

A Roadmap for a Sustainable Space Law Regime

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International space law contains remarkably few effective incentives for avoiding accidents in space and the subsequent long-term environmental effects of human-made space debris. In particular, the Liability Convention contains important gaps that have the unintentional result of allowing satellite owners (and nations) to take risks without culpability. Since most experts agree that it would be very difficult to change any of the existing space treaties, other ways of encouraging a solution to this problem and to create more responsible use of outer space must be addressed. One problem is with the limiting definition of a space object; all space objects can become space debris, but not all space debris can be classified as a space object. If it is not a space object, it is not subject to the Liability Convention. Another, and perhaps most important, is the gap created by the lack of a definition of a duty of care in the space treaties and without that, negligence and fault are very difficult to prove. The IADC Space Debris Mitigation Guidelines are a very important and necessary step, but are not sufficient to accomplish this. Technological changes in the way spacecraft are built and regulated have occurred and today few new satellites of high value are launched without the capability to maneuver. With on-board thrusters, valuable satellites have the potential to avoid collisions as well as meet the requirements that some nations have for end-of-life de-orbit or safe orbits. This creates an opportunity to define a duty of care, assuming there is a proper warning system. This paper will address these gaps in the Liability Convention with the suggestion that a new protocol should be considered to make space operations more sustainable without changing or contradicting any existing provisions of the Liability Convention or other space treaties. An approach of this type also has the advantage of retaining the present rules, which will remain applicable to some situations in space. Since the treaties are not self-enforcing, national laws will still be necessary to provide enforcement mechanisms for any space protocol or treaty.

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I Introduction¹

Times have changed and new challenges for space law have developed. This paper addresses issues related to two specific challenges: the first is to improve the incentives for nations and companies to refrain from activities that will increase the risk of safe operations in space, and 2) to develop a legal regime capable of delivering effective, enforceable, and equitable relief in an efficient and timely manner for damages caused by an accident in space.

The current Space Treaties are weak.² They will not be able to deliver an effective space law regime as we move into an era that inevitably will be characterized by:

1. More private activities in space,
2. More government/industry partnerships,
3. More activities that involve international arrangements among multiple nations (both cooperative government initiatives as well as multilateral corporate partnerships) and
4. New technological capabilities that will include satellites with advanced maneuverability and the ability to alter, service, and move both human created and natural space objects.

This paper will focus on one aspect of the gaps in the Treaties—the inadequate provisions of the Liability Convention to handle future legal liability issues for in-space and on-orbit activities. The discussion will outline some of the important factors to consider and suggest that a protocol or a new treaty be developed that will address these gaps without amending, negating, or changing the current Treaty. This approach has the advantage of applying the current regime, without change, to satellites and other space objects using older technologies in space while allowing the law to adapt to a new set of rules for specific newer technological capabilities and situations. In that way we can gradually and

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2 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [Outer Space Treaty or OST]. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [Rescue and Return Agreement]. Convention on International Liability for Damage caused by Space Objects, *opened for signature* Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [Liability Convention or Liability Convention]. Convention on the Registration of Objects Launched into Outer Space, *opened for signature* Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S.15 [Registration Convention]. Agreement Governing the Activities of States on the Moon and Outer Space, UN Doc. A/34/664, *opened for signature* Nov. 1979; UN Doc. A/34/20, Annex 2; UN Doc. A/RES/34/68; 1363 UNTS (1979) ILM 1434 [Moon Agreement].

smoothly transition to a more realistic set of liability rules that not only reflect current and future conditions but also align international space law more closely with other legal regimes such as the law of the seas, civil nuclear liability, and environmental damage from oil tankers and platforms.³

II 1967 and 2012: 45 Years of Change

The world has changed dramatically since the Outer Space Treaty was drafted and came into force. It was a product of its era—essentially an agreement between the two space-faring nations, the United States and the Soviet Union. All access to space was through the government. Private companies were involved, but mainly as contractors and agents of the United States government (in the Soviet Union all companies were government owned). And, the two superpowers were deeply engaged in the hostile environment of the Cold War. Space was a technological battleground—not with weapons, but an important place for both powers to use and show their superiority and prowess.

Space was also in its primacy. Launch and landing mechanisms were primitive in comparison to the sophistication and accuracy of today's vehicles. Space is a harsh environment—it is risky and complex. The space environment was devoid of human-created debris but it was not without many natural risks, among them, asteroids, meteorites, and space weather. Furthermore, private enterprise did not exist in space activities; however the beginnings of the telecommunications capabilities were evident, but with very significant government involvement and regulation.

Space applications were mainly for security and military intelligence gathering. Commercial interests in space were not encouraged until the early 1980s.

