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FAULT LIABILITY FOR THIRD PARTY DAMAGE IN SPACE: IS ARTICLE IV(1)(b) OF THE LIABILITY CONVENTION USEFUL TODAY?

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I. ABSTRACT

Space debris now populates the LEO environment. Collisions between spacecraft have occurred. It will be only a matter of time before active satellites under the control of parties uninvolved in such a collision will be the targets of uncontrolled debris. Both the environmental conditions in outer space as well as the technology available to track debris are very different from what existed in the 1960s when the Outer Space Treaty and the Liability Convention were drafted. We need to take a new approach to 3rd party liability for in-space accidents for the following reasons. First, the legal conditions for defining fault are undefined in the Treaties. The test of a duty of a nation and a standard of care are unclear. Technology to determine the origin of the debris is improving but without physical evidence, proving the origin is still not a perfect science and there is no defined legal test as to what would determine ownership, responsibility, and therefore liability. Since Article IV requires a finding of fault; the injured party could not collect for the damage, a clearly inequitable result and one that could encourage current owners of space assets to engage in risky and hazardous activities. What this article suggests is a new look at Article IV towards a revision that would establish strict liability for 3rd party in-space injury. This would make States absolutely liable for damage from debris, which consequently will: 1) encourage national legislation for financial responsibility for damage similar to rules that are already an industry standard for launch activities, 2) encourage other safety and financial regulation of in-orbit activities, and 3) encourage more sharing of situational awareness data among nations in order to minimize accidents involving debris. In effect, this change in Article IV would provide a legal stimulus for responsible State action for in-orbit activities.

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II. INTRODUCTION

Article IV(1)(b) of the Convention on International Liability for Damage Caused by Space Objects (U.N., 1969) is the part of the space liability regime that assigns fault liability for damages that occur in space to innocent parties. This paper will argue that fault liability for such accidents will rarely, if ever, result in compensation to injured parties. In-orbit collisions were regarded as a "non-issue" when the Convention was drafted. Today in-orbit collisions have occurred and clearly pose a serious economic and environmental hazard, particularly in Low Earth Orbit (LEO) operations. In essence, there is no adequate legal regime for 3rd party liability in space. This paper will develop a rationale for correcting this inequity and beginning to build a plan to deal with emerging legal issues as space operations continue to move from a government dominated environment to a business and commercial enterprise.

The current Space Treaty System consists of five Treaties (U.N. 1969(2), 1972, 1975, 1984). Of those, three are directly relevant to liability: the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space (U.N. 1969) (OST), the Liability Convention (U.N. 1972), and the Registration Convention (U.N. 1975). The enforcement provisions in all three treaties are weak, relying more on diplomacy and legislative provisions in each State's laws than on any United Nations or other international body. With the exception of a Claims Commission that can be convened under the Liability Convention, all of the Treaties, including the Liability Convention call for "diplomatic negotiations" to resolve problems of international space liability. To date, even a Claims Commission has never been convened and damages from accidents have been resolved peacefully among nations.* However, the "big accident" has not as yet occurred and the Treaty provisions on fault liability have never been tested in a tribunal. When an accident occurs that involves major economic consequences to private actors in space, the question

* The highest visibility and most referenced accident was the Soviet Cosmos 954 satellite with a nuclear reactor that crashed into Canadian territory in 1978. In 1981 the parties released a "Settlement of Claim for Damages, but that settlement was the result of lengthy negotiations rather than a formal Claims Commission (Settlement, 1981). Although the Space Treaties and the liability provisions were referenced in that Settlement, the primary written justification for the payment of damages to Canada was the violation of Canadian airspace without proper warnings.

remains whether the Treaty provisions are adequate to provide for an equitable resolution. I argue that they ultimately will prove inadequate and the space legal community should consider alternative and additional liability standards.

I. CHANGES IN SPACE SINCE THE 1960s

Two major changes in space activities have occurred since the early days of the space era, which was the time frame and conditions under which the current international legal regime was developed. The first is the slow and steady shift from government ownership of both launch vehicles and in-space assets to private ownership operating under government regulations coupled with the remarkable growth of space applications creating an increasing demand for more launches and instruments in space. The second is the crowding of some of the most useful orbits in space from human-made sources including: additional operational satellites, abandoned satellites that have not de-orbited, space debris from collisions, intentional in-space destruction of equipment, and smaller particles from launch operations and miscellaneous pieces that once were part of some space equipment.

