonctionnement de systèmes spatiaux

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Abstract

Outer space is becoming a more accessible and less expensive domain in which to operate. Consequently, growing numbers of state and non-state actors (NSAs) are operating in, to, and through space. At the same time, instances of space-based and ground-based interference with space systems are also increasing, disrupting crucial space-supported services and applications relied on by millions, with great financial and operational costs. The increased participation of NSAs in space activities raises particular concerns, especially the threat of intentional interference with space systems by nefarious actors like terrorist organizations. It also

Résumé

L'espace devient plus accessible et les opérations extra-atmosphériques moins coûteuses. Par conséquent, un nombre croissant d'acteurs étatiques et non-étatiques opèrent dans ce domaine. Parallèlement, les ingérences spatiales et terrestres dans le fonctionnement de systèmes spatiaux se multiplient, perturbant les services et applications spatiaux essentiels sur lesquels comptent des millions de personnes et occasionnant des coûts financiers et opérationnels considérables. La participation accrue d'acteurs non-étatiques (ANE) aux activités spatiales soulève des préoccupations particulières, notamment la menace d'ingérence intentionnelle dans le

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requires consideration of whether states bear responsibility and/or liability for the acts of NSAs with a nexus to those states. At first glance, it is tempting to conclude that one or more normative legal regimes would apply. The potential regimes include international space law, international telecommunications law, and the law of state responsibility. On further examination, however, when it comes to interference, there appears to be no effective legal mechanism to hold states accountable for NSA interference with space systems, which can be exploited by NSAs and challenge efforts by states to enforce “good” behaviour.

fonctionnement de systèmes spatiaux par des acteurs néfastes tels des groupes terroristes. Elle pose également la question à savoir si les États portent une responsabilité quelconque pour les actes des ANE ayant un lien avec ces États. À première vue, il semblerait que plusieurs régimes juridiques internationaux s’appliqueraient à cette question, y-inclus le droit international de l’espace, le droit international des télécommunications et le régime de la responsabilité étatique. Cependant, un examen plus minutieux révèle qu’il ne semble pas y avoir de mécanisme juridique efficace pour imposer une responsabilité quelconque aux États pour les éventuelles ingérences des ANE dans le fonctionnement de systèmes spatiaux. Cette lacune pourrait être exploitée par les ANE et remettre en cause les efforts des États pour faire respecter les “bons” comportements dans le domaine extra-atmosphérique.

Keywords: International space law; international telecommunications law; non-state actors; outer space; space systems; state responsibility.

Mots-clés: Acteurs non-étatiques; droit international de l’espace; droit international des télécommunications; espace extra-atmosphérique; responsabilité des États; systèmes spatiaux.

INTRODUCTION

Over the past decade, space systems have experienced increasing levels of interference from a variety of sources.¹ Interference with space systems can take the form of jamming, spoofing, piggybacking, or cyber interference.² There are many classified and unclassified examples of

¹ A space system includes “all devices and organizations forming the space network,” which includes the satellite(s), the transmissions, and the ground station and associated infrastructure. “Space assets” are elements of space systems and are the “equipment that is an individual part of a space system, which is or can be placed in space or directly supports space activity terrestrially.” United States Department of Defence, *DOD Dictionary of Military and Associated Terms* (July 2017) at 215-16, online: <http://www.dtic.mil/doctrine/new_pubs/dictionary.pdf>.

² “Jamming” is the deliberate interference with wireless communications. “Spoofing” is “[masquerading] through the falsification of data.” Many types of interference affect the electromagnetic spectrum. Todd Harrison et al, “Escalation and Deterrence in the Second Space Age,” *Center for Strategic and International Studies* (October 2017) at 14-15, online:

interference with space systems by both state and non-state actors (NSAs). For instance, in 2007, the Liberation Tigers of Tamil Eelam (LTTE), based in Sri Lanka, pirated and jammed an Intelsat satellite transponder signal.³ The LTTE then used this hijacked signal to broadcast propaganda transmissions for two years.⁴ Interference like this is becoming an increasing problem with serious political, social, military, and economic consequences.⁵ It poses a growing challenge to satellite operators and can impede military, civil, and commercial uses by disrupting space-based applications, costing system operators millions of dollars.⁶ The emergence of NSAs interfering with space systems also poses challenges to the application of existing international law and raises questions of whether and how states, as key actors and subjects in international law, can be held responsible and liable for NSA actions.

In 1967, with the adoption of the *Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (*Outer Space Treaty*), states were recognized as the pre-eminent actors in space and international law because it was states that traditionally accessed, used, and explored space.⁷ However, as financial

<https://csis-prod.s3.amazonaws.com/s3fs-public/publication/171003_Cooper_EscalationDeterrenceSecondSpaceAge.pdf>. “Piggybacking” refers to the practice of using another entity’s satellite signal without consent or knowledge. “Interference by cyber means” can include interference with satellites by controlling various elements of a system to jam, spoof, or hack communications networks, control systems, and payloads or to interfere with ground infrastructure, including satellite control centres. David Livingstone & Patricia Lewis, “Space, the Final Frontier for Cyber Security?” *Chatham House* (22 September 2016) at 2, online: <<https://www.chathamhouse.org/publication/space-final-frontier-cybersecurity>>.

³ Peter B de Selding, “Intelsat Vows to Stop Piracy by Sri Lanka Separatist Group,” *Space News* (18 April 2007), online: <<http://spacenews.com/intelsat-vows-stop-piracy-sri-lanka-separatist-group/>>. The Liberation Tigers of Tamil Eelam used a vacant Ku-band transponder on an Intelsat satellite to essentially hijack the signal.

⁴ Nina-Louisa Remuss, “The Need to Counter Space Terrorism: A European Perspective,” *European Space Policy Institute* (6 January 2009) at 3, online: <<http://www.espi.or.at/images/stories/dokumente/Perspectives/espi%20perspectives%2017.pdf>>.

⁵ Sarah Mountin, “The Legality and Implications of Intentional Interference with Commercial Communication Satellite Signals” (2014) 90 *Intl L Stud* 101 at 107.

⁶ In 2016, the commercial satellite service industry represented revenues of US \$127.4 billion. In 2015, global satellite industry revenues represented US \$208 billion. Satellite Industry Association, “2016 SIA State of Satellite Industry Report,” *Satellite Industry Association* (September 2016), online: <<http://www.sia.org/wp-content/uploads/2017/03/SSIR-2016-update.pdf>>.

⁷ *Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967) [*Outer Space Treaty*]; James Crawford, *Brownlie’s Principles of Public International Law*, 8th ed (Oxford: Oxford University Press, 2012) at 20.

and technological barriers to space launch and the use of space have decreased over time, space has become more accessible to NSAs (including commercial companies, civil organizations, academic institutions, and private individuals and entities, including terrorist and extremist organizations (TEOs)).⁸ The emergence of NSAs as important space actors was not envisioned during the drafting of the major space treaties, which now form part of the international space law (ISL) regime.⁹ Further, the increased accessibility of space means that NSAs with nefarious motives can leverage space technologies to conduct illicit activities and interfere with state and other NSA interests.¹⁰

When considering responsibility and liability for interference with space systems, there are multiple intersecting normative regimes at play, including domestic law, ISL, the International Telecommunication Union (ITU) regime, and the law of state responsibility.¹¹ The *Outer Space Treaty* establishes the basis of the ISL framework, and the *Convention on International Liability for Damage Caused by Space Objects (Liability Convention)* expands on this by

⁸ Non-state actors (NSAs) include: international governmental organizations (e.g., European Space Agency), international organizations (e.g., International Telecommunication Union (ITU)), non-governmental organizations, domestic and multinational corporations (i.e., commercial, telecommunications, and remote-sensing companies), rebel groups, terrorist organizations, civil society organizations, academic institutions, and individuals. Bob Reinalda, ed, *The Ashgate Research Companion to Non-State Actors* (Burlington, VT: Ashgate, 2011) at 21; George D Kyriakopoulos, "Legal Challenges Posed by the Actions of Non-State Actors in Outer Space" (Lecture delivered at the second Manfred Lachs Conference on Global Space Governance, 30 May 2014) [unpublished].

⁹ Gérardine Meishan Goh, *Dispute Settlement in International Space Law: A Multi-Door Courthouse for Outer Space* (Leiden: Martinus Nijhoff, 2007) at 23.

¹⁰ NSAs can utilize space assets for operational planning of activities, which include the use of satellite navigation, high-resolution imagery, and digital mapping. Anne-Sophie Martin, "Space Applications as Instruments to Face Terrorist Threats" (Lecture delivered at the fifth Manfred Lachs Conference on Global Space Governance and the UN 2030 Agenda, 6 May 2017) [unpublished]. NSAs can also interfere with space systems in three general ways: a) measures can be taken directly against satellites, b) measures can be taken against launch facilities or ground stations/infrastructure, or c) interference or measures can occur against the use of equipment that services the space system. Interference can occur as a result of any of the following actions or a combination thereof: disruption, degradation, denial, deception or destruction. Remuss, *supra* note 4 at 3–5.

¹¹ The ITU is the international organization that plays a key role in globally managing the radio-frequency spectrum and satellite orbits, which are "limited natural resources which are increasingly in demand from a large and growing number of services such as fixed, mobile, broadcasting, amateur, space research, emergency telecommunications, meteorology, global positioning systems, environmental monitoring and communications services" and are leveraged every day for services on land, at sea and in the air. François Rancy, "Welcome to ITU-R," *International Telecommunication Union* (2017), online: <<https://www.itu.int/en/ITU-R/information/Pages/default.aspx>>.

setting out absolute and fault-based liability provisions.¹² Concurrently, the ITU regime sets out a detailed framework governing radio communications and aspects of state responsibility, which is also applicable to space systems. Meanwhile, the law of state responsibility applies where responsibility flows from an internationally wrongful act attributable to a state. Often viewed separately, it is unclear how these frameworks interact, particularly where NSAs interfere with space systems during peacetime.¹³

This article will begin by outlining the extent of global dependence on space systems, the wide range of NSAs operating in the space domain (with a focus on TEOs), how space systems function, and the various types of interference that can affect them. It will then consider the ISL framework, the ITU regime, the law of state responsibility, and how these legal regimes interact. Finally, the article will analyze the application of these frameworks to NSAs by looking at three scenarios: space-based jamming from one space asset to another, ground-based orbital interference, and ground-based terrestrial interference. Each scenario will focus on intentional interference with space systems by NSAs under these regimes to illustrate that both individually, and collectively, these legal regimes are inadequate tools for affixing state responsibility and liability in such cases. In other words, this article will demonstrate that there are gaps in the international legal frameworks that can be exploited by NSAs interfering with space systems, challenging efforts by states to enforce “good” behaviour by NSAs.

SPACE ACTORS AND GLOBAL DEPENDENCE ON SPACE SYSTEMS

Before exploring interference by NSAs, and to better appreciate the impact of such interference, it is important to understand the extent of our global dependence on space systems. Since the first satellite launched in 1957, more than sixty states and twenty organizations have operated one or more

¹² *Outer Space Treaty*, *supra* note 7; *Convention on International Liability for Damage Caused by Space Objects*, 29 November 1971, 961 UNTS 187 (entered into force 1 September 1972) [*Liability Convention*]. Currently, the *Outer Space Treaty* has been ratified by 108 states, and twenty-four states have signed, but not ratified, it. The *Liability Convention* has been ratified by ninety-five states parties, while another nineteen have signed the treaty. United Nations, “Status of International Agreements Relating to Activities in Outer Space as of 1 January 2018,” *United Nations Office of Outer Space Affairs* (April 2018), online: <http://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2018_CRPO3E.pdf>.