When the treaties were drafted, the issues that are now creating problems for space law were non-existent. Without human-created space debris, without commercial space applications, with only two instead of eleven States capable of accessing space, and with the threat of nuclear war, the legal concerns were different and the approaches and solutions different.

III Law Allows for Formal Changes

The Treaties haven't changed or been altered for over 37 years.⁴ Provisions in the Treaties do contain mechanisms for review as well as a method for States to

3 For example: Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage, International Atomic Energy Agency, Information Circular 566, 22 July 1998, International Convention for Oil Pollution Damage, Nov. 29 1969, 973 U.N.T.S. 3; UN Convention on the Law of the Seas, 1833 U.N.T.S. 3, 397 adopted 10 December 1982, entered into force 16 November 1994.

4 Excluding the Moon Treaty which came into force in 1979 and has only been ratified by 11 States.

withdrawal.⁵ There has never been a formal review of any of the Treaties, nor have any States withdrawn their ratifications.

The Outer Space Treaty of 1967 sets out a number of general principles and provisions for the use and exploration of space. Recognizing the need for more detailed specification, supplemental treaties to the OST quickly followed in the 1970s. They elaborated on topics involving the rescue and return of astronauts, liability, registration, and the exploration and use of the Moon and other celestial bodies. Applying the principle of *lex specialis*, where two laws govern the same factual situation, a law governing a specific subject matter overrides a law that only governs general matters. Furthermore, Article 30(3) of the Vienna Convention on the Law of Treaties states: “When all the parties to the earlier treaty are parties also to the later treaty but the earlier treaty is not terminated or suspended in operation under article 59, the earlier treaty applies only to the extent that its provisions are compatible with those of the later treaty.”⁶

Article 62 of The Vienna Convention on the Law of Treaties provides a method for States to opt-out of a treaty.⁷ The reasons require fundamental changes of circumstances from when the treaty in question came into force. Although the tests for complying with Article. 62 are strict and do not allow States to withdraw from treaties unless there are “circumstances radically to transform the extent of obligations still to be performed under the treaty.”⁸

Space conditions continue to change dramatically from the 1960s. International law recognizes the fact that changes do occur and that laws and treaties can become obsolete. We are approaching a point with regard to many legal principles concerned with the use of space where consideration must be given to the adequacy of the OST and the Liability Convention with regards to technology changes and the various threats to the sustainability of space operations.⁹

IV Gaps in the Liability Convention

The Liability Convention has never really been invoked to find fault and to resolve an in-orbit accident. The few major accidents that have occurred in

5 Withdrawal provisions are found at: OST Art. XVI; R&R Art 9; Liability Convention Art. XXVII, RC, Art. XI. An option for a formal review of a space treaty is found at: Liability Convention Art. XXVI, and RC, Art. X.

6 Vienna Convention on the Law of Treaties 1969. done at Vienna on 23 May 1969. Entered into force on 27 January 1980. United Nations, *Treaty Series*, vol. 1155, p. 331.

7 Ibid, Art. 30(3).

8 Ibid, Art. 62(1)(b).

9 For further discussion on this point, see: Robinson, G., *Public Space Law, The Legal Practitioner, and the Private Entrepreneur: Distinguishing What “Ought to Be from What Is”*, Chapter 4, 2012 (forthcoming in Morris & Cox, eds, *International Cooperation for the Development of Space*, ISU, IISC, 2012).

space either were outside of situations that the Liability Convention covers or that didn't result in enough damage to anything valuable to warrant either unresolvable diplomatic efforts or more formal dispute resolution regimes.¹⁰

The Liability Convention has so many major gaps and legal loopholes that it is highly unlikely that if an accident occurred in space that created major economic losses that there would be a fair and equitable judgment.¹¹ Finding fault is key, but there are no definitions or clear instructions as to what constitutes fault in the Liability Convention.

As will be discussed below, the purpose of this roadmap is not to amend or change the current Liability Convention, but to look toward a new protocol or treaty that will apply to future commercial vehicles and satellites or spacecraft that incorporate today's technologies in order to deal with future challenges in space.

Applicability only to Space Objects

The Liability Convention and the Registration Convention define a space object as:

*"[a]space object includes component parts of a space object as well as its launch vehicle and parts thereof."*¹²

The definition is quite obviously circular and difficult to interpret. It is also important to note two often overlooked details. The English version is quoted

10 The 1978 Cosmos 954 accident involved a Soviet satellite falling through Canadian airspace and causing damage and nuclear contamination to Canadian property. It was resolved and the absolute liability for damage on Earth from falling space objects (Art. II) was part of the reasoning of the diplomatic resolution: Canadian Department of External Affairs Communiqué No. 27 Issued on: 02.04.1981: *Disintegration of Cosmos 954 over Canadian Territory in 1978*. The February 2009 Iridium 33/ Cosmos 2251 accident in space involved a defunct Russian satellite and a fully depreciated and uninsured U.S. satellite. Debris was created but there has been no report of actual economic loss from either the original satellites or the debris field.