Other important changes have also occurred. Access to space is no longer limited to two major superpowers. There are at least 8 nations with launching capabilities and anyone with a legitimate reason to get to space can easily order a satellite and purchase a launch from either a government entity or a private company. There are now over 40 nations that own and/or operate satellites.

Many space applications have become part of the everyday life of nearly everyone in a developed economy even a very large number of people in developing nations. The reliance on satellite weather maps and forecasts, space navigation signals, and a multitude of telecommunications services is taken for granted. Losing these services from a debris created accident in space would be expensive, inconvenient, and involve serious economic consequences.

The crowding of the space environment and the fear of losing capabilities was not of major concern during the drafting of the Treaties. Space is a vast area and the thinking at that time was that problems with used spacecraft and other debris would not be serious. Fifty years later, we now realize that a serious problem looms and that future space applications could be jeopardized. Several well-publicized incidents have underscored this problem of increasing risks of in-space collisions: the Chinese intentional destruction of a polar orbiting

decommissioned weather satellite, the Iridium/Cosmos collision, the destruction of a U.S. non-functioning spy satellite about to re-enter the atmosphere, and the uncontrollable Intelsat satellite in Geostationary orbit. Fortunately, there has to date been no report of the debris from these incidents causing third party damage. But, many of those pieces of debris will remain in orbit for a long time and the danger is obvious and has raised the level of risk in certain orbits to a much higher level (Weeden, 2009).

Both national and international legal regimes can deal with these changes as they have with other hazardous human activities such as strict liability for oil pollution on the high seas and for nuclear damage. (One of the legal tests in the United States for determining that either a public or private activity could be classified as ultra-hazardous is the appropriateness of the activity to the surrounding environs. (Restatement, 1977) The Restatement (Second) of Torts also lists 5 other tests, and emphasizes that not all have to be met to justify applying strict liability to a hazardous activity. They have direct applicability to activity in outer space. Looking at these criteria today versus the conditions and economics of operating in outer space in the 1960s will clearly result in different legal conclusions.

Therefore, applying rules of absolute liability to launch activities as well as to damage from space objects to the Earth was a logical application of the law to the Liability Convention when it was drafted. Conditions as has been noted, have changed. Parts of outer space are now crowded with human-made space objects and other areas are becoming more crowded. It is now time to fit the legal criteria of ultra-hazardous or dangerous activity to in-orbit activities in a similar way that terrestrial launching activities in virtually all launching States have been applied to launches.

* The Restatement (Second) of Torts §520 reads as follows: *"Abnormally Dangerous Activities"* provides six factors that are considered in determining whether an activity is abnormally dangerous. These six factors are: (a) existence of a high degree of risk of some harm to the person, land or chattels of others; (b) likelihood that the harm that results from it will be great; (c) inability to eliminate the risk by the exercise of reasonable care; (d) extent to which the activity is not a matter of common usage; (e) inappropriateness of the activity to the place where it is carried on; (f) extent to which its value to the community is outweighed by its dangerous attributes.

As a society, we appear incapable of solving the problem of space debris on an international basis. The issues are complex and involve many space and security components that go well beyond a simple discussion of the status of legal liability. Diplomatic efforts such as those proposed and discussed in the Geneva based U.N. Conference on Disarmament (CD) have stalled mainly due to the difficulty of defining what might be considered a weapon in the space environment. (Hitchens, 2009) Nations may eventually agree on a version of the various proposals for new rules-of-the-road, but these rules tend to be vaguely worded and focus on improving transparency and best practices for nations operating in space. They are an important start but lack enforceability and legal sanctions.

Technical solutions are also important and the recent issuance of the U.N. General Assembly Guidelines on Debris Mitigation represents years of work at the U.N. Committee on Peaceful Uses of Outer Space (UNCOPOUS). (U.N.G.A., 2008) They deal mainly with the design and operation of launch vehicles and payloads and are a very important component of the international community's efforts to avoid additional future debris in space. But, again, they are guidelines, and abiding by these guidelines is at the option of each nation, either as operating procedures and/or through national legislation. At present, they do not have the status of customary international law and are not binding. If an accident in the future was to occur, and a nation had not followed these guidelines, it would be arguable whether they would have legally violated the Article VI OST provision of "international responsibility."