¹³ Deborah Housen-Couriel, “Disruption of Satellite Transmissions *Ad Bellum* and *In Bello*: Launching a New Paradigm of Convergence” (2012) 45:3 *Israel L Rev* 431 at 442. While interference by both states and NSAs is a problem, this article will only focus on interference conducted by NSAs. This article will consider states that are able to operate functioning governments and exercise some level of oversight for space activities with a nexus to it; it will not address those states that could be considered to be “failed” or “failing.”

space-based assets.¹⁴ There are currently over 1,738 operational satellites orbiting the Earth.¹⁵ As the number of space actors increases, so too does the world's reliance on space systems, applications, and technologies to conduct day-to-day governmental, business, and private tasks.¹⁶ Space-based platforms have a wide variety of uses, such as communications, environmental and weather observation (which is used for environmental-change monitoring and weather forecasting), navigation, and scientific research (from cellular biology to astrophysics).¹⁷ Many countries are dependent on space systems for the operation of much of their critical infrastructure: "Almost all of the world's aircraft, maritime vessels, land-transportation networks, energy grids, financial transactions" and military systems are highly dependent on space systems to operate.¹⁸ Satellites are also used for Internet connectivity, mobile phone use, and other telecommunications, allowing increased, cost-effective connectivity in remote locations with limited infrastructure.¹⁹ As such, space systems and the evolution of space technologies have fostered development by promoting economic growth, alleviating poverty, and predicting and managing disasters.²⁰

Beginning with the first Gulf War in 1991 — often considered to be the "first space war" due to the extent that space systems were used to enable operations — militaries have increasingly relied on space-enabled applications and capabilities to support the conduct of their operations.²¹

¹⁴ Patricia Lewis, "The 21st Century Star Wars," *Chatham House* (February and March 2016), online: <<https://www.chathamhouse.org/publications/twt/new-star-wars>>.

¹⁵ Union of Concerned Scientists, "UCS Satellite Database," *Union of Concerned Scientists* (7 November 2017), online: <<https://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.WozwLU2Wy7o>>.

¹⁶ Dan Glass, "What Happens If GPS Fails?" *The Atlantic* (13 June 2016), online: <<https://www.theatlantic.com/technology/archive/2016/06/what-happens-if-gps-fails/486824/>>; National Defence, "Strong, Secure, Engaged: Canada's Defence Policy," *Department of National Defence* (2017) at 56, online: <<http://dgpapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf>>.

¹⁷ Mountin, *supra* note 5 at 109–10; Lewis, *supra* note 14.

¹⁸ Lewis, *supra* note 14; Francis Lyall & Paul B Larsen, *Space Law: A Treatise* (Burlington, VT: Ashgate, 2009) at 389–90.

¹⁹ Mountin, *supra* note 5 at 103; Lewis, *supra* note 14.

²⁰ Lewis, *supra* note 14.

²¹ The first Gulf War is considered to be the first space war because Operation Desert Storm saw operational militaries become more dependent on space technologies to conduct operations in multiple domains. Position, navigation and timing, weather, communications, remote sensing, and early warning satellites were used and proved their mettle during this conflict. Ivan A Vlasic, "Space Law and the Military Applications of Space Technology" in Nasdasiri Jasentuliyana, ed, *Perspectives on International Law* (London: Kluwer Law International, 1995) 385 at 385, 388; Mountin, *supra* note 5 at 111; National Defence, *supra* note 16 at 56, 71.

Space systems support a variety of military uses at the tactical, operational, and strategic levels. For example, satellites are used for operations, navigation, communications, command and control systems, intelligence, surveillance and reconnaissance, and the guidance of weapons.²² On the ground, soldiers use satellite radios to communicate, and satellites control and receive real-time video feeds.²³

Over the years, civil and military uses of outer space have become intertwined as both sectors have become highly dependent on space-based applications and technologies.²⁴ Numerous satellites are considered to be “dual use,” as they often host multiple payloads that can support both civilian and military space applications.²⁵ The purpose and operation of satellites differ between civil and military uses. Civilian satellites tend to be more technologically advanced to maximize signal strength over large areas,²⁶ but they lack security and encryption in order to reduce cost and weight,²⁷ rendering them more vulnerable to interference

²² Mountin, *supra* note 5 at 112; Housen-Couriel, *supra* note 13 at 437; Michael Schmitt, “International Law and Military Operations in Space” (2006) 10 Max Planck YB UN L 89 at 89–90.

²³ Mountin, *supra* note 5 at 114.

²⁴ Civilian uses of satellites include support to the functioning of financial and economic systems, the provision of telephone and television services, which provide instantaneous communications via the Internet, supports for the transmission of financial transaction data, the coordination of air traffic control, and the provision of “just-in-time” delivery of goods and the operation of cell phones. National Defence, *supra* note 16 at 56; Olaf Acker, Florian Pötscher & Thierry Lefort, “Why Satellites Matter: The Relevance of Commercial Satellites in the 21st Century: A Perspective 2012–2020” (Presentation by Booz & Company, September 2012) [unpublished], online: <<https://www.esoa.net/Resources/Why-Satellites-Matter-Full-Report.pdf>>.

²⁵ At the beginning of the space age, the concept of dual use was essentially irrelevant because national space programs were largely controlled and led by the military, while civilian agencies were largely in a supporting role. However, over time, commercial space actors began operating space systems, which supported civilian and military applications. Steven J Dick & Roger D Launius, eds, *Societal Impact of Spaceflight* (Washington: National Aeronautics and Space Administration, 2007) at 354; Mountin, *supra* note 5 at 113.

²⁶ David Wright, Laura Grego & Lisbeth Gronlund, “The Physics of Space Security: A Reference Manual,” *American Academy of Arts and Sciences* (2005) at 121, online: <https://www.amacad.org/publications/Physics_of_space_security.pdf>.

²⁷ Civilian commercial satellites do not tend to have much encryption protecting their signals because encrypting satellite signals can result in an 80 percent drop in performance. Pierluigi Paganini, “Hacking Satellites ... Look Up to the Sky,” *Infosec Institute* (18 September 2013), online: <<http://resources.infosecinstitute.com/hacking-satellite-look-up-to-the-sky/#gref>>.

than military satellites.²⁸ Interference with dual-use space systems is problematic for both civilian and military users as they are relied on for everything from dispatching emergency services to supporting military operations.²⁹

WIDE RANGE OF NON-STATE ACTORS USING SPACE SYSTEMS

The multitude of NSAs operating in the space domain adds a layer of complexity to applying state responsibility regimes.³⁰ NSAs can include international governmental organizations (for example, the European Space Agency), international organizations (for example, the ITU), non-governmental organizations,³¹ domestic and multinational corporations (such as commercial, telecommunications, and remote-sensing companies), rebel groups, TEOs, civil society organizations, academic institutions, and individuals.³² This article will focus on TEOs, a particular subset of NSAs. Many TEOs use space-based technologies to facilitate the conduct of their operations, in the same way that militaries use space systems.³³ In addition to conventional uses, NSAs might also

²⁸ Tom Wilson, "Threats to United States Space Capabilities," *Commission to Assess United States National Security Space Management and Organization* (2000) at IV.F, online: <<http://www.fas.org/spp/eprint/article05.html>>. Commercial communications satellites are easily located due to their consistent, relatively stationary position over the Earth. Wright, Grego & Gronlund, *supra* note 26 at 121. Most commercial communications satellites are located in geostationary orbit, which is 35,786 kilometres above the Earth in a plane along the equator that remains fixed relative to the Earth as their orbit rotates at the same speed as the Earth. Lyall & Larsen, *supra* note 18 at 246, 256.

²⁹ The United States relies on commercial satellites for 80–90 percent of its communications. Loren B Thompson, "Lack of Protected Satellite Communications Could Mean Defeat for Joint Force in Future War," *Lexington Institute* (blog) (14 April 2010), online: <<http://www.lexingtoninstitute.org/lack-of-protected-satellite-communications-could-mean-defeat-for-joint-force-in-future-war/?a=1&c=1171>>.

³⁰ Reinalda, *supra* note 8 at 1.

³¹ *Ibid* at 21.

³² *Ibid*. It is interesting that so many NSAs are gaining access to space or attempting to enter the operational sphere; it has even prompted the Secure World Foundation to create a handbook to assist them in operating responsibly in space. Christopher D Johnson, ed, *Handbook for New Actors in Space* (Denver: Integrity Print Group, 2017).

³³ Martin, *supra* note 10. E.g., cellular phones used for command and control operate using applications based on satellite communications (SATCOM), and the Internet is used to communicate and obtain information for planning purposes, such as obtaining imagery of specific locations from remote sensing data, which can be used to perpetrate attacks or other disruptions.

use small satellites³⁴ or ground-based equipment to leverage space systems to interfere with the transmissions and operations of other space systems, which can cause a degradation, disruption, or denial of services to users.³⁵

The issue of NSAs using and interfering with space systems is challenging because international law generally, and space law and the law of state responsibility specifically, are based on regulating the actions and interactions of states.³⁶ NSAs are generally not subject to international law, with the exception of international humanitarian law and international criminal law, which give rise to narrower forms of responsibility.³⁷

HOW SPACE SYSTEMS WORK

To understand how interference occurs, it is important to appreciate how space systems function. Space systems comprise the physical elements launched into space, their associated ground infrastructure, and the transmissions travelling wirelessly between them using the electromagnetic spectrum.³⁸ The satellite in space is known as the “space segment,” and the transmission and data reception facilities on Earth are known as the “ground segment.”³⁹ Electromagnetic transmissions flow between these segments and other space systems via uplinks, downlinks, and intra-satellite signals (see Figure 1).⁴⁰ Transmissions between space and the ground segments operate by line of sight and avoid signal conflict through the use of allotted frequencies and orbital slots in certain orbits, which de-conflict the electromagnetic spectrum and operations in space, minimizing unintentional interference.⁴¹

³⁴ Light small satellites include mini-satellites (500 kilograms), micro-satellites (10–100 kilograms), and nano-satellites (1–10 kilograms), while pico-satellites (0.1–1 kilograms) and femto-satellites (10–100 grams) are in development. These satellites could be used to conduct space-based interference and would be much less expensive to launch due to their small weight. Patricia Lewis & David Livingstone, “What to Know about Space Security,” *Chatham House* (27 September 2016), online: <<https://www.chathamhouse.org/expert/comment/what-know-about-space-security>>.

³⁵ Handheld jammers can be purchased over the Internet for a relatively low cost. Mountin, *supra* note 5 at 131.

³⁶ James Crawford, Alain Pellet & Simon Olleson, *The Law of International Responsibility* (Oxford: Oxford University Press, 2010).

³⁷ Nicholas Tsagourias, “Non-State Actors, Ungoverned Spaces and International Responsibility for Cyber Acts” (2016) 21:3 *J Confl & Sec L* 455 at 458, 461.

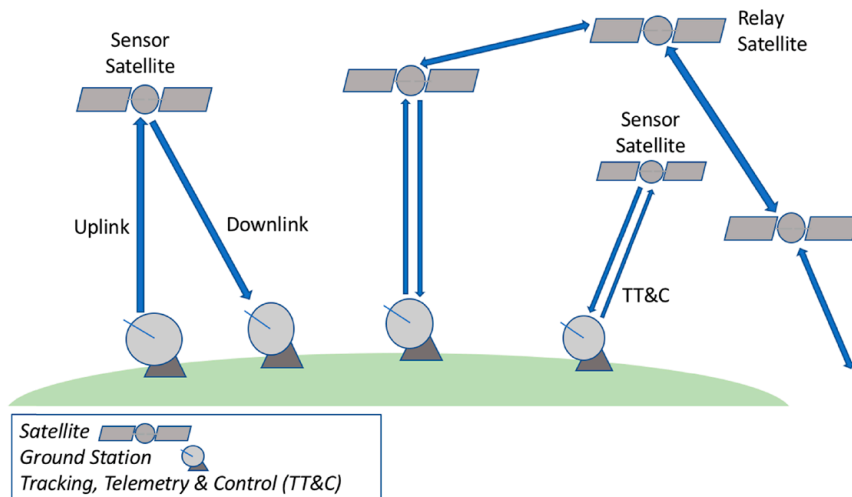
³⁸ Housen-Couriel, *supra* note 13 at 433.