11 Economic losses can be viewed as the threshold for the future of private enterprise in space since they are pivotal for commercial operators and operations. Insurance is a form of risk management for private companies, but if these losses are not recoverable in legal actions, either insurance will be unavailable or will be very expensive. Governments can survive economic shocks and losses far better than companies are able to. If future commercial space involves significant dual-use operations and governments deem these to be critical, then government indemnification or insurance program may provide relief for private companies. (The question of great importance then revolves around another issue: exactly what is meant by "commercial" space; a topic that will not be addressed in this paper.)

12 Liability Convention Article, 1(d); Registration Convention, Article I(b).

above. In the French (quoted below) and other official U.N. languages a comma is inserted and the definition reads as follows:

“L’expression ‘objet spatial’ désigne également les éléments constitutifs d’un objet spatial, ainsi que son lanceur et les éléments de ce dernier.”¹³

The importance of this is that definition, with the comma inserted, can be read to separate the issue of what the drafters meant by component parts. For launch vehicles the definition now includes all parts of a vehicle—whether a nut or bolt or a full upper stage. But, for satellites a component part has to be one that is more than a nut or bolt or chip of paint—it should follow the definitional elaboration of the Registration Convention that calls for the part to have a national identifier and a part number.¹⁴

It is likely that the drafters of the Treaties were focusing on the technology used to separate the stages of launch vehicles. Explosives were employed and fragments were routinely thrown into orbit. (Today different techniques have been developed to separate the stages of launch vehicles that do not create the debris field.) The possibility of a satellite itself entering into a collision that created many fragments was not completely ignored but it was not a routine or expected occurrence in space.¹⁵ Therefore, the treatment of launch vehicles separately from satellites in both the OST and the Liability Convention may have been logical in the 1960s, but it is not today.

Yet, even with different translations, the definition remains unclear. In today’s space environment, it has been proven that human-created space debris may even be a small or unidentified part of a former spacecraft or vehicle. These small fragments can cause serious damage to an operating satellite or spacecraft. Therefore, it is of critical importance to have a new definition of a space object that makes it clear that it includes a number of things that have become important to the sustainability of space for human operations, both commercial and governmental. A proposed definition that is comprehensive is suggested below:

A space object is anything created, fabricated, or launched in any manner from Earth that enters outer space. This includes the entire launch vehicle and payload, as well as any part or parts thereof, whether attached or separated. It also shall include anything that human beings have modified or moved in space and/or brought back to Earth and re-launched into space.

The latter part of the definition looks to the future when and if celestial bodies or celestial materials are used or exploited for governmental or commercial purposes. A designation as a space object should clearly stipulate that there are

13 The French, Spanish, Russian and Chinese versions have been checked; all include the comma.

14 R.C., Article IV(1)(a through (d)).

15 Liability Convention, Article 4 assigns a fault regime to such incidents.

no claims of ownership (for private entities) or sovereignty (for nations); but it only designates a responsible party for purposes of potential liability if actions caused by the space object resulted in damage or injury.

Definition of Damages

Damages are defined in the Liability Convention as follows:

“The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will 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.”¹⁶

What distinguishes this definition from others used in international law is that it omits reference to payment for economic monetary damages that often include lost revenues or profits. For example in the U.N. Draft, Responsibility of States for Internationally Wrongful Acts 2001, compensation for reparations is as follows:

“1. The State responsible for an internationally wrongful act is under an obligation to compensate for the damage caused thereby, insofar as such damage is not made good by restitution.

2. The compensation shall cover any financially assessable damage including loss of profits insofar as it is established.”¹⁷

Furthermore, the OST, Article VI makes States ultimately responsible and Article VII makes the Launching State liable for damage from space objects. Other international high-technology liability regimes put the burden first on a commercial operator (assuming that the fault is with a commercial entity, not a governmental entity). States may ultimately need to be guarantors of payments for damages associated with proven fault, but the operator is clearly responsible. Some other liability regimes also have monetary caps on the amount of damages that can be paid.¹⁸ Examples of these regimes are found in aviation, maritime, and civil nuclear treaties as well as international agreements.¹⁹ The Space Treaties do not specify any limits on the potential liability.

¹⁶ Liability Convention, Article XI.

¹⁷ Responsibility of States for Internationally Wrongful Acts 2001, Article 36; U.N. General Assembly resolution 56/83 of 12 December 2001, and corrected by document A/56/49(Vol. I)/Corr. 4, 2005.

¹⁸ See, for example, Martinez Gutierrez, Norman A., *Limitation of Liability in International Maritime Conventions*, London, Routledge, IMLI Studies in International Maritime Law, December 2010.