Diplomatic approaches and technical approaches, therefore, are being proposed and but none are legally binding on any nation or company. It would be useful to have a legal regime that provides assurances that an economic recovery for damages to innocent victims for in-space incidents. At present we do not have that assurance.

An effective legal approach would involve both before-the-fact requirements (i.e. national legislation and regulations) as well as after-the-fact clear definitions of what could be considered in developing a case as well as clear definitions of what is fault, what are standards of care, what are evidentiary rules, and what types of recovery are possible. None of these are currently provided in the space law Treaty regime.

The issues raised in this paper are not new. Other conferences and papers have discussed them but there has been no resolution. Over the 50 years of formal international space law, the weak points concerning

liability of the Treaties have been discussed.* But, nobody and no nations have yet found a way to begin to amend or change these provisions. And, there has been no international tribunal or legal decision on these issues as they apply to space.

Perhaps this attests to the flexibility of the Treaties and the good will among space-faring nations. Perhaps this is just plain luck since there has yet to be real test of the liability provisions from a very major physical loss resulting from an accident involving more than one State, either in-space or on Earth from a space object.

But, as the world moves from a space environment populated by government owned and operated launch vehicles and payloads to one that involves private companies and private equity providing space access, operations, and services, the legal environment will also change. The major question is whether the Treaties will provide a predictable, manageable, and adequate future space commercial legal platform that can resolve disputes fairly, equitable, and efficiently.

It is unlikely that they will be very effective as the basis for future commercial space law in more formal tribunals.

As developed in more detail below, one suggestion for a beginning to develop changes that would improve the legal remedies for in-space accidents would be to adopt an amendment to the Liability Convention that would put in-space accidents under similar rules for launch vehicles. That is, to make States absolutely liable for damage to innocent 3rd parties for damage caused by a space object (broadly defined to include all space debris as well) for which that State was the Launching State.

By removing the requirement of finding fault, much of the fact finding changes from developing tests of negligence to one where the facts are based on finding the national origin of the object that was responsible for the ultimate damage.

* See, for example, Baker, 1989, Kayser 2001, and Kerrest 2002. The issues are well known in the space law community, but there has been little push for change, mainly due to two factors: 1) the lack of the "perfect accident" in space to test the issues in a formal tribunal, and 2) the reluctance to amend the Space Treaties due to the possibility of a long negotiation process and many other unrelated and possibly significant changes would be proposed that could change the long-held basic principles underlying the Treaties.

II. SPACE LIABILITY: THE TREATIES

A. The Outer Space Treaty

The liability regime of the OST is stated in straightforward and simple terms in Article VII:

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.

This establishes a general rule of liability but does not elaborate on a definition of international liability, nor does it describe whether the liability should be absolute, strict, or fault based.

The wording of Article VII emphasizes the launching of space objects. The actual launch is considered an "ultra-hazardous" activity since it involves highly dangerous chemicals. In fact, in the United States all government launches fall under the provisions of P.L. 85-804 (U.S. Congress 1958) and ensuing Executive Orders (Executive Office of the President, 1958) that provide for government indemnification if an accident occurs upon launching. Commercial launches do not fall under this provision of the law but government (FAA) regulations require proof of financial responsibility for all launch operations. (FAA 1998)

One unresolved issue is in-orbit activities. Since there is no comprehensive formal regulation of those activities, either for government or for private spacecraft, it is still an open issue whether in-orbit operations are ultra-hazardous (or in more recent terminology, "abnormally dangerous" or not. Although a finding of ultra-hazardous is not a necessary condition for regulating all in-orbit activities, it does clarify the present situation in space as well as allow a set of strong legal precedents to be applied to space law.

Should in-orbit space activities (again, note that launch operations already are defined as ultra-hazardous) eventually be considered "abnormally dangerous," a regulatory scheme for in-orbit operations will be very different than if they are considered routine. Using the above tests, the outcome of the legal debate could hinge on what is and what is not technologically feasible at any given time. Many in-orbit maneuvers are routine and most likely are not abnormally dangerous. But, space

debris—space objects that are uncontrollable or have reached an uncontrollable state, could fall within the definition. And, if anything in-orbit is considered as abnormally dangerous, the owner would be found to be strictly liable.