³⁹ *Ibid* at 433–35.

⁴⁰ *Ibid* at 435.

⁴¹ *Ibid* at 439. Orbital slots are regulated in geostationary orbit.

Figure 1. Example diagram of space asset transmissions



INTERFERENCE WITH SPACE SYSTEMS

Space systems are vulnerable to both intentional and unintentional interference.⁴² Interference can occur because of physical damage to the space or ground segments (kinetic) or the impairment of the electromagnetic spectrum (non-kinetic), presenting a “dual threat” that can cause disruption or denial of service, degradation of capabilities, deception, or destruction of the space system.⁴³ Intentional and unintentional interference with space systems takes many forms, and its effects range from the temporary interruption of information flow,

⁴² It should be noted that jamming could be endorsed as an appropriate measure under Article 41 of the *United Nations Charter*; otherwise, it is generally considered to be interference. Jamming may be permitted where the United Nations (UN) Security Council calls upon member states to interrupt “postal, telegraphic, radio or other means of communication” in response to a threat to peace, a breach of the peace or aggression. *Charter of the United Nations*, 26 June 1945, 1 UNTS XVI, art 41 (2) (entered into force 24 October 1945) [*UN Charter*].

⁴³ Housen-Couriel, *supra* note 13 at 434, 437, 440. Space systems are vulnerable to two main threats: non-kinetic (which can include electromagnetic interference or cyber-enabled interference) or kinetic (the effect of physically interfering, damaging, or destroying another satellite with another object either in orbit or launched from the ground for that purpose — e.g., direct ascent anti-satellite weapons). This “dual threat” is amplified by cyber interference as satellites, the transmissions, and their associated ground stations are connected, commanded, and controlled using cyber platforms. However, cyber interference is outside the scope of this article. Lewis & Livingstone, *supra* note 34.

to the degradation of system efficiency, to the complete shutdown of the segment or system. Intentional interference with satellite transmissions by states and NSAs is on the rise.⁴⁴

As introduced above, there are two broad types of threats to space systems: kinetic and non-kinetic. Kinetic interference involves physical damage (achieved by means such as cyber interference or directing other space objects or direct ascent projectiles into a satellite), including the destruction of ground-based links that relay transmissions or control satellite position (potentially rendering a satellite uncontrollable).⁴⁵ Kinetic interference in space is also problematic because, if carried out against the space segment, it can create additional debris that can propagate, and damage or destroy, other critical space systems.⁴⁶ By contrast, non-kinetic interference does not cause physical damage to a system but, instead, deceives, degrades, or denies the system; this type of interference includes jamming, spoofing,⁴⁷ lasing,⁴⁸ and cyber action.⁴⁹

⁴⁴ Housen-Couriel, *supra* note 13 at 440. In 2006, it was noted by Lieutenant General Robert Kehler that there were fifty documented instances of interference with military communications over SATCOM during Operation Iraqi Freedom, of which five were determined to be hostile. Paganini, *supra* note 27.

⁴⁵ The 2009 conjunction of the Cosmos and Iridium satellites produced many pieces of space debris that interfered with other satellites. Mountin, *supra* note 5 at 104; Housen-Couriel, *supra* note 13 at 437; Harrison et al, *supra* note 2 at 11–12.

⁴⁶ Lubos Perek, “Space Debris Mitigation and Prevention: How to Build a Stronger International Regime” (2004) 2:2 *Astropolitics* 215; Mountin, *supra* note 5 at 120; Wright, Grego & Gronlund, *supra* note 26 at 22, 118, 137; Harrison et al, *supra* note 2 at 12.

⁴⁷ Jamming is intentional interference that involves overloading a specific radio frequency with too much electronic noise so that the communication is blocked at the planned destination. Wright, Grego & Gronlund, *supra* note 26 at 118–23; Harrison et al, *supra* note 2 at 14.

⁴⁸ Micah Zenko, “Dangerous Space Incidents,” Contingency Planning Memorandum No 21, *Council on Foreign Relations* (April 2014), online: <https://www.cfr.org/sites/default/files/pdf/2014/04/CPA_ContingencyMemo_21.pdf>.

⁴⁹ More recently, interference by cyber means has risen, with hackers gaining full functional control of the National Aeronautics and Space Administration (NASA) computers in 2011. This particular hacking incident resulted in the hackers getting full system access, which would have allowed them to “modify, copy or delete sensitive files,” which could have affected the International Space Station. In addition, between 2010 and 2011, NASA suffered 5,408 computer security incidents. Hacks to NASA systems range from those perpetrated by individuals testing their hacking skills, to organized criminal organizations looking for profit, to intrusions that may be sponsored by foreign intelligence services. “Hackers Had ‘Full Functional Control’ of NASA Computers,” *British Broadcasting Corporation* (8 March 2012), online: <<http://www.bbc.com/news/technology-17231695>>. A consideration of interference with space systems by cyber means is outside the scope of this article. For further information on this topic from a legal perspective, see Harrison et al, *supra* note 2 at 15; Michael N Schmitt, ed, *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations*, 2nd ed (Cambridge: Cambridge University Press, 2017).

This article will focus on non-kinetic interference.⁵⁰ An example of non-kinetic interference by a state occurred in 2005 when Libya jammed a number of international satellites to cease transmission of a program discussing human rights issues in Libya.⁵¹ This resulted in widespread disruption of services, including broadcasts by CNN International and BBC World, and disruption of US military communications in the Mediterranean.⁵²

Non-kinetic interference can be either space based or ground based. Space-based interference occurs when a space object interferes with another system, while ground-based interference, illustrated by the LTTE example, emanates from the Earth.⁵³ While it is possible to conduct space-based intentional interference, the ability to do so falls mainly within the capabilities of states, as it is costly and difficult to orchestrate.⁵⁴ Space-based interference most often occurs in a geostationary orbit;⁵⁵ however, it is often difficult to determine whether it is intentional or unintentional, illustrating the challenge of attributing responsibility to an actor for a particular event.⁵⁶ It is unlikely that space-based interference would be conducted by NSAs because it would be prohibitively expensive and technically complex to orchestrate, whereas ground-based interference is much easier and cheaper to effect.

There are two types of non-kinetic ground-based interference: orbital and terrestrial interference (Figures 2 and 3).⁵⁷ Orbital jamming transmits a conflicting signal towards a satellite from the ground or from another satellite, disrupting all of the signals on that frequency within the whole satellite footprint.⁵⁸ Terrestrial jamming occurs at a specific place on the

⁵⁰ It is notable that where non-kinetic interference renders a satellite uncontrollable, that satellite could cause space debris as a second- or third-order effect if it collides with other debris or another satellite.

⁵¹ "Space Security Index 2006" (2007) 32 *Ann Air & Sp L* 201 at 427; Brandon L Hart, "Anti-Satellite Weapons: Threats, Laws and the Uncertain Future of Space" (2008) 33 *Ann Air & Sp L* 344 at 350.

⁵² "Space Security Index," *supra* note 51 at 433; Hart, *supra* note 51 at 351.

⁵³ Housen-Couriel, *supra* note 13 at 433–35.

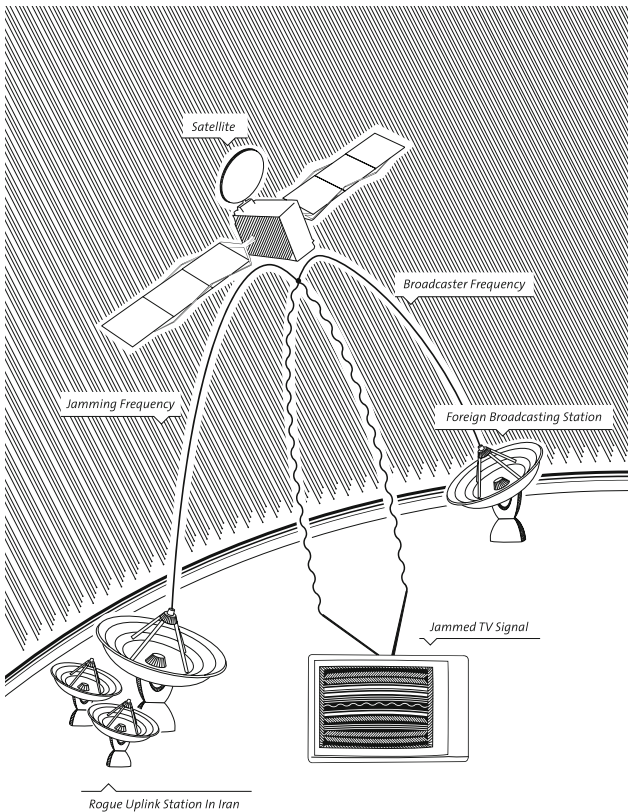
⁵⁴ Wright, Grego & Gronlund, *supra* note 26 at 121–23.

⁵⁵ Geostationary orbit is an orbit at an altitude of 35,786 kilometres above the equator, where satellites travel at the same rate as the Earth rotates. Satellites in geostationary orbit are typically used for television and radio broadcasting as they allow real-time data transfer over a wide geographic area. They are also used for military and commercial communications. Harrison et al, *supra* note 2 at 18; Wright, Grego & Gronlund, *supra* note 26 at 13, 43.

⁵⁶ Michael J Finch, "Limited Space: Allocating the Geostationary Orbit" (1986) 7:4 *NW J Intl L & Bus* 788 at 788.

⁵⁷ Jamming is the most common form of interference activity. Mountin, *supra* note 5 at 131; Wright, Grego & Gronlund, *supra* note 26 at 166.

⁵⁸ Mountin, *supra* note 5 at 129–30.

Figure 2. Example diagram of orbital interference

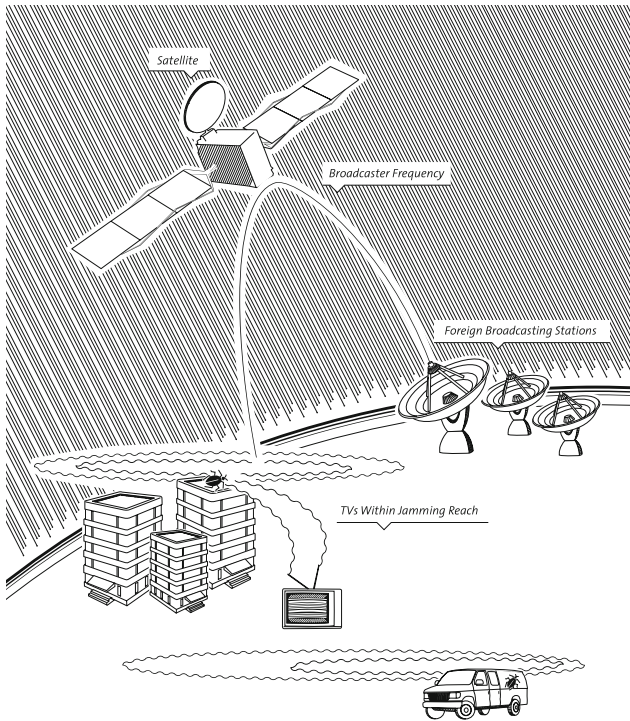
Source: "Satellite Jamming in Iran: A War Over Airwaves," *Small Media* (November 2012), online: <<https://smallmedia.org.uk/sites/default/files/Satellite%20Jamming.pdf>>.

Earth near a communication node or ground station; it can be easily conducted using inexpensive and accessible equipment, and it affects a limited geographic area.⁵⁹ States and NSAs commonly engage in terrestrial interference, which is easy and inexpensive to undertake.⁶⁰ It is often difficult to determine the cause of a disruption and whether it was intentional or accidental, as disruptions might be attributable to operator error, equipment

⁵⁹ *Ibid* at 130.