¹⁹ See citations in footnote 3; Also, Dempsey, P., *Liability for Damage Caused by Space Objects Under International and National Law*, draft manuscript, 15 September 2011.

To date, accidents that have occurred in space have not resulted in significant economic losses.²⁰ However the potential exists and will increase dramatically, particularly in orbits that most valuable and are heavily populated with satellites such as the geostationary orbit and the sun-synchronous polar orbits around 850 km above the Earth.

No Working Definition of a Duty of Care, Negligence, or Fault

For in-space accidents, the Liability Convention requires a finding of fault for damages to be paid.²¹ In the United States tort law regime, fault involves:

- A duty of care that exists between the parties
- A breach of that duty occurred
- Something of value was damaged or injured, and
- That breach was the proximate cause of the injury or damage

A duty of care may be defined by a law, through a regulatory action, or by accepted practices under Customary International Law. In the U.N. treaties on space there are no guidelines provided for defining negligence, duty of care, due diligence, or any other test of reasonable and responsible behavior in space that could be used in legal proceedings to find fault. But there are clear rules for made for gross negligence or willful misconduct in space. States are absolutely liable in those cases.²²

Since there is no clear duty of care established for space operations and there is also no clear definition of what level of evidence would be needed in a space accident case to establish a proof of a violation of the duty of care. Is it reasonableness, is it clear and convincing evidence, or is it just a weight of the evidence? There are no court decisions that shed light on this as a legal precedent,

20 It is noteworthy that the one major collision in space, the Iridium/Cosmos accident in 2009, was never formally analyzed in regard to a finding of fault, mainly because there were no significant economic damages—Iridium was fully depreciated and the company had a spare satellite in place and Cosmos had been decommissioned by the Russian Government years before the accident. If debris from that collision eventually causes another accident, the issue of fault may be opened again. (However, the rules under the current LC would apply because of the timing of the accident before new rules would have been established. (see: Hertzfeld, H. R. and Baseley-Walker, B., *A Legal Note on Space Accidents*, *GERMAN JOURNAL OF AIR AND SPACE LAW*, Summer 2010.

21 If there are two or more launch States involved, the damages are shared if it is not possible to identify which State's space object caused the damage to a third party. However, the implication is that there has to be a finding of fault for the accident itself before damages could be awarded or negotiated. (Liability Convention., Article IV).

22 A full discussion of this can be found in any standard legal text and is too detailed to elaborate fully in this summary "roadmap." But, the Liability Convention specifically excludes willful misconduct and gross negligence by making States absolutely liable for those types of actions.

and there are not even any official judgments or records of negotiated resolutions of space accidents that attempt to clearly define these terms.²³

The important question for the upcoming years with commercial operations in space growing rapidly is whether this should be defined by treaty, by multilateral agreements of other types, by an international court such as the International Court of Justice, by analogy to other regimes different from space, by contract clauses, or *ad hoc* by any court where a law suit may be filed when and if an accident occurs.

A definition alone will not suffice unless it is clearly part of a treaty or other multilateral document that is accepted and recognized by most, if not all nations. In order for it to become customary international law (CIL) it also needs to be found in judicial opinions as well as part of national regulations or practice. Specific new customary international law is not recognized quickly and it is always subject to change.

This paper suggests that a new treaty should address this issue and, for specific cases where newer space technologies and national regulations are involved, that a simpler and more direct rule for assigning fault for in-space accidents be developed and implemented. As described above, the new treaty would only apply to specifically defined situations and would not contradict the Liability Convention.

SA Weak and Non-binding Dispute Resolution Regime

The Liability Convention includes a formal, but optional, dispute resolution regime in the provision for a Claims Commission to resolve issues of liability²⁴. Although not identical, the Claims Commission is essentially modeled after commercial arbitration rules and procedures. The Claims Commission provision has a major problem: it is not binding unless the parties agree.

And in the 40-year history of the Liability Convention, a Claims Commission has never been used for disputes. This is somewhat remarkable, but the reasons are twofold: 1) disputes have been settled diplomatically and, as mentioned above, 2) an accident with large economic and/or property damage has not yet occurred in space.

International arbitration has been recognized as a useful process for settling disputes involving space issues.²⁵ Its advantages over formal legal proceedings

23 See: *Seabed Disputes Chamber of the International Tribunal for the Law of the Sea, Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area*, Advisory Opinion, Case No. 17, 1 February 2011. That Advisory Opinion discusses the question of responsibility and liability in international law and as it applies to the UNCLOS. The concept and language are very similar to that of the Outer Space Treaty, but they are not identical. This Advisory Opinion, therefore, is analogous to the issues discussed in this paper but it should not be treated as either a formal judicial opinion or determinative for issues that involve space matters.