Article VII should be read in concert with Article VI and Article VIII of the OST, which state in part:

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

...

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. ...

These three Articles, taken together, establish a regime whereby States are liable and responsible for their activities in space as well as those of their companies and citizens. The State assumes ultimately liability to other nations for damage in space and on the Earth and the ownership of space objects remains with the launching State and cannot be transferred.

There is no other private economic activity where States have formally assumed the financial liability for the actions of private companies.* Of course, nothing in the OST prevents States from pursuing reimbursements from private citizens through regulation, insurance, or law suits.

This provision in Article VI of the OST which holds States responsible for the actions of their citizens in space is the result of a political compromise between the United States and the Soviet

Union in 1967 to remove the Soviet opposition to allowing private activity in space. (Christol 1997)

B. Liability and Registration Conventions

The Liability Convention entered into force in 1972, just 4 years after the OST. It established two different liability regimes: 1) an absolute liability for space objects that fall and cause damage on Earth as well as for those that hit an airplane in flight (Article II) and 2) a fault-based liability regime for accidents that occur in space (Article III). As mentioned above, the issue of in-space accidents was not a pressing problem at the time and space was seen as a very large and empty location with a very small, almost non-existent chance of human-made space objects colliding. Therefore, they envisioned no need for special rules in space and applied traditional fault liability that applies to accidents terrestrially.

And, this was and is not an irrational position to take. The closest analogy would be two moving airplanes, automobiles, or other vehicles colliding. Since a human being is either responsible for or operating each vehicle, the issue of proving negligence and assessing damages is well established in the legal systems of all nations.

In the simplest of space cases, a collision in space of two operating space objects, the fault liability regime of Article III does not present any unusual problems. Of course it may be technically more difficult to determine fault through an accident investigation than for a terrestrial accident and there may be other Treaty provisions that cloud the picture of which State may be responsible for a spacecraft, but clearly, if negligence can be shown, the party that is negligent should be liable for monetary or other compensation to the injured party.

But other aspects of space are different. There is no junkyard for used spacecraft (or for inoperable parts of spacecraft).* And, these orbiting objects can remain in space and present dangers to other spacecraft for 10s and even 100s of years in the future. The potential for damage to an innocent victim in space is a growing and very real threat of the 21st Century.*

Following the OST and the Liability Convention logic, States are responsible for their activities and

* Special international liability regimes have been adopted for commercial nuclear installations and for oil pollution on the high seas (U.N. IAEA, 1996) (U.N.T.S 1969). Both regimes hold the operators strictly liable but hold the State responsible to compensate for 3rd party losses and then recover those funds from the companies. In both cases potential liability is capped.

* The U.S. FCC does require all geostationary satellites at the end of their life to be boosted to orbits out of harms way. (Kessinger 2009)

* The exponentially growing threat of space debris has been well documented elsewhere.

the activities of their citizens. The Treaty regime first suggests diplomatic negotiations to resolve liability issues. So far, this has worked reasonably well. But, as pointed out elsewhere in this article, the Treaties do not clearly define “international liability,” they do not provide for any standards of negligence, nor do they provide any guidelines for what types of evidence and proof of negligence would be acceptable in a formal legal proceeding. The Liability Convention additionally allows for a formal Claims Commission to be established. However, its findings are only binding if the parties agree. The Treaties also allow harmed States to sue in Court even before all diplomatic and other proceedings have been exhausted.

Diplomacy has worked. However, in a future space commercial environment, the probability of any recovery for damage in a Court proceeding operating under the liability regime of Article IV(1)(b) is almost zero. And since commercial space is the emerging trend for space operations, these rules will become even more of an issue as private operations in space continue to grow.

III. NATIONAL LEGISLATION

The Space Treaties are not self-enforcing. Nations must enact legislation and develop a regulatory framework for implementing and enforcing the provisions of the Treaties they have ratified. And, national laws not only have to be in accordance with the Treaties but also with other existing domestic law. No two nations have identical laws, nor do the Courts in each nation have any obligation to abide by any precedents, laws, or customs of other nations. Therefore, there will be differences among nations in the implementation and execution of any law or Treaty obligation.