⁶⁰ Jamming equipment is so accessible that hand-held jammers, easily available on the Internet, can override signals up to eighty kilometres away. Due to the small and mobile nature of jamming equipment, it is difficult to locate and track where the interference originates. *Ibid* at 131; Wilson, *supra* note 28 at IV.F.

Figure 3. Example diagram of terrestrial interference



Source: "Satellite Jamming in Iran: A War Over Airwaves," *Small Media* (November 2012), online: <<https://smallmedia.org.uk/sites/default/files/Satellite%20Jamming.pdf>>.

error, equipment degradation, inadvertent misuse, poorly coordinated frequency spectrum use, or naturally occurring phenomena (that is, space weather or solar flares).⁶¹

In 2015, there were more than 260 cases of US transmissions being jammed between the satellite and ground station.⁶² Interference disrupts space applications critical to the functioning of everyday life and costs commercial operators and end-users millions of dollars annually.⁶³ Commercially, short-term costs include revenue and customer loss, increased

⁶¹ Ram Jakhu & Karan Singh, "Space Security and Competition for Radio Frequencies and Geostationary Slots" (2009) 58 *Zeitschrift für Luft- und Weltraumrecht* 79 at 83–85.

⁶² Joan Johnson-Freese, *Space Warfare in the 21st Century: Arming the Heavens* (New York: Routledge, 2017) at 67.

⁶³ Mountin, *supra* note 5 at 118.

personnel and system-repair costs, interference protection costs, and detection system costs.⁶⁴ Long-term costs include a degraded reputation as a reliable provider, resulting in lost investments and future profits.⁶⁵ For militaries, a lack of dependable access to space applications diminishes operational effectiveness.⁶⁶

Finally, it is estimated that thousands of new satellites will be launched in the coming years — from mini-satellites to mega-constellations.⁶⁷ If those satellites experience non-kinetic interference, such non-kinetic incidents could have secondary and/or tertiary kinetic effects, as space debris may in turn harm other space systems as it propagates and impacts other space objects.⁶⁸ If this were to occur in a commonly used orbit, such as the low Earth orbit, it could render the orbit partially or fully unusable and cease cooperative programs situated there, such as the International Space Station. Consequently, the increase in the number of space systems operating in a finite number of orbits and orbital

⁶⁴ Johnson-Freese, *supra* note 62 at 84; Greg Berlocher, “Interference: Operators Making Advances in Flight,” *Satellite Today* (1 June 2008), online: <<https://www.satellitetoday.com/telecom/2008/06/01/interference-operators-making-advances-in-flight/>>.

⁶⁵ Mountin, *supra* note 5 at 118.

⁶⁶ It should be noted that under art 2(4) of the *UN Charter*, interference with satellite signals would not generally amount to a threat of force or a use of force against the territorial integrity or political independence of a state. However, depending on the effects of space-based or ground-based interference and the type of system affected, it may be considered to rise to the level of a threat of force, use of force or armed attack, and, therefore, the law relating to the use of force (*jus ad bellum*) or international humanitarian law (*jus in bello*) could apply depending on the situation. Mountin, *supra* note 5 at 108, 111–12.

⁶⁷ A mega-constellation is a collection of related satellites, usually in low Earth orbit (LEO) operating to provide increased coverage and resilience for a particular satellite service. An example of a mega-constellation is OneWeb, which is planning a constellation of 648 satellites in LEO to provide global broadband communications services. Other proposed mega-constellations are considering using 1,400 and 3,000 satellites. Jeff Foust, “Mega-Constellations and Mega-Debris,” *The Space Review* (10 October 2016), online: <<http://www.thespacereview.com/article/3078/1>>; “Managing Mega-Constellations,” *European Space Agency* (30 March 2017), online: <<https://gsp.esa.int/articles/-/wcl/IGnXP6cuQgi6/10192/managing-mega-constellations>>.

⁶⁸ Orbital space debris can occur when a piece of space debris is in orbit itself and strikes another space asset or piece of debris, which is called a conjunction. Space debris can have catastrophic effects if it hits a functioning satellite, not only in the first instance by disabling, degrading, or destroying the satellite but also in then producing pieces of debris that, due to the Kessler effect, result in the propagation of more and more space debris as secondary and tertiary effects. Wright, Grego & Gronlund, *supra* note 26 at 136. NASA tracks approximately 500,000 pieces of space debris, in addition to millions of pieces that are too small to track, which are a threat to space assets, including the International Space Station. National Aeronautics and Space Administration, “Space Debris and Human Spacecraft,” *National Aeronautics and Space Administration* (26 September 2013), online: <https://www.nasa.gov/mission_pages/station/news/orbital_debris.html>.

slots, and increasing cases of interference by NSAs that could potentially result in space debris and damage to other space-based systems, raise the real likelihood of claims for damages, and highlight the need to better understand how state responsibility and liability are addressed in outer space.

INTERNATIONAL LEGAL FRAMEWORKS

INTERNATIONAL LEGAL FRAMEWORK FOR RESPONSIBILITY AND LIABILITY IN SPACE

Having described the extent of the global dependence on space systems, the broad range of NSAs involved in space, and how space systems operate and can be interfered with, the remainder of this article will consider the following three scenarios to determine whether and how ISL, the ITU regime, and the 2001 *Draft Articles on Responsibility of States for Internationally Wrongful Acts (Draft Articles)* could apply.⁶⁹ The three scenarios that are referenced throughout the remainder of this article are: (1) space-based jamming from one space asset to another; (2) ground-based orbital interference; and (3) ground-based terrestrial interference.

Responsibility and Liability Generally

“International responsibility” under general international law “is the necessary corollary of a right,” as “all rights of an international character involve international responsibility.”⁷⁰ It relates to a state’s obligation to supervise activities carried out by the state or “anyone under its legal structure, in accordance with international law.”⁷¹ International responsibility requires that a breach of an international obligation triggers the responsibility of the implicated state.⁷² Forms of international responsibility can be seen in Article VI of the *Outer Space Treaty*,⁷³ in the 1979 *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement)*,⁷⁴

⁶⁹ International Law Commission, *Draft Articles on Responsibility of States for Internationally Wrongful Acts*, GA Res 53/83, UNGAOR, 53rd Sess, Supp No 10, UN Doc A/56/10 (2001) [*Draft Articles on State Responsibility*].

⁷⁰ Translation of French text of *Spanish Zone of Morocco (Great Britain v Spain)* (1925), reprinted in 2 UNRIAA 615; Crawford, *supra* note 7 at 541.

⁷¹ Henry R Hertzfeld, “A Guide to Space Law Terms,” *Space Policy Institute, George Washington University and Secure World Foundation* (December 2012) at 54, online: <http://swfound.org/media/99172/guide_to_space_law_terms.pdf>.

⁷² Crawford, *supra* note 7 at 540.

⁷³ *Outer Space Treaty*, *supra* note 7, art VI.

⁷⁴ *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 5 December 1979, 1363 UNTS 2, art 14 [*Moon Agreement*]. It should be noted that the *Moon Agreement* is not widely subscribed to, particularly by the major space-faring states.

in the 1959 *Antarctic Treaty*,⁷⁵ and in the 1982 *United Nations Convention on the Law of the Sea*.⁷⁶ Such international responsibility may arise even if no damage or injury is caused.⁷⁷ However, it is mainly concerned with the maintenance of international order over the compensation of victims.⁷⁸

Meanwhile “international liability” refers to a state’s “obligation to compensate another state for any injury that is caused to the people or property of the latter nation.”⁷⁹ Normally, states are responsible for acts attributable to them or directly to their officials acting in an official capacity.⁸⁰ Under ISL, international liability emanates from Article VII of the *Outer Space Treaty*⁸¹ and is expanded on mainly in Articles II, III, and IV of the *Liability Convention*.⁸²

In the space context, as will be outlined below, responsibility and liability for actions of NSAs appear to be more expansive than under most other legal regimes and could be extended to states in certain circumstances, which is unusual in international law.⁸³

Extraterritorial Application of International Law in Outer Space

Following the first entry of artificial objects into space in 1957, there was an impetus to create international law applicable to outer space. Over the following twenty years, the five core space treaties were drafted to provide a framework for space operations, exploration, and use.⁸⁴ Over time, “space law” developed into a functional grouping of domestic and international rules relating to outer space and the human activity within it.⁸⁵ ISL is part

⁷⁵ *Antarctic Treaty*, 1 December 1959, 402 UNTS 71 (entered into force 23 June 1961).

⁷⁶ *United Nations Convention on the Law of the Sea*, 10 December 1982, 1833 UNTS 3, arts 31, 139 (entered into force 16 November 1994).

⁷⁷ Ram Jakhu, “Liability and Principles of State Responsibility” (Lecture delivered at the Strategic Space Law Program, McGill University Institute of Air and Space Law, 31 May 2016) [unpublished].

⁷⁸ *Ibid.*

⁷⁹ Hertzfeld, *supra* note 71 at 52.

⁸⁰ Lyall & Larsen, *supra* note 18 at 66.

⁸¹ *Outer Space Treaty*, *supra* note 7, art VII.

⁸² *Liability Convention*, *supra* note 12, arts II–IV.

⁸³ Lyall & Larsen, *supra* note 18 at 66.

⁸⁴ The five major space law treaties include the *Outer Space Treaty*, *supra* note 7; the *Liability Convention*, *supra* note 12; the *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Space*, 22 April 1968, 672 UNTS 119 (entered into force 3 December 1968); the *Convention on the Registration of Objects Launched into Outer Space*, 14 January 1975, 1023 UNTS 15 (entered into force 15 September 1976); and the *Moon Agreement*, *supra* note 74.

⁸⁵ Patrick K Gleeson, “Legal Aspects of the Use of Force in Space” (LLM thesis, McGill University Institute of Air and Space Law, 2005) at 24 [unpublished].

of public international law and goes beyond the five core treaties to include rules that apply to space activities even when space is not referenced.⁸⁶

The 1967 *Outer Space Treaty* is the main space law treaty around which the rest of the regime was constructed, and certain aspects of the *Outer Space Treaty* are considered to be reflective of customary international law.⁸⁷ It considers the exploration and use of outer space to be the “province of all mankind.”⁸⁸ It reflects the fundamental principles of: (1) common interest and equitable access to space;⁸⁹ (2) freedom of access to, use of, and exploration of outer space subject to certain constraints;⁹⁰ (3) non-appropriation and the prohibition on claims of sovereignty of outer space and celestial bodies, which is an extension of the common interest and freedom principles; and (4) the applicability of international law to outer space.⁹¹ Article III recognizes that international law applies in outer space; however, not all general international law principles apply in space.⁹² While the confirmation that international law applies is helpful, the numerous legal frameworks that may interact in the case of interference by a NSA are challenging to unravel. Additionally, various United Nations (UN) General Assembly resolutions, over time, have led to developments in the ISL regime⁹³ and have served to provide guidance on the interpretation of the international law applicable in outer space.⁹⁴

⁸⁶ Ram Jakhu & Paul Stephen Dempsey, *Routledge Handbook of Space Law* (New York: Routledge, 2017) at 12.

⁸⁷ Schmitt, *supra* note 22 at 99; Bin Cheng, *General Principles of Law* (Oxford: Clarendon Press, 1997) at 621–40; A Kerrest, “Remarks on the Responsibility and Liability for Damages Other Than Those Caused by the Fall of a Space Object” (Proceedings of the Fortieth Colloquium of the International Institute of Space Law, Turin, Italy, 1997) at 92–112 [unpublished].

⁸⁸ *Outer Space Treaty*, *supra* note 7, art I; Gbenga Oduntan, *Sovereignty and Jurisdiction in the Air-space and Outer Space: Legal Criteria for Spatial Delimitation* (New York: Routledge, 2012) at 193.