24 Liability Convention, op. cit., Articles XIV through XX.

25 Bockstiegel, Karl-Heinz, *Settlement of Disputes Regarding Space Activities*, Journal of Space Law, Vol. 21, No. 1, 1993.

in a court of law are numerous and include: speed, confidentiality, the ability to use treaties, national laws, and CIL in finding equitable and fair resolutions of disputes, and more relaxed rules of evidence. Additionally, nations as well as companies and individuals can be parties to arbitration proceedings. The arbitration process is governed by formal rules and it can be binding under various multilateral treaties.²⁶

Arbitration is not a perfect solution to liability issues in space. Its applicability up to now in space issues has been limited to contract disputes (often in communication satellite contracts) where the parties have agreed to arbitration in the clauses of the contract. Although technically arbitration proceedings are not limited to contracts, the question becomes one of its applicability to tort law where the parties to the accident may have no prior agreements that bind them to arbitration. Questions needing further analysis include: Can binding arbitration be applied to accidents in space that occur among parties that may not even have ratified the Liability Convention, let alone have any contractual responsibilities to each other? Can binding arbitration apply to issues outside of the specific issues covered in the contract itself and its arbitration clause?

The answers may rest with national laws that could require commercial arbitration in the event of an accident in space between companies from different Launching States. However, nations are reluctant to yield jurisdiction across their borders and, particularly because nations may themselves be parties to such a dispute, binding arbitration for on-orbit accidents will be difficult. Yet, the process transcends many of the problems with the Liability Convention and the Outer Space Treaty and could become a reasonable method for developing a better system of resolving issues in space, particularly those that might in the future involve significant economic damages.²⁷

Lack of Clear Delineation of the Border of Outer Space

Lawyers, diplomats, business executives, engineers, physicists, and scientists of all kinds have been arguing since the beginning of the era of space exploration about where the Earth's atmosphere ends and outer space begins. Today we are no closer to a clear border than we were years ago, except that society now does understand the characteristics of that border better.

26 For example the World Bank International Centre for the Settlement of Investment Disputes and the WTO Dispute Settlement Process for Trade Disputes. Multilateral Treaties such as the United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards, June 30, 1998, 330 U.N.T.S., 28 (New York Convention) provides for international recognition of foreign arbitral awards (with very limited exceptions). And recently the Permanent Court of Arbitration in The Hague issued Optional Rules for Arbitration of Disputes Relating to Outer Space Activities (Dec. 6, 2011).

27 It should be noted that some nations have agreed to binding arbitration in a number of instances including disputes under the World Trade Agreement, and the UNCLOS (Part XV, Articles 279-299). It should also be noted that the United States has not ratified the UNCLOS.

The question becomes important only if an accident between space objects occurs in the narrow and undefined area around the 90 km to 110 km altitude where outer space begins. If the accident is below the border, national laws apply (except if it is over international territory such as the high seas). If it is above that border, then the space treaties and other international law apply.

The issue is of particular importance not to most satellites, but to the growing commercial suborbital flight industry. If these vehicles are carrying cargo or people to that undefined region, there could be interesting insurance and regulatory issues emerge about responsibility and liability. This paper only takes note of the problem and will not attempt to define what other experts have not been able to.

However, it should be pointed out that with more commercial flights, insurance and other contracts between the operators, passengers, insurance carriers, and customers may elect, for purposes of clarity and convenience to declare that for purposes of meeting those contractual relationships that the border does exist and the contract will define it but only for the limited purposes of that agreement. Over time, customary business practices could lead to agreement on a physical distance that can be considered the border of outer space, at least for legal purposes.

Applicability only to States Party

Finally, treaties only are applicable to those States that have ratified or signed them. Of the approximately 190 U.N. nations, 128 nations (67%) have ratified or signed the Outer Space Treaty, and 112 nations (59%) the Liability Convention. All space faring nations are parties to the OST, but not all recognize the Liability Convention. Whether this will matter if there is an accident involving a nation that isn't a party to the Liability Convention is not a settled issue.²⁸

V Other Related Gaps

OST Article VI

Much has been written about the requirements and meaning of Article VI of the OST. States, not commercial operators, are internationally responsible for their own activities in space as well as those of their non-governmental entities.

²⁸ In part, the question could focus on whether the principles contained in the Outer Space Treaty and the Liability Convention are considered as Customary International Law. With only 2/3 of all nations agreeing to adhere to the OST, that could be a difficult argument to make, particularly if the future involves States that are not Parties to the Treaties sponsoring or subsidizing private space activities at less cost due to less stringent regulatory rules.