What is of increasing importance in the global reach of the space sector is to have an internationally coordinated system for space issues. There is no international governance body for space and the development of one is unlikely in the near future. Therefore it will be necessary to have enough uniformity in the laws of different nations with respect to space issues so that nations and companies are not given incentives to circumvent national laws in order to avoid costs related to global concerns such as safety, environmental damage, and financial responsibilities.

The issues of liability are extremely important in terms of costs and cost avoidance. Launches and associated liabilities have been addressed by all nations with launch capabilities. Licenses are required as is an assurance, usually through

compulsory insurance or government indemnification provisions for damages both to the vehicles and to innocent 3rd parties.

To date, very few national laws or regulations exist for in-orbit activities. As space gets more crowded and as more nations own space assets it is clear that nations will have to directly address in-orbit activities and make provisions for responsible operations, insurance, and protection.

The 2008 French space law provides an interesting approach to in-orbit responsibility. (France, 2008) It makes the operator of a space object liable for in-orbit activities for one-year after Launch. After that, the government accepts the liability. For international wrongs (under the OST and the Liability Convention), the government will compensate the injured and then take action against the operator for indemnification.*

However, these provisions rely on the fault principles as defined in the Liability Convention. Because of this and because of the difficulties in proving fault, these provisions may be as ineffective in compensating injured 3rd parties as any other application of the Liability Convention in a formal tribunal.

IV. A REVISED LEGAL APPROACH TO IN-ORBIT ACTIVITIES AND 3RD PARTY LIABILITY

It should be clearly stated that there is no easy, clear, immediately implementable legal resolution to the many legal and liability issues that will become very important for commercial space.

What has been adequately handled at the State level though diplomatic negotiations will transfer to contentious commercial law issues that may have to be settled in formal legal tribunals. Once this occurs, the “gentlemen’s game” of diplomacy in space activities will be over. The current Treaties that are the basis of international space law will still apply to State activities and States will still be responsible for the activities of their citizens. However, if the vague terms used in the Treaties are every to be subjected to rules of evidence and courtroom or arbitration proceedings, space law as we now know it may diverge into a dual regime—one that applies differently to State-owned space equipment and one that applies to commercially owned space hardware and services.

The reasons are as follows:

* Id. Article 14.

1. Liability is for damage done by space objects; a space object is defined in a circular way in the Treaties. Even some space debris may not be included in the definition of a space object. Therefore, if damage is not done by a space object (as formally defined in the Treaties), the Liability Convention provisions would not apply.
2. Definitions of exactly what qualifies as a space objects for purposes of registration are up to each State, although the definition in the Registration Convention is identical to that in the OST and the Liability Convention. This allows another, possibly conflicting, set of rules for determining ownership and liability for in-space liability.
3. Definitions of exactly what constitutes international liability and international responsibility are not clear.
4. The Treaties only apply to nations that have ratified or signed them. Although all current space-faring nations are States Party to at least the OST, there are still 67 members of the U.N. that have not ratified or signed the OST. (And, the number of States that have not ratified or signed the other Space Treaties is even larger.) In the commercial aviation industry by comparison, nearly all (190 of the 192) members of the U.N. are Contracting States to the International Civil Aviation Organization (ICAO).
5. None of the Treaties defines fault liability. What is a standard of care? What is a State's duty to regulate? What evidence would be determinative of finding fault? Is it a preponderance of the evidence, clear and convincing evidence, or some other test? Are these tests subject to traditional commercial law and customary international law or are they to be determined by each nation separately in their courts of law?

The Space Treaties are inadequate to directly answer these questions. Even the most obviously logical answers to simple questions could be distorted by judicial rules. For example, the paint chip from a damaged satellite that is orbiting as debris can cause substantial damage to an operating satellite. Is that paint chip a space object or not? Clearly, it should be and the liability for the damage to an innocent victim should be compensated by the launching State of that satellite from which the paint chip originated.

But, both the Liability and Registration Conventions define "the term space object (to) include component parts of a space object as well as its launch vehicle and parts thereof."