⁸⁹ *Outer Space Treaty*, *supra* note 7, art I, preamble; *International Co-operation in the Peaceful Uses of Outer Space*, GA Res 1721, UNGAOR, 16th Sess, UN Doc A/RES/1721 (XVI) (1961) [*Co-operation on Peaceful Uses of Outer Space*]; Gleeson, *supra* note 85 at 38.

⁹⁰ *Outer Space Treaty*, *supra* note 7, art I.

⁹¹ Gleeson, *supra* note 85 at 39; *Outer Space Treaty*, *supra* note 7, art III.

⁹² Gleeson, *supra* note 85 at 40. E.g., traditional notions of territory and sovereignty do not easily translate into space, given the associated physics of the environment.

⁹³ The 1962 UN General Assembly resolution on the *Declaration of Legal Principles* in space was the first instance where the UN indicated that international law applied in space. This principle was later codified in art III of the *Outer Space Treaty*, *supra* note 7, requiring that activities in space be conducted in accordance with international law, including the *UN Charter. Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*, GA Res 1962 (XVIII), UNGAOR, 18th Sess, UN Doc A/RES/18/1962 (1963).

⁹⁴ *Co-operation on Peaceful Uses of Outer Space*, *supra* note 89; Gleeson, *supra* note 85 at 38. *Outer Space Treaty*, *supra* note 7, art III; *UN Charter*, *supra* note 42.

International Space Law Liability Regime

Prior to 1957, international law scholars proposed unlimited liability regimes for damage caused by space objects to persons or property on Earth.⁹⁵ After a series of launches in the 1960s, this construct was advanced by diplomats who were also concerned with codifying an appropriate liability regime, as pieces of falling launch debris threatened significant damage.⁹⁶ In 1962, when the United Nations Committee on the Peaceful Uses of Outer Space began developing space responsibility and liability regimes, various schemes were explored, and the committee recognized the need to balance freedom to peacefully use outer space with reparations for damage due to the dangerous nature of space activity.⁹⁷ From the outset, most states agreed that states had to bear international responsibility for national activities in outer space.⁹⁸ Responsibility applied regardless of whether the activity was considered lawful or was carried out by a state or NSA.⁹⁹

Consequently, grounded by a series of UN resolutions, the *Outer Space Treaty* and the *Liability Convention* became the basis of the ISL responsibility and liability regimes.¹⁰⁰ The drafters of the *Liability Convention* drew upon other unique regimes involving ships, aircraft, and atomic energy,

⁹⁵ Vladimir Mandl, *Das Weltraumrecht: Ein Problem Der Raumfahrt* (Berlin: J Bensheimer, 1932); Paul Dembling, "A Liability Treaty for Outer Space Activities" (1970) 19:1 *Am U Intl L Rev* 33 at 34.

⁹⁶ Dembling, *supra* note 95 at 34–35. In utilizing space for social, economic, and national security activities, it is generally accepted that the risk of damage or injury should not be passed from "the creator of the risk to the public at large," except in certain circumstances where the launching state reaps the benefits; however, damages in that context would be dealt with under domestic law via a claim against a government.

⁹⁷ Crawford, Pellet & Olleson, *supra* note 36 at 903–05. The negotiations for the *Liability Convention* were so controversial that it occupied the UN Committee on the Peaceful Uses of Outer Space's legal sub-committee for nine years. Robert Jennings & Arthur Watts, *Oppenheim's International Law*, vol 1: *Peace*, 9th ed (London: Longman, 2008) at 834.

⁹⁸ The construct of tracing responsibility to the supervising state was codified during the creation of the space age as a compromise between the United States, which favoured the unhampered use of space by private entities, and the Soviet Union, which advocated for a prohibition on private space activities and entities in space. Marco Pedrazzi, "Outer Space, Liability for Damage" in *Max Planck Encyclopedia of Public International Law* (Oxford: Oxford University Press, 2008) at para 2; Crawford, Pellet & Olleson, *supra* note 36 at 909.

⁹⁹ Responsibility can also flow under international law for lawful acts, which is normally the case with high risk, very dangerous activities, as is the case with space activities. Krystyna Wiewiorowska, "Some Problems of State Responsibility in Outer Space Law" (1979) 7:1 *J Space L* 23 at 32.

¹⁰⁰ Bin Cheng, *Studies in International Space Law* (Oxford: Oxford University Press, 2004) at 72 [Cheng, *Space Law*]; Wiewiorowska, *supra* note 99 at 24.

all of which imposed liability without fault for damage.¹⁰¹ Under the *Liability Convention*, claimants need only prove that damage to an object on the ground or in flight was caused by a space object, and they are not required to prove negligent or wilful misconduct.¹⁰² This “absolute liability” regime was chosen due to the unique circumstances of space launch, the speed of technological advances, and the variety of possible mission circumstances.¹⁰³ This regime was subsequently referenced by the International Law Commission (ILC) when drafting the *Draft Articles*.¹⁰⁴

The *Outer Space Treaty* provides that the “appropriate state” will bear international responsibility for “national activities” carried out in space by states or NSAs.¹⁰⁵ As a result, states are required to authorize and continuously

¹⁰¹ Crawford, Pellet & Olleson, *supra* note 36 at 904. Some examples include the *Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface*, which indicates that “any person who suffers damage on the surface shall, upon proof only that damage was caused by an aircraft in flight or by any person or thing falling therefrom, be entitled to compensation.” *Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface*, 7 October 1952, 310 UNTS 182 (entered into force 4 February 1958). A similar principle has been applied to atomic energy, which utilizes similar absolute liability regimes, including the *Convention on Third Party Liability in the Field of Nuclear Energy*, 29 July 1960, 956 UNTS 251 (entered into force 1 April 1968), and the *Convention on the Liability of Operators of Nuclear Ships*, 25 May 1962, 57 AJIL 268 [*Nuclear Ships Convention*]. Art II of the *Nuclear Ships Convention* provides that “[t]he operator of a nuclear ship shall be absolutely liable for any nuclear damage upon proof that such damage has been caused by a nuclear incident involving the nuclear fuel of, or radioactive products or waste produced in, such ship.” *International Convention on Civil Liability for Nuclear Damage*, 21 May 1963, 1063 UNTS 265 (entered into force 12 November 1977).

¹⁰² Dembling, *supra* note 95 at 34. Absolute liability is contrasted with “fault-based liability,” which is “liability based on some degree of blameworthiness.” *Black’s Law Dictionary*, 9th ed, sub verbo “fault-based liability.” “Fault” is defined as “an error or defect of judgment or of conduct; any deviation from prudence or duty resulting from inattention, incapacity, perversity, bad faith, or mismanagement. Under the civil law, “fault” is “the intentional or negligent failure to maintain some standard of conduct when that failure results in harm to another person.” *Black’s Law Dictionary*, 9th ed, sub verbo “fault.”

¹⁰³ LFE Goldie, “Liability for Damage and the Progressive Development of International Law” (1965) 14 ICLQ 1189. This determination appears to be based on the *Trail Smelter Arbitration Tribunal* (1935), which held that a state “from whose territory or facility an object is launched” has a duty at all times to “protect other states against injurious acts by individuals from within its jurisdiction.” *Trail Smelter Case (United States v Canada)* (1941), reprinted in 3 UNRIAA 1905 [*Trail Smelter*]; Cheng, *Space Law*, *supra* note 100 at 237.

¹⁰⁴ BA Hurwitz, *State Liability for Outer Space Activities in Accordance with the 1972 Convention on International Liability for Damage Caused by Space Objects* (Dordrecht: Martinus Nijhoff, 2002) at 147, 207.

¹⁰⁵ *Outer Space Treaty*, *supra* note 7, art VI. For a thorough discussion of the interpretation of “appropriate state” under art VI of the *Outer Space Treaty*, see Bin Cheng, “Art VI of the 1967 Space Treaty Revisited: ‘International Responsibility’, ‘National Activities’, and the ‘Appropriate State’” (1998) 24 J Space L 7 at 18.

supervise those activities to ensure they abide by ISL and their international obligations generally.¹⁰⁶ The scope of what is considered to be “national activities” is not clear, and scholars have varying opinions on the matter.¹⁰⁷ A commonly asserted interpretation is that the provisions automatically impute all private activities where harm is caused to the state.¹⁰⁸ This approach differs from the rules on attribution under the law of state responsibility as reflected in the *Draft Articles*.¹⁰⁹ Additionally, states must retain a registry of the space objects launched and retain “jurisdiction and control” over them.¹¹⁰ Consequently, an incident may implicate multiple states with varying domestic regulations in the requirement to authorize and supervise space activities of NSAs,¹¹¹ creating confusion and possibly over-regulation, and undermining investment.

UN General Assembly Resolution 59/115 advocates for states to consider enacting and implementing national laws to authorize and facilitate the supervision of space activities of NSAs under their jurisdiction, and states have adopted differing approaches to defining their jurisdiction.¹¹² The United Kingdom’s *Outer Space Act* uses personal jurisdiction, which applies to all nationals, natural or commercial.¹¹³ The United States’ more expansive *Commercial Space Launch Act* applies to launch activities, launch site operation, American citizens, and any person within the United States.¹¹⁴ In addition to outlining the scope of authorization and supervision, these national laws provide indications of state practice, such that more expansive domestic law may establish, over time, as other states enact space

¹⁰⁶ *Outer Space Treaty*, *supra* note 7, art VI. It should be noted that there are interpretation differences between the various translations of the text of the *Liability Convention*, in that the French and Spanish versions do not recognize a difference between “responsibility” and “liability.” Different translated versions also provide varying scopes of application for absolute liability. For more information, see Sylvia Ospina, “International Responsibility and State Liability in an Age of Globalization and Privatization” (2012) 17 *Ann Air & Sp L* 479; *Liability Convention*, *supra* note 12 (in French and Spanish); Cheng, *Space Law*, *supra* note 100 at 632.

¹⁰⁷ *Outer Space Treaty*, *supra* note 7, art VI.

¹⁰⁸ This is because all activities, whether carried out by states or NSAs “are deemed to be governmental activities involving direct state responsibility.” Cheng, *Space Law*, *supra* note 100 at 237.

¹⁰⁹ Pedrazzi, *supra* note 98 at para 2.

¹¹⁰ *Outer Space Treaty*, *supra* note 7, art VIII; Cheng, *Space Law*, *supra* note 100 at 635.

¹¹¹ Cheng, *Space Law*, *supra* note 100.

¹¹² *Application of the Concept of the “Launching State”*, GA Res 59/119, UNGAOR, 59th Sess, UN Doc A/RES/59/115 (2004); Pedrazzi, *supra* note 98 at para 3.

¹¹³ *Outer Space Act 1986* (UK), c 38.

¹¹⁴ *Commercial Space Launch Competitiveness Act* (US), 51 USC § 5050 (2015); Cheng, *Space Law*, *supra* note 100 at 634.

regulatory regimes, a broader conception of state responsibility, resulting in a desire to mitigate risk associated with NSA activities in space that could result in liability for the implicated state.¹¹⁵ Under the liability regime, launching states are internationally liable for damage to “natural or juridical persons” by space objects that occurs “on the earth, in airspace or outer space.”¹¹⁶ In the *Liability Convention*, a “launching state” is defined to be “a state which launches or procures the launching of a space object” or “a state from whose territory or facility a space object is launched.”¹¹⁷ Some argue that this conception of a launching state effectively imposes “personal jurisdiction” over individuals, corporate persons, or businesses having nationality in order to attach liability where territorial jurisdiction does not apply.¹¹⁸

To further define key terms used in the *Liability Convention*, a “space object” includes “component parts of a space object as well as its launch vehicle and parts thereof.”¹¹⁹ “Damage,” which is the premise of liability,¹²⁰ is defined as “loss of life, personal injury or other impairment of health; or loss of or damage to property of states or of persons, natural or juridical, or property of international intergovernmental organizations.”¹²¹ The *Liability Convention* uses broad terms, applicable to a variety of technologically evolving space objects, which could also encompass interference causing disruption to space systems.¹²² While there are no publicly known instances of interference directly causing injury or death,¹²³ a claim could potentially be advanced under the *Liability Convention* where interference

¹¹⁵ Bin Cheng, “Whose Parking Space Is It Anyway? Mapping Out a Legal Minefield in the Celestial Outlands,” *Times Higher Educational Supplement*, No 789 (30 May 1986) at 14–15.