Beyond that, States are also required to provide continuing supervision of those activities. Article VII of the OST makes States liable—a clear financial requirement to compensate innocent victims in space as well as terrestrially.²⁹

There is no other industry or activity where States have agreed to this, although States often do provide some form of indemnification for commercial operators of high technology, high-risk activities that also usually have a low probability of accidents and/or contribute to critical national security or economic infrastructure.³⁰

A traditional reading of the meaning of Article VI and VII is clear—States bear the ultimate responsibility and liability for all activities in space, regardless of ownership, and they are liable for as long as that space object exists.³¹ There is no method provided by the treaties to disclaim that responsibility and liability, even if the space object is sold or transferred to another entity or another State. As commercial space grows, this issue raises to a higher priority—resolving the line between State responsibility and private responsibility for mistakes, accidents, and financial liability. Should States continue to be at risk for large losses if the cause of the loss is a commercial mistake, negligence, or inaction? A suggestion for the future is look at the requirements of Article VI carefully and to study the possibility of defining the requirement of “continued supervision” in a slightly more limited context.

If a nation takes all due care, abides with all international space norms, has a strict and comprehensive licensing regime, requires compliance reports and oversees the space mission, and an accident occurs because a private operator acts unpredictably and independently, should that nation be held liable for damages? According to the OST Article VI and VII, the answer today is, yes.³²

29 When the OST was being negotiated, the Soviet Union was concerned about the potential for private firms from the United States to own satellites and use space. This provision was a compromise on this issue between the United States and the Soviet Union. See, Christol, Carl Q., *Development of Current Outer Space Law*, Symposium on Commercial Opportunities in Space, Roles of Developing Countries, Taipei, Taiwan, 21 April 1987.

30 An example of this in the United States is Public Law 85-804: (Pub.L. 85-804, § 1, Aug. 28, 1958, 72 Stat. 972; and Executive Order 10789) that provides government indemnification to contractors involved in ultrahazardous activities. The law and Executive Order have been amended a number of times since 1958 to further clarify the provisions of Public Law 85-804 and extend the authorization beyond the U.S. Defense Department to utilize its provisions to the heads many other agencies including NASA and the Department of Transportation.

31 In space, objects can stay in orbit for a very long time. This distinguishes space objects and debris from that created from a shipwreck where the remains sink out of harm's way to the bottom or aviation where they fall back to Earth relatively quickly.

32 This follows a standard precedent in tort law (U.S.) that when there is a close relationship between two parties such as parent/child, employer/employee, *vicarious liability* can be attached to the responsible party under the reasoning that that party should take reasonable measures to prevent the incident.

But, the Treaty was drafted in the 1960s when almost all satellites were government launched and owned.³³ As mentioned above, today there are private satellites as well as private launch vehicles. Clearly, some change in the interpretation of Articles VI and VII may be needed to accommodate the changing technologies and ownership of space objects.³⁴

End of Life of a Spacecraft

The United States has imposed regulatory requirements for the disposal of commercial communications satellites that require FCC approvals and remote sensing satellites under the DOC/NOAA licenses.³⁵ In most cases, this is a formal recognition of industry norms and best practices that have been implemented gradually over the past 15 years.

However, at present, the rules are different for each licensing authority as well as for each agency. The FCC requires companies to allocate sufficient fuel for putting satellites that are in GEO orbit into higher orbits that are safely out of the way. NOAA only requires companies to present a “plan for end of life that satisfies the Secretary of Commerce.” (Currently this requires a LEO earth observation satellite to deorbit within 25 years.) Additionally, the enforcement procedures for these rules are weak.

And, there are many possible definitions of the end-of-life. Each one has different operational and cost considerations:

- End of full performance to specifications
- Major system failure on-board
- Insurance claims made
- De-commissioned or de-orbited notification to U.N. Registry
- Payload no longer being ‘used’

33 In the 1960s there were a few early U.S. communications satellites that were privately owned but heavily regulated by the U.S. Government and all launchers were government owned and operated.

34 The Sea Bed Tribunal’s Advisory Opinion of February 2011. (See footnote, supra.) addresses this issue and finds that the words of the UNCLOS (Article 153) read: “the obligation of the sponsoring State in accordance with article 139 of the Convention entails ‘taking all measure necessary to ensure’ compliance by the sponsored contractor.” They further argue that Annex III, article 4, paragraph (4) makes it clear that sponsoring States “responsibility to ensure applies within their legal systems.” They then conclude in Section 119 of their Advisory Opinion that the “main purpose of these provisions is to exempt sponsoring States that have taken certain measure from liability for damage.” In other words, the State may use these measures to clarify its due diligence obligation.

35 U.S. Federal Communications Commission, In the Matter of Mitigation of Orbital Debris, FCC 04-130, June 21, 2004 and U.S. Department of Commerce, NOAA, Federal Register/Vol. 71, No. 79/Rules and Regulations, Licensing of Private Land Remote-Sensing Space Systems, Final Rule. Tuesday, April 25, 2006.