The wording of that definition is both unclear and circular. A space object must be a *component part* of a [sic] space object, but only a *part* of a launch vehicle. Does this mean that a paint chip from a launch vehicle that is in orbit can be a space object while a paint chip from a satellite would not because the latter might not be considered a *component part*? What is a component part? Does a component part have to be a working part of space hardware and have an identifying number and national origin imprinted on it as called for in the Registration Convention?

The logical resolution of this is to include all parts of space hardware as space objects, and it is likely that diplomatic negotiations among nations would consider something like a paint chip as a space object. But a court of law, following rules of evidence, might very well make this distinction and defeat the thrust of the Space Treaties on issues of in-orbit liability through a finding that such a paint chip was not clearly a space object under the definitions in the Treaties.

V. CONCLUSION

International tort liability issues are complex and difficult to resolve, especially when dealing with relatively new technologies. The law is fragmented and not always consistent across different economic sectors and different nations. The proposal discussed above and developed in more detail below would recognize the changed conditions in space and would also apply similar rules to 3rd party damage in space to those already applied to other sectors of economic activity.

One possible step toward that change would be to make 3rd party damages for in-space collisions a regime of strict liability rather than having it fault based. Such a change is:

- a) Fully consistent with the liability provisions of the OST,
- b) A stimulus for national legislation and regulations to implement financial responsibility provisions (e.g. insurance) for the full lifetime of the spacecraft, and
- c) A stimulus for nations to improve their ability to track all space components and to retain some degree of ability to maneuver obsolete space objects, as well as to share such information with other nations.

However, this suggestion is not a solution to the problems of space debris. It would be a stimulus to better manage future in-space operations. The new rules would:

- a) Not be fair to apply to existing space objects or debris since nations need to provide regulations for in-space issues before space objects are launched,
- b) Require each space-faring nation to adopt enabling legislation,
- c) Work best if all nations adopted identical rules for defining space objects and space debris.

Over time the technical ability to identify objects and determine their origin will improve. Rather than a legal test, determining origin will be a technological determined process. The legal implications will follow, much the way the "black box" inside airplanes often can be used to pinpoint the cause of the accident and provide evidence as to fault. In space, rather than fault in 3rd party damages, the issue is identifying ownership and consequently responsibility for the space object.*

And, following the recently approved U.N. Resolutions on Launching States and Registration, (U.N. 2005 and 2008) nations could agree in advance of launching on ownership and responsibility for spacecraft. To adjust to a commercial environment it would also be beneficial to allow contractual agreements among nations and among private companies to transfer this ownership and responsibility in the event of a sale or lease of a space asset.*

Although changes to any Treaty are difficult to negotiate and one as complex as this would require a more detailed analysis that would not only look at its effect on the space environment but would also require comparisons with other existing liability regimes for hazardous activities such as the Conventions on Civil Liability for Nuclear Damage.*

* This process may be difficult even for determining fault and liability for the parties directly involved in an accident. See Hertzfeld & Walker, 2010.

* Currently, the Space Treaty Regime makes any launching State responsible for the space object forever, without any exceptions. However, there is no clause in any of the Treaties that specifically prohibits another State from accepting responsibility for an existing space object.

* The 1997 Protocols on the Vienna Convention on Civil Liability for Nuclear Damage specifically channel liability to the operator of the nuclear installation, make the liability absolute, but limits the amount of compensation. Insurance

It would also be important to consider the provisions of the 2001 U.N. General Assembly Resolution on the Responsibility of States for Internationally Wrongful Acts. In that G.A. Resolution, as in the space treaties, States are responsible for the acts of their citizens. But damages may include compensation for economic losses, something not directly provided for in the Space Treaty Regime.

Additionally, there is a need for broader national and international agreement on many specific terms and definitions. A discussion of all of those is beyond the scope of this article, but it is clear that without developing a more specific set of rules for in-space activities, the useful space environment will be jeopardized. Diplomatic and technical resolutions will not be enough. The commercial sector will also need legal rules with economic consequences. Without those rules, there are too many incentives for avoiding near-term costs and significantly increasing long-term risks.

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is mandatory but if the amount is insufficient, the State where the installation is located is required to make up the difference. One principal difference in the space environment is the lack of sovereignty and a clear definition of what State might be responsible.

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