¹¹⁶ *Liability Convention*, *supra* note 12, art IV. This provision illustrates the broad basis for establishing fault without any requirement for a wrongful act in multiple domains. However, it is not clear whether the potentially liable state could be exonerated from being responsible or how that may function. Pedrazzi, *supra* note 98 at paras 4–5.

¹¹⁷ *Liability Convention*, *supra* note 12, art I(c).

¹¹⁸ Cheng, *Space Law*, *supra* note 100 at 73, 622. There may also be some element of “quasi-territorial jurisdiction” over space objects launched from a state with a type of “nationality” attachment.

¹¹⁹ *Liability Convention*, *supra* note 12, art I(d). It is not clear how far the interpretation of “component parts” extends and whether it is understood to include (and, therefore, attach liability for) space debris (i.e., no longer functioning satellites or fragmented parts originating from the degradation of a space assets), which constitutes a major source of space pollution. Pedrazzi, *supra* note 98 at para 5; Cheng, *Space Law*, *supra* note 100 at 506; Hurwitz, *supra* note 104 at 23–26.

¹²⁰ Wiewiorowska, *supra* note 99 at 32.

¹²¹ *Liability Convention*, *supra* note 12, art I(a).

¹²² Wiewiorowska, *supra* note 99 at 32, 34–35.

¹²³ Mountin, *supra* note 5 at 120.

renders emergency notification or commercial air traffic control systems ineffective or disrupts financial transactions,¹²⁴ resulting in chaos, panic, and violence where the loss is sufficiently quantifiable.¹²⁵ It is notable that outside the space law context the World Intellectual Property Organization considers that satellite transmissions are property and therefore subject to proprietary rights.¹²⁶ However, the *Liability Convention* appears to contemplate only physical damage caused by a space object,¹²⁷ which requires that the causal link must be “sufficiently direct” to establish liability.¹²⁸ Such a sufficiently direct causal link may be hard to establish where it is difficult to attribute interference and will become more challenging as the number of space actors and methods of interference increase.¹²⁹

Where space-based interference is alleged to have caused damage (Scenario 1), an analysis must be undertaken to determine where the damage occurred (that is, the surface of the Earth, the aircraft in flight, or another location) to indicate whether the absolute liability or fault-based regime would apply. Finally, the “reparation” regime, as with general international law,¹³⁰ must “restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.”¹³¹

There are other features of the ISL liability regime worth noting. Where multiple states are implicated as launching states, joint and several liability flows.¹³² Thus, a state whose persons sustain damage may seek total compensation from one or more of the states involved in the launch, unless other arrangements have been made.¹³³ Where the implicated states cannot agree

¹²⁴ Financial systems rely on global positioning systems for global accuracy and synchronization between various time zones, which is crucial for stock market operation. Paganini, *supra* note 27.

¹²⁵ Mountin, *supra* note 5 at 120.

¹²⁶ “WIPO Intellectual Property Handbook: Policy, Law and Use,” 2nd ed, *World Intellectual Property Organization* (2004) at 450–53, online: <http://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf>.

¹²⁷ Pedrazzi, *supra* note 98 at para 12.

¹²⁸ *Ibid* at para 10.

¹²⁹ “Attribution” relates to two concepts: first, in the context of state responsibility, it considers what state bears responsibility for a breach of an international obligation, which is required before counter-measures may be undertaken; and, second, it relates to determining the identity of an actor perpetrating an action. This note references the latter instance. Harrison et al, *supra* note 2 at 31.

¹³⁰ Crawford, Pellet & Olleson, *supra* note 36 at 909; Wiewiorowska, *supra* note 99 at 36.

¹³¹ *Liability Convention*, *supra* note 12, art XII.

¹³² Pedrazzi, *supra* note 98 at para 10; Crawford, Pellet & Olleson, *supra* note 36 at 906.

¹³³ Pedrazzi, *supra* note 98.

on apportionment, the cost of compensation must be borne equally.¹³⁴ This can be problematic because it places all implicated states on an equal footing, even where their interests and resources differ.¹³⁵ However, this approach does make it easier for claimants to gain access to damages.¹³⁶ Article VI(1) of the *Liability Convention* attenuates absolute liability where the damage occurs as a result of the claimant's gross negligence.¹³⁷ Additionally, no exoneration can occur where damage is due to non-compliance with international law.¹³⁸ Finally, joint liability may occur under the *Liability Convention* where there is a collision of two space objects from two states that harms a third party.¹³⁹

Finally, given that the liability regime applies to damage caused by launched space objects, it appears that the liability regime can only apply to damage caused by space-based assets conducting interference (Scenario 1). This concept is similar to the attribution of transboundary harm as seen in the *Trail Smelter* and *Corfu Channel* cases, which were considered in the drafting of the *Liability Convention*.¹⁴⁰ It is interesting that the Soviet Union initially argued that a liability convention was not required due to the general international legal principles of responsibility for transboundary harm set out in those very cases.¹⁴¹ These considerations were subsequently deliberated by the ILC during the drafting of the *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities*.¹⁴² Even though these sources relate to harm emanating from a territory, it is possible that a parallel argument could be drawn for damage caused to a space system based in another state.¹⁴³

The international responsibility and liability regimes provided for in ISL are complex. However, as this analysis has shown, for all of the complexity of the space liability regime, it only appears to have limited application to incidents of space-based interference.

¹³⁴ *Liability Convention*, *supra* note 12, art IV(2).

¹³⁵ Crawford, Pellet & Olleson, *supra* note 36 at 905; Wiewiorowska, *supra* note 99 at 29.

¹³⁶ Crawford, Pellet & Olleson, *supra* note 36; Matthew J Kleiman, Jenifer K Lamie & Maria-Vittoria Carminati, *The Laws of Spaceflight: A Guidebook for New Space Lawyers* (Chicago: American Bar Association Publishing, 2012) at 64.

¹³⁷ *Liability Convention*, *supra* note 12, art VI(1).

¹³⁸ *Ibid*, art VI(2).

¹³⁹ *Ibid*, art V.

¹⁴⁰ *Trail Smelter*, *supra* note 103; *Corfu Channel Case (UK v Albania)*, Merits, [1949] ICJ Rep 4 at 23. Transboundary harm is damage that occurs outside the state where the risk-originating activity takes place.

¹⁴¹ Cheng, *Space Law*, *supra* note 100 at 237, 289.

¹⁴² ILC, *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries*, GA Res 56, UNGAOR, 53rd Sess, UN Doc A/56/10 (2001) at 148 [*Draft Articles on Transboundary Harm*].

¹⁴³ *Ibid* at 150–51.

Application of Space Liability Regime in Practice

Since the absolute liability regime only applies to damage caused by “space objects” that are “launched,” it appears that claims can only be advanced where damage from interference emanates from a space-based asset. As highlighted above, space-based interference, which is unlikely to be undertaken by NSAs, may implicate the liability of multiple states for damage caused under either an absolute or fault-based liability scheme. States that are implicated as the “launching state” are responsible for exercising continuing supervision and control over space activities.¹⁴⁴ If a state fulfils its supervision and control responsibilities, it is only likely to mitigate potential damage and limit its exposure to liability where the fault-based regime may apply.¹⁴⁵ Since the ISL absolute liability regime only deals with space-based objects causing damage, where there is ground-based interference, even if this interference affects the operation of space assets and/or their transmissions, one is only left with general international law.

Procedurally, where a claim arises, it must be submitted through diplomatic channels, within a limitation period.¹⁴⁶ Claims are to be advanced by states on behalf of victims.¹⁴⁷ Multiple victim states may advance a claim, including states whose persons or territory sustained damage.¹⁴⁸ Finally, a claim does not require the exhaustion of other remedies¹⁴⁹ and can be brought in multiple fora simultaneously; however, “double reparation” for the same incident would be prohibited under customary international law.¹⁵⁰

Despite various examples of damage due to space debris,¹⁵¹ the *Liability Convention* has only been invoked once. It was referenced in the claim in relation to an incident that occurred on 24 January 1978, when a Soviet military satellite — COSMOS 954 — crashed into the Canadian north, leaving debris in the Northwest Territories, Alberta, and Saskatchewan.¹⁵²

¹⁴⁴ Cheng, *Space Law*, *supra* note 100 at 638.

¹⁴⁵ *Ibid.*

¹⁴⁶ It is settled in international law that only a state may bring a claim on behalf of an injured national. Dembling, *supra* note 95 at 43. *Liability Convention*, *supra* note 12, arts IX–X.

¹⁴⁷ Dembling, *supra* note 95.

¹⁴⁸ This guards against the use of diplomatic protection to avoid a claim, whereby the advancement of claims is at the discretion of the state of nationality, as other avenues are permissible. Crawford, Pellet & Olleson, *supra* note 36 at 910.

¹⁴⁹ *Liability Convention*, *supra* note 12, art XI(1); Crawford, Pellet & Olleson, *supra* note 36 at 910.

¹⁵⁰ *Factory at Chorzow (Germany v Poland)* (1925), Merits, PCIJ (Ser A) No 17 at 4, 48, 59; Crawford, Pellet & Olleson, *supra* note 36 at 911.

¹⁵¹ Hurwitz, *supra* note 104 at 2.

¹⁵² Pedrazzi, *supra* note 98 at para 15.

Initially, Canada claimed reimbursement for the remediation costs from the Soviet Union under the *Liability Convention*, as portions of the debris were radioactive.¹⁵³ In addition to its arguments under the *Liability Convention*, Canada also argued absolute liability for high-risk activities, including space activities that used nuclear energy, as a “general principle of international law.”¹⁵⁴ Canada also claimed that the entry of the satellite into Canadian airspace was a “violation of Canada’s sovereignty,”¹⁵⁵ appearing to rely on the general international law of responsibility for internationally wrongful acts.¹⁵⁶ However, due to the remote location, there was no physical damage to people or property in the strict sense.¹⁵⁷ After three years, the dispute was settled through diplomatic negotiations without reference to the *Liability Convention*.¹⁵⁸ The Soviet Union agreed to pay Canada \$3 million, half the sum originally claimed.¹⁵⁹ The COSMOS 954 incident demonstrates the potential complexity of the ISL liability regime for a relatively straightforward incident and how there may be multiple other, and potentially preferable, international legal bases upon which to advance a claim. Finally, since the regime has seldom been referenced since its inception in 1972, it is difficult to fully understand its application or utility in practice or how it may interact with the other regimes set out below.¹⁶⁰ Thus, it would seem that this regime is in danger of being “overtaken by general international law.”¹⁶¹

¹⁵³ Crawford, Pellet & Olleson, *supra* note 36 at 908.

¹⁵⁴ Statement of Claim (Letter of the Canadian Secretary of State for External Affairs, 23 January 1979), reprinted in (1979) 18:4 ILM 907 at para 22 [Statement of Claim].

¹⁵⁵ *Ibid* at para 21; Crawford, Pellet & Olleson, *supra* note 36 at 912–13.

¹⁵⁶ Crawford, Pellet & Olleson, *supra* note 36 at 912.