All end of life requirements clearly cost money, mainly by shortening the useful lifetime of a satellite by using fuel that otherwise would have been used to maintain the proper position in orbit. The interesting component of this requirement is that any new U.S. commercial satellite has to have the capability to maneuver in space during its lifetime.

This requirement offers a different legal option than existed in the early days of space when many spacecraft did not possess the capability to move and deorbit. The ability to move also means the ability to avoid a collision in space provided adequate notice and situational awareness exists. This suggests that satellite operators might actually have a “last clear chance to avoid an accident,” creating a basis for a rule could be applied to two newer satellites that have the ability to avoid each other and/or to a satellite that could avoid a collision with one that can’t be moved. In either case, a regime where fault could be attached to the satellites that had adequate notice and failed to take reasonable measures to avoid the collision would be an appropriate and effective measure to provide incentives to operators to use the fuel and capability to move or else face a possible large financial liability.

Servicing Satellites and Very Small Satellites

Another technological development is the building and operating of new satellites that can provide services to existing satellites on-orbit. These services can range from diagnosing faulty hardware using remote cameras or re-fueling satellites to extend their lifetime to actually fixing broken or inoperable parts. Servicing operations can also be used to move satellites to safe orbits and/or to deorbit them.

Clearly, these capabilities, when and if proven operational, open up a host of legal issues. Not only can these robotic missions affect the definition of the end-of-life of a satellite, but also interesting international liability issues arise if servicing satellites are used to change the parameters of satellites owned by nations other than the nation launching and operating the servicing satellite.³⁶ Beyond this, the large numbers of new nano-, micro- and cubesats being developed or planned for launch into LEO may result in large contributions to additional remnants (debris) of these very small satellites that often have short useful lifetimes. Most of the ones that are now launched do not have the ability to maneuver. (Although it is technologically possible to equip many very small satellites with inexpensive thrusters.) The current legal standard of allowing them to naturally deorbit within 25 years of launch may result in significant risk to operational space objects.

Clearly, both of these recent technological developments will raise many questions concerned with defining the requirements for the end-of-life of a satellite or space object.

36 A full discussion of these issues is beyond the scope of this paper. See: Hertzfeld, H, *Satellite Servicing*, Second International Workshop on On-Orbit Satellite Servicing, Goddard Space Flight Center, 30 May 2012 (<http://scco.gsfc.nasa.gov/workshops.html>).

VI A New Protocol or Treaty

This paper has suggested that we consider a new protocol or treaty that supplements the Liability Convention in specific cases where an accident would involve satellites with private ownership and capabilities not existing when the treaties were drafted. Examples include:

- Private telecommunications and earth observation satellites with deorbit fuel and thrusters,
- Accurate deorbiting and landing capabilities,
- Sophisticated satellite positioning and navigating technologies operated by both governments and private space security networks that provide data on accident probabilities³⁷ and,
- In the not too distant future, large numbers of very small satellites such as nanosats, microsats, and cubesats that may involve uncontrolled and uninsured space objects in LEO.³⁸

There are many remaining questions to be addressed before formally suggesting that the outlined roadmap can be implemented. One is to clearly define the situations where the new treaty can be used and clearly differentiated from incidents where the current provisions of the Liability Convention would be applicable.

For example, if two operational satellites were launched after the new treaty or protocol was in effect and both satellites were maneuverable, (i.e. were licensed in nations where end-of-life provisions existed; had followed all national rules concerning a duty of care for mitigating damage; were notified about the possibility of an accident in space; and took no reasonable actions to avoid the accident, it follows that at least one of those operators would have had a “last clear chance” to avoid a collision. If the collision occurred, then that operator would be liable for damages. In this example, two recently launched satellites collided, indicating that there would likely be significant economic losses involved.

Essentially, this protocol would create a duty of care to avoid an accident and the onus would be on the operator, not the launching state, to take all reasonable measures to move the satellite out of the way. Although this scenario could be implied under the current Liability Convention convention rules, there are several important differences: 1) a duty of care has been defined making removing many questions about what types of evidence and rules exist for finding fault, 2) if there was a law suit, economic damages could be recovered, and 3) a license to launch and/or other national laws would include provisions mandating binding arbitration.

It should be emphasized that this treaty would not replace, contradict, or invalidate the existing Liability Convention. It would, though, close loopholes

37 Issues of government responsibilities, accuracy, cost, implementation, timely notice, classified military information, and international cooperation with the operation of these systems have yet to be fully resolved.