¹⁵⁷ Canada argued that there was a danger posed by the fragments from radioactivity, which constituted damage to property under the *Liability Convention*. Statement of Claim, *supra* note 154 at 904; Andrew Brearly, “Reflections upon the Notion of Liability: The Instances of Kosmos 954 and Space Debris” (2008) 34:2 J Space L 291 at 298.

¹⁵⁸ A formal agreement between the two countries was signed on 2 April 1981. *Protocol between the Government of Canada and the Government of the Union of Soviet Socialist Republics* (2 April 1981), online: <http://www.spacelaw.olemiss.edu/library/space/International_Agreements/Bilateral/1981%20Canada-%20USSR%20Cosmos%20954.pdf>.

¹⁵⁹ This incident led to the inclusion of some principles in the UN General Assembly resolution regarding the Outer Space Nuclear Principles. While this statement is non-binding, it has contributed to the understanding and clarification of liability under the *Liability Convention*. *Principles Relevant to the Use of Nuclear Power Sources in Outer Space*, GA Res 47/68, UNGAOR, 35th Sess, UN Doc A/RES/47/68 (1992); Pedrazzi, *supra* note 98 at para 15; Michael Listner, “Revisiting the Liability Convention: Reflections on RORSAT, Orbital Space Debris and the Future of Space Law,” *The Space Review* (17 October 2011).

¹⁶⁰ Pedrazzi, *supra* note 98 at para 17.

¹⁶¹ Crawford, Pellet & Olleson, *supra* note 36 at 913.

THE INTERNATIONAL TELECOMMUNICATIONS LAW REGIME

It is impossible to consider legal regimes relating to interference with space systems without considering international telecommunications law. The ITU is the UN technical agency that regulates international coordination of information and telecommunications technologies.¹⁶² The ITU allocates the global radio spectrum, coordinates and regulates electromagnetic spectrum use, assigns orbital slots to satellites in geostationary orbit, and prohibits “harmful interference.”¹⁶³ Under this regime, “telecommunications” are “any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems.”¹⁶⁴

“Harmful interference” is “interference with a radio signal that endangers the function of a radio service or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with the *ITU Radio Regulations*.”¹⁶⁵ Article 45 of the *ITU Constitution* prohibits harmful interference¹⁶⁶ and requires that states prohibit it within their jurisdiction.¹⁶⁷ The prohibition against interference is based on reciprocity among those operating under the ITU regime.¹⁶⁸ The ITU regime makes no distinction between intentional and unintentional interference.¹⁶⁹ The *ITU Radio Regulations* play an important role in ensuring interference-free operations of radio communication services.¹⁷⁰ They also outline resolution mechanisms where interference occurs, requiring

¹⁶² Founded in 1865, the ITU evolved in its regulatory function, and, currently, 193 countries and over 700 private entities and academic institutions are members. ITU, “Overview” (2017), online: <<http://www.itu.int/en/about/Pages/overview.aspx>>.

¹⁶³ ITU, *Radio Regulations: Articles*, Edition of 2016, art 8.5 [*ITU Radio Regulations*]; Housen-Couriel, *supra* note 13 at 435. It is notable that art 48 of the *ITU Constitution* provides for an exception for military radio installations. It exempts “national defence services” from the ITU rules and regulations. *Constitution of the International Telecommunication Union*, 22 December 1992, 28 ATS 28 (entered into force 1 July 1994) [*ITU Constitution*].

¹⁶⁴ *ITU Constitution*, *supra* note 163 at Annex 1012.

¹⁶⁵ *ITU Radio Regulations*, *supra* note 163, art 1.169.

¹⁶⁶ *ITU Constitution*, *supra* note 163, art 45.

¹⁶⁷ *Ibid*, art 6(1); Jakhu & Singh, *supra* note 61 at 6; Attila Matas, “Harmful Interference related to Space Services” (Lecture delivered at the Strategic Space Law Program, McGill University Institute of Air and Space Law, 31 May 2016) [unpublished] [Matas, “Harmful Interference”].

¹⁶⁸ Housen-Couriel, *supra* note 13 at 439.

¹⁶⁹ Attila Matas, “Orbit/Spectrum ITU International Regulatory Framework” (Lecture delivered at the Strategic Space Law Program, McGill University Institute of Air and Space Law, 31 May 2016) [unpublished] [Matas, “Orbit/Spectrum”].

¹⁷⁰ Matas, “Harmful Interference,” *supra* note 167.

the notification and cessation of harmful interference through bilateral negotiations.¹⁷¹ Where negotiations fail, states may choose arbitration¹⁷² or dispute resolution,¹⁷³ although there is no compulsory dispute resolution mechanism.¹⁷⁴ Compliance with ITU settlement provisions where interference occurs relies on goodwill and cooperation, and states have tended to observe the framework voluntarily out of self-interest to preserve spectrum use.¹⁷⁵ However, where it is difficult to attribute interference, it is challenging to apply mitigation measures. Consequently, the ITU regime is marginally effective in ceasing interference.

Lacking enforcement powers, the ITU has attempted to publicly name and shame states into ceasing jamming emanating from their territory.¹⁷⁶ In 2012, the ITU declared that violations of Article 45 of the *ITU Constitution* and Article 15.1 of the *ITU Radio Regulations* required action by member states, including taking steps against NSAs causing harmful interference within their jurisdiction.¹⁷⁷ Unfortunately, this did little to reduce incidents of interference. Despite the applicability of the ITU framework to both space-based and ground-based harmful interference, it has been practically ineffective in preventing interference by NSAs with space systems. Further, there is no equivalent of Article VI of the *Outer Space Treaty*, which requires state authorization and continuing supervision of NSA activities. Since there is no liability under this regime for interference resulting in damage,¹⁷⁸ the resolution of these issues may be more effectively dealt with as a breach of domestic contractual obligations or under domestic law.¹⁷⁹ This analysis of the ITU regime reveals a further gap in international law when it comes to addressing space- and ground-based interference by NSAs.

¹⁷¹ *ITU Radio Regulations* *supra* note 163, arts 11.42, 11.42A, 15.21; Jakhu & Singh, *supra* note 61 at 83–85, 88.

¹⁷² *ITU Constitution*, *supra* note 163, art 41.

¹⁷³ *Ibid*, art 56; Mountin, *supra* note 5 at 135.

¹⁷⁴ Mountin, *supra* note 5 at 136.

¹⁷⁵ *Ibid* at 135.

¹⁷⁶ Theresa Hitchens, “Multilateralism in Space: Opportunities and Challenges for Achieving Space Security” (2010) 4 *Sp & Def J* 3.

¹⁷⁷ Of the 193 member states at the time, 165 approved of the amendment. *ITU Radio Regulations*, *supra* note 163, as modified by WRC-12, art 5.21; Matas, “Orbit/Spectrum,” *supra* note 169.

¹⁷⁸ *Ibid*.

¹⁷⁹ Stephen Gorove, *Developments in Space Law: Issues and Policies* (Leiden: Martinus Nijhoff, 1991) at 49.

THE LAW OF STATE RESPONSIBILITY

It is generally recognized under international law that states bear responsibility for “internationally wrongful acts.”¹⁸⁰ However, the applicability of the law of state responsibility to states for NSA activities, particularly those that interfere with space systems, is less clear. The *Draft Articles* on state responsibility, prepared by the ILC, have become authoritative to the extent that they reflect customary international law and have been cited in various international treaties and judicial decisions.¹⁸¹ In 2015, the International Court of Justice (ICJ) noted that elements of the *Draft Articles* have gained the status of customary international law.¹⁸²

The *Draft Articles* set out a framework of fifty-nine articles for determining and addressing internationally wrongful acts. The articles are divided into four sections: (1) internationally wrongful acts;¹⁸³ (2) the scope of international responsibility;¹⁸⁴ (3) the implementation of international state responsibility;¹⁸⁵ and (4) general interpretive provisions.¹⁸⁶ The *Draft Articles* address the responsibility of states under international law, not that of persons, natural or juridical, for an internationally wrongful act.¹⁸⁷ A state bears responsibility for a breach of an international obligation attributable to that state.¹⁸⁸

The *Draft Articles* consider the circumstances whereby organs and agents of the state, as well as those authorized or directed, instructed, or controlled

¹⁸⁰ Crawford, Pellet & Olleson, *supra* note 36. It is notable that the notion of “international responsibility” of a state to supervise activities carried out by the state or those under its legal structure under the international space law regime differs from “state responsibility” under the law of state responsibility.

¹⁸¹ Jakhu & Dempsey, *supra* note 86 at 14. Similar draft articles have been produced that relate to outer space, including those relating to the responsibility of international organizations and transboundary harm. However, for the purposes of this article, these will not be considered as they are outside the scope of consideration. *Draft Articles on Transboundary Harm*, *supra* note 142; ILC, *Draft Articles on the Responsibility of International Organizations*, GA Res 66, UNGAOR, 63rd Sess, UN Doc A/66/10 (2011).

¹⁸² *Application of the Convention on the Prevention and Punishment of the Crime of Genocide (Croatia v Serbia)*, Merits, [2015] ICJ Rep 3 at paras 128, 399–407.

¹⁸³ *Draft Articles on State Responsibility*, *supra* note 69, general principles (arts 1–3); attribution (arts 4–11); breach of international obligation (arts 12–15); responsibility in connection with another state (arts 16–19); circumstances precluding wrongfulness (arts 20–27).

¹⁸⁴ *Ibid*, general principles (arts 28–33); reparations (arts 34–39); breaches of peremptory norms (arts 40–41).

¹⁸⁵ *Ibid*, invocation of the responsibility of a state (arts 42–48); countermeasures (arts 49–54).

¹⁸⁶ *Ibid*, arts 55–59. James Crawford, *International Law Commission’s Articles on State Responsibility: Introduction, Text and Commentaries* (Cambridge: Cambridge University Press, 2002) at 2.

¹⁸⁷ *Draft Articles on State Responsibility*, *supra* note 69, art 1.

¹⁸⁸ *Ibid*, art 2.

by the state, can be considered to act on behalf of the state.¹⁸⁹ International tribunals have also played a significant role in articulating and refining the test for assessing the level of control a state must exert over NSAs to determine whether state responsibility flows to it. In *Military and Paramilitary Activities in and against Nicaragua*, the ICJ applied the “effective control” standard, which considered that the conduct of armed units was attributable to a state if they were operating on the instruction or direction of the state.¹⁹⁰ In preparing Article 8 of the *Draft Articles*, which relates to conduct directed or controlled by a state, the drafters considered the *Nicaragua* case in providing a flexible adaptation of the control standard, such that an act of a person is considered to be that of a state where a “person or group of persons” (that is, the NSA) is acting on the “instructions of, or under the direction or control” of that state.¹⁹¹ Article 9 of the *Draft Articles* considers whether a state can be responsible for an act of a NSA without attribution where the conduct of a person or group exercising elements of state authority, in the absence or default of the official authorities, can be considered an act of state.¹⁹² This envisages a partial or total government collapse, where a NSA may operate as a default authority.

Where there is an attributable internationally wrongful act flowing from a breach of an international obligation,¹⁹³ this triggers an obligation to cease the unlawful conduct and re-establish the status quo through restitution,¹⁹⁴ compensation,¹⁹⁵ or satisfaction.¹⁹⁶ If the matter is not resolved, then it could be brought before another body for investigation and resolution.¹⁹⁷ Finally, Article 55 and the commentaries to the *Draft Articles* discuss the application of the general principle of *lex specialis* and provide that the *Draft Articles* do not apply where the existence and conditions for an internationally wrongful act or international responsibility are governed by special international law rules.¹⁹⁸ Having outlined the key elements of

¹⁸⁹ *Ibid*, arts 4–7.

¹⁹⁰ *Military and Paramilitary Activities in and Against Nicaragua (Nicaragua v United States of America)*, Merits, [1986] ICJ Rep 14 at para 115 [*Nicaragua*].