38 As the technology for very small satellites improves over time, their capabilities and economic viability will improve.

and gaps where it is possible to fairly and equitably apply the new rules in order to encourage business, safety, and fairness when and it an accident occurs that creates significant economic or strategic losses.

VII Results: New Incentives for Responsible Behavior in Space

In summary, space law is operating under a set of treaties that contain a number of ineffective provisions when considering fair and equitable resolutions to issues of fault for on-orbit activities.³⁹ Technology has changed since the treaties were drafted, as have the use of space capabilities and applications, many of which have become very important contributors to global and national economic infrastructure. Accidents in space, just as accidents on Earth need to be minimized. Effective and binding rules need to be implemented to discourage activities that can lead to accidents as well as to provide adequate compensation in the event that a party is at fault. Today, those rules and guidelines give no assurance that a satisfactory resolution will be found.

Additionally, as commercial operations grow in space, the treaty regime of first looking to diplomatic solutions to incidents involving different nations may not work as well as it has in the past. This paper has also suggested that other types of binding dispute resolution be studied and eventually implemented that can bridge national concerns and private sector concerns.

The space sector is unique in making States responsible and liable for the actions of non-governmental entities under its jurisdiction. Other international incidents such as civil nuclear power plants and maritime law make the operator of a private facility responsible for damages, with the State a possible guarantor. In space, it is the State's option whether to directly indemnify losses to 3rd parties or to attempt to pass that responsibility to an operator through national regulatory authority. However, the State is still responsible for payment, even if the operator fails to pay in full.

Other international diplomatic and legal attempts in the past few years to develop codes of conduct in space, or encourage governments to adopt "best practices," are worthy exercises but have, so far, failed to be agreed upon. Even if they eventually are adopted, they still fail to provide enforceable, binding, and effective legal regimes. Hopefully, over time, such agreements may find their way into becoming customary international law, but that is a long process. Even the U.N. Debris Mitigation Guidelines,⁴⁰ which are being cited in newly drafted national laws⁴¹ and upon which governments are basing

39 This is not to imply that there aren't other areas of these treaties that need attention, but only that the main focus of this paper is on the Liability Convention and issues of liability for on-orbit activities.

40 IADC Mitigation Guidelines, IADC-02-01, Revision 1, September 2007.

41 See, for example, Federal Law on the approval of space activities and the establishment of a space register (Space Act), Government of Austria, December 2011, §5.

rules⁴² are still weak when viewed from the perspective of enforceability. They, for instance, call for best efforts to minimize debris without defining what that is or providing any penalties for non-compliance. And, they consider the 25-year end-of-life as an adequate compromise, a provision that may allow some very small satellites to be left in orbit far beyond their relatively short lifetime.

Today, space engineers are proposing ways to go to space and remove debris and larger non-working objects. These methods are unproven and not built as yet. They are also expensive and there appears to be no international collaboration or agreement on finding funding sources from the various nations responsible for the debris. Cleaning up space is difficult and does not guarantee that spacecraft will not be endangered from debris. It may lessen the probability, but at the same time, sending equipment into space also involves mission risks and significant legal risks that are similar to those for future satellite servicing operations.

Furthermore, most engineers and space experts also agree that even if we never launched another vehicle or spacecraft from Earth, the crowding of some orbits is enough to almost guarantee that future accidents will occur.⁴³

There are two important concerns for the future. First, the legal community has done nothing to change the law as yet and needs to act soon. Second, there are real possibilities to resolve these growing problems in space without going through the very difficult process of amending the current treaties. Unfortunately, it may be diplomatically and logistically impossible to change what now exists in time to benefit all space actors, no matter how problematic the current agreements may be and how inequitable the resolution of disputes falling under those provisions may be.

A new treaty or protocol on liability will also not be quick or easy to agree upon but, as described in this paper, has the advantage of focusing on one key issue and would not alter the status quo nor would it open up the totality of international space law for discussion or change. A treaty solely on liability issues and that leaves the old rules untouched for most existing spacecraft could be easier and faster to negotiate, ratify, and provides a legal regime for space that better reflects current conditions and provides for fair and equitable resolution of disputes involving liability claims in the future.

42 In the United States: NASA Technical Standard 8719.14, "Process for Limiting Orbital Debris," which provides "uniform engineering and technical requirements for processes, procedures, practices, and methods" for NASA projects and programs; available at <www.hq.nasa.gov/office/codeq/doctree/871914.pdf>; and U.S. Department of Defense Directive NUMBER 3100. 10 October 18, 2012.

43 The cost/benefit formula of operating in space, or at least in some crowded orbits will change. However, how much it will and whether the risks still are less than the potential revenues for commercial companies meaning that companies are continuing to make space investments and operate spacecraft. In fact, the risks from debris may still be less than those of a successful launch. A serious accident with widespread debris could change this current scenario overnight.