¹⁹¹ *Draft Articles on State Responsibility*, *supra* note 69, art 8, commentaries at 47; Kimberly N Trapp, *State Responsibility for International Terrorism* (Oxford: Oxford University Press, 2011) at 42–43.

¹⁹² *Draft Articles on State Responsibility*, *supra* note 69, art 9.

¹⁹³ *Ibid*, arts 2, 12

¹⁹⁴ *Ibid*, art 35.

¹⁹⁵ *Ibid*, art 36.

¹⁹⁶ *Ibid*, art 37.

¹⁹⁷ *UN Charter*, *supra* note 42, art 35.

¹⁹⁸ *Draft Articles on State Responsibility*, *supra* note 69, art 55.

the law of state responsibility, this article will now turn to the application of the three international legal frameworks to the interference with space systems conducted by NSAs.

INTERACTION: INTERNATIONAL SPACE LAW, THE ITU REGIME, AND THE LAW OF STATE RESPONSIBILITY

The normative regimes discussed above can apply to certain types of interference with space systems and can illustrate instances of norm conflict. Given the probable facts relating to interference by NSAs, especially the fact that the most likely type of interference will be ground based, it is unlikely that any of these frameworks will be straightforward in their application or yield effective results. Some commentators believe that the international liability regime under the ISL automatically trumps the law of state responsibility in relation to an internationally wrongful act and that liability under the ISL regime persists regardless of whether the activity is wrongful or not;¹⁹⁹ others understand that it is separate from the law of state responsibility but that both regimes could apply.²⁰⁰ This illustrates the uniqueness of the ISL regime in international law and magnifies confusion in this complex analysis. Ultimately, when assessing the application of each legal regime, it is critical that the facts in each circumstance be considered to determine the location of the interference, the location from which the interference emanated, the NSA involved, its connection to a state, and the damage suffered.

This analysis will start by considering the law of state responsibility as a broad regime under general international law that may apply. In the case of interference with space systems caused by NSAs, there would likely be a limited number of NSAs that could be considered to be directed or controlled by a state since many operate independently. However, if a state directed or controlled the NSA that caused the interference that breached an international obligation of the state, then it may implicate

¹⁹⁹ Pedrazzi, *supra* note 98 at para 11.

²⁰⁰ The issue of *lex specialis* and how it applies to specialized bodies of law that interact has been much debated, particularly as it relates to the interaction of international humanitarian law (IHL) and international human rights law (IHRL). *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, [1996] ICJ Rep 226 at para 25; *Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory*, Advisory Opinion, [2004] ICJ Rep 136 at para 106; *Armed Activities on the Territory of the Congo (Democratic Republic of the Congo v Uganda)*, [2005] ICJ Rep 168 at paras 216–20. These discussions reflect the view that potentially competing *lex specialis* should be read harmoniously to the greatest extent possible and that the analysis should be considered through the lens of the specialized body of law. Further consideration of the interaction of other areas of international law (i.e., IHL and IHRL) and how they may apply in the present scenarios is outside the scope of this article.

that state under the law of state responsibility. If so, then a *lex specialis* analysis must be undertaken considering the circumstances of the interference (for example, space-based or ground-based, orbital or terrestrial) to assess whether the law of state responsibility would apply or whether another specialized legal regime would come into play. However, without a sufficient link between the NSA and the state, it is unlikely that the law of state responsibility would apply to interference by a NSA, and, thus, responsibility would not flow to a state under that regime.

If a state did direct or control the NSA that conducted the interference, then one must move on to the *lex specialis* considerations and determine whether there are conflicting bodies of specialized international law.²⁰¹ The commentaries to Article 55 provide elements to consider in assessing the *lex specialis* question. They not only note that special legal rules applicable to a situation will prevail over general rules,²⁰² but also recognize that the later rule in time may take precedence.²⁰³ Article 55 also contemplates whether the instruments are of the “same legal rank” in order to help determine which is more legally authoritative.²⁰⁴ The commentaries further explain that an analysis of a specialized body of law must consider the extent to which the *lex specialis* establishes state responsibility such that the law of state responsibility can be displaced.²⁰⁵ It is not sufficient that the subject matter is dealt with in two different provisions — there has to be an inconsistency for one regime to apply over the other.²⁰⁶ Finally, the commentaries note the distinction between so-called “strong” or self-contained regimes, where the law in an area appears relatively comprehensive, and weaker regimes, which might only amount to single provisions within other treaties.²⁰⁷

There are no previous real-life examples to reference regarding how the *lex specialis* considerations noted in the commentaries to Article 55 apply to the law of state responsibility and to the ISL and ITU regimes. ISL provides a specific scheme for determining responsibility and liability in relation to damage caused by space objects, and it arguably appears to be a “strong”

²⁰¹ Crawford, Pellet & Olleson, *supra* note 36 at 140; Silvia Zorzetto, “The *Lex Specialis* Principle and Its Uses in Legal Argumentation: An Analytical Inquiry,” *Eunomia Revista en Cultura de la Legalidad* (September 2012) at 64, online: <<https://e-revistas.uc3m.es/index.php/EUNOM/article/viewFile/2093/1027>>.

²⁰² *Draft Articles on State Responsibility*, *supra* note 69, art 55, commentary at para (2).

²⁰³ *Vienna Convention on the Law of Treaties*, 23 May 1969, 1155 UNTS 331, art 30(3) (entered into force 27 January 1980).

²⁰⁴ *Draft Articles on State Responsibility*, *supra* note 69, art 55, commentary at para (2).

²⁰⁵ *Ibid*, art 55, commentary at para (3).

²⁰⁶ *Ibid*, art 55, commentary at para (4).

²⁰⁷ *Ibid*.

treaty regime. However, on further examination, its vague terminology and challenging application undercut this assumption. For example, where a satellite is owned by an entity in State A, which uses an entity in State B to procure the launch from a company in State C, whose launch facility is in State D, it becomes very difficult to assess the application of responsibility and liability where that satellite interferes with a space system. Moreover, the scenario is further complicated where no state registers the satellite but where its ownership is later transferred to a NSA residing in State E, which then uses the satellite to conduct interference.

The ISL regime is of a higher “legal rank” than the *Draft Articles* (acknowledging that they are widely accepted as customary international law). Within the ISL regime, state liability can only be established for objects launched into space, which would only provide liability in that case for space-based interference from another space object (Scenario 1) but not for ground-based interference (Scenarios 2 and 3), illustrating a further gap in application. For more common ground-based interference activities, the law of state responsibility would presumably apply, and responsibility under Article VI of the *Outer Space Treaty* to provide authorization and continuing supervision could apply, but the *Liability Convention* would not. Therefore, it appears that the law of state responsibility could complement the ISL regime in situations involving ground-based interference by a NSA, provided there is a sufficient nexus between the NSA and state.

When considering the Article 55 commentary *lex specialis* analysis of the ITU regime, it provides a specific and very detailed scheme for telecommunications and interference, it is one of the most current regimes, and it is frequently updated by way of amendments to its regulations. However, it is limited in its enforceability and has no ability to project liability on states for activity of NSAs.²⁰⁸ The ITU regime is again arguably of a higher legal rank, as the specific and detailed regime is based in treaty as opposed to guidelines reflecting customary international law. However, the ITU regime falls short when attempting to trace responsibility to the state from whose jurisdiction the NSA is conducting interference, as the regime lacks an enforcement mechanism and liability provisions. Therefore, the *Draft Articles* can be interpreted to complement the ITU regime when interference activities are attributed to a NSA and the required level of state direction or control of the NSA exists to establish state responsibility for internationally wrongful acts.

Where interference by a NSA is not directed or controlled by a state, the analysis turns to the applicability of the ISL and ITU regimes. As discussed above, the ISL liability regime would only apply to space-based interference. For the more common ground-based orbital (Scenario 2) and terrestrial

²⁰⁸ Mountin, *supra* note 5 at 136; Housen-Couriel, *supra* note 13 at 440–41.

(Scenario 3) interference, the ITU regime would apply, but it may prove to be ineffective due to the lack of an enforcement mechanism. Consequently, as this analysis has shown, the key challenge is affixing state responsibility and liability.

PRACTICAL CONSIDERATIONS

Even where one or more legal regimes could apply to instances of interference with space assets perpetrated by NSAs, it is extremely challenging to technically attribute those actions to the responsible NSA²⁰⁹ and then from the NSA to the state to affix state responsibility or liability. Even where attribution to the NSA for the action can somehow be achieved, there is no practice to draw upon in order to understand how such an incident would (or could) be dealt with from a responsibility and liability perspective. Furthermore, it is possible that while it appears that ground-based interference by an independent NSA cannot be effectively dealt with by any of these regimes, an argument could be made (as was done by the Soviet Union prior to the inception of the *Liability Convention* and by Canada in its statement of claim in the COSMOS 954 matter) that, where there is no effective mechanism to claim for damages resulting from intentional interference, general international law principles apply. Such general international law principles, as discussed in the *Trail Smelter* and *Corfu Channel* cases, could provide a basis for advancing a claim for transboundary harm emanating from another state.

Even where states and companies may be able to attribute interference to a particular actor, they may choose to avoid publicly condemning the interference for a number of reasons. For example, states may avoid referring matters to external bodies for investigation, mediation, or arbitration since this cedes control over determining the outcome of a dispute to an external party. In some instances, the decision to avoid highlighting potentially internationally wrongful acts may be made to preserve the flexibility for that state to potentially conduct the same activity itself in the future.²¹⁰ Practically, where interference is conducted by a NSA, states may deny the existence of the act, or their inability to regulate it (that is, authorize and supervise), because doing so would admit a failure in exercising their

²⁰⁹ The interference event may provide a signature that can be used to determine the source. However, due to the nature of the space domain, especially where there is no damage to a space asset, it may not be suspicious due to the expansive and “distant nature of the domain” and the ability to masquerade assets as those operating for other purposes (i.e., military satellites pretending to be civilian or commercial). Zenko, *supra* note 48.

²¹⁰ This was the case when Sputnik I was launched, as the United States did not launch a protest because they wanted to take advantage of the orbital overflight of other countries when they launched their own satellite shortly thereafter. Mountin, *supra* note 5 at 139.

responsibilities. Additionally, before a state or company determines whether they wish to respond publicly by shaming the responsible party, making a claim, or exercising a counter-measure (in the case of state-to-state interactions), they must determine whether they wish to publicly share information about who and possibly how the interference was committed. The danger of sharing the attribution information is that the method of attribution, and the often classified or proprietary tactics, techniques, and procedures used to identify the responsible party, are more likely to be revealed. These concerns can result in further vulnerability or may undermine the use of international legal dispute resolution mechanisms in the first place.

CONCLUSION

As outer space becomes an increasingly accessible and less expensive domain in which to operate, the instances of interference with space-based and ground-based space systems by NSAs are expected to rise. Combined with the increasing reliance of societies on space systems and the growth of the global space industry, this raises concerns regarding whether and in what circumstances states can be held responsible or liable for the actions of NSAs that are connected to their jurisdiction. Several intersecting normative regimes have been analyzed to explore the limited legal mechanisms that could apply to space-based and ground-based interference scenarios. The absolute liability regime of ISL would only apply to space-based interference activities (Scenario 1) by NSAs and could in certain limited circumstances result in state liability. Furthermore, the ISL framework has been referenced in a very limited way over the past forty years, which could indicate that it is being overtaken by general international law. The ITU regulatory regime is inadequate to address both space-based and ground-based interference as it lacks an enforcement mechanism. Finally, the law of state responsibility may apply to both space-based and ground-based interference where interference by a NSA is attributable to a state and the other specialized regimes do not overtake it. As a result, the normative legal regimes relating to responsibility and liability for interference with space systems by NSAs present a challenge to efforts by states to enforce “good” behaviour by NSAs, which can be exploited by NSAs (or states) seeking to interfere with space systems.